Joint European Research Infrastructure network for Coastal Observatory – Novel European eXpertise for coastal observaTories - **JERICO-NEXT**	
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1. Executive Summary

Coastal observations are an important part of the marine research jumble of activities and applications. However, the technological designs of the related observing systems, the measured parameters, the practices for maintenance and quality control, as well as quality standards for sensors and data exchange, are all characterized by a significant heterogeneity. This is especially true in Europe, where coastal observatories have developed in a rather uncoordinated way, usually based on national funding and priorities.

The JERICO (FP7) project was the first transnational initiative aimed at the harmonization and coordination of Europe’s established coastal research observatories. By the end of the project, significant progress had been made towards achieving these objectives, particularly in three key areas of observing technologies: fixed platforms, ferryboxes and gliders.

A crucial element of successful harmonization across extended networks is persistence. The understanding of technologies, the refinement of methodologies, and the establishment of effective procedures, requires time and constancy. The goal is to preserve instituted harmonization efforts and ensure continued conformity of “established” network elements to the state-of-the-art.

In this document, we report on the results of an on-line survey that was aimed at monitoring the status and progress of the continuing efforts at harmonization for the above-mentioned technologies within the JERICO observing network in the framework of the JERICO-NEXT project.

2. Introduction

A significant number and variety of coastal observatories have been deployed in European coastal waters in the last decades, most of them based on national funding and priorities. The designs, architectures and scientific “paraphernalia” associated with these observatories vary widely, seeing that they usually depend on several factors that are intimately related to specificities: like the location, the characteristics of the energy supply used, the accessibility, the scientific questions that need answering, etc. This heterogeneity has led to very different practices when it comes to their day-to-day operation and maintenance.

The JERICO (FP7) project was the first transnational initiative aimed at the harmonization and coordination of Europe’s established coastal research observatories. By the end of the project, significant progress had been made towards achieving these objectives, particularly in three key areas of observing technologies: fixed platforms, ferryboxes and gliders. Since technical harmonization is by nature an unending process, it was recognized that there was a need in the succeeding JERICO-NEXT (H2020) project to monitor how these efforts within the JERICO observing network (Fig 2.1) were proceeding. An on-line survey was therefore designed and carried out amongst the partners of the new project for this purpose.

Figure 2.1. *The JERICO network of coastal observatories in JERICO-NEXT.*

The survey was performed by means of an on-line questionnaire organized in 4 parts aimed at gathering specific information:

- general details about the responding partners/observatories;
- details on management aspects of the partner’s coastal observatory/ies;
- Details on operational aspects of the partner’s coastal observatory/ies;
- details on the partner’s perception in regard to harmonization within the JERICO observatory network.

We got answers from 17 partners representing 13 institutions operating different types of coastal observatories. Some parts of the questionnaire were not filled, and others were answered by more than one operator for each partner. As a result, the information collected in each part of the online questionnaire varied. The institutes that took part in the on-line survey are listed below:

1. Universitat Poltècnica de Catalunya (UPC)
2. Institute of Marine Research (IMR)
3. Centre for Environment, Fisheries and Aquaculture Science (Cefas)
4. Istituto di Scienze Marine - Consiglio Nazionale delle Ricerche (ISMAR-CNR)
5. Finnish Meteorological Institute (FMI)
6. L'Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER)
7. Helmholtz-Zentrum Geesthacht, Institute of Coastal Research (HZG)
8. Balearic Islands Coastal Observing and Forecasting System (SOCIB)
9. Institute of Oceanology (BAS)
10. Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS)
11. Norwegian Institute for Water Research (NIVA)
12. Finnish Environment Institute (SYKE), Marine Ecology Research Laboratory
13. Hellenic Centre for Marine Research (HCMR)

The distribution of partner responses in terms of the type of technology reported on in the survey are presented in Figure 2.2.

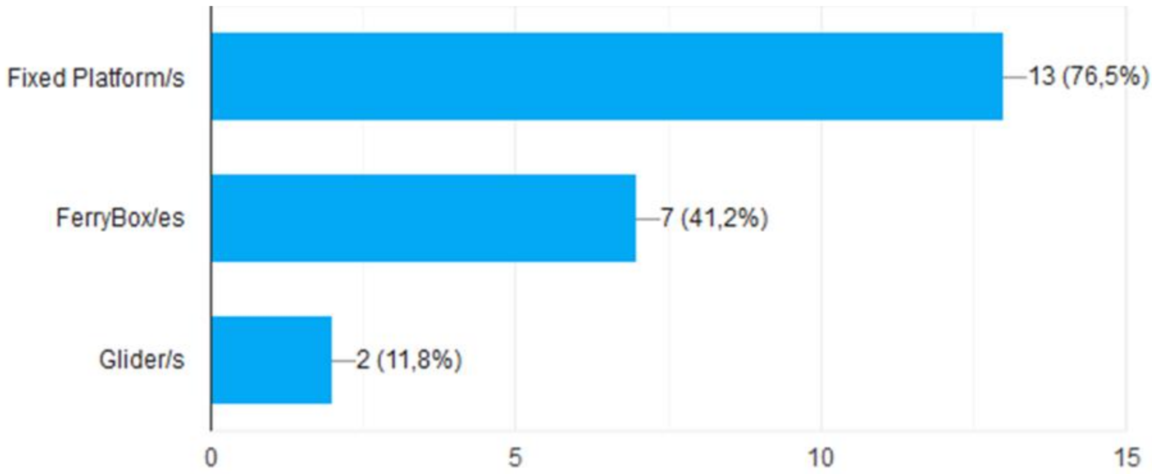


Figure 2.2. *Distribution of partner responses based on the type of technology reported on in the on-line survey.*

3. Main report

3.1. Part A: Management

The first part of the survey dealt with some general aspects of managing a marine observatory, such as the way it is run, and questions regarding personnel, funding and organization. 93.8% of the respondents said that they operate their observatories with dedicated staff. 81.3% reported a clear hierarchy/command structure, and 87.5% affirmed that their organizations maintained a transparent chain of responsibility for technical/scientific and operational decisions.

Read in another way, these results would seem to be indicating that more than 6% of the infrastructures, are run in an “ad hoc” way, nearly 20% of them lack a clearly defined framework for decision-making, and around 12% possess an organizational structure that does not favour accountability for actions and decisions taken. From a network perspective, similar numbers are dangerous if one wishes to maintain overall performance at a high level of efficiency.

The funding supporting the observatories is also not constant. Most (58.8%) reported intermittent funding, such as with money from projects (Figure 3.1.1).

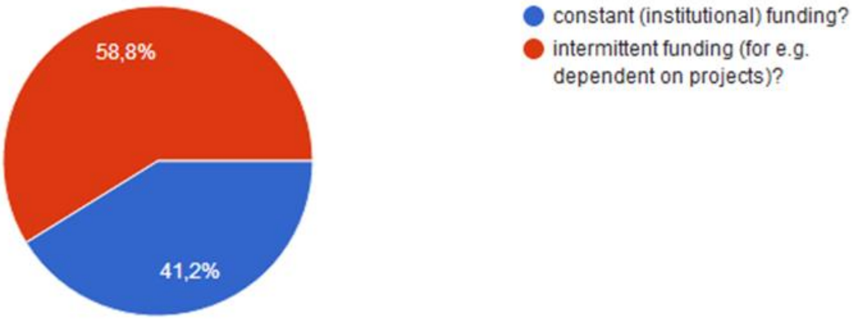


Figure 3.1.1. *Breakdown of the funding of the JERICO observatories.*

Something similar is seen when it comes to the budget for upgrading the observatories (with new sensors, equipment and modules). 70.6% of the observatories in the network reported separate funding for this purpose while the remaining must fit this cost into the general allotted budget. As for the implementation of recognized management standards like ISO 9000, ISO 10012, etc., only 5 out of 17 participants in the survey acknowledged that they were implementing similar formal certification schemes, although 14 out of 17 declared that they do maintain formal documentation relating to observatory activities (e.g. registers) containing at the very least:

- listings and descriptions of equipment and procedures;
- maintenance/calibration records and certificates for instrumentation;
- safety precautions and regulations.

In other words, while official certification schemes are not common within the JERICO network, there is often some kind of system in place for overseeing many routine operations.

From the standpoint of human resources, 76.5% of the respondents said their organizations employed distinct, institutionally-recognized teams for the day-to-day running of their observatory/ies.

However, often, there is no clear division of such teams into coherent units for specific tasks such as deployment/recovery, on-site maintenance, instrumentation, data handling, etc. In fact, only 9 out of 17 observatory operators reported highly organized teams. Capacity-building is also not a common practice (Fig. 3.1.2). More than half of the network partners do not have adequate training programmes for topics and activities relevant to the running of their observatories.

Figure 3.1.2. *Overview of the availability of institutional training programmes for observatory activities amongst operators within the JERICO network.*

3.2. Part B: Operation

A key element of running a coastal observatory network is the maintenance of the infrastructures, including instrumentation. Different types of platforms and environmental conditions mean that the procedures for this can vary a lot among operators.

