NET4mPLASTIC PROJECT

WP5 – Act. 5.3 EWS setting and calibration

D 5.3.4

Integrated System Final Test Procedure and Report

June, 2022 - Version 1.1

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Acronyms / Abbreviations

ACRONYM	DEFINITION
EWS	Early Warning System
MP	Microplastic
OBU	On board Unit
PP	Project Plan
PT	Project team
TC	Technical task coordinator
TGS-ML	Technical Subgroup on Marine litter, European Union expert group On marine litter
TM	Task Manager
UML	Unified Modelling Language
WP	Work package
ACT	Activity
OBU	On-board unit
UAV	Unmanned aerial vehicle
DB	Database
DBMS	Database Management System
APP	Application
HW	Hardware
SW	Software
GIS	Geographic information system
ICT	Information and communications technology
WEB	World Wide Web
WebGIS	Geographic Information Systems available on web platforms
HMI	Human-machine interface

1 INTRODUCTION

1.1 Background of the project

The main goal of the NET4mPLASTIC project is to achieve an efficient monitoring system for plastic and MP distribution along the Croatian and Italian coastal and marine areas in order to improve the environmental coastal and marine sea quality conditions.

According to doc R1, the WP5 deals with the design implementation of the EWS - Early Warning System including:

a control centre, based on system hardware and network (Prosoft), and a EWS application (Hydra Solutions) integrated with the transport model and external systems (such as the oceanographic model - (Marche Region);
Integrated Marine Drone, for collection of MP - microplastic, and geolocalized water indicators on the route (Hydra Solutions);
Integrated Marine OBU, a unit to be installed on board of ships for improved MP collection with geolocalized water indicators on the route (Hydra Solutions).

The design shall be carried out with the modern system engineering approach based on UML - Unified Modelling Language (Hydra Solutions). UNITS and RERA SD will provide data for the first set up of the platform related to MP. Based on this WP, the transport model will be developed in WP4. The development of the EWS platform integrated with the transport model will be done in WP5.

The activities planned for WP5 are the following:

development of the EWS - Early Warning System data centre platform and integration with the transport model (WP4)
development of the UAV/marine drone for real-time data acquisition
testing and calibration
business simulation for testing the solution with real users –
final assessment of the solution, including a CBA–cost benefit analysis and the preparation of the business plan.

The main expected output will be:

- EWS integrated platform, implemented and tested
- Training for the required personnel and users - Assessment of the platform.

The required main software modules of the EWS platform will be:

MP Transport model, providing data with distribution and concentration,
MP WebGIS platform, for: a) Display MP data (historical, actual forecast, 24-72h forecast) b) Early warning provision, based on the transport model c) Data entry, recording & replay
MP DB, the DB for collecting data
A mobile APP, for starting/closing the field activities and for data reporting
Firmware for marine remote units - Integration with external system, for meteorological/other data

The coordinator will be Hydra Solutions. The EWS SW platform will be developed by Hydra Solutions, with the support of Marche Region for the transport model, and Prosoft for localization, the ICT implementation, the integrated testing, training and support for maintenance activities. UNITS will coordinate the assessment of the platform. The other partners involved will give contribution for data entry, as target user, and for preparation of the required documentation. The user target group will be based on the main project partners, institution, regions and councils. They will be involved in the design stage for collecting the main needs, for testing and user training of the solution. The target group will be required to use the system during the business simulation, and provide feedback.

The expected reports within WP5 are the following:

D 5.1.4 –Hardware and Network Integration Report (Report): this deliverable will provide a report with details on integration of the network and other hardware required for the system;

D 5.1.5 –Test procedures and reporting (Report): this deliverable will provide the procedures for testing the data centre and the integrated solution in the test bed environment, and the reporting of the tests done to assure the quality of the solution provided;

D 5.1.6 –Hardware & Network Maintenance Manual (Document); this deliverable will provide the manual for the maintenance of the hardware and the network of the system;

D 5.1.7 –Software User and Maintenance Manual (Document); this deliverable will provide the manual for the maintenance of the software and the User manual for the operators

D 5.2.4 – Marine OBU / Drone Test Procedure and Report (Document): this deliverable will provide the procedures for testing the drones and the OBU, and the reporting of the tests done to assure the quality of the solution provided;

D 5.2.5 –Marine OBU / Drone Maintenance Manual (Document); this deliverable will provide the manual for the maintenance of the Drone and OBU;

D 5.2.6 – Marine OBU / Drone User Manual (Document); this deliverable will provide the User manual for the operators;

