COMMON SENSE
MARINE SENSORS - MARINE MONITORING

**Acronym: COMMON SENSE**
**Title: COST-EFFECTIVE SENSORS, INTEROPERABLE WITH INTERNATIONAL EXISTING OCEAN OBSERVING SYSTEMS, TO MEET EU POLICIES REQUIREMENTS**
**Grant agreement n° 614155**

# Deliverable 3.4
# Sensor Web Platform Testing and Evaluation Report

***31-07-2016***

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| **Dissemination Level** | |
| **PU** Public | X |
| **PP** Restricted to other programme participants (including the Commission Services) | |
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## EXECUTIVE SUMMARY


### *Objectives*

The objective of this report is to test and evaluate the Common Sensor Web Platform (CSWP). Testing includes integration of the sensor device network with the platform, and the platform's data access web service and visualisation web portal.

### *Rationale*

COMMON SENSE WP3 aims to design and implement the Common Sensor Web Platform for connecting, processing, storing, managing and sharing sensor data. It aims to convert data and metadata into standard delivery formats and also aims to develop a service based platform to provide access to the web service network through a sensor data access and visualisation web portal.

This report first outlines the testing methodology which includes:

- capturing of sensor descriptions during field trials,
- technical testing of individual platform software components,
- user feedback on the portal,
- end-to-end workflow testing,
- data interoperability tests.

Appendix A provides a framework for interviewing platform operators and data managers during field testing regarding deployed sensor devices. This aims to capture sensor descriptions in forms which is used to build SenorML descriptions.

Technical testing of individual platform software components is required to ensure that that they work and perform as expected. Testing of data ingestion procedures into the COMMON SENSE SOS web server was successful. This is described in Chapters 3 and 4. This includes testing the data conversion tool from NMEA to O&M data, and testing the upload of data into the SOS server.

The COMMON SENSE Web Platform portal is introduced in Chapter 5. Regarding user feedback on this portal, Appendix B contains a user feedback questionnaire. The questionnaire will capture feedback under the key headings of data quality, usability and functionality.

As a separate initiative the Oceans of Tomorrow data interoperability working group has started initial steps towards coordinating SWE interoperability tests. This activity is very useful for demonstrating both the cooperation between the different Ocean of Tomorrow projects and to help identify potential interoperability issues. If any interoperability problems occur, these issues will be discussed via email list. This report will also be updated with relevant information from this cooperation.

This is a preliminary report as end-to-end integration is still under final development. At present sample data is being emailed to WP3 for testing. WP3 is waiting for WP4's final results, which will enable sensor devices to work the Smart Sensor Unit (SSU). Thereafter, the SSU connects to the Common Sensor Web Platform using telecommunications. The COMMON SENSE consortium is planning end-to-end integration during the common deployment period in Oristano, Sardinia, during the final week of September 2016. This report will be updated with these results after the Oristano testing period, and also incorporate user feedback.

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# 1 INTRODUCTION

## *1.1 Background*

The COMMON SENSE project aims to support the implementation of European Union marine policies such as the Marine Strategy Framework Directive (MSFD) and the Common Fisheries Policy (CFP). The project has been designed to directly respond to requests for integrated and effective data acquisition systems by developing innovative sensors that will contribute to our understanding of how the marine environment functions. It aims to develop and provide cost-effective and multi-functional innovative sensors to perform reliable in-situ measurements in the marine environment.

The core project research will focus on increasing the availability of standardised data on: eutrophication; concentrations of heavy metals; microplastic fraction within marine litter; underwater noise; and other parameters such as temperature and pressure. This will be facilitated through the development of a sensor web platform and smart sensor unit, the overall block diagram of the ***Common Sensor Web Platform*** is shown in Figure 1-1.