Located, as they are for the most part, in coastal waters, the JERICO observatories operate in an extremely hostile environment that subjects them to severe dynamical stress, wear-and-tear, and corrosion. For example, unprotected steel structures continuously immersed for long periods in seawater show corrosion rates of 100 - 200 μm per year. Thus, the materials and methods of protection employed for its various components - including structural elements, connectors, mechanical interfaces, cables and sensors - are essential choices that determine the quality of the performance of an observatory.

In the light of their importance, the online survey, therefore, included some specific questions about anticorrosion and antifouling techniques.

3.2.1. Section 1: Fixed platforms

The fixed platforms section of the on-line survey was filled by 9 partners of the JERICO network (Table 3.2.1).

FIXED PLATFORM	OPERATOR	COUNTRY
CABLED OBSERVATORY, OBSEA	UPC	Spain
ACQUA ALTA OCEANOGRAPHIC TOWER, SICILY CHANNEL MOORING, E1 BUOY, PALOMA	CNR ISMAR	Italy
UTÖ ATMOSPHERIC AND MARINE RESEARCH STATION	FMI	Finland
4 SMARTBUOY TYPE FIXED STATIONS	Cefas	UK
FIXED BUOY MAREL MOLIT	IFREMER	France
BALCHIK COASTAL STATION	BAS	Bulgaria
4 METEO-OCEANOGRAPHIC DATA BUOYS (IN-HOUSE DESIGN), 3 WAVE BUOYS (DATAWELL DIRECTIONAL WAVERIDER DWR-G), 2 CABLED RIVERINE ADCP (NORTEK AQUADOPP) STATION	OGS	Italy
UTÖ FIXED STATION	SYKE	Finland
HERAKLION COASTAL BUOY, ATHOS BUOY, SARONIKOS BUOY	HCMR	Greece

Table 3.2.1. *The JERICO-NEXT fixed platform operators who responded to the survey.*

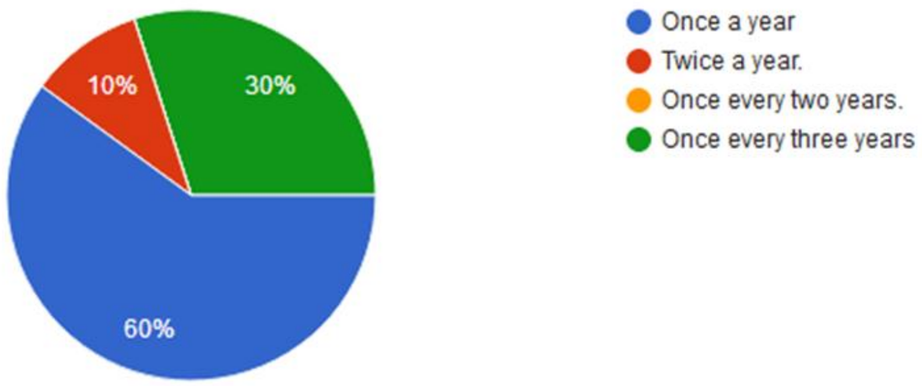
Although fixed platforms in the JERICO observatory network can be significantly different in terms of design and equipment, the way they are run tends to be strikingly similar.

The first part of the fixed platforms section in the survey questionnaire concerned the guidelines and procedures for maintenance that were produced and documented as Best Practice for coastal observatories during the JERICO project. Participants were asked whether these procedures were being followed at their observatories. The answers received demonstrate that these Best Practices have been adopted, and a certain level of harmonization in terms of operating fixed platforms has been achieved within the JERICO network (see the box below).

Level of observance of some main JERICO Best Practice recommendations for fixed platforms within the JERICO observatory network (expressed as percentages of affirmative answers to relevant questions by respondents).

- Structural inspection by knowledgeable personnel (to the degree permitted by the nature of the platform). [**100%**]
- Where possible, run diagnostics of basic functional components/modules (power, cabling, telemetry, communications, data transmission, etc.) to monitor their status. [**92.3%**]
- Evaluate seaworthiness (e.g. platform stability and station-holding capacity). [**69.2%**]
- Inspect the state of antifouling and anti-corrosive coatings. [**100%**]
- Inspect the state of sacrificial anodes (protection against galvanic corrosion). [**76.9%**]
- Inspect the state of the positioning system, including single elements (e.g. mooring lines, anchors, piles, etc.). [**76.9%**]
- Inspect the state of signalling elements (e.g. beacons). [**76.9 %**]

The maintenance procedures and practices specified in the questionnaire were divided into two classes: those carried out on-site and those carried out on land. The replies indicated that the majority of the maintenance (60%) is undertaken both in-situ and on land once every year (Figure 3.2.1).



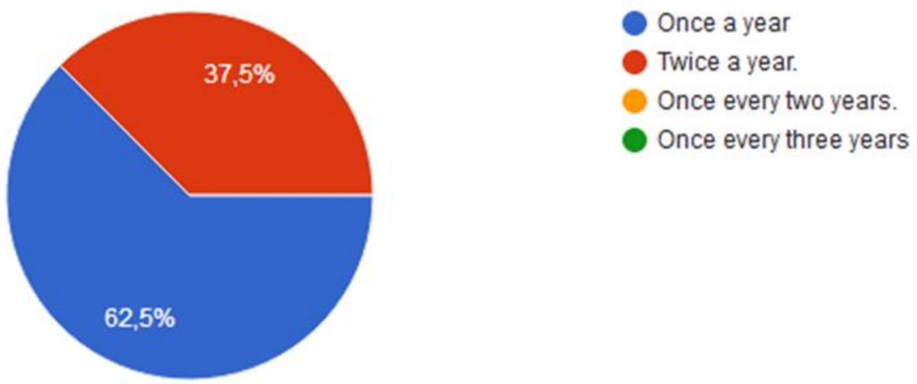


Figure 3.2.1. *The frequency of maintenance for fixed platforms in the JERICO network: on land (upper panel) and in-situ (lower panel).*

However, deployed marine infrastructure usually requires a combination of on-site and dry land maintenance. It would be wise to consider the periodicity portrayed in figure 5 as indicative only because the majority of respondents mentioned that their maintenance activities were strongly related to the availability of funding, ship time and weather conditions.

A common challenge for all coastal fixed platforms is protection against biofouling and corrosion. These topics were addressed in the survey by asking questions concerning the recurrence of the following operations:

- The substitution of sacrificial nodes;
- The retouch of antifouling coatings;
- The retouch of anticorrosion coatings;
- The removal of biofouling;
- Small repairs on-site (including replacement of defective parts, if this was necessary)

Figures 3.2.2 - 3.2.6 summarize the answers received to these questions.

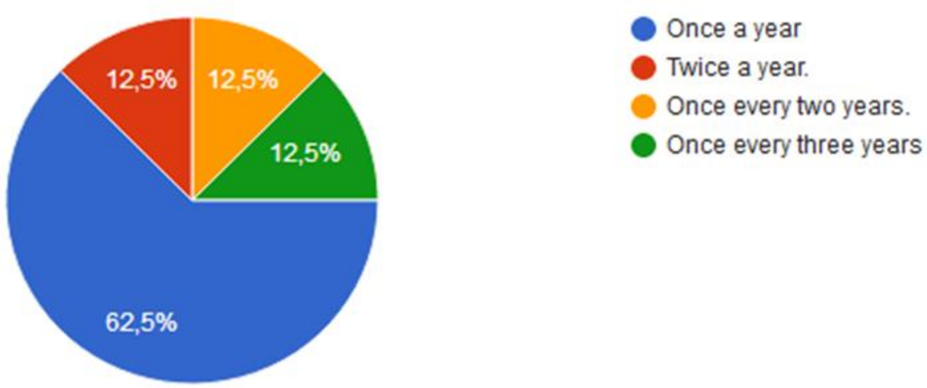


Figure 3.2.2. *Frequency of on-site substitution of sacrificial nodes for JERICO-NEXT fixed platforms.*

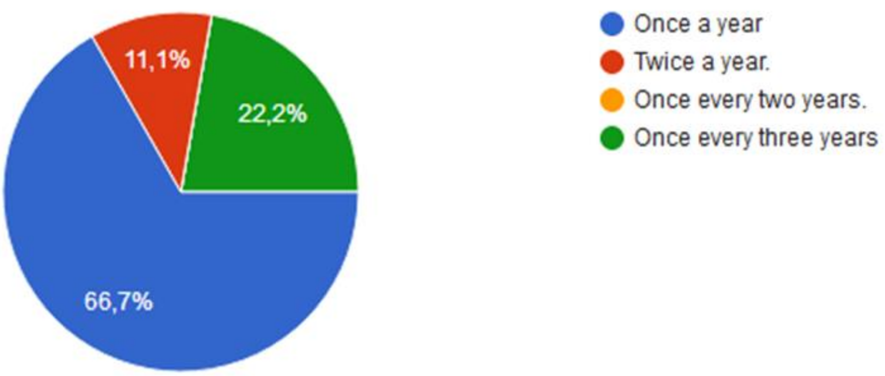


Figure 3.2.3. *Frequency of on-site retouch of antifouling coatings for JERICO-NEXT fixed platforms.*