D 5.3.1 – Data Centre Hardware and Network Facility implemented (Hardware, report), in this deliverable is relevant to the implementation of the data centre for the integrated solution, hardware and the network facility, and the preparation of the AS BUILT document describing the data centre facility;

D 5.3.2 – Remote Units and Data Centre Communication Test Procedure and Report (Document); this deliverable will provide the procedures for testing the communication integration between remote units and the data centre, and the relevant reporting of the tests done to assure the quality of the solution provided;

D 5.3.3 – Data Centre Test Procedure and Report (Document): this deliverable will provide the procedures for testing the features of the solution provide in the data centre, and the relevant reporting of the tests done to assure the quality of the solution provided, that will be done in cooperation with the main stakeholders;

D 5.3.4 – Integrated System Final Test Procedure and Report (Document): this deliverable will provide the procedures for the integrated test cases testing the integrated solution, and the relevant reporting of the tests done to assure the quality of the solution provided, that will be done in cooperation with the main stakeholders.

D 5.4.1 – Training documentation (document): this deliverable is relevant to the implementation of the required documentation for performing training to the personnel involved in the business simulation (as defined in the WP3.3 and the design of the solution);
D 5.4.2 – Training assessment (report): this deliverable is relevant to the implementation of the training to be done for the personnel involved in the business simulation, with a reporting on evaluation of the training;
D 5.4.4 – Questionnaire for platform assessment (report) this deliverable is relevant to the preparation of a questionnaire for evaluation of the platform from the user point of view involved in the business simulation;
D 5.4.5 –Cost Benefits Analysis – CBA of the platform (Document); this deliverable will provide a final document with lessons learnt during the real use of the platform, an evaluation of the benefits of the platform, and costs for full exploitation of the solution, including the future recommendations on potential improvement, and including a business plan for a full implementation of the platform.

1.2 Purpose of the report

This document describe the **deliverable D.5.3.4 – Integrated System Final Test Procedure and Report**, following the implementation of the EWS, according to the activity 5.1 - Implementation of the platform (HW, SW) with field and laboratory data , and the activity 5.2, Development of the UAV/marine drone for real-time data acquisition, and will provide the procedures for the integrated test cases of the EWS solution and the relevant reporting of the tests done to assure the quality of the solution provided, that will be done in cooperation with the main stakeholders.

This deliverable is within the activity 5.3 of the Net4mPlastic project - EWS setting and calibration, that is focused on the EWS setting and calibration. The main tasks planned in this activity are the following:

Definition of integrated test cases including functional test, communication tests, performance tests of software applications and communication lines
Tuning of the methods to collected data from sensors and/or laboratory equipment to choose/define optimal input method
Implementation of the Data Centre in the final location; ICT operation and performance parameters will be monitored and adjusted accordingly
Final integrated test will be performed in cooperation with the main stakeholders

The coordinator of this activity is PROSOFT, in cooperation with HYDRA, UNIST-FGAG, UNIFE, UNITS, MARCHE
The purpose of this document is summarized as follows:

Procedure for testing the integrated solution,
reporting of the tests done to assure the quality of the solution provided

1.3 Reference documentation

No	Title	Rif/Report N.	Published by
[R1]	**APPLICATION FORM - NET4mPLASTIC Project - New Technologies for macro and Microplastic Detection and Analysis in the Adriatic Basin** 2014 - 2020 Interreg V-A Italy - Croatia CBC Programme Call for proposal 2017 Standard - NET4mPLASTIC Priority Axis: Environment and cultural heritage	Application ID: 10046722, dated 30/06/2017	Lead applicant: UNIVERSITY OF FERRARA
[R2]	D 5.1.4 –Hardware and Network Integration Report	HYD514-SPE-001.0	ACT5.1 – Net4Mplastic
[R3]	D 5.1.5 –Test procedures and reporting (Report)	HYD515-SPE-001.0	ACT5.1 – Net4Mplastic
[R4]	D 5.1.6 –Hardware & Network Maintenance Manual	HYD516-SPE-001.0	ACT5.1 – Net4Mplastic
[R5]	D 5.1.7 –Software User and Maintenance Manual	HYD517-SPE-001.0	ACT5.1 – Net4Mplastic
[R6]	D 5.2.4 – Marine OBU / Drone Test Procedure and Report	HYD524-SPE-001.0	ACT5.2 – Net4Mplastic
[R7]	D 5.2.5 –Marine OBU / Drone Maintenance Manual	HYD525-SPE-001.0	ACT5.2 – Net4Mplastic
[R8]	D 5.2.6 – Marine OBU / Drone User Manual	HYD526-SPE-001.0	ACT5.2 – Net4Mplastic
[R9]	D 3.3.1 – EWS Requirements definitions based on the stakeholders and users' needs, through questionnaires and specific meeting	HYD331-SPE-001.0	ACT3.3 – Net4Mplastic
[R10]	D 3.3.2 – EWS Hardware Architecture and network design (central Data Centre Hardware Architecture Client/Server, Data network architecture and related communication segments)	HYD332-SPE-001.0	ACT3.3 – Net4Mplastic
[R11]	D 3.3.3 – EWS Software Architecture design (data modelling software, GIS applications, early warning detection software, etc.), the Relational Database	HYD333-SPE-001.0	ACT3.3 – Net4Mplastic