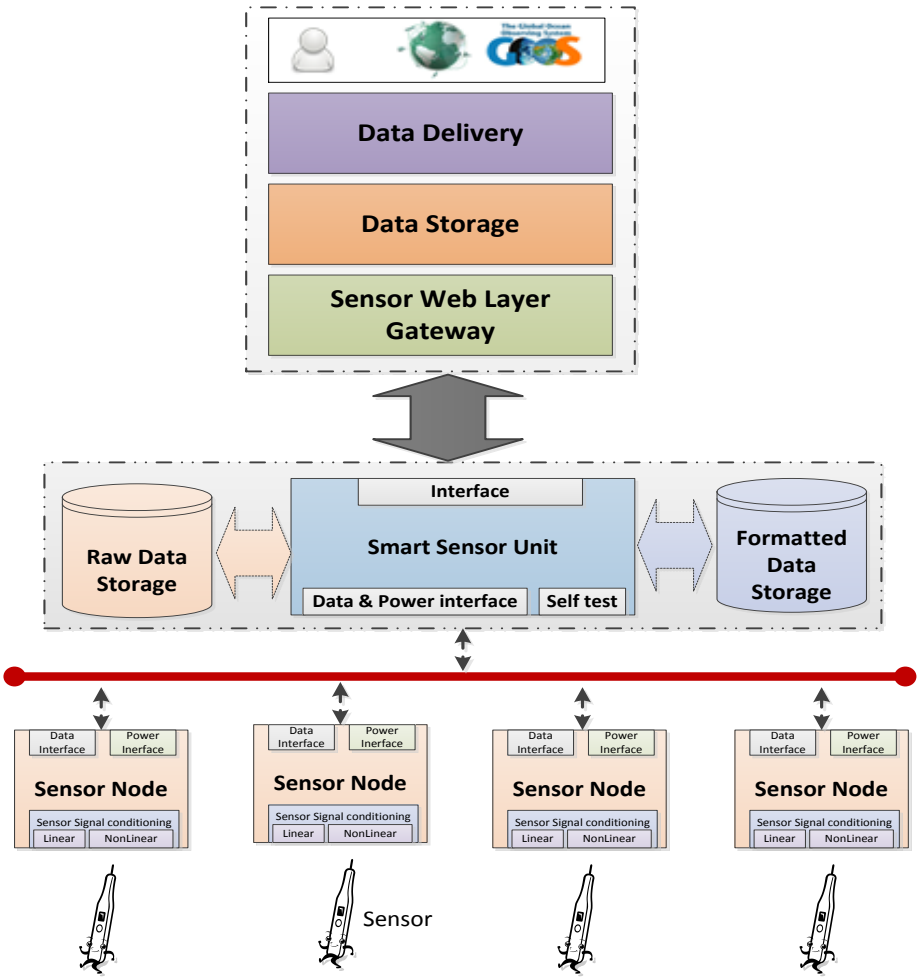


*Figure 1-1. Overall block diagram of Common Sensor Web Architecture*

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This objective of this report is to test and evaluate the Common Sensor Web Platform (CSWP) providing access to the web service network through a sensor data access and visualisation web portal. Testing includes integration of the sensor device network with the platform.

For background reading the COMMON SENSE deliverable report D3.3 “Sensor Data Processing and Conversion Tools, semantic framework and standard sensor web service” provides information on the data processing and web service architecture design.

## *1.2 Organisation of this report*

Chapter 2: Testing Methodology
This chapter outlines the methodology to test and evaluate the Common Sensor Web Platform.

Chapter 3: O&M Conversion Tool Testing
This chapter describes the testing of a transformation tool developed in Python. The tool converts data from CSV or NMEA into O&M 2.0.

Chapter 4: SOS Testing
This chapter describes the testing of the web services deployed for the Common Sensor Web Platform. Python scripts are used to test various SOS web service endpoints.

Chapter 5: Client Testing
This chapter introduces the client or web portal to access sensor data. User testing will commence when more data is available after sensor field trials.

Appendix A:
This appendix provides a framework for interviewing platform operators and data managers during field testing regarding deployed sensor devices. This is information is used to capture SensorML descriptions.

Appendix B:
This appendix contains user feedback questionnaire for testing and evaluating the web portal.

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# 2 TESTING METHODOLOGY

The testing methodology to test and evaluate the Common Sensor Web Platform includes:

- capturing of sensor descriptions during field trials,
- technical testing of individual platform software components,
- user feedback on the portal,
- end-to-end workflow testing,
- data interoperability tests.

Appendix A provides a framework for interviewing platform operators and data managers during field testing regarding deployed sensor devices. This aims to capture sensor descriptions. The framework is in the form of tables. The first table is used to describe the overall sensor platform (or station), the second to describe an individual instrument on this platform (or station). While not all fields need to be filled, and some instrument specific fields may be missing, it is used to document knowledge to describe the sensors being tested. This information will be used to construct SensorML documents. The boundary between the platform and its instruments can be ambiguous at times depending on the level of integration. This will be better defined on a case by case basis during the interview process. This is because of the various deployment scenarios using different platforms and specialised instrument devices. For example, a CTD platform can contain numerous instruments measuring different parameters. Because of the nature of sensor systems, no one person is expected to automatically know all fields. Knowledge will come from various sources including manufacturers, operators, and data managers.