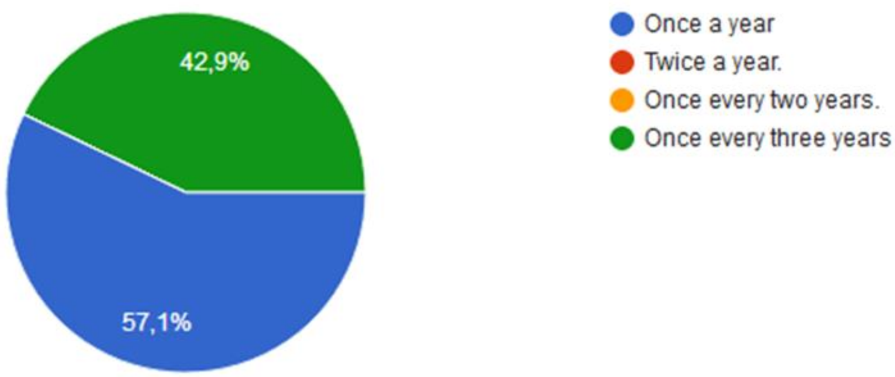


Figure 3.2.4. *Frequency of on-site retouch of anti-corrosion coatings for JERICO-NEXT fixed platforms.*

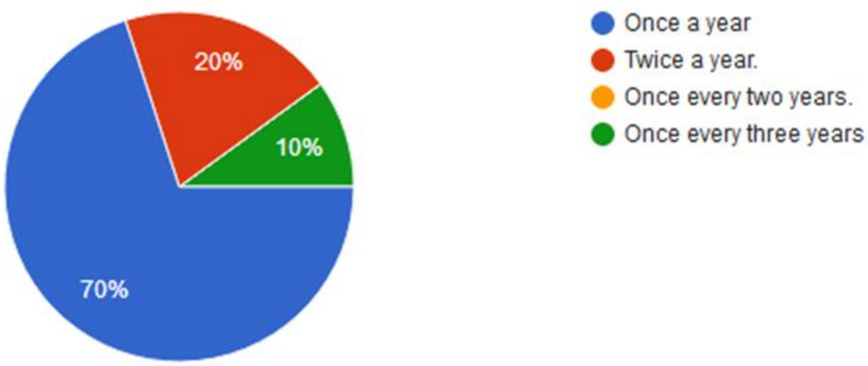


Figure 3.2.5. *Frequency of on-site cleaning of submerged surfaces for JERICO-NEXT fixed platforms.*

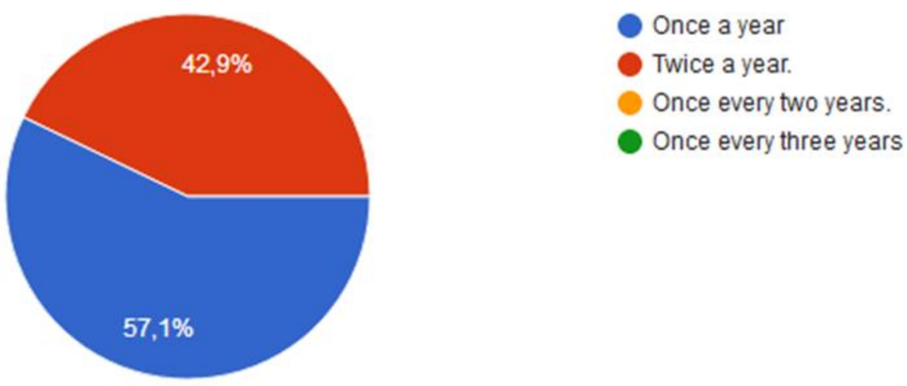


Figure 3.2.6. *Frequency of on-site cleaning of submerged surfaces for JERICO-NEXT fixed platforms.*

There are significant dissimilarities within the network as regards the periodic maintenance of fixed platforms. This is mainly due to the different locations and operating environments of the platforms, and their significant diversity from the standpoint of design and construction. For example, highly dynamic environments would tend to lead to more frequent failures requiring small repairs while platforms operating in biologically productive areas would demand replenishment of antifouling measures more often than those in oligotrophic waters.

In the last part of the fixed platforms section of the survey, respondents were asked to provide estimates of the annual operating cost for their platforms. We got feedback from 12 partners. The operating costs, reported below (Table 3.2.2), varied significantly as expected because of the very reasons touched on in the previous paragraph.

FIXED PLATFORM	OPERATOR	ANNUAL OPERATING COST
CABLED OBSERVATORY, OBSEA	UPC	200,000
ACQUA ALTA OCEANOGRAPHIC TOWER, SICILY CHANNEL MOORING, E1 BUOY, PALOMA	CNR ISMAR	300,000
UTÖ ATMOSPHERIC AND MARINE RESEARCH STATION	FMI	300,000
4 SMARTBUOY TYPE FIXED STATIONS	Cefas	77,000
FIXED BUOY MAREL MOLIT	IFREMER	10,000
BALCHIK COASTAL STATION	BAS	20,000

4 METEO-OCEANOGRAPHIC DATA BUOYS (IN-HOUSE DESIGN), 3 WAVE BUOYS (DATAWELL DIRECTIONAL WAVERIDER DWR-G), 2 CABLED RIVERINE ADCP (NORTEK AQUADOPP) STATION	OGS	30,000-60,000 (pending on the platform)
UTÖ FIXED STATION	SYKE	5,000
HERAKLION COASTAL BUOY, ATHOS BUOY, SARONIKOS BUOY	HCMR	40,000

Table 3.2.2. *The JERICO-NEXT fixed platforms: examples of annual operating costs.*

3.2.2. Section 2: Ferryboxes

Ferryboxes are unique in that they are hosted in a relatively controlled environment, such as a ship's engine room. Although not exposed directly to the sea, the maintenance of ferrybox systems is demanding and, in many cases, requires them to be placed offline or dismantled (fully or partly) and transported to the laboratory.

Ferryboxes use a pumped, closed hydraulic circuit to drive seawater for analysis past sensors before flushing it back to the sea. Biofouling and corrosion are significant issues, affecting not only data quality but also some of the operations of the hosting ship. This section of the survey was completed by 7 JERICO-NEXT partners (Table 3.2.3) operating ferryboxes in different European seas.

Ferrybox	Operator	Country
Finnmaid (Helsinki-Travemünde) Silja Serenade (Helsinki- Stockholm)	SYKE	Finland
MS Vesterålen	IMR	Norway
Cefas FerryBox	Cefas	UK
-4H-Jena Ferrybox (R/V Thalassa) ,-4H-Jena Pocket Ferrybox (R/V Europe), SubCtech AUMS (R/V Marion Dufresne 2)	IFREMER	France
FerryBox, 3 platforms (Hafnia Seaways, Lysbris Seaways, Funnygirl)	HZG	Germany
FerryBox, 3 lines, Color Fantasy, Trollfjord, Norbjørn	NIVA	Norway
Poseidon FerryBox	HCMR	Greece

Table 3.2.3. *The JERICO-NEXT ferrybox operators who participated in the survey.*

In the first question of the section, a list of on-site maintenance procedures was listed, and respondents were asked to declare if they were following these for their ferryboxes (see box below). These procedures were some of the Best Practice recommendations for ferrybox maintenance formulated during the JERICO project. The responses received revealed that almost all of the operators were following them, indicating a high level of harmonization within the JERICO network's ferrybox community. Of course, this situation could be partly due to the fact that most of the systems in question were comparable since there are not that many manufactures/suppliers for such equipment, worldwide.

Level of observance of some main Best Practice recommendations for FerryBoxes within the JERICO observatory network (expressed as percentages of affirmative answers to relevant questions by respondents)

- Structural inspection by knowledgeable personnel (to the degree permitted by the nature of the platform). [**100%**]
- Where possible, run diagnostics of basic functional components/modules (power, cabling, telemetry, communications, data transmission, etc.) to monitor their status. [**100%**]
- Evaluate hydraulic circuit performance (e.g. flow rate, pump functions) - **100%**
- Inspect the state of antifouling. [**85.7%**]
- Inspect the state of the positioning system. [**85.7%**]

The practice of carrying out the maintenance of the whole ferrybox system on land, removing all the modules from the host ship, while common, does not follow any regular pattern (Figure 3.2.7). It would appear that this operation is usually performed when deemed necessary.