	to manage all collected data with related meta data, the communication Front-End for web remote access, the Data Centre Software Interfaces for users		
[R12]	D 3.3.4 – EWS Hardware and other software Components Specifications design (Integrated Marine Drone and Marine OBU, with details of required components (hardware and firmware), firmware and other software components (mobile apps for managing the drones and for remote mobile activities).	HYD334-SPE-001.0	ACT3.3 – Net4Mplastic
[R13]	D 3.3.5 - Report and database provision with all the collected data	HYD335-SPE-001.0	ACT3.3 – Net4Mplastic

2 TEST PROCEDURE AND REPORT

2.1 Introduction

This document presents a recapitulation and integration of test procedures (with associated reports) performed for drones, OBUs, data centre and users connected to a computer, tablet or smartphone to the data centre. Therefore, the purpose of this document is to recapitulate the procedures and results of system testing that are detailed in other specific deliverables in order to confirm the consistency and integrity of the delivered system and serves for the acceptance of integrated system.

2.2 Integrated system test environment

The test environment is based on:

- Remote units:
  - drone
  - OBU
  - User with PC or tablet or smartphone do upload or download and display data
  - User to upload Macro Plastic pictures from smartphone of PC or tablet
- Data Centre with all software modules completed and fully operative

2.3 Participants

For testing the features of the solution provide in the data centre, all project partners, from Italy and Croatia are invited to join. Prosoft led the testing.

2.4 Test procedures and results

The final testing of the integrated solution was carried out in accordance with the test procedures foreseen as part of activities 5.1 Implementation of the platform (HW, SW) with field and laboratory data and 5.3 EWS setting and calibration. The tests of individual parts of the system are defined and reported in D 5.1.5 –Test procedures and reporting (Report), D 5.3.2 – Remote Units and Data Centre Communication Test Procedure and Report (Document), D 5.3.3 – Data Centre Test Procedure and Report (Document).

The test summary results of integrated solution are given below.

2.4.1 EWS System components connectivity check

Final Integrated system components availability/connectivity test is performed according to system specification reported in D 5.3.1 Data Centre Hardware and Network Facility implemented to established availability and is prerequisite for all other system functionality.

Test purpose: Check availability of all servers
Test prerequisites: Cloud infrastructure running, all servers installed, test devices with Internet access, valid user credentials
Test objectives: Test round-trip response for all Data Centre servers and Resources

Test date: multiple dates, last test on 29/06/2022
Performed by: Project partners

Item	**Presentation/Web Server**	**Network address**	**Test results**
TN-1	Web/GIS Modules	https://www.net4mplastic.net/	OK
TN-1.1	GIS Data Reporting Module	https://www.net4mplastic.net/upload.php	OK
TN-1.2	GIS Data Visualization Module	https://www.net4mplastic.net/	OK
TN-1.3	GIS Reporting Module	https://www.net4mplastic.net/	OK
TN-1.4	Smartphone Macroplastic Reporting Module - SeaSentinel	https://www.net4mplastic.net/seasentineldm.php	OK
	Database Server	**Network address**	**Test results**
TN-2.1	DBMS MySQL Server	https://www.net4mplastic.net/	OK
	Storage	**Network address**	**Test results**
TN-3.1	Cloud Storage (UNIFE drive)	https://drive.google.com/drive/folders/11jyAiHCuf3etZXRyV0EXQ0dF9DwoxrC8?usp=sharing	OK
	Marche Region OM	**Network address**	**Test results**

TD-4.1	MP Oceanographic Model (from Marche Reg. Svr)	https://www.net4mplastic.net/griglia/	OK
	Remote Units		
TN-5.1	OBU/Drone remote units' missions	https://www.net4mplastic.net/mission.php	OK (last test mission on 4.5.2022.)

