Project Number: 101048546

Project Acronym: MPCS

Project title: Marine Pollution Control Simulator

Mathematical Models Validation Report

Deliverable 4.2

Version 1.0

15 December 2023

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Acronyms and Abbreviations

DCPM - Directorate for Combating Pollution of the Sea

History of Changes

Table 1 - History of changes

Version	Publication date	Changes
1.0	15.12.2023	Initial version.

Contractual aspects

Project name: Marine Pollution Control Simulator (MPCS)

Project number: 101048546

Deliverable: D4.2 – Mathematical Models Validation Report

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Dissemination Level: SEN - Sensitive

Version: 1.0

Contractual Date of Delivery to the EC: 30.11.2023

Actual Date of Delivery to the EC: 15.12.2023

Leader entity: QUALISEG assumed the leading due to the DGAM's low availability in this period.

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Legal Disclaimer

1 Introduction

This document is the Mathematical models validation for the Marine Pollution Control Simulator (MPCS).

The MPCS should be multilingual (Portuguese, Spanish, and English), software-based, and accessed simultaneously by different users at different geographical locations. It should be an environment for teaching, training, and performance evaluation of individual and team Marine Pollution Response actions.

Teaching should consist of a set of e-learning courses on Marine Pollution Response, Simulator operation, and Simulator management.

The performance evaluation should allow qualitative and quantitative assessment of the users' performance in training.

The purpose of this Test Specification is to evaluate the accomplishment of the MPCS project requirements, the usability of the MPCS and the satisfaction from the user's point of view. It is intended to be a test of the operation and management features.

2 Objectives

The goals of this validation process will be aligned with the objectives of the MPCS Project and the MPCS Functional Requirements, deliverable 2.2, and will focus on the realism of the spill drift but also detecting errors, ensuring the software works as intended and satisfying the end user functional needs.

In this validation, it is assumed that the tests of the code units have been carried out during the development as well as the integration tests of these same code units.

3 Development

The training (simulation) will run in a multi-user environment, where each user will assume the role of a real professional belonging to the existing real means consisting of bodies, facilities, people, and equipment. The simulation will run in a given geography, based on a map's platform, and use real weather conditions recorded from the relatively recent past to simulate spill movement. Users can, and should, interact with each other, with the equipment, and with the spill to achieve the exercise's goal. A mathematical model of the spill and its interaction with the elements and combat actions will simulate reality as necessary and sufficient for the MPCS objectives.

The MPCS should provide two types of Exercises: the *Exercise for teaching* and the *Exercise for training*. The former is intended for schools and professionals in training. The second is intended for professionals to maintain high readiness.

Users should be able to run the Exercise via their smartphone, tablet, or computer.

In the case of the *Exercise for training*, the users' login will determine which person they are in the Exercise. Each available profile will correspond to one of the elements of the existing means, as well as the bodies, facilities, and equipment. The responsibility of updating this data will be up to the MPCS Manager and the adhering entities.

In the case of the *Exercise for teaching*, after logging in, the user can choose, among the available virtual persons, which person is in the Exercise. The bodies, facilities, people, and equipment can be fictitious and be created and configured for each Exercise by the MPCS Manager.

Users, when assuming an identity, will inherit the properties that the database has defined for that identity, which will differ from person to person (for example: qualifications, roles, contacts, Hxh cost, ...).

All users, in the role of a given virtual person, will be able to change their geographic location, will be able to rest and eat to recover virtual health (a property that varies with working hours, resting, eating, and random injury), and will be able to interact virtually with other people and equipment.

Some of their current properties should determine any interaction between the different virtual entities.

The available interactions should allow the simulation of the necessary and fundamental procedures in pollution response, such as the use of equipment (booms, skimmers, pumps, shovels, hoses, blankets, ...), communication between people, movement of people and equipment, refuelling, maintenance, etc.

The drift of the spill, the hypothetical effect on the shore, and the effect of equipment on its drift, as well as its quantity, should be based on a realistic mathematical model and actual geography, meteorology, and hydrodynamics, as well as actual material specifications.

4 Scope

This validation specification will cover the realism of the spill drift on the following situations/cases:

1. At open sea
2. At coast
3. At port
4. Reaction of the spill to booms
5. Reaction of the spill to skimmers

5 Validation Plan

The Validation Plan followed these steps:

1. Coimbra University created several videos demonstrating the mathematical models realism at the 5 situations listed at topic 3 – Scope. After some interactions with partners, Coimbra University shared the following videos (available by link-clicking):
   a. Open sea: altomar1 and altomar2
   b. Coast: costa1mapa and costa2mapa
   c. Port: porto1mapa, porto2mapa e porto3mapa
   d. Booms: porto2barreiramapa e porto2barreiramapazoom
   e. Skimmers: costa1recuperadoresmapa
2. Partners gave a first visualization having the possibility of providing comments and suggestions.
3. MPCS End User Validation has been developed by DCPM.

6 Conclusions

After visualizing the videos, DCPM concluded that they fulfil established requirements and subsequent expectations concerning the simulator validation, therefore the simulator has the appropriate conditions to start the operational tests in January, as planned.