Technical testing of individual platform software components is required to ensure that that they work and perform as expected. Initial testing of test data ingestion procedures into the COMMON SENSE SOS web server has commenced. This is described in Chapters 3 and 4. This includes testing the data conversion tool from NMEA to O&M data, and testing the upload of O&M data into the SOS server.

The COMMON SENSE Web Platform portal is introduced in Chapter 5. Regarding user feedback on this portal, Appendix B contains a user feedback questionnaire. The questionnaire will capture feedback under the key headings of data quality, usability and functionality. The portal needs more sensor data before this task can commence.

End-to-end integration is still under final development. At present sample data is been emailed to WP3 for testing. WP3 is waiting for WP4's final results, which will enable sensor devices to work the Smart Sensor Unit (SSU). Thereafter, the SSU connects to the Common Sensor Web Platform using telecommunications. The COMMON SENSE consortium is planning end-to-end integration during the common deployment period in Oristano, Sardinia, during the final week of September 2016. This report will be updated with these results after the Oristano testing period, and also incorporate user feedback.

Finally, as a separate initiative, the Oceans of Tomorrow data interoperability working group has started initial steps towards coordinating SWE interoperability tests. This activity is very useful for demonstrating both the cooperation between the different Ocean of Tomorrow projects and to help identify potential interoperability issues. If any interoperability problems occur, these issues will be discussed via email list.

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# 3 O&M CONVERSION TOOL TESTING

As described in COMMON SENSE report D3.3 “Sensor Data Processing and Conversion Tools, semantic framework and standard sensor web service” data from the Smart Sensor Unit (Figure 1-1) is uploaded and stored on an FTP server in the NMEA data format. Thereafter, data is harvested from the FTP into the Common Sensor Web Platform (CSWP) gateway, processed and transformed into O&M 2.0, and pushed into the SOS Server.

A transformation tool developed in Python has used sample oceanographic CTD and noise summary data in CSV and NMEA format respectively. The tool converts the data into O&M 2.0 As more test data becomes available, the script is extensible by adding a new data handler per sensor device type based on customised O&M templates.

Below are command line examples for executing the tool that is used for testing example data from IDRONAUT and CEFAS. In this case it converts CSV or NMEA data into the O&M data format. The O&M data outputs of this tool are used in the next chapter regarding SOS server testing.

```
python3 data_loader/data_loader.py
  -type cefas
  -template templates/cefas_om.xml
  -identifier cefas/1
  cefas_data.txt
  cefas_data.xml
```

```
python3 data_loader/data_loader.py
  -type idronaut
  -template templates/idronaut_ctd_om.xml
  -latitude 38.086333
  -longitude 11.957500
  -identifier cast/213
  icnhussa15004.txt
  icnhussa15004.xml
```

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# 4 SOS TESTING

The 52North implementation of SOS is installed and accessible at http://commonsense.ucc.ie/sos. We are currently using 52North SOS version 4.3.6.

Before installation, a PostgreSQL user and a dedicated PostgreSQL database for the SOS are created. PostGIS, a spatial database extender for PostgreSQL, is installed into this database. For installation, a 52North SOS WAR (Web application ARchive) deployment file is required. A precompiled SOS WAR file can be downloaded from http://52north.org/downloads/category/3-sos.

Alternatively, the source code can be downloaded from https://github.com/52North/sos. This is useful if you need to compile and debug the code. Once the Java WAR file (Web application ARchive) is ready for installation, it is just a matter of copying it into the Apache Tomcat webapps folder.

Python scripts are used to both upload SensorML and O&M documents, and to test various SOS web service endpoints. An example test script is shown below. These test 52North SOS operations including:

- GetCapabilities
- DeleteSensor
- InsertSensor
- DescribeSensor
- DeleteObservation
- InsertObervation
- GetDataAvailability
- GetObservation.

