Italian Pilot Study for WP4 – Testing

Improving the cycle management of in-formation necessary for the update of cartography to ensure safety to marine users
Testing

Deliverables no 4.3.9 and 4.3.10

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Preliminary study on the pilot activity

In this document will be considered all the operations and considerations that have been carried out in order to realize the specifics of the platform that will be realized. Will be analyzed in particular all the technical issues that constitute the main choices, hardware and software, which must be operated in such a way that the platform is userfriendly and responsive to expectations.

Support in the realization of study reports in the field of diagnosis, analysis on interoperability issues for the creation and expansion of webgis platforms (WP3 - activity 3.2)

In this phase the platforms currently available at the HO (Hydrographic Office) and in particular in use at the IIM (Italian Hydrografic office) was analysed in order to create a unique workflow that could be adapted to all European cartographic realities. The main cartographic production suites used by IIM concern application packages from Jeppesen, Caris and ESRI. First of all the evaluation was carried out on the possibility of interoperability of these applications by checking the lack of software that can act as a collector of information and transformation of these when they arrive, through the document system, to the production area. Moreover to the current state doesn't exist an automatic system of insertion, of the information generated from the external stakeholder and in particular from the Coast Guard offices, directly in the geo-databases with the parameters required by international standards (IHO S57, IHO S63, etc.). These two problems combined make the information difficult to use without the help of an operator who must report them in a format supported by the cartographic suites.

figure 1 – Cartographic Projection type S100

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In this context, the potential of all the suites in use at IIM was analysed and in particular the products of Teledyne CARIS and ESRI were evaluated to assess whether and which of the two suite was more versatile, flexible and could allow, also through the creation of additional modules, artfully made for the specific need, an interaction of information with cartographic products and be adherent to the project presented.

CARIS has among its products an MSDI (Marine Spatial Data Infrastructure) suite that has no expansive potential through the addition of additional modules. In addition, the platform is strictly oriented to the next international standard IHO (International Hydrographic Organization) Series S100 and therefore may be poorly suited to the needs of the project. Analyzing the ESRI suites we have evidence of the possibility, through a "marine" module, to display the information contained in the map databases, produced by IIM and other HO, with the symbology provided by international standards (IHO S52). This possibility connected to the possibility of inserting/creating additional packages that can represent data in a different format and coming from the main servers or cartographic applications thus allowing the interoperability of the information coming from the outside with the wanted webgis software. A first problem that arose in the analysis of the possibility of using this application with European and national standards was found in the principle of using mainly GPL (General Public Licence) applications. This issue has led to analyzing and evaluating all available GPL geo-servers.

Figure 2 – Comparison between MSDI and S100's

Basic conditions of the Geo database

A basic condition posed is the guarantee of the integrity of the geodatabase that generates the Electronic Charter that was to represent the foundation of the MSDI. A no integrate chart, while not cre-

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ating dangerous conditions in the safety of navigation, could generate a stream of untruthful information and accumulate an additional and unsolicited workload in addition to producing official documents (ordinances, messages of danger, creation of corrections, etc.) *ab origin* wrong, unsatisfactory condition and that would require the complete annulment of the act. The second condition placed in the choice was made on the type of representation/projection that the server had to make of the nautical charts: or all the features present in the paper must maintain a digital display according to the symbology provided with the possibility to query the related metadata The geoportal thus created must allow, in addition to allowing the creation, through simple geometries (points, single lines, multiple lines, arcs and circles), of graphic attachments to updating/information to be communicated to IIM, to display data and/or metadata already present on the electronic cell (ENC) and which are being queried/modified.

Cartography and Nautical Information

In the analysis of cartographic elements to represent spatial information, some necessary and essential factors must be considered.You also need to consider information requirements when planning requirements for the webgis application. This consideration has been developed by analysing the following information layers and cartographic characteristics

Horizontal Datum

Geospatial data is organized in databases with a horizontal Datum that provides the planimetric reference system with different rules and orientations (different spatial orientation and different reference ellipsoid). For this reason, the same point in reality can have different coordinates according to the chosen planimetric datum.

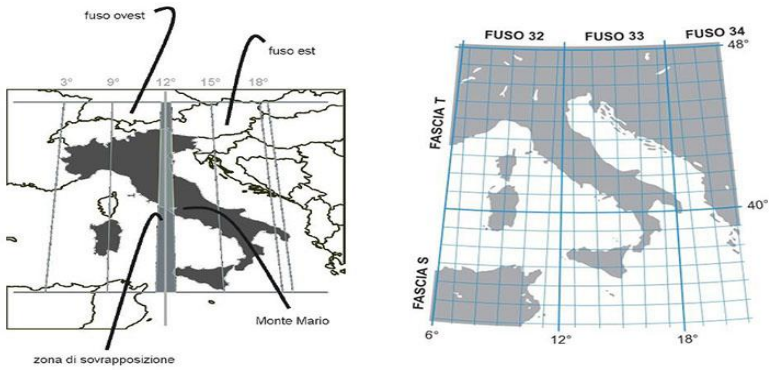

Figure 3- Italian Horizontal Datum

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Currently in Italy there are four different spatial Datums. The law[1] indicates in the ETRF2000 epoch 2008[2] (in the ETRS89) the Datum of reference for all the terrestrial cartography while in nautical within the International Maritime Organization (IMO) specifies that the global planimetric reference system must be WGS84[3] with frame ITRF2000 in order to use satellite positioning systems (GNSS - Global Navigation Satellite System) without making corrections/conversions between different reference systems and the different obstacles/ features on the chart are easily located and identifiable. Conversions between reference systems generate increasing errors as the distance between control points increases. If we wanted to make a comparison between the WGS84 and the ETFR2000 on the national territory, we would find errors of up to 40 cm[4]. In this respect, data from different reference systems but represented in a single system should be loaded into the webgis system.

The conversion between the different Datum (Coordinate Transformation Methods) can be carried out considering different approaches:

- a 3-parameter conversion algorithm (latitude, longitude and ellipsoidal height - Molodensky formulas)
- a 7-parameter algorithm (3 translations, 3 rotations and a scale factor);
- transformation gratings.

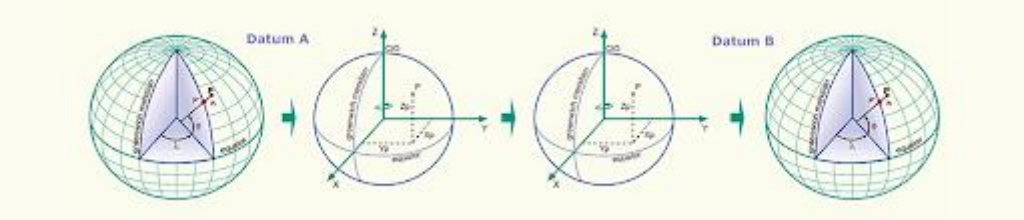

Figure 4 - Coordinate Transformation Methods

It is necessary, in all case, to create a network of points with a set of coordinates in the different reference systems in order to generate the conversion matrices from the individual algorithms.

[1] Decreto del Presidente del Consiglio dei Ministri 10 novembre 2011 – "Adozione del Sistema di Riferimento geodetico nazionale"
[2] European Terrestrial Reference Frame 2000 epoch 2008
[3] In Europe and in Italy is identify in the ETRF89
[4] Dovuto quasi essenzialmente agli spostamenti crostali.

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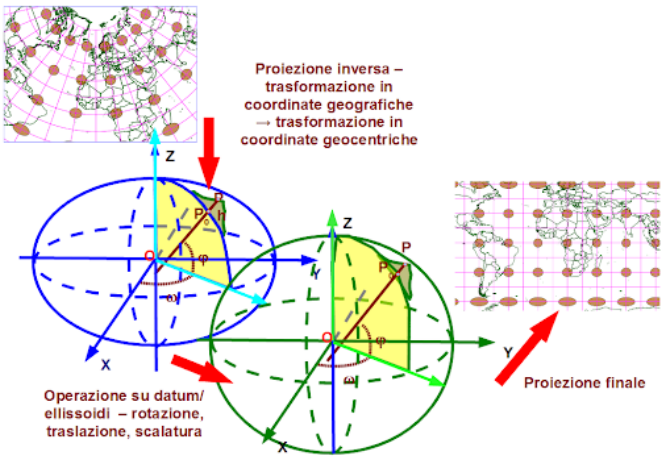

Figure 5 - Conversions between cartographic projections and Datums

The production of digital cartography of the Hydrographic Institute is carried out using as Datum the WGS84 this could create problems related to spatial information made with other reference systems.

The Istituto Geografico Militare has produced a web application for the conversion between the coordinate systems used, in the terrestrial scope, in Italy. The application must not allow the direct conversion between Datum except with the use of the matrices spread and distributed by the IGM. Only this operation/ methodology allows to reduce the deformations and errors between the different Datum.

Cartography Representation

Cartography is the representation on paper, that is on a two-dimensional support, of a portion of territory or an object previously detected with topographic and/or photogrammetric techniques.

Cartographic representations are, therefore, geometric transformations from a spherical surface to a plane.

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Figure 6 - Schematization of a cartographic representation

The cartographic representation can be two-dimensional (paper chart) or three-dimensional, when geospatial information is treated and managed with GIS (Geographic Information System) that allow the treatment of information along the three-dimensional Cartesian axes

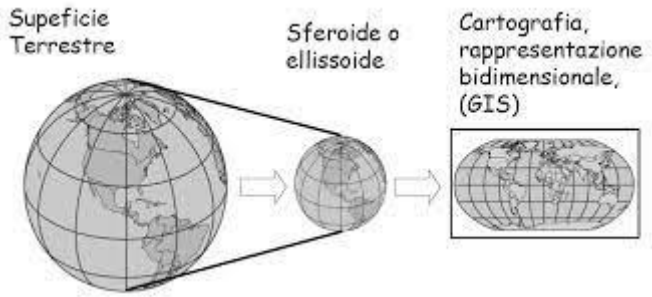

Figure 7 - GIS representation process of the Earth's surface

In order to represent spatial information from the real surface to a bi/three-dimensional surface, we must consider deformations that vary part of the features represented. In function of the deformations that can be found we can subdivide the cartographic representations in:

- *conformality* or *orthomorphism* when it is required that the angle between two lines leaving a point of the surface to be represented remains unchanged in the cartographic representation;

- *equal area* when it is necessary to maintain the relationship between the areas of corresponding infinitesimal figures unaltered*;*

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- *equidistant* when the ratio between the corresponding infinitesimal distances must be maintained unaltered*;*

- or *aphylactic* when you do not impose the perfect preservation of the angular, surface or linear elements but try to keep within acceptable limits all deformations.