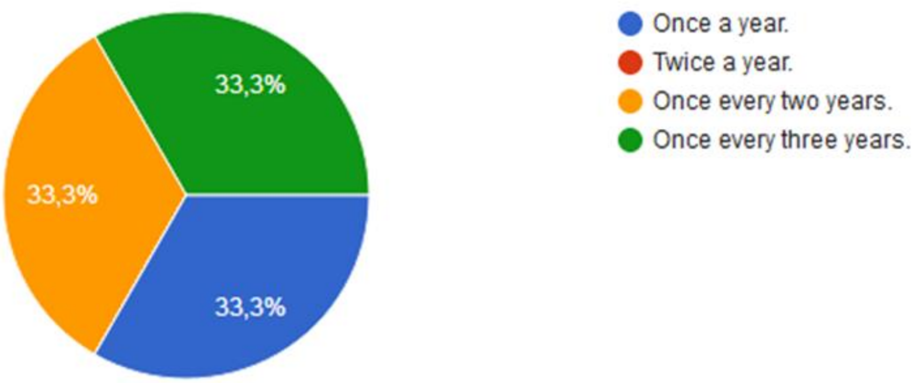


Figure 3.2.7. *The frequency of maintenance on land for ferrybox systems within the JERICO network.*

The next questions were concerned with the on-board maintenance of the ferryboxes, which takes place more regularly: both the frequency (Figure 3.2.8) and some specific operations (Figure 3.2.9).

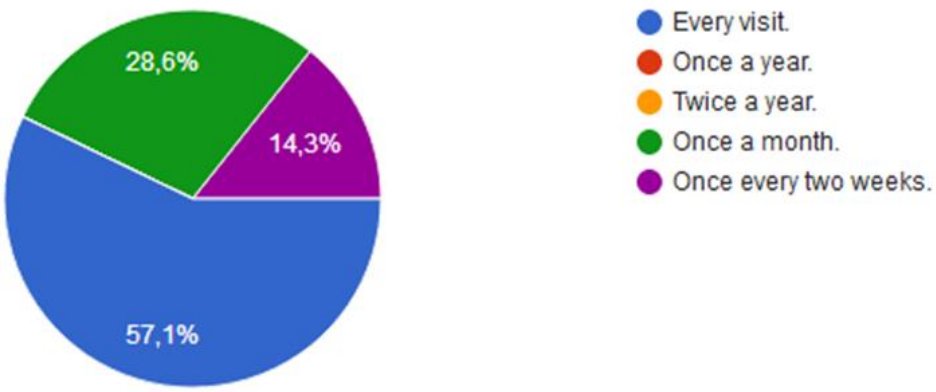
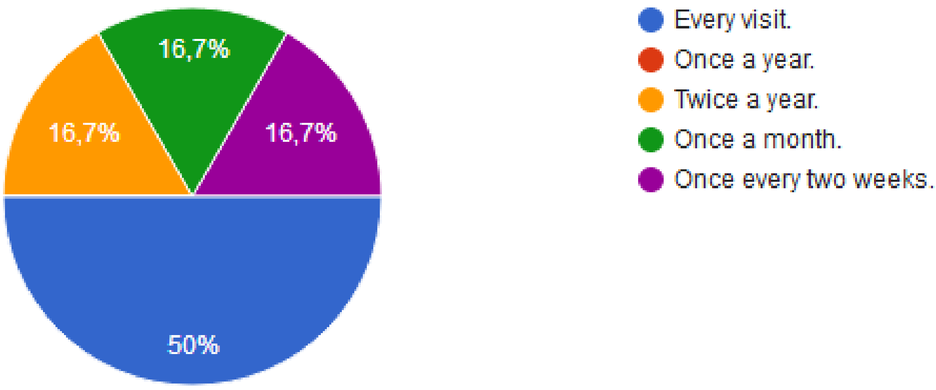
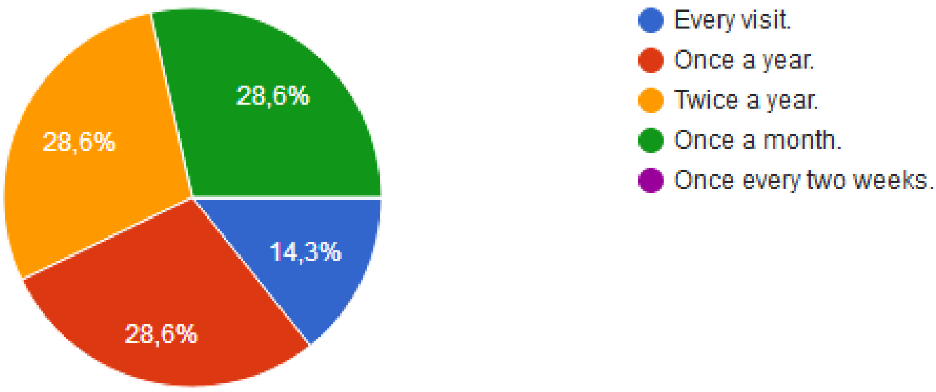


Figure 3.2.8. *The frequency of onboard maintenance for ferrybox systems within the JERICO network.*





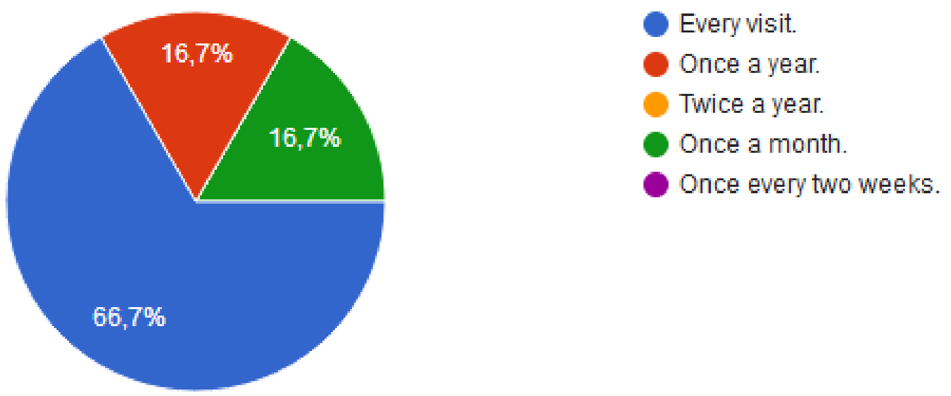


Figure 3.2.9. *The frequency of some specific onboard maintenance operations for ferryboxes within the JERICO network: retouch of antifouling devices (top panel), cleaning of the hydraulic circuit (middle panel), and small repairs, including replacement of defective parts (lower panel).*

The responses as regards on board maintenance show that fouling and impairment of functionality, not necessarily caused by any major damage or full system shutdown, are the main difficulties. Surprisingly, the cleanness of the hydraulic circuit of the ferrybox does not appear to be seen as a big problem. More than half of the respondents reported that they were performing this operation twice a year at most.

The last question of the section asked respondents to provide estimates of their annual operating costs for ferrybox activities. The answers, from the 6 institutes that replied to this question, are summarized in the table below. It is very hard to draw any clear conclusions on the basis of these numbers though, without a more detailed breakdown to help understand what they mean.

FERRYBOX	OPERATOR	ANNUAL OPERATING COST
FINNMAID (HELSINKI-TRAVEMÜNDE) SILJA SERENADE (HELSINKI-STOCKHOLM)	SYKE	5,000
MS VESTERÅLEN	IMR	80,000
CEFAS FERRYBOX	Cefas	54,000
-4H-JENA FERRYBOX (R/V THALASSA) ,-4H-JENA POCKET FERRYBOX (R/V EUROPE), SUBCTECH AUMS (R/V MARION DUFRESNE 2)	IFREMER	Not experienced yet
FERRYBOX, 3 PLATFORMS (HAFNIA SEAWAYS, LYSBRIS SEAWAYS, FUNNYGIRL)	HZG	N/A

FERRYBOX, 3 LINES, COLOR FANTASY, TROLLFJORD, NORBJØRN	NIVA	80,000
POSEIDON FERRYBOX	HCMR	35,000

Table 3.2.4. *The JERICO NEXT ferryboxes: examples of annual operating costs.*

3.2.3. Section 3: Gliders

Gliders are among the novel technologies of the JERICO observatories, providing new capabilities to characterise the coastal ocean and its variability with a very high resolution and, usually, in near-realtime.The section of the survey dealing with gliders was filled only by 3 operators (Table 3.2.5) because this technology is still not common within the network, so the information collected is limited.

Glider	Operator	Country
Slocum G1 Shallow (1; ICOAST00); Slocum G1 Deep (2; IDEEP00, IDEEP02); Slocum G2 Deep (3; SDEEP00, SDEEP04, SDEEP01); SeaGlider (2; SDEEP02, SDEEP03)	SOCIB	Spain
Sicily channel Glider	CNR ISMAR	Italy
Poseidon Gliders	HCMR	Greece

Table 3.2.5. *The JERICO-NEXT glider operators who responded to the survey.*

As before, some specific procedures were listed, and respondents were asked to declare if they were following them for their gliders (see box below). The procedures were some of the Best Practice recommendations for glider operation formulated during the JERICO project. All 3 respondents were aware of the procedures, and were following them to one degree or other. The discrepancies are probably due to differences in the make of the vehicles themselves, and their sensor payloads and configurations.