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```
# Test SOS GetCapabilities
python3 GetCapabilities_KVP.py

# Delete SensorML from the SOS Server
python3 DeleteSensor_KVP.py urn:ogc:object:feature:sensor:cefas:noise

# Upload SensorML XML document to the SOS Server
python3 InsertSensor_POST_POX.py InsertSensor_SML_v20.xml

# Test get SensorML from the SOS Server
python3 DescribeSensor_KVP.py
urn:ogc:object:feature:sensor:cefas:noise

# Delete O&M from the SOS Server
python3 DeleteObservation_KVP.py cefas/1

# Upload O&M XML document to the SOS Server
python3 InsertObservation_POST_POX.py cefas_om_data1.xml

# Test get O&M results from the SOS Server
python3 GetDataAvailability_procedure_KVP.py
urn:ogc:object:feature:sensor:cefas:noise

# Test get O&M results from the SOS Server
python3 GetDataAvailability_observedProperty_KVP.py
urn:ogc:def:phenomenon:commonsense:noise_summary

# Test get O&M results from the SOS Server
python3 GetObservation_observedProperty.py
urn:ogc:def:phenomenon:commonsense:noise_summary

# Test get O&M results from the SOS Server
python3 GetObservation_offering.py
urn:commonsense:station:cefas:summary_noise
```

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# 5 CLIENT TESTING

A demo client has been setup at http://commonsense.ucc.ie/client. This client is based on an existing web GIS mapping framework developed at University College Cork (http://smartatlas.ucc.ie/). It is an interactive web mapping viewer which enables a user to visualise data. It supports functionality such as panning, zooming, querying, animation, data overlay, data download, and role based access control to data products.

The following figures illustrates the current version of the COMMON SENSE demo client with sample data from two CTD locations using test outputs from the previous chapters. First the locations of the two casts are illustrated. Next the user opens the attribute table for one of the locations. This includes links to the O&M data, SensorML metadata, and a link to plots. The final figure illustrates a sea water temperature plot from a CTD instrument.

This client will undergo further testing as more data becomes available during the Oristano field fields in September 2016. Appendix B contains a user feedback questionnaire. The questionnaire will capture feedback under the key headings of data quality, usability and functionality.

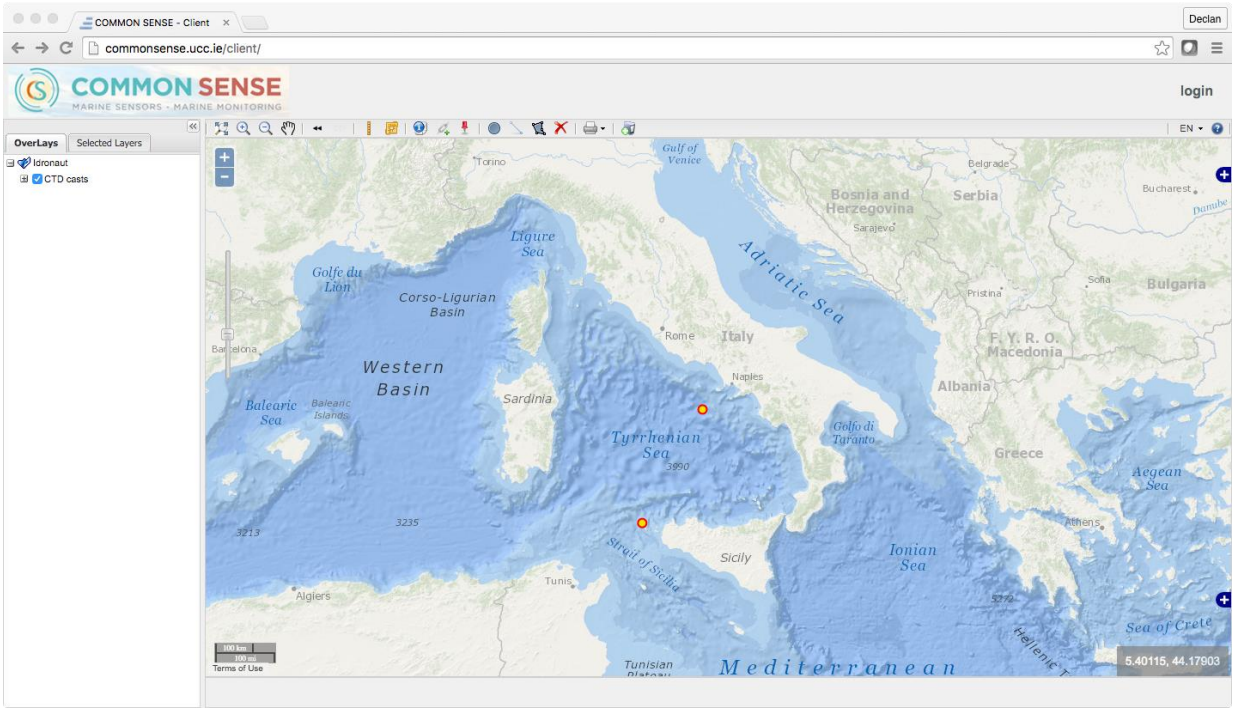


*Figure 5-1. Web mapping: location of two CTD casts*