In general, considering how the cartographic representations are made, these can be classified into:

- *perspective projections*: when projecting the points from the reference surface (the mathematical surface of the Earth - generally the ellipsoid) on the cartographic plane from a point of view called the projection centre;

- *geometrical projections*: when considering a conical or cylindrical development surface, tangent or secant to the reference surface, on which the points of the ellipsoid are projected generally from its centre, or from a point to infinity in the normal direction to the line of tangency or secance. Depending on how the axis of the ellipsoid is arranged with respect to the axis of the cylinder or cone, projections can be identified:

    - *direct*: if the two axes coincide;

    - *transverse*: if the two axes are orthogonal;

    - *inverse*: if the two axes form at an angle between 0° and 90°.

The geometric aspect of the cartographic representations has, however, a limited interest as their study must be mostly addressed only by analytical, determining the formulas between the curvilinear coordinates on the surface to be represented and the Cartesian coordinates on the map plane.

From the transformation of the representation of the ellipsoid on the plane, realized numerically, we reach the graphic representation on the map, by means of a reduction factor of linear lengths, *n* (*scale of the paper*).

For the purpose of nautical cartography, nautical charts are conformal representations that leave the outgoing angle from a point on the surface unaltered so that the routes, the heading and the measurements are easily representable by the navigator.

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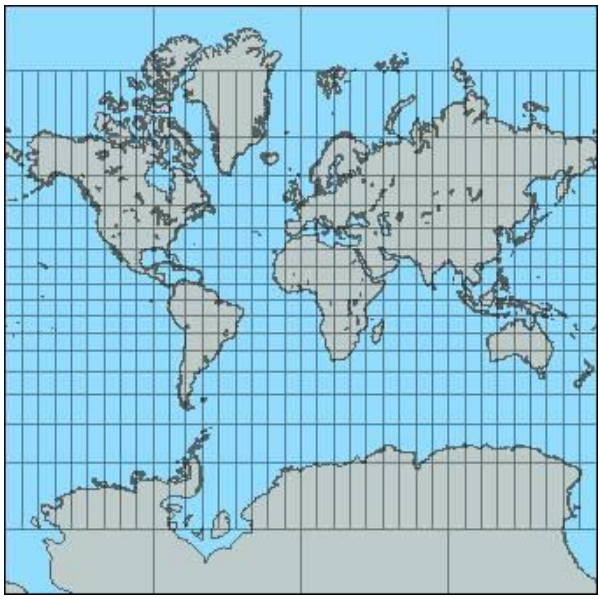

Figure 8 – Mercator projection

The digital representation by Geographical Information Systems transcends the choice and definition of representation by defining a list of geographical representations that perform the visualization. This possibility allows the transformation and coexistence of information from different cartographic representations (for example Mercator projection with UTM or Lambert or cylindrical, etc.).

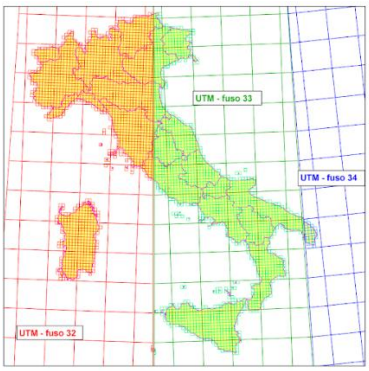

Figure 9 – Italy's UTM projection (Universal Transverse Mercator)

In consideration of the selected representation the grid could be showed in different way and therefore not be coherent with nautical chart. The cartographic representation of the nautical charts is Mercator with cylindrical secant in order to minimize the deformations due to the two-dimensional transformation of the Earth's surface and in the choice of *orthomorphism*.

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The chart's representation used by the software MUST be similar as that used by the ECDIS (Electronic Chart Display and Information System) but it will have to be possible to load georeferenced vector or raster files with a different cartographic representation of departure without deterioration of the information or distortions.

EPSG Code

In Italy there are 5 different planimetric reference systems used both in the terrestrial and nautical chart in the last century. Internationally this number is increasing enormously.

In order to share cartographic information on a global scale and with the recent spread of GIS and open source software, it has become necessary to catalog all the datum information, to avoid confusion and errors.

The reference systems and their transformation parameters is reported in registers maintained by world organisations. Among all these registers, the most widespread is the EPSG (European Petroleum Survey Group) register currently managed by the Geodetic Committee of the International Association of Oil and Gas Producers (OGP). EPSG codes are now recognised as the standard for the classification of Reference Systems worldwide.

Map display

Some consideration should be given to which symbology, during the chart visualization, should be used in order to homogenise the representation. The traditional nautical charts are produced considering as reference the chart of the "Symbols, Abbreviations, Terms in use in the nautical charts" (INT 1) that produce a representation very similar to the following:

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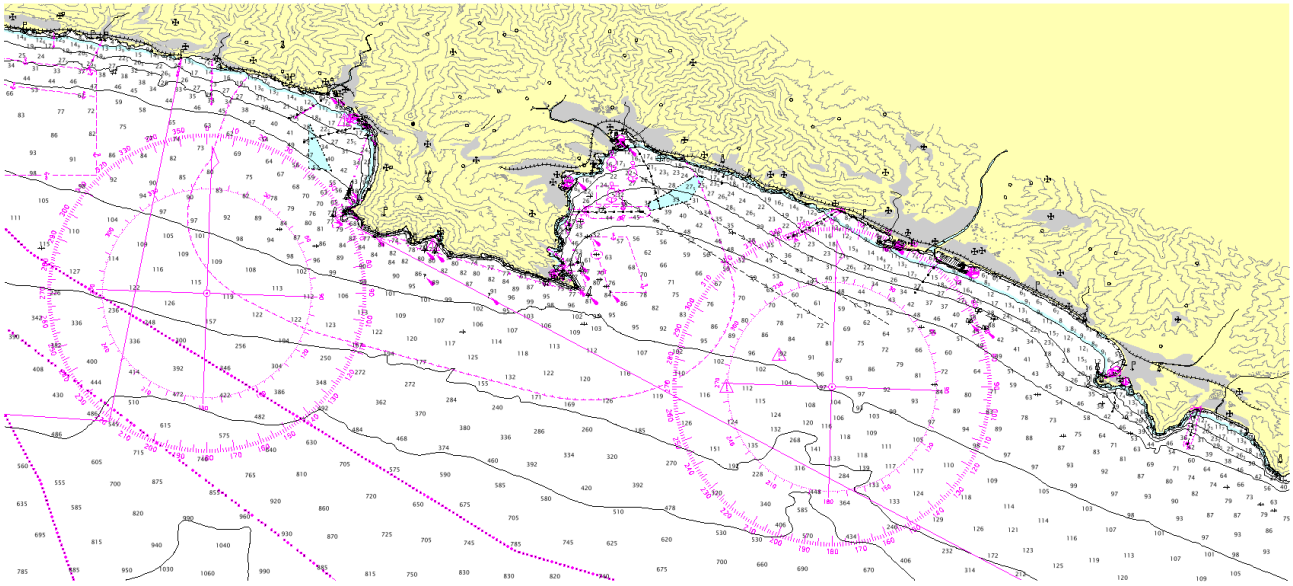

Figure 10 – Nautical Chart I.I. 107 with IHO INT1 symbolism

On the ECDIS, the electronic nautical charts (ENC) follow a representation/display in accordance with the indications of the publication IHO S52[5] (Specifications for Chart Content and Display Aspects of ECDIS) that produces a display like the following:

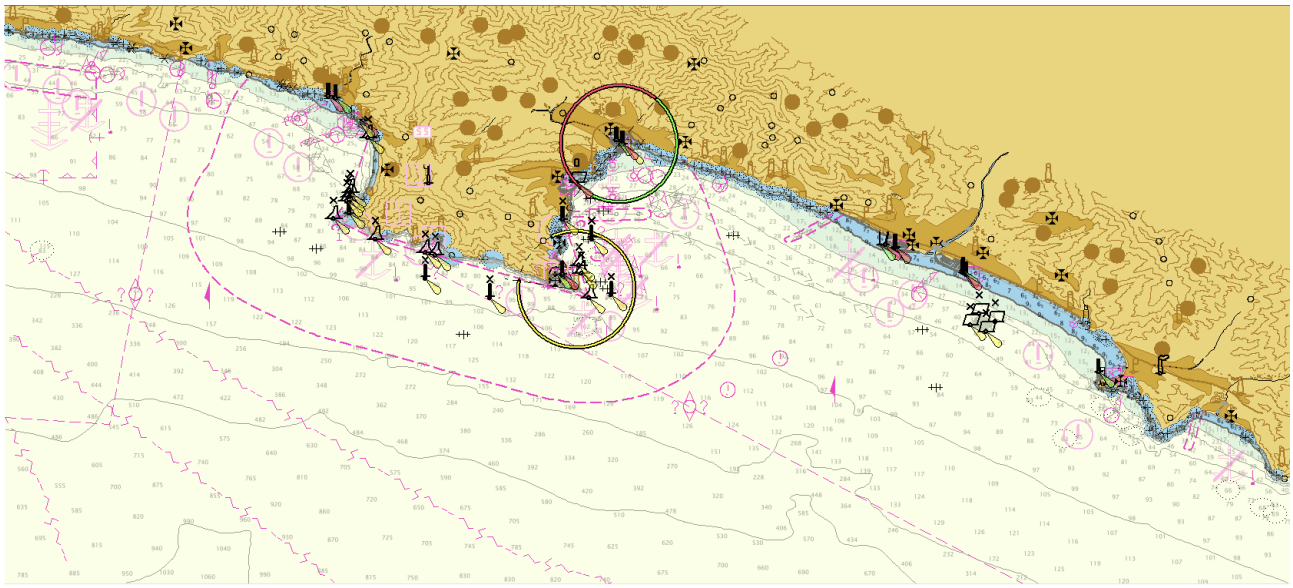

Figure 11 – Nautical Chart I.I. 107 with IHO S52 symbolism

[5]Available at https://iho.int/uploads/user/pubs/standards/s-52/S-52%20Edition%206.1.1%20-%20June%202015.pdf