Level of observance of some main Best Practice recommendations for gliders within the JERICO observatory network.

- Mandatory pre-mission planning, including characterization of the operating area (bathymetry, currents, dominant processes, fishing and other anthropic activities), endurance calculations, development of the sampling programme, definition of vehicle settings, etc.
- Pre-mission laboratory bench and field testing of vehicle, including ballasting.
- Check of vehicle's internal pressure (high pressure leak test) before/near start of mission (prior to deployment).
- Check of vehicle's compass before/near start of mission (prior to deployment).
- Fine ballasting and trimming of vehicle before/near start of mission (prior to deployment).
- Manufacturer-recommended pre-flight qualification tests during vehicle deployment.
- Post-mission inspection and cleaning of vehicle.
- Protocols and checklists developed in-house or provided by manufacturer (for all phases of vehicle operation).
- CTD casts in a vehicle's area of operations during a mission for data inter-comparisons/adjustments and quality evaluations.
- Additional vehicle safety features such as, for example, an Argos tag, an underwater locator beacon (ULB), etc.

The full periodic maintenance of the gliders, either by the manufacturer or in-house by the operator, is taking place every 1 or 2 years, whereas minor repairs or replacements of defective parts are performed when required. Finally, the annual operating cost per glider, as declared by two partners who actually provided this information, is on the order of € 30,000 - 35,000.

3.2.4. Section 4: Sensors

A shared feature of the observing systems in the JERICO network is that they make use of sensors in order to serve their scientific purpose. The technology and techniques behind the sensors can vary, sometimes even considerably. But there are many commonalities when it comes to running them in the laboratory and in the field. In the first part of the section on sensors in the survey, respondents were asked to provide information about the variables they were measuring in their observatories. The answers, from 17 operators, are summarized in figures 3.2.10 and 3.2.11, below.

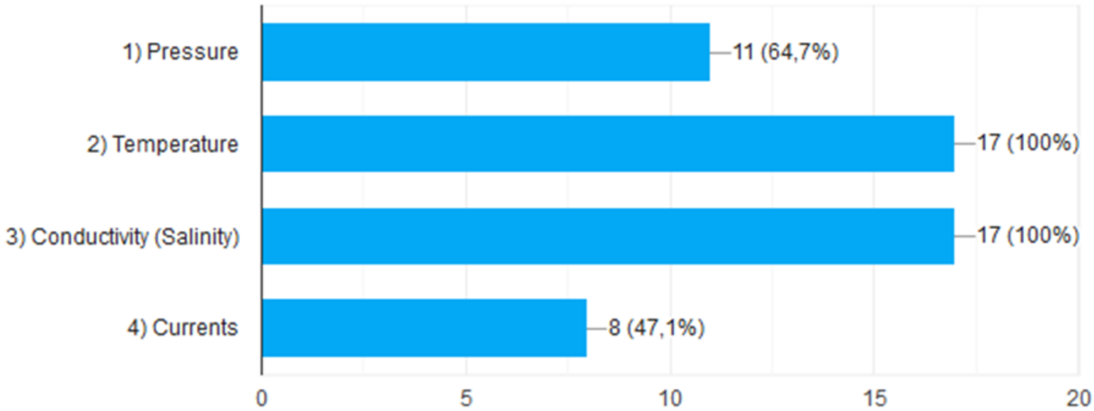


Figure 3.2.10. *Variables inherent to Physical Oceanography.*

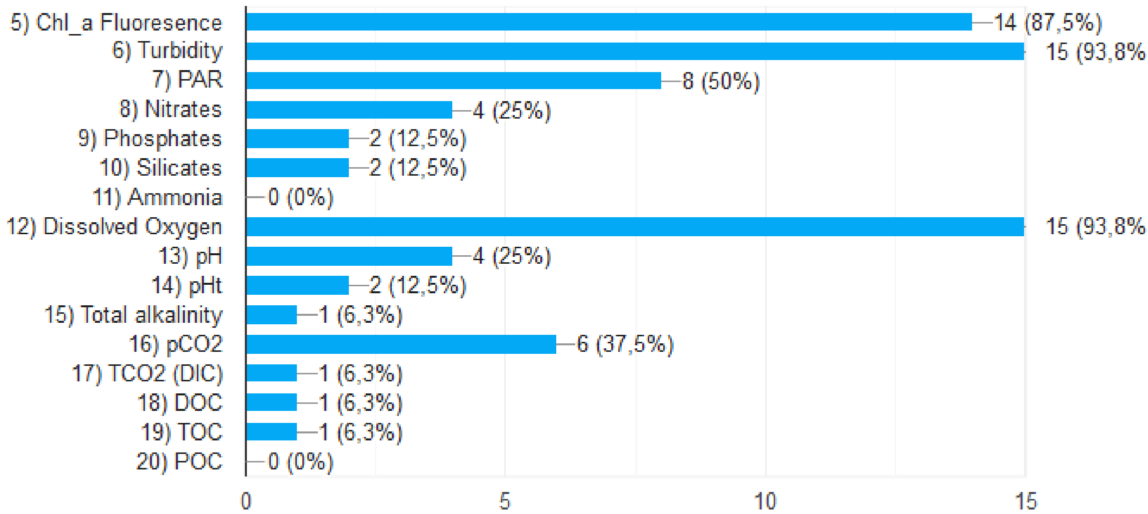


Figure 3.2.11. *Variables inherent to Biological Oceanography/Marine Biogeochemistry.*

In addition to those explicitly stated in the survey form, some respondents reported that they were also measuring one or more of the following variables:

- underwater noise;
- vibration/motion (seismometry);
- CDOM;
- EC flux;
- air temperature;
- atmospheric pressure;
- relative humidity;
- wind speed and direction;
- CO_2 concentration in air;
- phycocyanin and phycoerythrin fluorescence.

Note that sensors or instruments can have components that may require particular attention sometimes, such as actuators and moving parts (if any), front end electronics, and loggers. Thus, each sensor type can have specific maintenance procedures, not always applicable on-site, it is therefore good practice to have a second set of serviced and calibrated sensors available so that the ones operating in the field can be easily and swiftly replaced.

A list of procedures was specified, and respondents were asked if they were following them for their sensors (see box below). The procedures were some of the Best Practice recommendations for sensors formulated during both the JERICO and the JERICO-NEXT projects.

Some Best Practice recommendations for operating sensor endorsed by the JERICO coastal observatory network.

- Visual inspection by knowledgeable personnel (to the degree permitted by the nature of the sensor configurations).
- Where possible, run diagnostics to monitor basic functionality (power, telemetry, communications, data transmission, etc.).
- Inspect the state of antifouling and anti-corrosive coatings and/or devices.
- Inspect the state of sacrificial anodes (protection against galvanic corrosion), if present.
- Inspect the state of mounting elements (e.g. brackets, fixtures, etc.).
- Take reference samples for laboratory analysis (Winkler, HPLC, etc) and data validation.
- In-situ calibration during maintenance.

Respondents were also asked how often they performed sensor maintenance in the laboratory and in-situ. Most of the sensors within the JERICO network are subject to maintenance at least once a year in the laboratory and twice a year on-site. Of course, there are sensors that, in order to be fully serviced, need to be returned to the manufacturer. The minimum annual costs reported for sensor maintenance was € 1000, but the majority of respondents spend much more, in the range of € 10,000 - 70,000.

Regular sensor calibration is absolutely crucial for good data quality. But calibration requirements and methodologies may differ greatly from one sensor to another. Robust, well-documented calibration procedures enhance inter-comparability of data in the long-term. As a rule, it is wise to calibrate a sensor prior to and after every deployment in order to apply corrections to the acquired data in case of instrumental drift in the intervening period.

13 out of 17 respondents acknowledged maintaining a manual containing a description of their calibration methods and the measuring procedures, together with details of sample treatment and preparation when these were pertinent. But, only 8 perform internal quality audits to monitor and assess their calibration procedures, and just 4 employ independent (external) quality audits for the same purposes.

In-situ calibration and tests of performance of sensors usually take the form of:

- comparison against values obtained with a reference sensor/instrument (e.g. CTD).
- comparison against values obtained from the analysis of collected samples (e.g. salinity, chloropigments, dissolved oxygen, etc).

When it comes to the laboratory calibration of sensors, the frequency and the procedures followed depend on the type of technology involved, and the ability of the observatory operator's institution to carry out such operations on its own. On the basis of the replies received, sensors deployed on JERICO observatories are calibrated:

- annually or every two years in-house;
- every two or three years by the manufacturer.

The traceability of calibrations is ensured by using one or more of the following:

- certified reference material
- conventionally recognized in-house reference material
- traceable in-house reference material
- other kinds of reference material, where international consensus is lacking.

The last questions of the section on sensors dealt with calibration documentation. The participants in the survey were asked about their archiving practices for sensor calibration reports and certificates. 76.5% of the respondents actively maintain an archive of sensor calibration reports, and retain them indefinitely. Around the same fraction of respondents (75%) do the same with on-site performance reports.