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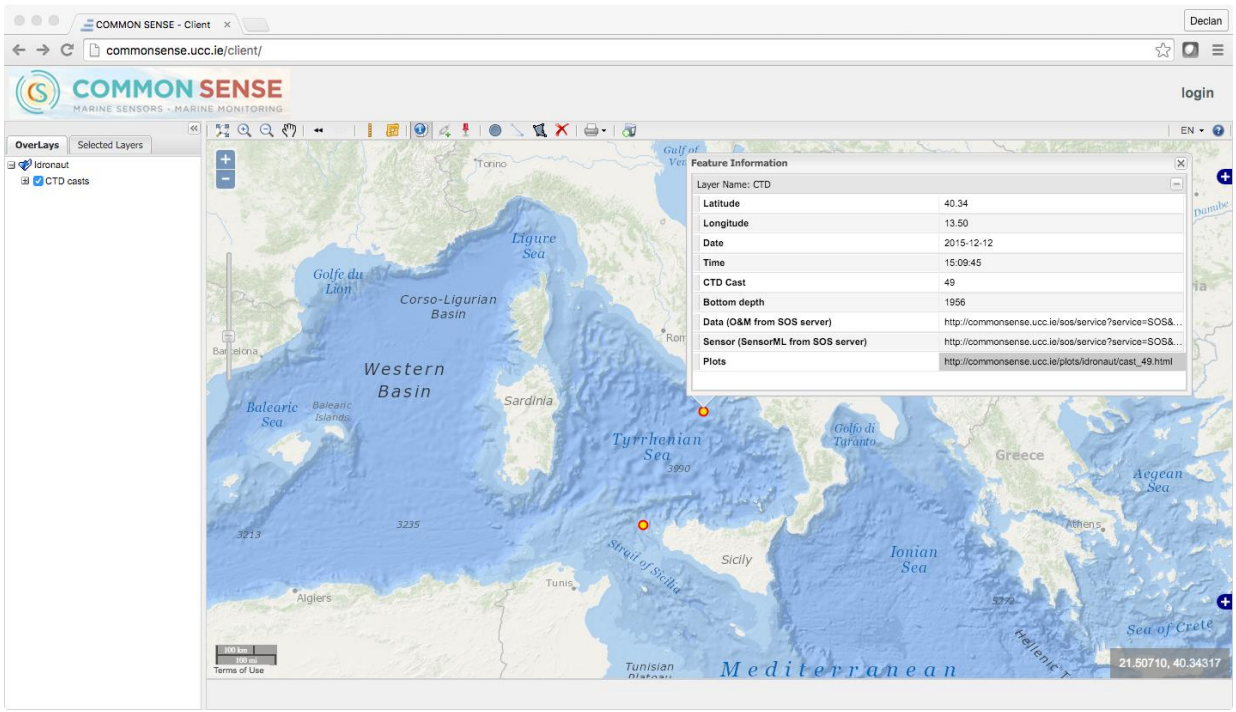


*Figure 5-2. Geo-location attribute table, includes links to O&M data, SensorML metadata, and plots*

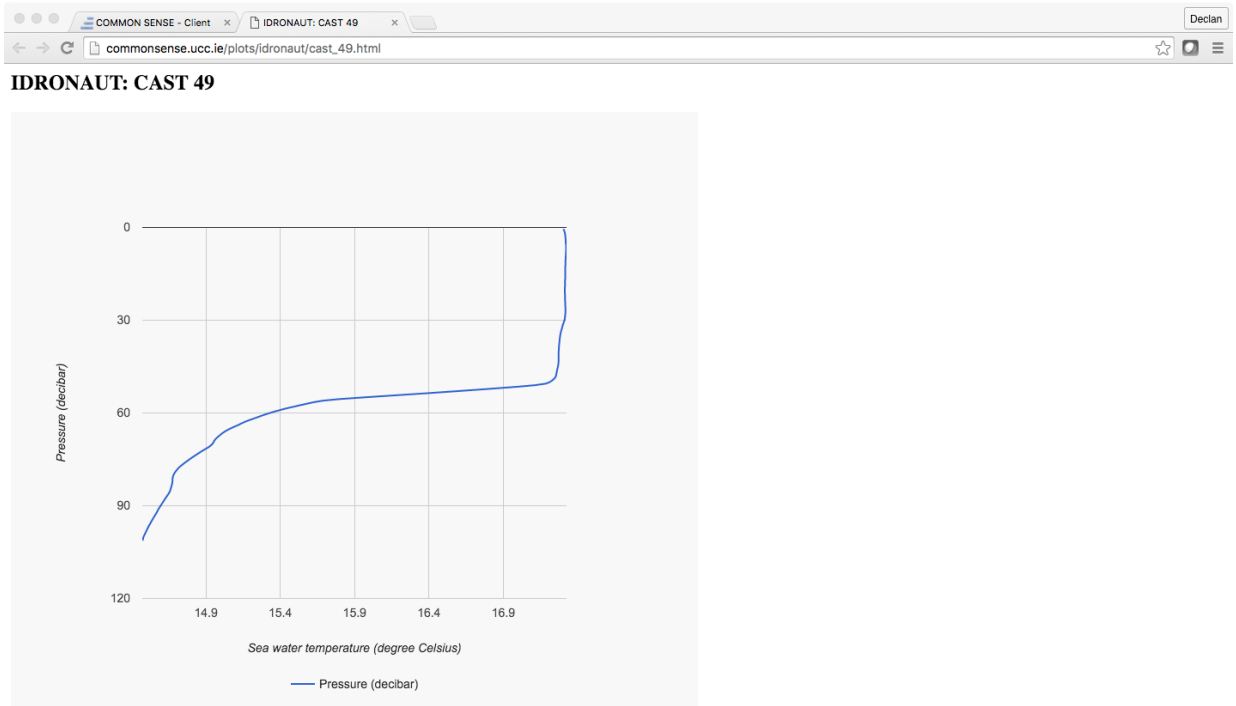


*Figure 5-3. Online plot, pre-generated from O&M*

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# APPENDIX A – SENSORML SURVEY

This Appendix provides a framework for interviewing platform operators and data managers during field testing regarding deployed sensor devices. The following sections contains two tables, which are based on information shared by the Oceans of Tomorrow technical group. The first table is used to describe the overall sensor platform (or station), the second to describe an individual instrument on this platform (or station). While not all fields need to be filled, and some instrument specific fields may be missing, it is used to document knowledge to describe the sensors being tested. This information will be used to construct SensorML documents. The boundary between the platform and its instruments can be ambiguous at times depending on the level of integration. This will be better defined on a case by case basis during the interview process. This is because of the various deployment scenarios using different platforms and specialised instrument devices. For example, a CTD platform can contain numerous instruments measuring different parameters. Because of the nature of sensor systems, no one person is expected to automatically know all fields. Knowledge will come from various sources including manufacturers, operators, and data managers.

## *A.1 Platform description table*

| **1 Platform Identification** |
|---|
| **Manufacturer name** |
| **Model number** |
| **Serial number** |
| **Unique identifier** |
| **Name given by the operator** |
| **2 Platform Classification** |
| **Platform type (e.g. Moored Buoy, Glider, etc.)** |
| **Application domain** |
| **3 Platform Characteristics** |
| **Weight** |

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| |
|---|
| **Height** |
| **Length** |
| **Width** |
| **Material** |
| **Storage Type** |
| **Storage Capacity** |
| **4 Platform Capabilities** |
| **Operating depth** |
| **Survival depth** |
| **Sampling rate** |
| **Resolution** |
| ***Modify / add new fields as required*** |
| **5 Platform Documentation** |
| **Documentation URL** |
| **6 Platform Contacts** |
| **Manufacturer** |