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Some simil-ECDIS systems also employ IHO S52 visualization but reduced and simplified that work on less complex systems

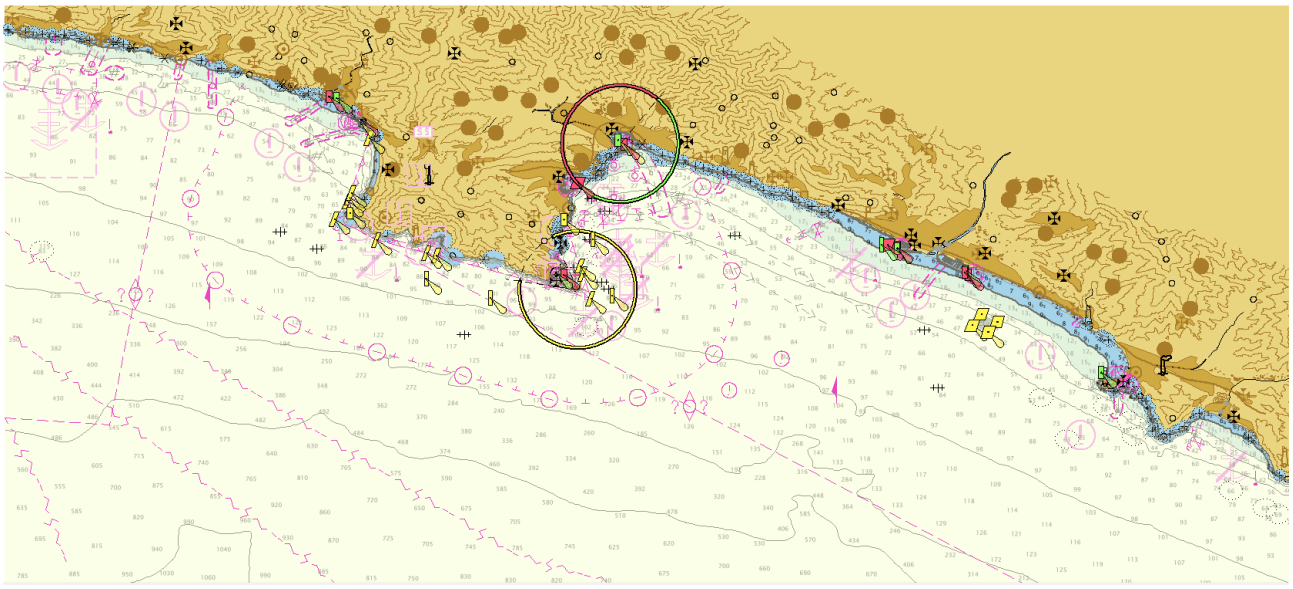

Figure 12 - Nautical Chart I.I. 107 with IHO S52 simplified symbolism

In the above three representations, the difference in representation between the three methodologies is easily visible. For the purposes of the application, the traditional or the intended ECDIS representation must be guaranteed.

NNII Update and NNII Form

The nautical information (NNII) that the Marine Authorities must communicate to the IIM is reported in a publication in favor of all the Coast Guard offices to the aim to standardize the flow of information. These communications are made through cards with fields, preformatted or free, reported in a publication that the AAMM use in official communications with the IIM.

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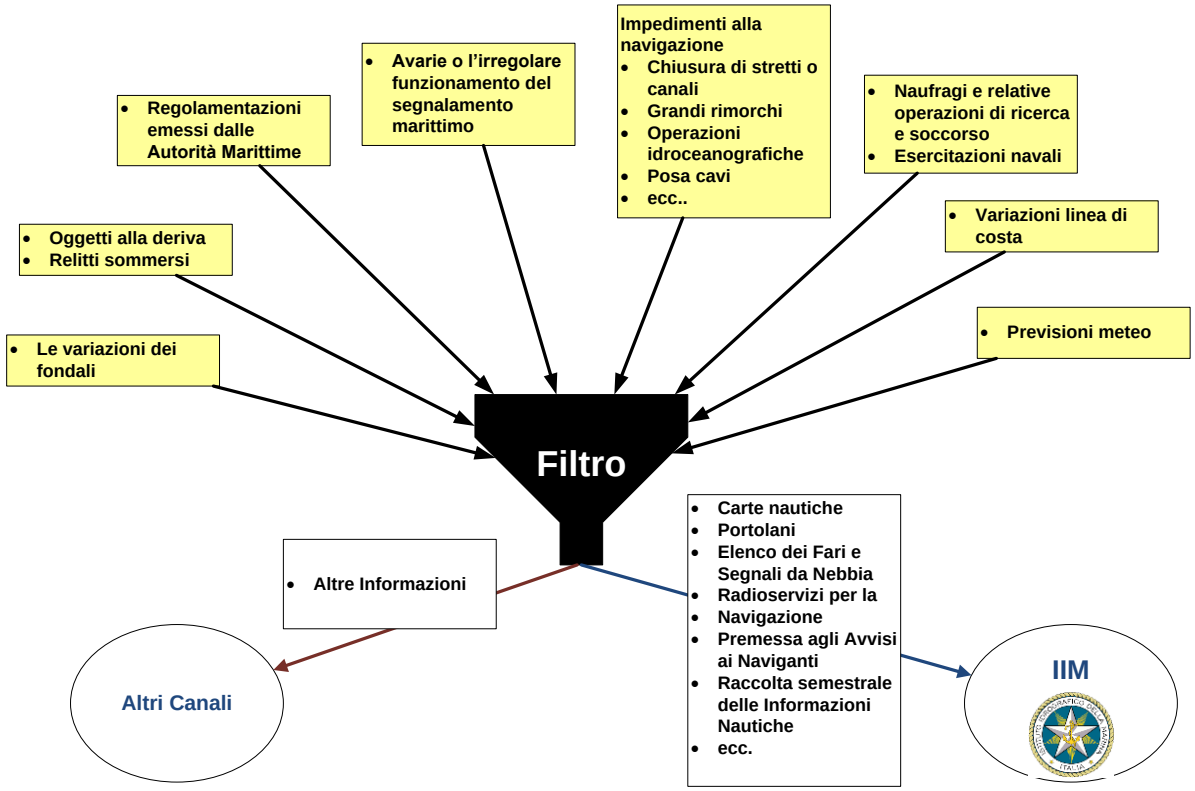

Figure 13 – Workflow of the Nautical Information

During the first months of this activity have been revised the form in the publication I.I. 3173 integrating them with the new information required by international standards for the adaptation of nautical cartography to the new S100 series standards. The new forms contain more detailed and accurate information than those currently reported in the publication in order to integrate the geospatial information that every single Marine Authority must supply to the Hydrographic Institute for the update of the databases cartographers. The forms in force are not exhaustive related to a webgis DB. The updating of the information required for Notice to Mariner has turned out pre-eminent for the digitalization of all the production process and communication of the update to the nautical documentation.

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8.14 Ostacolo/ostruzione/secca/scoglio

#	Nome	Proprietà	Valori	Obbligatorio	Verifica *App*
1	LOCALITÀ	LOCALITÀ	NOMINATIVO A TESTO LIBERO	**NO**	
2	TIPOLOGIA	TIPOLOGIA	SCELTA A TENDINA TRA: - **ARTIFICIALE EMERGENTE,** - **ARTIFICIALE SOMMERSO** • **INSERIMENTO VALORE BATTENTE IN METRI** - **NATURALE EMERSO** - **NATURALE SOMMERSO** • **INSERIMENTO VALORE BATTENTE IN METRI**	**SI**	
3	COORDINATE CENTRO	COORDINATE	Come definito in ***App***	**SI**	
4	COORDINATE ESTREMITA' 1, 2 ETC	COORDINATE	Elenco puntato di coordinate come definite in ***App***	**NO**	
5	DATUM DI RIFERIMENTO DELLE COORDINATE	DATUM	Di base WGS84 ma modificabile in ETFR2000	**SI** preformattato variabile manualmente	
6	ESTENSIONE	RAGGIO DELL'AREA	valore in METRI o SCONOSCIUTO	**NO**	
7	MATERIALE	MATERIALE	SCELTA A TENDINA TRA: - **roccia,** - **blocchi di cemento, tetrapodi,** - **sabbia** - **fango** - **massa ferrosa** - **altro materiale**	**SI**	
8	ZONA INTERDIZIONE	ZONA DI INTERDIZIONE	SI/NO – SE SI INSERIRE⇒ ORDINANANZA N°_____	**SI**	
9	AVURNAV	AVURNAV	○ SI….numero ○ NO	**SI** **Se presente obbliga ad inserire copia dell'AVURNAV**	

Figure 14 – Example of a update Form in IT language.

With the new forms the IIM will be able to maintain up to date all the spatial database in order to share information with public administrations, other hydrographic institutes and all stakeholders. New forms have also been created for future feature not yet provided in the database such as oil platforms, wind farms and others. Below are an example between the old forms and the scheme of the new forms that the hydrographic institute intends to insert within the web application. The new data forms also define the most frequent cases by defining the mandatory fields or recommended and therefore the minimum information to be received by the maritime authorities or stakeholders.

The minimum data of every single object will have to be easily recoverable/queryable every time is clicked on the object as happens currently on the ECDIS.

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Figura 15 - informazioni nautiche desumibili da una cella cartografica digitale (carta nautica elettronica)

National and International Standards

National and international regulations impose requirements for spatial information systems and data exchange.