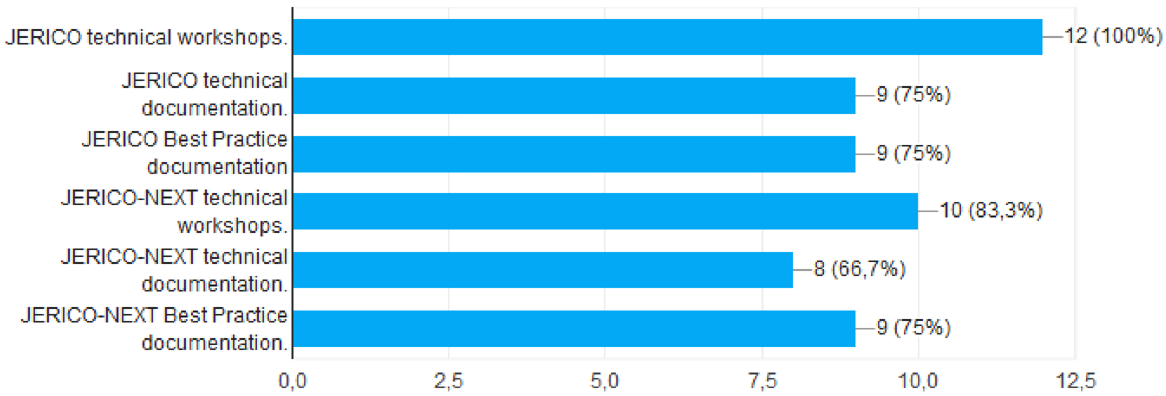
3.3. Part C: Best Practices

The final part of the on-line survey focussed on Best Practices and technical harmonization (Figure 3.3.1). Respondents were first of all asked to describe their understanding of the term "Best Practice". The answers received are listed in the box below

Some definitions of the term “*Best Practice”* received from the online survey respondents.

- *A set of well-defined procedures, already tested and applied by the community that avoid re-inventing the wheel or having errors.*
- *Best methodology applied.*
- *Operating according to manufacturer recommendations and recommendations from expert groups (e.g. EuroGOOS, Jerico, FerryBox)*
- *Compromise between good and practical.*
- *All the operations that allow the station to operate providing the best possible data, with documented, standardized and commonly accepted procedures of maintenance, calibration and data handling.*
- *Elaborate a process to control our system/sensor, be homogeneous between all of our assets, run calibration, data comparison, and so on.*
- *A well-documented, openly accessible methodology implemented to achieve a defined objective that has repeatedly been shown to produce superior results (within the context of specified resource limitations and feasibility) relative to other methodologies with the same objective that is widely accepted and adopted by the broader community.*
- *Protocols and methods collated and approved by the community.*
- *International cooperation to get comparable observations.*
- *Best practices are a set of guidelines and methodologies that represent the most efficient and common acceptable way to perform a specific task.*

These answers reveal that, while the concept of “Best Practice” is broadly acknowledged and accepted, it tends to remain somewhat confusing and difficult in actual practice.



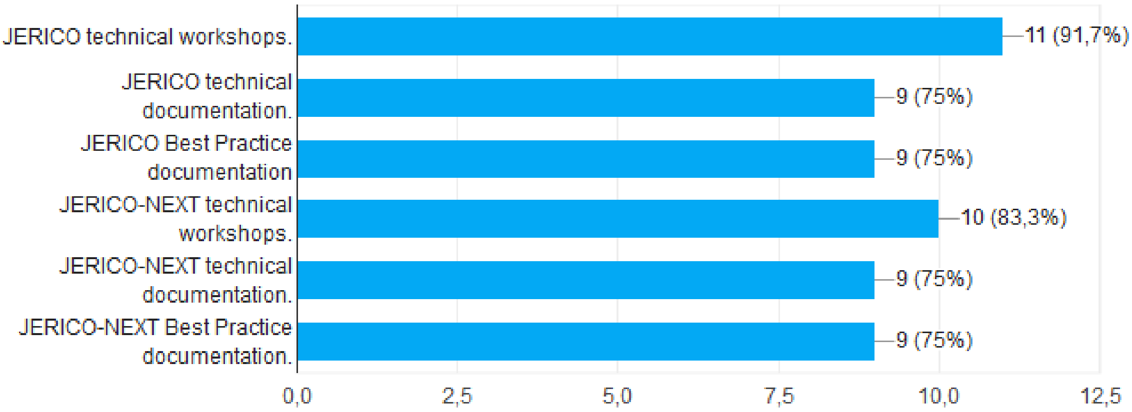


Figure 3.3.1. *Levels of involvement of partners in various kinds of Best Practice activities during JERICO and JERICO-NEXT: as participants (upper panel), and as contributors (lower panel).*

All the same, 82.4% of the respondents declared that they seek to formulate and apply Best Practices in their observatories, 81.3% affirmed that they had been using Best Practices well before the JERICO and JERICO-NEXT projects, and 64.7% said that it was a standing policy at their organizations to maintain Best Practice documentation.

However, in regard to the last assertion above, only 15.4% of the organizations represented in the survey offer their Best Practice documentation freely online, though another 38.5% provide them openly upon request. Remarkably, 61.5% of the organizations keep such documentation and guidelines restricted for internal use only. Thus, while there is a lot of Best Practice information available within the JERICO network, much of it tends to remain unexploited despite the various attempts to improve accessibility through activities like technical meetings, workshops, etc.

The final question of the survey asked respondents to indicate what kind of Best Practice initiatives of the JERICO and JERICO-NEXT projects they felt had been the most useful to them and their organizations: workshops, technical documentation or Best Practice documentation. The responses (Figure 3.3.2) clearly show that all three types of activities are beneficial.

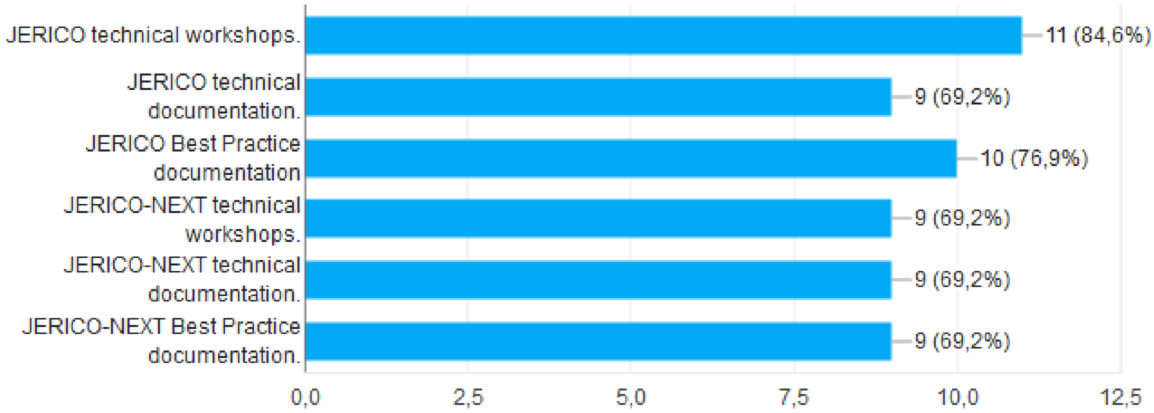


Figure 3.3.2. *Perception by survey participants of the utility of different types of initiatives adopted in the JERICO and JERICO-NEXT projects to promote Best Practices.*

4. Conclusions

Although some partners of the JERICO-NEXT consortium did not participate in the survey, it is possible to draw some conclusions on the progress of network harmonization, in terms of sharing and adopting Best Practices, and to identify topics for work in the future.

4.1. Advances in the harmonization process in the JERICO-RI

JERICO (FP7) laid down the foundation of a permanent framework for identifying and establishing Best Practices within the JERICO network. This activity principally involved the different phases of the operation of the network's observing elements (e.g. pre-deployment testing, maintenance, calibration, etc.), and led to a number of recommendations to adopt common methodologies and protocols (Petihakis et al., 2015). The present survey shows that there has been much progress in the network in adopting the recommendations made then for running fixed platforms, ferryBoxes, and gliders, where a discrete level of harmonization is in fact evidenced.

4.1.1. Fixed platforms

Maintenance practices, both in-situ and on dry land, show a general uniformity. Any differences can reasonably be attributed to differences in the design and equipment of the platforms themselves, their locations and the availability of funding and ship time. In the case of on-site maintenance, structural inspections, general instrument checks, and control of antifouling and anti-corrosion measures are a norm. But, the seaworthiness of the platform is much less frequently evaluated. The prevailing tendency is to perform dry land maintenance once a year at least, though many perform this operation once every three years. All in all, the level of harmonization is quite good, though there may be room for improvement on issues like cables and connectors, sensors for specific kinds of measurements, and data management.