2.4.2 EWS - Data centre functionality test results

The final Data centre functionality test aimed verifying the correct behaviour of NET4mPLASTIC platform and its readiness for commissioning, is performed and reported according to the test procedure defined in D.5.3.3 Data Centre Test Procedure and Report**.**

Test purpose: Check NET4mPLASTIC software readiness for handover
Test prerequisites: Cloud infrastructure running, all servers installed, test devices with Internet access, valid user credentials
Test objectives: Test all NET4mPLASTIC functionalities

Test date: Reported in D 5.3.3

Use Cases	Description	Note
NF-DB-001	Database instantiation	passed
NF-DB-002	Automatic import procedure of the data in the Database	passed
NF-DB-003	Database connection with the online WebGIS platform	passed
F-DB-004	Database backup and rollback	passed
NF-WG-001	WebGIS Platform online loading	passed
NF-WG-002	WebGIS Platform visualization scripts (PHP) and map interpolation scripts (JavaScript) integration	passed
F-WG-003	User Login/Logoff	passed
F-WG-004	Photo gallery navigation	passed
F-WG-005	Drone-OBU Mission navigation and data retrieving	passed
F-WG-006	Data Model navigation and data retrieving	passed
F-WG-007	Microplastic Concentration (Plastic Index) navigation and data retrieving	passed

F-WG-008	Lab Data Analysis navigation and data retrieving	passed
F-WG-009	Sea Sentinel navigation and data retrieving	passed
F-WG-101	General Table mode data retrieving, data visualization and csv export	passed
F-WG-102	General Plot mode data retrieving, data visualization	passed
F-WG-103	General Map mode data retrieving, data visualization, rastering	passed
F-WG-104	General Map mode Fullscreen mode, map/satellite mode, zoom in/out, navigation and waypoint detailed info.	passed

2.4.3 EWS – Remote units' connectivity test

Remote units' connectivity is verified by the test performed and reported in D 5.3.2 Remote Units and Data Centre Communication Test Procedure and Report with the results as follows:

Test purpose: Check NET4mPLASTIC remote units' connectivity
Test prerequisites: Cloud infrastructure running, all servers installed, test devices with Internet access, valid user credentials
Test objectives: Test of the correct behaviour of data centre in receiving and displaying data from remote devices

Code	Description	Note
DCC-001	Access to the data centre via web client application of PC, tablet or smartphone	passed
DCC-002	Visualization of meteo-marine data in plot, table and chart format related to the past years for the 4 sites	passed
DCC-003	Visualization of coastal MP concentration on chart and table format	passed
DCC-004	Visualization of drone mission collected data related to MP measured concentration. For each mission information regarding route of the drone, samples of maim pictures of collected microliters are reported.	passed

DCC-005	Possibility for the user to insert data through the front-end page.	passed
DCC-006	Possibility for the user to export data in CSV format	passed
DCC-007	Visualization of the hazard level for a specific season considering the percentiles of MP concentration calculate by the model in the past years.	passed
DCC-008	Reception of daily model simulation with comparison to the percentiles of the season to detect hazard level	passed
DCC-009	Generation of daily hazard report	passed
DCC-010	Possibility for the user to load geo-referenced pictures with macroplastics and to see them on a webGIS repository	passed

2.4.4 Test of Drone and OBU

Test cases and related results for Drone and OBU functionalities that were tested during drone and OBU mission performed in Italy and Croatia in autumn 2021 are detailed in deliverable *D 5.2.4 Net4mPlastic - Marine OBU and Drone Test Procedure and Report. The mission performed in spring 2022 in Croatia reconfirmed*

Summary of the results of test cases of the Drone are presented in the following table:

Code	**Description**	**Note**
F-DR.001	*Able to navigate with Manta and LISST-HOLO2*	passed
F-DR.002	*Remote Control of Drone Navigation*	passed
NF-DR.003	*Average speed*	1 – 2 knots
NF-DR.004	*Autonomy of Navigation*	45 – 60 min

Summary of the results of test cases of the OBU are presented in the following table:

Code	Description	Note
F-OBU.001	*Acquisition of CT and GNSS data*	passed
F-OBU.002	*Download of collected data*	passed
NF-OBU.003	*Autonomy of data acquisition*	passed
NF-OBU.004	*Light and easy to install on board of a boat*	passed