Inside the IHO organization there's a working group that has been set up to deal with the marine part of the SDI (Spatial Data Infrastructure) of which the IIM is a member and in which the platforms and the management of the exchanged data are discussed. The compliance of the systems with the requirements of the IHO, for the creation, training and management of platforms are reported in the publication IHO C-17[6]. Within the MSDIWG (Marine Spatial Data Infrastructure Working Group) the activities of the OGC (Open Geospatial Consortium[7]). In the European context, the INSPIRE[8] Directive

[6] Available at https://iho.int/uploads/user/pubs/cb/c-17/C-17_Ed2.0.0_EN.pdf.
[7] OpenGIS Consortium
[8] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishes the infrastructure for spatial information of the European Community (INSPIRE- infrastructure for spatial information in Europe) has been transposed into Italian law by Legislative Decree 32/2010 on "Implementation of Directive 2007/2/EC, establishing the infrastructure for spatial information of the European Community (INSPIRE)

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establishes the criteria for the implementation of a data infrastructure in the countries of the Community and in particular the generation of databases of data, metadata and services to be shared. The standards considered in the Directive are some of those issued by the ISO (in particular the ISO/TC211 standard) and those of the OGC.The webgis application must therefore comply with all the standards of the OGC, IHO and those referred to by the INSPIRE directive in addition to being prepared for the nascent IHO S100 series.

Communication

The channels of communication suitable for the transmission of the information required for the updating of the Nautical Information have been identified. The current sending provides only the Official exchange by certified e-mail. The exchange of information for the preliminary verification of orders and the production of cartographic excerpts normally takes place via CEM (Certified Electronic Mail) or Institutional Electronic Mail (IEM) without prior verification of the coordinates or graphics indicated by the AAMM. The webgis application must allow the exchange, in advance evaluation and validation, to the IIM of all the ordinances of particular interest.

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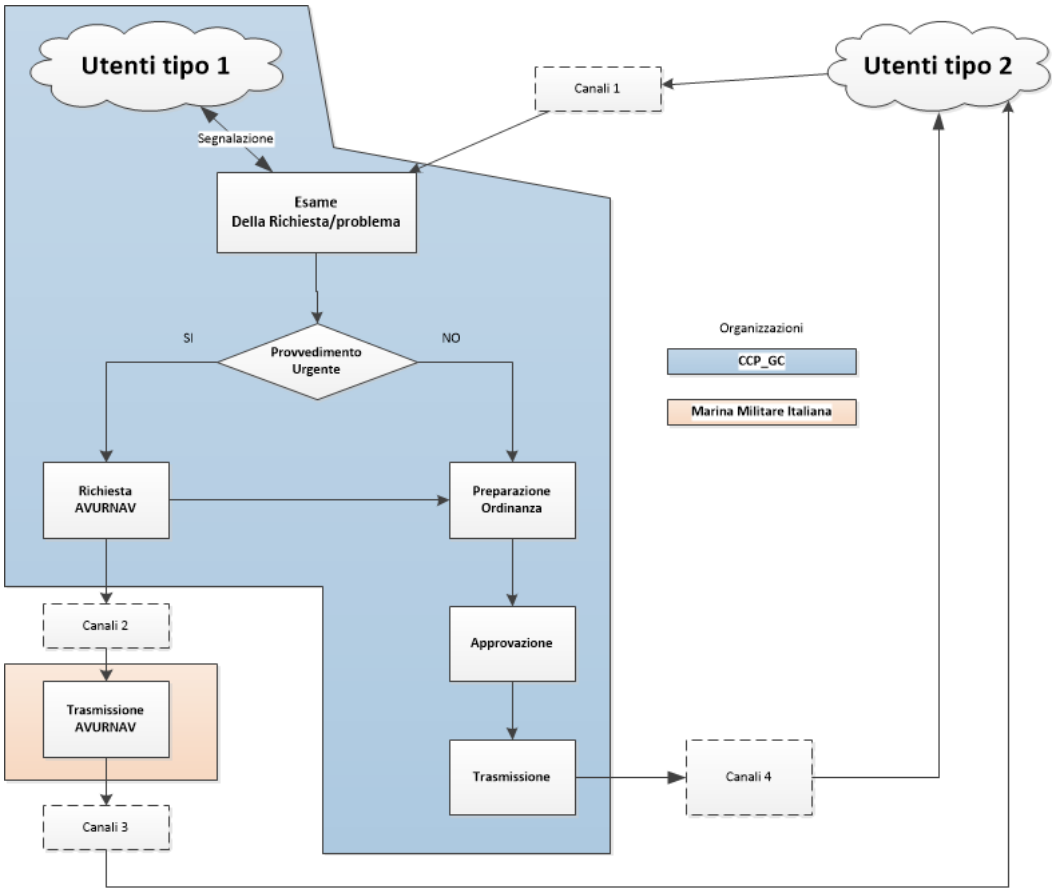

Figure 16 – Workflow of the NNII sharing from the stakeholders and the Hydrographic Office

ACTIVITY 2 GIS mapping and mapping support (WP3 – Pilot action 3.3.1 and 3.3.2);

The basic maps and information layers are the basis for a webgis application. The possibility of inserting the information contained in the map databases S57/S63 allows to make the display compliant with an ECDIS then similar to the representation that a Officer on duty have on the bridge.

For reasons related to the scale of information held by IIM or the "age" of the information layers it may be necessary to integrate the nautical information layers with other territorial information. Terrestrial data is often available in stand-alone format and in vector chart formats (e.g. dxf, dwg, dgn, etc.) or as layers of GIS systems (e.g. shp, hob, etc.) or as georeferenced raster (geotiff).

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In addition to digital charts in S57 format, the webgis application must be able to allow the connection and representation of data, metadata and services (WMS/WMTS/WCS/etc.) made available to all national and international public entities. This condition will allow the Coast Guard to verify the compliance of the nautical information with the data published by the subjects presenting and publishing data of the area of interest/competence. Many layers of information of this type are already available online so easily implementable within GIS.

Moreover the possibility to visualize, from the stakeholders, all the territorial information, both terrestrial that nautical, for example, in the marine spatial plan, could become an essential element in the updating and planning of maritime spaces. The superimposition of layers coming from different platforms/entities would also provide a sufficiently exhaustive representation of the orographic changes resulting from weather-marine events.

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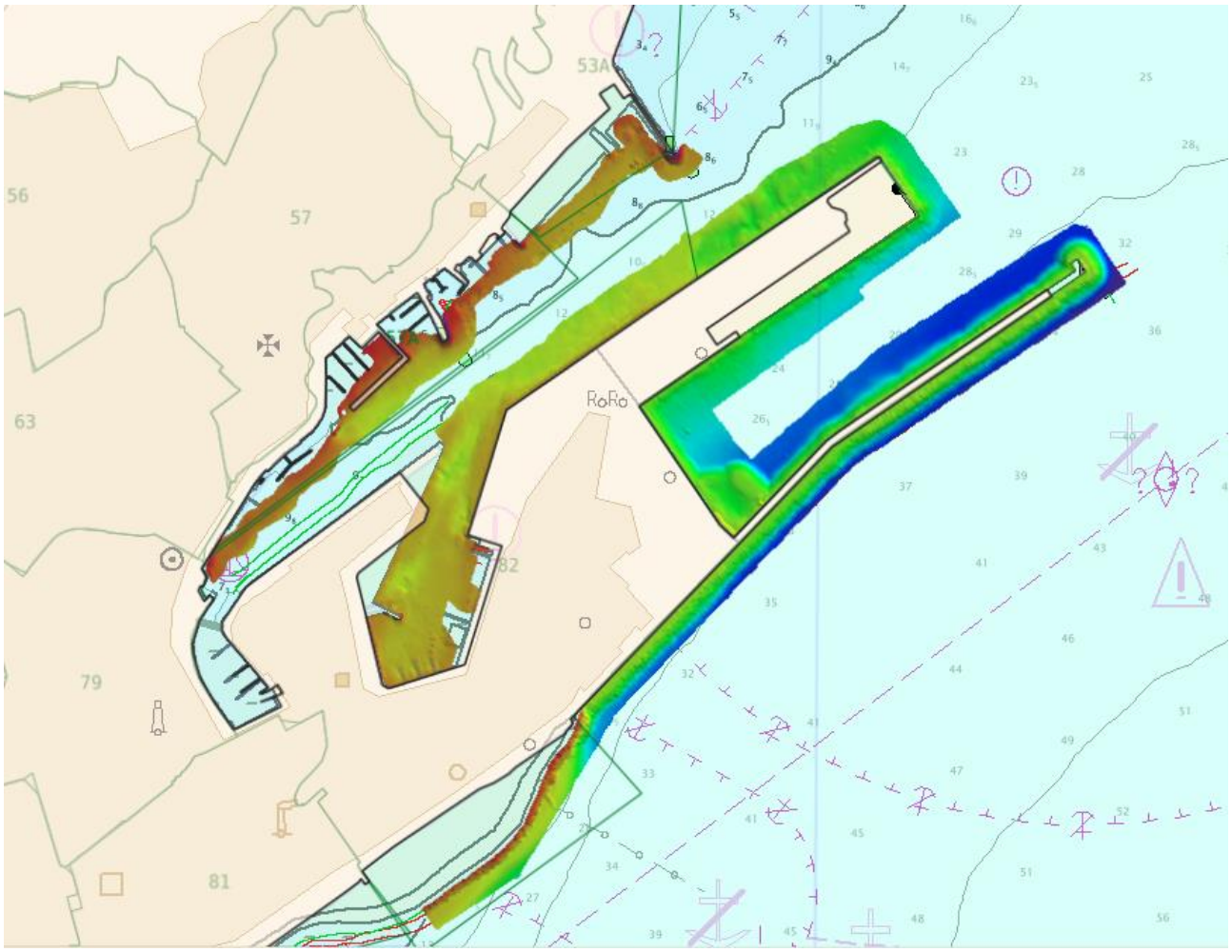

Figure 17 - Representation of different information layers on the chart in a GIS environment with obvious differences between the different layers

during the preparation of the project, other aspects and other information, not yet considered in the preparation of this report, will also be considered, which will be analyzed in consideration of the technical aspects chosen and additional information necessary for the completion of the NI cards that will be updated also in the light of the Pilot actions that will be compiled.