4.1.2. FerryBoxes

The results of the online survey revealed that a high level of harmonization has been achieved by the ferrybox operators in the JERICO network, partly due to the participation of many of them in the very active European ferrybox community and the dedicated EuroGOOS Task Team. It must be said that, in the case of ferrybox systems, a fundamental factor facilitating harmonization is that there aren't any big differences between the devices used in the network because of the very limited number of manufactures/suppliers for the technology worldwide. Challenges may be expected in integrating new kinds of sensors, measuring techniques, and control and communication technologies as these come to market.

4.1.3. Gliders

The section of the survey on glider operations was completed by only three operators, therefore the information collected is limited. From the point of view of operating practices, the level of harmonization among these operators is quite good at present, again partly because of close links with relevant Europe-wide initiatives. Challenges may be expected in integrating new kinds of sensors and measuring techniques as with ferryboxes, and in data quality management.

4.2. Recommendations for future work

Benefits of continuing harmonization efforts: better guarantees for the quality of the data produced, greater support for third-party users, qualification of the infrastructure, which will help to attract funding.

4.2.1. Management of oceanographic observatories (all platforms):

- Promote a higher level of efficiency by identifying a clear hierarchical management structure and a transparent chain of responsibility for technical/scientific and operational decisions.
- Promote staff training, for example through regular staff exchanges within JERICO-RI or other complementary infrastructure projects.
- Promote the maintenance of formal documentation (e.g. registers) containing at the minimum: listings and descriptions of equipment and procedures, calibration records and certificates for instrumentation, safety precautions and regulations.

4.2.2. Management of sensors

- Promote the maintenance of formal documentation containing descriptions of the calibration methods and the measuring procedures, together with details of sample treatment and preparations when relevant.
- Promote the maintenance of a repository, collecting sensor calibration reports and certificates, including on-site performance reports if any.
- Promote the use of internal and external audit procedures to assess calibration procedures in use by the observatory operator.

5. Annexes and references

5.1. References

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5.2. Annex A: The JERICO online questionnaire participants contact info

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5.3. Annex B: The JERICO online questionnaire form

JERICO-NEXT QUESTIONNAIRE
TASK 2.2 - CONSOLIDATION OF INITIATED NETWORK HARMONIZATION ACTIONS

Review of current practices in the management of Fixed Platforms, FerryBoxes, and Gliders within the JERICO-NEXT observing network

Type of Asset/s

Fixed Platform/s ☐ **FerryBox/es** ☐ **Glider/s** ☐

TYPE, NUMBER & NAME/S (IF EXISTING) OF YOUR ASSET/S ………..

MANAGING INSTITUTE/ORGANIZATION: …………………………………..
ADDRESS: ………………………………………………………………………..
COUNTRY: ……… TEL: ………. FAX: ……….. WEBSITE: ………………

Contact/s for Asset/s
NAME/S OF CONTACT/S: ……………………………………………………
E-MAIL ADDRESS/ES OF CONTACT/S: ……………………………………..

Part A: Management

1. Is the implementation of your asset/assets supported by a well-defined organizational Framework with:
   - ☐ dedicated staff?
   - ☐ clear hierarchy (command structure)?
   - ☐ transparent chain of responsibility for technical/scientific and operational decisions?

If your answer is "no", kindly provide a brief description of how you manage your asset/assets, below:

…………………………………………………………………………………………

2. Is the implementation of your asset/assets supported by:
   - ☐ constant (institutional) funding?
   - ☐ intermittent funding (for e.g. dependent on projects)?
   - ☐ other (please clarify): …………………………………..

3. Is the implementation of your asset/assets supported by separate funding for upgrading (e.g. acquiring new instrumentation, etc.)?
   ☐ Yes ☐ No

4. Is the implementation of your asset/assets supported by any recognized management standards (e.g. ISO 9000, ISO 10012, and the like)?

☐ Yes ☐ No

5. Is there a distinct, institutionally-recognized team overseeing the day-to-day running of your asset/assets?

☐ Yes ☐ No

If "Yes", is the team divided into specific groups for handling specific tasks (e.g. deployment/recovery, on-site maintenance, instrumentation, data handling, etc.)?

☐ Yes ☐ No

6. Are the personnel actively involved in the operation of your asset/assets supported by an adequate training programme covering subjects relevant to its proper implementation?

☐ Yes ☐ No

7. Does your facility maintain formal documentation (e.g. registers) in relation to the asset/s containing, at the very least, listings and descriptions of equipment and procedures, maintenance/calibration records and certificates for instrumentation, and safety precautions and regulations?

☐ Yes ☐ No

Part B: Operation

Section 1: Fixed platforms

1. Which of the following on-site operations do you routinely perform (indicate all that apply)?

- ☐ Structural inspection by knowledgeable personnel (to the degree permitted by the nature of the platform).
- ☐ Where possible, run diagnostics of basic functional components/modules (power, cabling, telemetry, communications, data transmission, etc.) to monitor their statuses.
- ☐ Evaluate seaworthiness (e.g. platform stability and station-holding capacity).
- ☐ Inspect the state of antifouling and anti-corrosive coatings.
- ☐ Inspect the state of sacrificial anodes (protection against galvanic corrosion).
- ☐ Inspect the state of the positioning system, including single elements (e.g. mooring lines, anchors, piles, etc.).
- ☐ Inspect the state of signalling elements (e.g. beacons).
- ☐ Other (please describe): ……………………………….

2. Is/are your Fixed Platform/s subject to regular maintenance?

Full maintenance, on land, platform/s only

- ☐ Once a year.
- ☐ Twice a year.
- ☐ Once every two years.
- ☐ Once every three years.
- ☐ Other (please specify): …………………….

In-situ maintenance, platform/s only

☐ Every visit.
☐ Once a year.
☐ Twice a year.
☐ Once every two years.
☐ Once every three years.
☐ Other (please specify): …………………….

On-site substitution of sacrificial anodes, platform/s only

☐ Every visit.
☐ Once a year.
☐ Twice a year.
☐ Once every two years.
☐ Once every three years.
☐ Other (please specify): …………………….

On-site retouches of antifouling coatings above the water line, platform/s only

☐ Every visit.
☐ Once a year.
☐ Twice a year.
☐ Once every two years.
☐ Once every three years.
☐ Other (please specify): …………………….

On-site retouches of anti-corrosion coatings above the water line, platform/s only

☐ Every visit.
☐ Once a year.
☐ Twice a year.
☐ Once every two years.
☐ Once every three years.
☐ Other (please specify): …………………….

On-site cleaning of submerged surfaces (e.g. removal of incrustations and unwanted flora/fauna), especially those of any mobile elements, platform/s only

☐ Every visit.
☐ Once a year.
☐ Twice a year.
☐ Once every two years.
☐ Once every three years.
☐ Other (please specify): …………………….

Small repairs on-site (including replacement of defective parts, if necessary)

- ☐ Every visit.
- ☐ Once a year.
- ☐ Twice a year.
- ☐ Once every two years.
- ☐ Once every three years.
- ☐ Other (please specify): …………………….

3. Typical annual operating cost?

- ☐ Per platform: ……………………………….
- ☐ All platforms (if applicable): ………………

Section 2: FerryBox

1. Which of the following on-site operations do you routinely perform (indicate all that apply)?

- ☐ Structural inspection by knowledgeable personnel (to the degree permitted by the nature of the platform).
- ☐ Where possible, run diagnostics of basic functional components/modules (power, cabling, telemetry, communications, data transmission, etc.) to monitor their statuses.
- ☐ Evaluate hydraulic circuit performance (e.g. flow rate, pump functions)
- ☐ Inspect the state of antifouling devices and/or systems.
- ☐ Inspect the state of the positioning system.
- ☐ Other (please specify): …………………….

2. Is/are your FerryBox/es subject to regular maintenance?

Full maintenance, on land (removing the FerryBox modules from the ship)

- ☐ Once a year.
- ☐ Twice a year.
- ☐ Once every two years.
- ☐ Once every three years.
- ☐ Other (please specify): …………………….

On-board maintenance, FerryBox only

- ☐ Every visit.
- ☐ Once a year.
- ☐ Twice a year.
- ☐ Once every two years.
- ☐ Once every three years.
- ☐ Other (please specify): …………………….

On-board retouches of antifouling devices and/or systems (e.g. acid or other antifouling techniques)

- ☐ Every visit.
- ☐ Once a year.
- ☐ Twice a year.
- ☐ Once every two years.
- ☐ Once every three years.
- ☐ Other (please specify): ……………………

On-board cleaning of hydraulic circuit/s (pipes, pumps, valves, tubes, etc.)

- ☐ Every visit.
- ☐ Once a year.
- ☐ Twice a year.
- ☐ Once a month.
- ☐ Once every two weeks.
- ☐ Other (please specify): ……………………

Small repairs on-board (including replacement of defective parts, if necessary)

- ☐ Every visit.
- ☐ Once a year.
- ☐ Twice a year.
- ☐ Once a month.
- ☐ Once every two weeks.
- ☐ Other (please specify): ……………………

3. Typical annual operating cost?

- ☐ Per FerryBox: ………………………………
- ☐ All FerryBoxes (if applicable): ……………

Section 3: Gliders

1. Which of the following operations do you routinely perform while conducting a glider mission (indicate all that apply)?