| **Operator** |

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| 7 Platform Local Reference Frame |
| --- |
| Description of the origin and X, Y, Z axis of platform.<br>(This is used to describe where an instrument is attached on this local reference frame) |
| **8 Platform Inputs** |
| Input phenomenon (e.g. wind) |
| **9 Platform Outputs** |
| Output measurements (e.g. wind speed and direction) |
| **10 Platform Interfaces** |
| Interface description (e.g. RS232, port number, bits, baud, parity, etc.) |
| **11 Platform Keywords** |
| Keywords (e.g. Project name, Mission name, Organisation name, etc.) |
| **12 Platform History** |
| Events such as deployment, maintenance, etc. (date and documentation URL) |
| **13 Platform Parameters** |
| Status (e.g. active/inactive) |
| **14 Platform Position** |
| Latitude / Latitude position if a fixed location |

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### *A.2 Instrument description table*

| 1 Instrument Identification |
|---|
| **Manufacturer name** |
| **Model number** |
| **Serial number** |
| **Unique identifier** |
| **Name given by the operator** |
| **2 Instrument Classification** |
| **Instrument type** |
| **Application domain** |
| **3 Instrument Characteristics** |
| **Weight** |
| **Height** |
| **Length** |
| **Width** |
| **Material** |
| **Storage Type** |

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| |
|---|
| **Storage Capacity** |
| **4 Instrument Capabilities** |
| **Sampling rate** |
| **Resolution** |
| ***Modify / add new fields as required*** |
| **5 Instrument Documentation** |
| **Documentation URL** |
| **6 Instrument Contacts** |
| **Manufacturer** |
| **Operator** |
| **7 Instrument Position** |
| **X, Y, Z location of the sensor instrument attached to the platform (relative to the Local Reference Frame described in the platform table)** |
| **Latitude / Latitude position if a fixed location** |
| **8 Instrument Inputs** |
| **Input phenomenon (e.g. wind)** |
| **9 Instrument Outputs** |
| **Outputs (e.g. voltage measurement of phenomenon)** |
| **10 Instrument Interfaces** |
| **Interface description (e.g. RS232, port number, bits, baud, parity, etc.)** |

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| 11 Instrument Keywords |
| --- |
| **Keywords (e.g. Project name, Mission name, Organisation name, etc.)** |
| **12 Instrument History** |
| **Events such as deployment, maintenance, etc. (date and documentation URL)** |