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Deliverable 4.3.9 - Additional information layers, documenting changes in the use of marine areas and their artifacts

Support in the drafting of preliminary studies related to pilot activities

The technical specifications formulated have allowed to define all the characteristics that the new platform/application had to possess, both in the field of the interface with the stakeholders, for the sharing of the nautical cartography in format S 57/S 63, is regarding the acquisition of the nautical information from the Coast Guard and from the Marine Authorities in general towards the Hydrographic Office for the production of the Notice to Mariner.

These characteristics have been realized having a look to the future and therefore able to collect the data also in compliance with the next standards in cartography provided by IHO (International Hydrographic Organization) and implement national marine databases.

The Annex shows the minimum technical specifications (in Italian) that the system will have when the programming is completed. These specifications were published on the Navy website during the various phases of the project.

Production of additional levels of information, documenting changes in the use of marine areas and their artifacts.

A focal point of the application are the communications between the Coast Guard office and the Hydrographic Office. Such communications happen, currently, only and exclusively via official channel

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(mail and certified e-mail) through the compilation of appropriate form, by topics, provided by a specific publication published by IIM and available for the Maritime Autorities. The nautical information form, so far available in editable pdf or Word, have been revised and a test file has been created, in Access format, containing all the set of information to populate the new databases of the Hydrographic Institute, both as State Cartographic Agency and as “cadastre at sea” is in anticipation of the introduction of new international cartographic standards. In particular, they have been considered a series of nautical data form for the collection of data that until a few years ago, for the sole function of State Cartographic Agency, were not necessary and that for the new function of cadastre at sea are to be considered prominent and important. In particular, the fact form on oil or gas platforms and offshore wind farms have been considered and introduced. All other form have been adapted to what will be the information required in the field of cartographic production according to the new international standard S-100’s series. This database, in Access format, is the basis for the construction of the cards within the Webgis Application for the collection and updating of all nautical information. Moreover the new application will be able to graphically show, through of the specific geometries, with the nautical chart of background, the information that is being communicated, so as to limit to the minimum the errors (reversal of coordinates, use of an incorrect or obsolete Datum, vertices in the wrong position or inshore, etc.).

When opening the new form, for the updating of an object and related information, you can take advantage of the information in the ENC DB by simply selecting the object and modify those that have changed. This mode will allow a correct data transmission communicating only the changed information and not repeating those already present in the IIM DB. This working methodology reduces the amount of information to be verified for the correctness of what is transmitted as well as streamlining the practice by reducing it only to the relevant/essential information/data. The same

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consideration can be made if a feature has a part of the data not filled in so it should turn out to be a partial information: in fact, only the specific significant fields can be filled in.

Software development

In consideration of the specifications produced and imposed as a base for the programming and management of webgis application have been identified IT solutions that allow to realize the application:

1. The maps are displayed with an external application on the webgis page and shared with it through a WMS service with IP address control (firewall control). This solution proposed as an additional option has proved to be the basic solution on which to proceed to the programming of the pages and that it allows never to expose the electronic nautical charts (ENC) that remain on a external layer. The objects present in the nautical charts are interrogatable and the information are immediately viewable through the dialogs and therefore employed in the programming/design of the nautical information forms.

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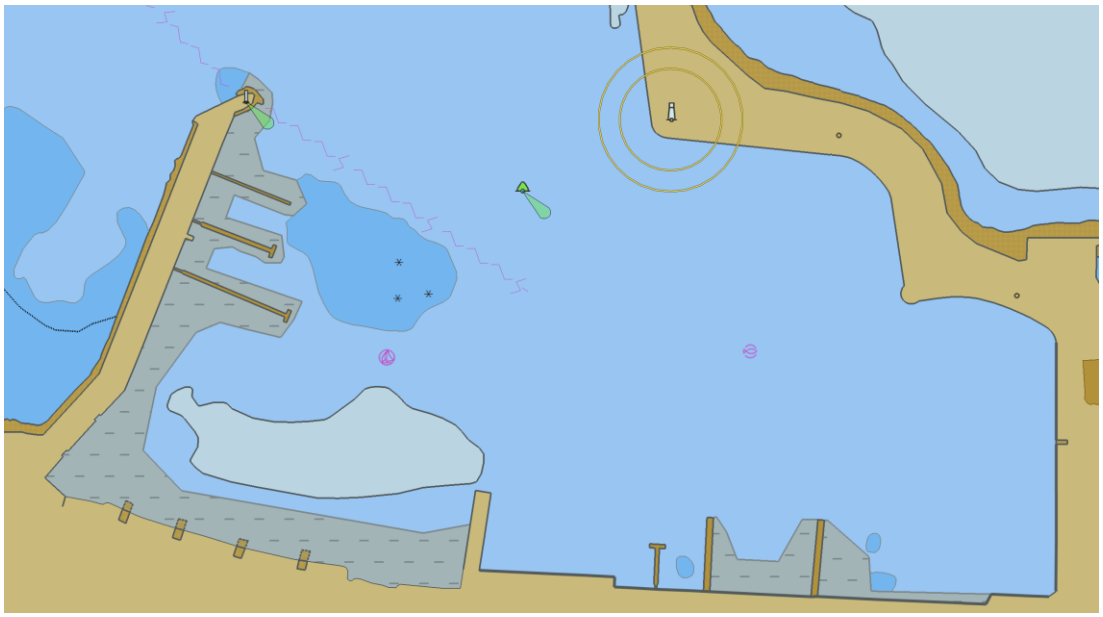

Figure 18 - Molfetta Harbour display

2. Background cartography: the main levels of the national and regional geoportals will be linked in visualization only. Such spatial information, which will be transparent in order to keep the nautical charts in the main view, will allow to verify the nautical information with those coming from the Local Authorities and to carry out, from the comparison of the layers, any updates and reports. All unofficial cartographic products (Streetmap, Google, etc.) have been riduced from the display layers because they are not an official source and therefore, in addition to being able to mislead the user, they would cancel the officiality and the legal certainty in the production of extracts for the administrative documents of the Marine Authorities and in the signalings carried out towards the IIM.

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Figure 19 - ENC and WMS integration

3. Different user-level settings have been created in view of the system specification. The Coast Guard users are differentiated between reporters and supervisors to create control redundancy in the information to be sent to Hydrographic Office. In the HO, two levels of users have been created in consideration of the operations to carry out and above all of the level of archiving/ approval of the nautical information. These solutions allow the separation of information management responsibilities according to experience and competence.
4. The development of the webgis application was carried out by developing the individual functions that can be activated directly by users with the highest levels of permissions. This modularity allows to intervene on any problems only on the incorrect/not working function, leaving unchanged those that are correctly working, minimizing the risk of bugs.
5. It's presented a possible graphical layout for the visualization of the working practices and approved for the Coast Guard interface and for those foreseen for the HO interface. The layout seem to be user friendly and intuitive so as to make easy the treatment and management (approval, rejection, storage, etc.) of the individual practice.

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Technical specifications

The operations carried out under review made it possible to prepare the development application in accordance with the technical specifications implemented and the operational choices. The app control tools have been developed and verification and testing operations have started with stakeholders outside the organisational structure (WP 4). Representatives of the Hydrographic Institute participated in the workshops for the presentation of pilot actions to the European partners of OSMOSIS (WP 3) both as auditors and presenters of the pilot project developed by Italy.

The following will explain the actions implemented:

Programming of the GIS Application

The pilot action (WP4) previews the realization of 2 structures of exposure of the nautical cartografia published from the distinct IIM and in particular in the continuation the module/tool for the collection of the nautical information will be considered. This module has been built through form divided by main topics/database and built with all the fields necessary to meet not only the update at the nautical charts and documentation but also to update the official databases also for the purposes of cadastre at sea. In addition to collecting basic information, the cards also offer the possibility of drawing or importing the basic geometry of the report. This condition allows you to verify that the data/ coordinates entered are correct and there are no discrepancies with the actual situation.

The application is available at https:\\geo.istitutoidrografico.it and the password could be required at follow e-mail iim.utentiup@marina.difesa.it.

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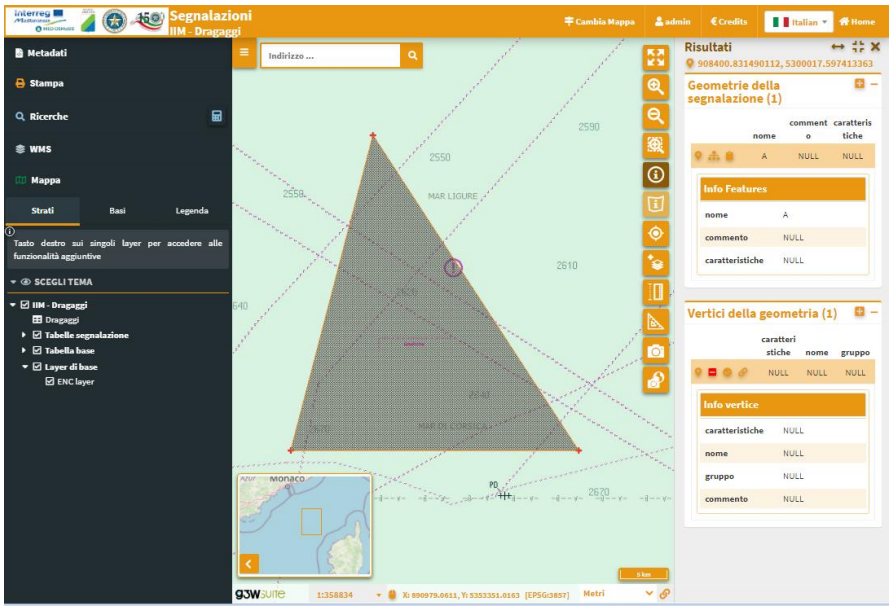

Figure 20 - Example of a form

The platform used, as mentioned, has two separate modules in order to ensure continuous operation 7/7 and 24/24, thus ensuring, that the service can also operate in degraded order because provided 2 series of independent but interconnected software that provide the conversion of databases from format S57 and the WMS, the first, and the exposure of cartography with data collection the second. Of the first, since there is no freeware software on the market able to guarantee the services requested, several software were tested at the same time and one that provides a WMS/WFS service was chosen, with the possibility to interrogate the single features present on the nautical chart (ENC) and to use a part of this information in order to fill the fields of the form of update of the nautical documentation. For the second module and the programming of the nautical information form a freeware geoserver has been employed that has allowed to generate the required additional modules together with the conversions between the coordinate systems (metric and geographic) mainly used in the nautical and topographic field using the datum, provided for by national legislation, ETRF 2000 (2008) (DPCM 10 November 2011).