- ☐ Mandatory pre-mission planning, including characterization of the operating area (bathymetry, currents, dominant processes, fishing and other anthropic activities), endurance calculations, development of the sampling programme, definition of vehicle settings, etc.
- ☐ Pre-mission laboratory bench and field testing of vehicle, including ballasting.
- ☐ Check of vehicle's internal pressure (high pressure leak test) before/near start of mission (prior to deployment).
- ☐ Check of vehicle's compass before/near start of mission (prior to deployment).
- ☐ Fine ballasting and trimming of vehicle before/near start of mission (prior to deployment).

- ☐ Manufacturer-recommended pre-flight qualification tests during vehicle deployment.
- ☐ Post-mission inspection and cleaning of vehicle.

2. Do you routinely employ any of the following in your glider activities:
- ☐ Protocols and checklists developed in-house or provided by manufacturer (for all phases of vehicle operation).
- ☐ CTD casts in a vehicle's area of operations during a mission for data inter-comparisons/adjustments and quality evaluations.
- ☐ Additional vehicle safety features such as, for example, an Argos tag, an underwater locator beacon (ULB), etc.
- ☐ Other (please specify): …………………….

3. Is/are your glider/s subject to regular maintenance?

Full maintenance, in-house, glider only
- ☐ Never.
- ☐ Once a year.
- ☐ Twice a year.
- ☐ Once every two years.
- ☐ Once every three years.
- ☐ Other (please specify): …………………….

Full maintenance, by manufacturer, glider only
- ☐ Never.
- ☐ Once a year.
- ☐ Twice a year.
- ☐ Once every two years.
- ☐ Once every three years.
- ☐ Other (please specify): …………………….

Small repairs, in-house (including replacement of defective parts, if necessary), glider only
- ☐ Never.
- ☐ When necessary.
- ☐ Every mission.
- ☐ Other (please specify): …………………….

Small repairs, in-situ (including replacement of defective parts, if necessary), glider only
- ☐ Never.
- ☐ When necessary.
- ☐ Every mission.
- ☐ Other (please specify): …………………….

4. Typical annual operating cost?
- ☐ Per glider:
- ☐ All gliders (if applicable):

Section 4: Sensors

1. Measured variables (kindly indicate the ones relevant to your asset).

Variables inherent to Physical Oceanography
1) Pressure
2) Temperature
3) Conductivity (Salinity)
4) Currents

Variables inherent to Biological Oceanography/Marine Biogeochemistry
5) Chl_a Fluoresence
6) Turbidity
7) PAR
8) Nitrates
9) Phosphates
10) Silicates
11) Ammonia
12) Dissolved Oxygen
13) pH
14) pHt
15) Total alkalinity
16) pCO2
17) TCO2 (DIC)
18) DOC
19) TOC
20) POC

Other (please specify): ………………….

2. Which of the following in-situ operations do you routinely perform on your sensors (select all that apply using the reference number [1-20] for each parameter)?

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Visual inspection by knowledgeable personnel (to the degree permitted by the nature of the sensor configurations).																				
Where possible, run diagnostics to monitor																				

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
basic functionality (power, telemetry, communications, data transmission, etc.).																				
Inspect the state of antifouling and anti-corrosive coatings and/or devices.																				
Inspect the state of sacrificial anodes (protection against galvanic corrosion), if present.																				
Inspect the state of mounting elements (e.g. brackets, fixtures, etc.)?																				
Inspect the state of signalling elements (e.g. beacons), if present?																				
Take reference samples for laboratory analysis (Winkler, HPLC, etc) and data validation																				
In-situ calibration during maintenance (e.g. by CRMs)?																				

Other (please specify using the reference number [1-20] for each parameter) …………………….

3. Are sensors subject to regular maintenance?
Maintenance procedures include: (substitution of sacrificial anodes, substitution of antifouling devices/coatings, retouches of anti-corrosion coatings, removal of incrustations and unwanted flora/fauna, small repairs on-site or otherwise)

Full maintenance, in the laboratory

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Once a year.																				
Twice a year.																				
Once every two years.																				
Once every three years.																				

Other (please specify using the reference number [1-20] for each parameter) …………………….

In-situ maintenance

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Once a year.																				
Twice a year.																				
Once every two years.																				
Once every three years.																				

Other (please specify using the reference number [1-20] for each parameter) …………………….

4. Typical annual cost, maintenance by Operator (all sensors): ……………………………………..

5. Are sensors subject to regular calibration?

Full laboratory calibration, Operator

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Never.																				
Once a year.																				
Twice a year.																				
Once every two years.																				
Once every three years.																				
Against conventionally recognized in-house reference material?																				
Against traceable in-house reference material?																				
Against certified reference material, when available?																				
Against other kinds of reference material?																				

Other (please specify using the reference number [1-20] for each parameter, e.g reference materials, etc.) ……………………………………………..

Does your facility maintain a manual with a description of the calibration method and the measuring procedures, together with details of sample treatment and preparation when these steps are present?

☐ Yes ☐ No

Does your facility perform:

- ☐ internal quality audits to monitor and assess its calibration procedures?
- ☐ independent quality audits to monitor and assess its calibration procedures?

Typical annual cost, calibration by Operator (all sensors): ……………………………………..

Full laboratory calibration, Manufacturer

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Never.																				
Once a year.																				
Twice a year.																				
Once every two years.																				
Once every three years.																				
Against conventionally recognized in-house reference material?																				
Against traceable in-house reference material?																				
Against certified reference material, when available?																				
Against other kinds of reference material																				

Other (please specify using the reference number [1-20] for each parameter, e.g reference materials etc) ………………………………………………………….

Typical annual cost, calibration by Manufacturer (all sensors): ……………………………………….

In-situ calibration

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Every visit																				
Once a year																				
Twice a year.																				
Once every two years.																				

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Once every three years.																				
By comparison against values obtained with a reference sensor/instrument																				
By comparison against values obtained from the analysis of collected samples																				

Other (please specify using the reference number [1-20] for each parameter, e.g in-situ calibration methods, etc.) ……………………………………..............

Typical annual cost, in-situ calibration by Operator (all sensors): ……………………………………..

On-site (field) performance checks

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Every visit																				
Once a year																				
Twice a year.																				
Once every two years.																				
Once every three years.																				
By comparison against values obtained with a reference sensor/instrument																				
By comparison against values obtained from the analysis of collected samples																				

Other (please specify using the reference number [1-20] for each parameter, e.g in-situ calibration methods, etc.) ………………………………………………

Typical annual cost,on-site (field) performance checks by Operator (all sensors): …………………

6. Does your facility actively maintain an archive of sensor calibration reports/certificates?

☐ Yes ☐ No

If your answer is “Yes”, what is the average retention time for such reports/certificates in the archive?

- ☐ Indefinite
- ☐ Six months
- ☐ One year
- ☐ Two years
- ☐ Three years
- ☐ Five years

7. Does your facility actively maintain an archive of reports of on-site (field) performance checks of sensors?

☐ Yes ☐ No

If your answer is “Yes”, what is the average retention time for such reports/certificates in the archive?

- ☐ Indefinite
- ☐ Six months
- ☐ One year
- ☐ Two years
- ☐ Three years
- ☐ Five years

Part C: Best Practices

1. Describe briefly your understanding of the term “Best Practice”:

…………………………………………………………
…………………………………………………………

2. Does your facility actively seek to formulate and apply Best Practices for operating your Assets?

☐ Yes ☐ No

If your answer is “Yes”:
Does this activity predate the JERICO and JERICO-NEXT projects?

☐ Yes ☐ No

Is it policy to actively maintain Best Practice documentation?

☐ Yes ☐ No

If Best Practice documents exist, are they

- ☐ freely available online
- ☐ freely available upon request
- ☐ for internal use, only

3. Has your facility participated in any of the following (select all that apply)?

- ☐ JERICO technical workshops.
- ☐ JERICO technical documentation.

- ☐ JERICO Best Practice documentation
- ☐ JERICO-NEXT technical workshops.
- ☐ JERICO-NEXT technical documentation.
- ☐ JERICO-NEXT Best Practice documentation.

4. Has your facility contributed in any of the following (select all that apply)?

- ☐ JERICO technical workshops.
- ☐ JERICO technical documentation.
- ☐ JERICO Best Practice documentation
- ☐ JERICO-NEXT technical workshops.
- ☐ JERICO-NEXT technical documentation.
- ☐ JERICO-NEXT Best Practice documentation.

5. In your opinion, the following have been useful in improving your facility's management of the indicated Platform (select all that apply)?

- ☐ JERICO technical workshops.
- ☐ JERICO technical documentation.
- ☐ JERICO Best Practice documentation
- ☐ JERICO-NEXT technical workshops.
- ☐ JERICO-NEXT technical documentation.
- ☐ JERICO-NEXT Best Practice documentation.
- ☐ Other (please specify): …………………………