| **13 Instrument Parameters** |
| **Status (e.g. active/inactive)** |

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## APPENDIX B – PORTAL SURVEY

**General**

| | |
|---|---|
| Organisation: | Country: |
| Name: | Position: |
| Short description of your responsibilities within the organisation: | |
| Choose one of the following statements to describe your opinion of the COMMON SENSE Web Platform:<br>☐ User-friendly<br>☐ Sufficient information<br>☐ Well-structured<br>☐ Appropriate to your responsibilities<br>☐ Other (*please comment*) | |
| Please provide detail of any issues regarding capabilities or constraints that would influence your use of the COMMON SENSE Web Platform you have evaluated. | |

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**Information Content and Data Quality**

| |
|---|
| In terms of using a resource such as COMMON SENSE Web Platform, what aspects of data use are most preferable?<br><br>☐ Visualisation of data<br>☐ Searching for data online<br>☐ Downloading data<br>☐ Generating statistics<br>☐ Ability to combine data<br>☐ Other (*please comment*) |
| In terms of your information requirements, how does this COMMON SENSE Web Platform answer your needs? |
| How often would you use a resource such as this COMMON SENSE Web Platform?<br><br>☐ Daily ☐ 2-3 /week ☐ 1/week ☐ rarely |
| Which of the following criteria would influence your future use of the COMMON SENSE Web Platform? Rank in importance, where 1 is most important and 5 is least important:<br><br>☐ Additional data and/or information<br>☐ Different presentation and structure of the data/information<br>☐ Improved user interface<br>☐ Translation to user's native language<br>☐ Additional explanatory information<br>☐ Other (Please suggest) |

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**Usability**

| |
|---|
| In your opinion is it easy to use the COMMON SENSE Web Platform?<br><br>☐ Yes ☐ No |
| If No: What remarks/recommendations would you suggest for improvement? |

**Functionality**

| |
|---|
| What are the three aspects you like most in the COMMON SENSE Web Platform you have evaluated?<br><br>1) _____<br><br>2) _____<br><br>3) _____ |
| What are the three weakest aspects of the COMMON SENSE Web Platform you have evaluated?<br><br>1) _____<br><br>2) _____<br><br>3) _____ |
| Please list any additional functionalities you feel would improve this COMMON SENSE Web Platform? |

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