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The webgis software considered is the G3W-Suite version 3.4 which, as mentioned, is Open Source that works under Mozilla Public License Version 2.0 and is freely downloadable from github. This choice allows you to program freely on the open source qgis platform and then to publish the contents online and make them available to all users.

In order to increase the platform's and the data security, a user access has been provided to identify and diversify users according to the operations they must perform on the platform. It can log in from any web browser independently of the operating system and/or machine language. Only control that is carried out at the level of recognition of the machine that accesses the service and only in the distribution of the data through the WMS in which a firewall allows access only of the machines recognized and authorized to this service.

The apllication and the data's exposure have been designed and built in order to be in line with the standards laid down by the OGC and the European INSPIRE legislation.

Account

the various user levels created and exchanged both internally at IIM and with the stakeholders who tested the platform and its functionalities were tested and tested..

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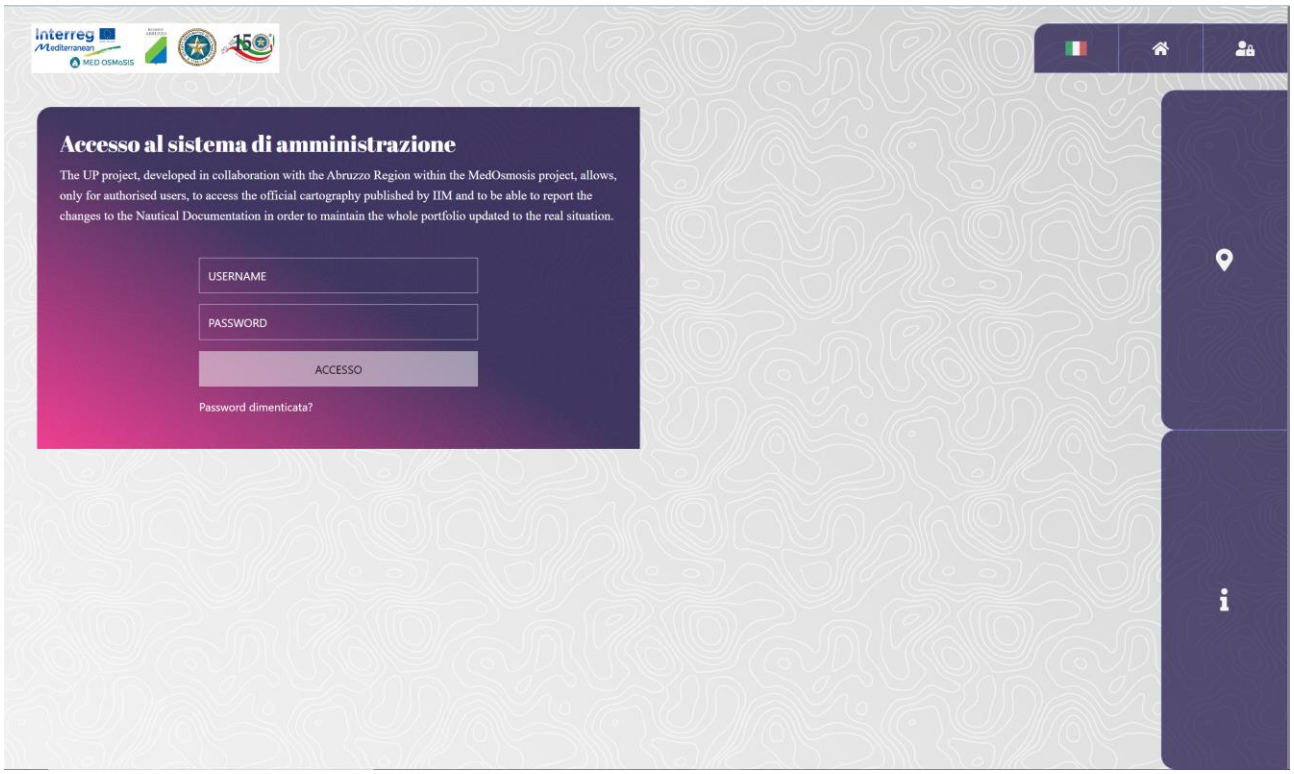

Figure 21 – Login page

Summarizing the user levels you can distinguish 6 classes of users:

- Public Administration or Stakeholder User: is a class of users who are allowed to view cartography up to a maximum scale of 1:100,000. At a larger scale the display is inhibited and only the base layer appears. There are no tools and therefore you should not interact with the cartography if not to query the various objects/feature/layer present;
- Reporter: class reserved for stakeholders and represents the basic compiler that introduces the information in the preformatted form. This class of users has permissions to use the entire platform including the creation and modification of projects but projects can only be shared to the higher user class or Supervisor;
- Supervisor: class of users of the Coast Guard offices who have the function of verification the information coming from the reporters and to send it for the analysis of the practice to the

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HO or to return it to the compiler for its verification/integration. The supervisor user can generate a new report and approve it for submission to HO. The forms can be sent in different ways:

  - As a final dispatch when the supervisor considers the practice complete or routine;
  - In approval by the HO in order to have a first verification on the form before the official sending in order to limit and reduce errors where the practice has critical issues and potential inaccuracies.

- Examiner: is the first level of operator within the HO that evaluates the information received and completeness. The operator cannot refuse or return to the Coast Guard/reporter the information but can comment the form/practice and make it available to the successive operator that completes it, archiving it, or returns it to the originator.
- Responsible: is the last operator that evaluates the practice and makes it available for the transfer of data in the databases of the Hydrographic Office or returns it, also at the suggestion of the Examiner, to the Reporter/Supervisor. This function is normally reserved for the individual layer/functional area managers.
- Administrator: users can see and verify the correct functioning of the application and create/generate new users and associate basic information. Platform administrators can also see the processing status of any user-created file/form. The number of these users is limited to a minimum to avoid overlap/interference in the management of the application.

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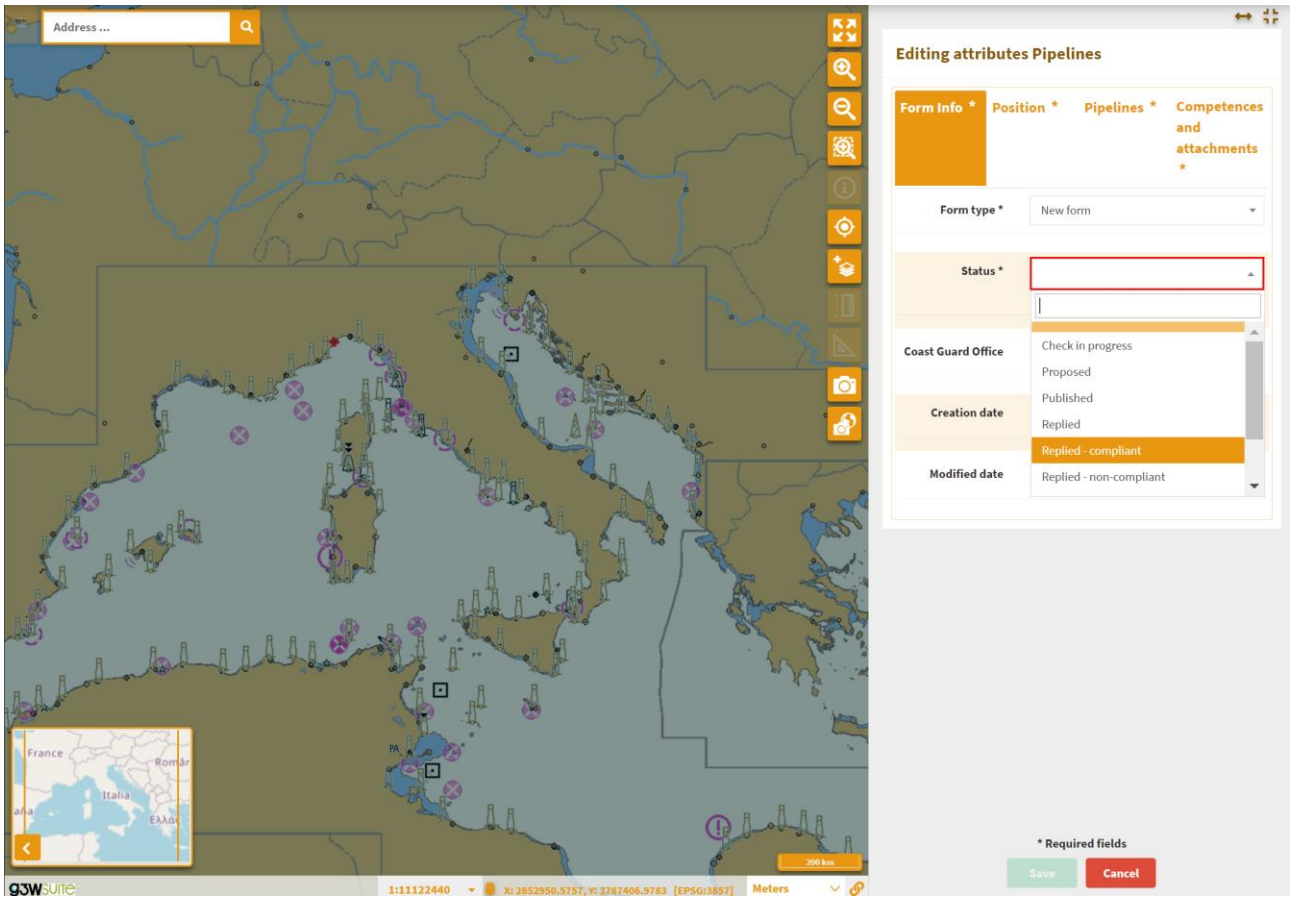

Figure 22 – Form's changing status (Administrator option that show all possibilities)

The following is a summary flow chart of the functions of the individual users with the control of the information and its path from the creation to the production of information for the databases or for the Nautical Documentation:

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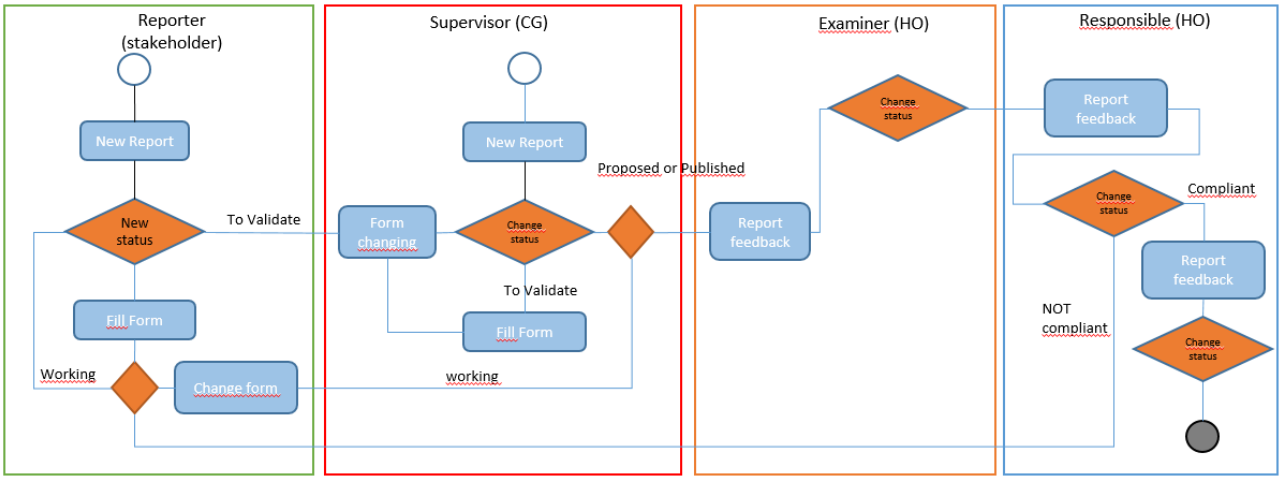

Figura 23 - Workflow for the Information both updating NtM or DB

Nautical information Forms

From the forms initially planned were made the new one, in Italian and English, on the basis of what was initially planned in the preliminary stages. The forms are made in such a way as to be in line with the developments of the next cartography and new databases in accordance with IHO (International Hydrographic Organizzation).

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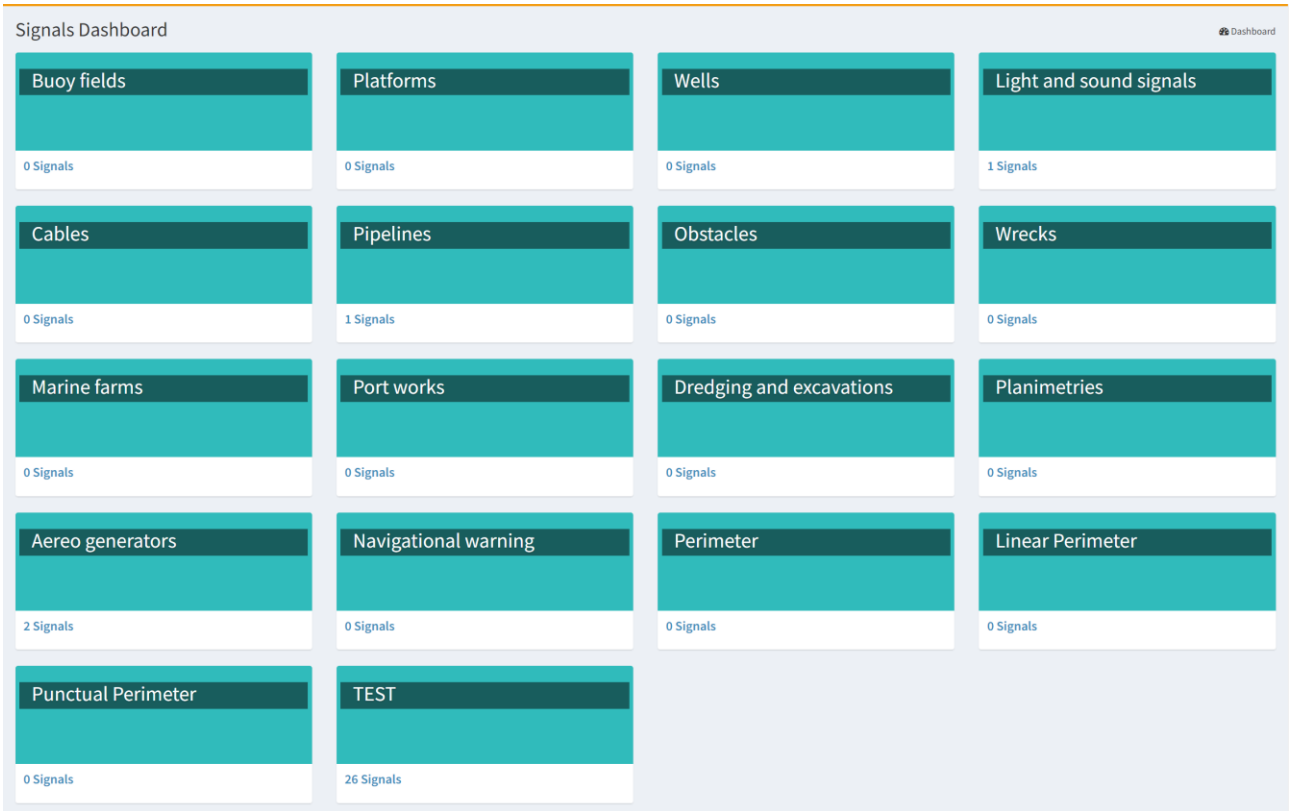

Figura 24 - form's page layout

The exposition of the forms is in compliance with INSPIRE legislation, so the data collected follow the main European and national legislation on the management and exposure of metadata and spatial and territorial information. The forms thus programmed have been divided into macro areas and by macro topics with a parent-child link in case of related forms within the same report. Such condition allows to realize a complete summary of an information without having to carry out multiple sendings. The forms is extrapolated and exported in its entirety. The operator can check the compilation status of all child cards at any time and view them independently of the father. In the summary screen, the child and father forms are displayed in different ways so that they can be easily identified by individual forms. In the compilation of the parent form is created, through a tool, a suggestion to compile one or more child forms. The compilation of the daughter forms becomes mandatory only if there is no information or, in case of update of the feature, this also concerns the additional information.

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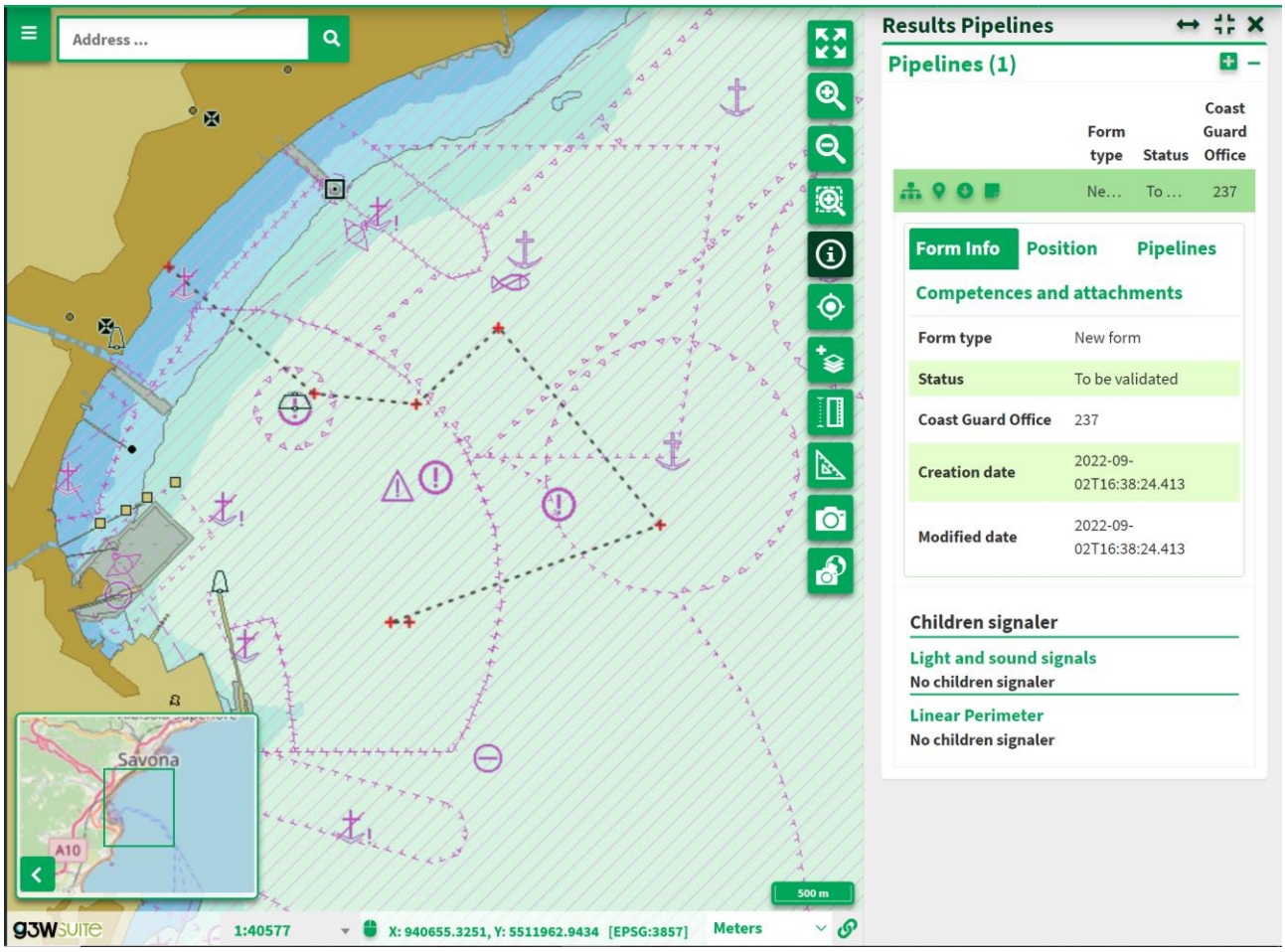

Figure 25 – example of a child-father form

The summary of the forms has been organized so that each Coast Guard Office/Stakeholder can see the generated form and, among those produced, those not yet archived by the HO. The HO can only see reports that are published or proposed while the form to be validated or in process are not visible.

The unique database has been programmed and built in such a way that it is unique for both Italian and English forms.

In providing information, it may be necessary to simultaneously create several geometries that are realized through geometries related, or daughters, to the main report, or father. This option allows to realize not only additional geometries but also not initially and specifically provided for that type of

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reporting. The screen view is similar to the screen where there are father and daughter forms as in the following image

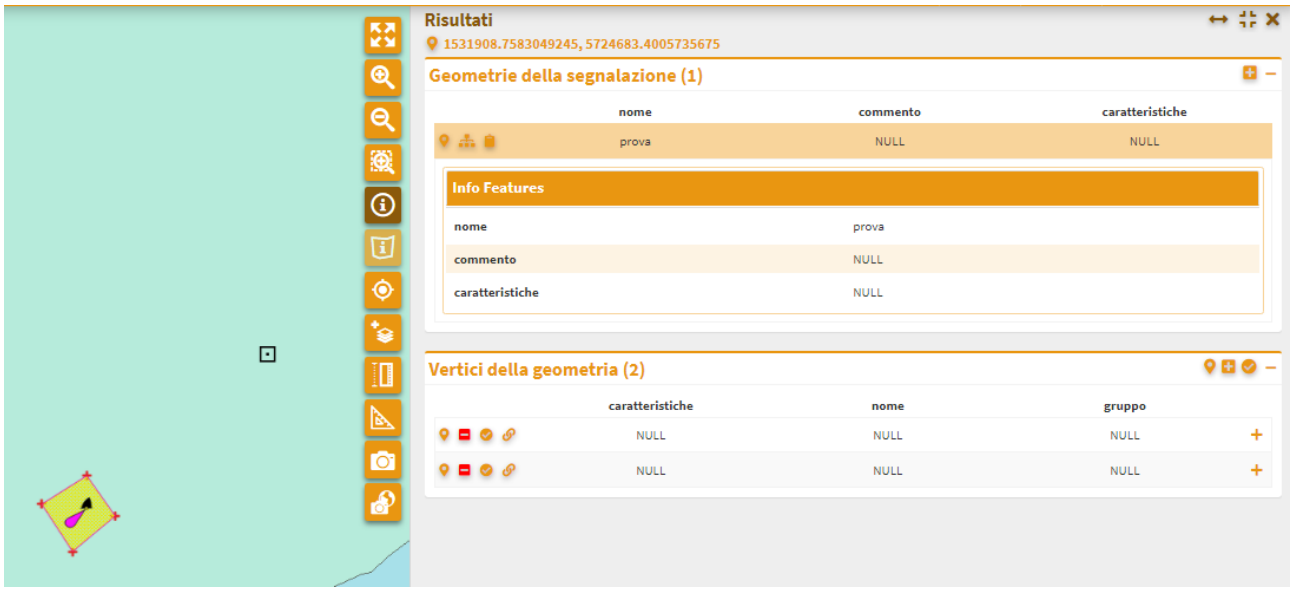

Figure 26 – Example of a multi geometries report

External Data

The application was created considering that stakeholders, at any level, needed to upload external data or connect layers from other geoportals, in order to make the report or simply to load a geometry instead of creating it through the tools in the app.

Among the import formats we find the main available cartographic exchange formats (gml, geojson, kml, kmz, csv, gpx, shp, etc.) in order to easily connect any layer and spatial information without having to manually build the geometries connected to the signal/card.

The use of web services such as WMS/WFS makes it possible to overlay spatial information with nautical cartography for a quick comparison and verification of data. In the image below have been loaded a part of the layers available on the regional WMS (coastline, anthropic structures, batometric

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and pipelines) and compared with the chart: a relative discrepancy between nautical cartography and reality is highlighted.

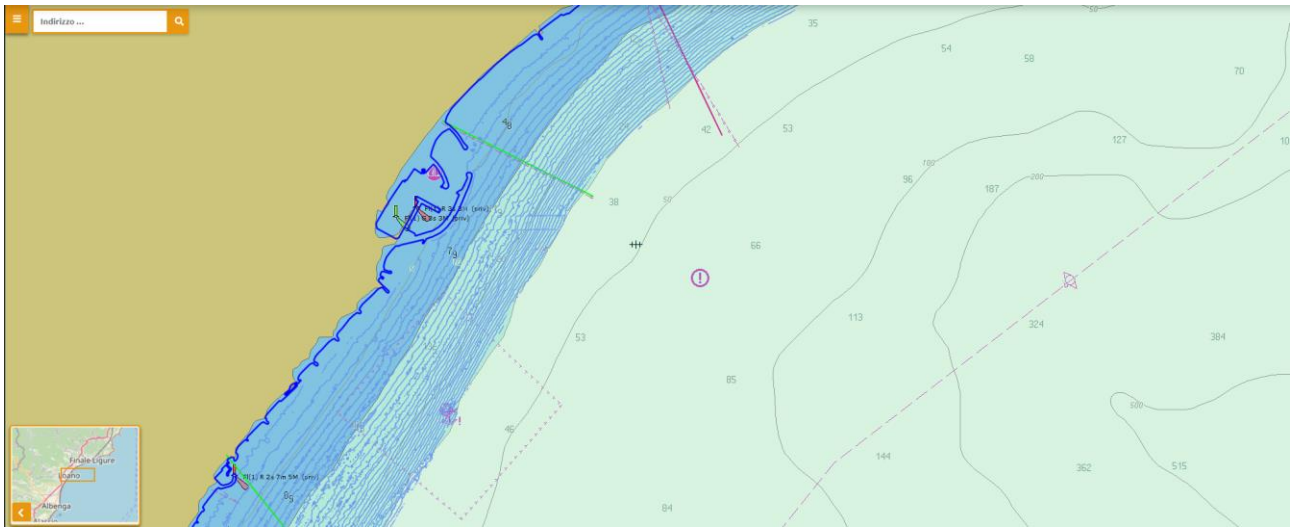

Figure 27 – the regional WMS layers is uploaded on the nautical chart: there are easily showed the difference between the layers/information

CONCLUSIONS

The realization of the webgis application fully follows the technical specifications that have been realized for it.

The form filled in via the application can be transformed into a geo-DB in shp file format and then imported into any other platform and interoperable with other systems or applications. As expected for export it is possible to import files of different formats so you can create a correct geometry, reloading it or generate external to the platform.

The transposition of the forms in the programming language of the software from the file in Access format, provided by IIM, has allowed to create new levels/layers of information that will speed up the operations of control and standardization of information for the production of NtM.

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The platform at present is a valuable aid for the management of information from the various stakeholders to the HO. In addition, the possibility to connect external layers through WMS/WFS services allows to align the nautical cartography with the published data on the regional geoportals.

Deliverable 4.3.10 - Digital charts portfolio supporting the management activities of relevant areas

All the operations have allowed to prepare all the technical specifications that the new platform had to possess, both in the field of the interface with the stakeholders, for the sharing of the nautical cartography, in S 57/S 63 format.

Technical specifications have been produced in accordance with national and European legislation, which highlight the features that have been identified as essential for the application.

Connection

The application allows simultaneous access to multiple users with different authorizzation depending on the user profile selected. All stakeholders will have access to all official nautical cartography from a predefined scale for the needs of MSP and other similar projects (1:100.000 if referred to traditional nautical charts while 1:90.000 for the display of ENC) up to the general chart in order to have a complete view of all the Italian coasts.

This configuration will allow to view all relevant spatial information and regulated areas reported on electronic charts during the marine spatial planning .

Contrarily the Coast Guard and the Marine Authorities will have the possibility to view all the nautical chart (all the scales available) and will have to disposition the nautical information that are revised in order to adapt them to the pilot action 4.3.9.

The information about the areas, as well as all other features, are reported in the metadata in the card database and then easily viewable by querying the object itself.

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For all users, the use of a display scale greater than that of paper, through the appearance of an on-screen warning, shall be immediately apparent, and the information shall not be viewable when the representation at a scale four times greater than that of compilation, so as not to draw the user into the error of accuracy of the information.

Account

One of the most delicate and important aspects of the design phase is the access to the application that must be to the User's controlled. For this reason, as part of the definition of access for stakeholders, a consideration has been made on accounts dividing it according to the map priority of the information to which the user must reach. Generic users, who need to view only nautical cartography, will have a dedicated access to only cartographic information, without the possibility to create the nautical information form necessary to the Hydrographic Institute for the updating of the nautical documentation (see pilot action 4.3.10).

During the developing operation of the Webgis Application, external users were also considered to work on GIS-like software using cartographic data in WMS mode. To ensure the integrity of the starting vector data in S 57/S 63 format, a limited number of users with controlled access to WMS-type services have been provided. This option has become necessary, even if not foreseen by current national and international policies, in order to guarantee the integrity of the nautical chart data and avoid the possible navigation of users through software interfaced to GNSS (Global Navigation Satellite System) receivers, eventuality that it would violate the current norms on navigation emitted is from the national legislator is from the IMO (International Maritime Organization) as it could allow the use of a navigation system which is not approved and does not comply with safety standards, creating a potential hazard for safety of navigation (condition expressly provided for and pursued also by the Italian navigation code).

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Software development

In consideration of the specific produced and imposed like base for the programming and management of the webgis application have been estimated of the followed software solutions:

1. The charts' display is carried out with an external application to the webgis page and shared with the latter through a WMS service with IP address control. This solution proposed as an additional option has proved to be the basic solution on which to proceed to the programming of the pages and that it allows never to expose the electronic nautical charts (ENC) that remain on a basic level. The objects present in the nautical charts are interrogatable and the information are immediately viewable through the dialog box and therefore employed in the programming/design of the nautical information cards.

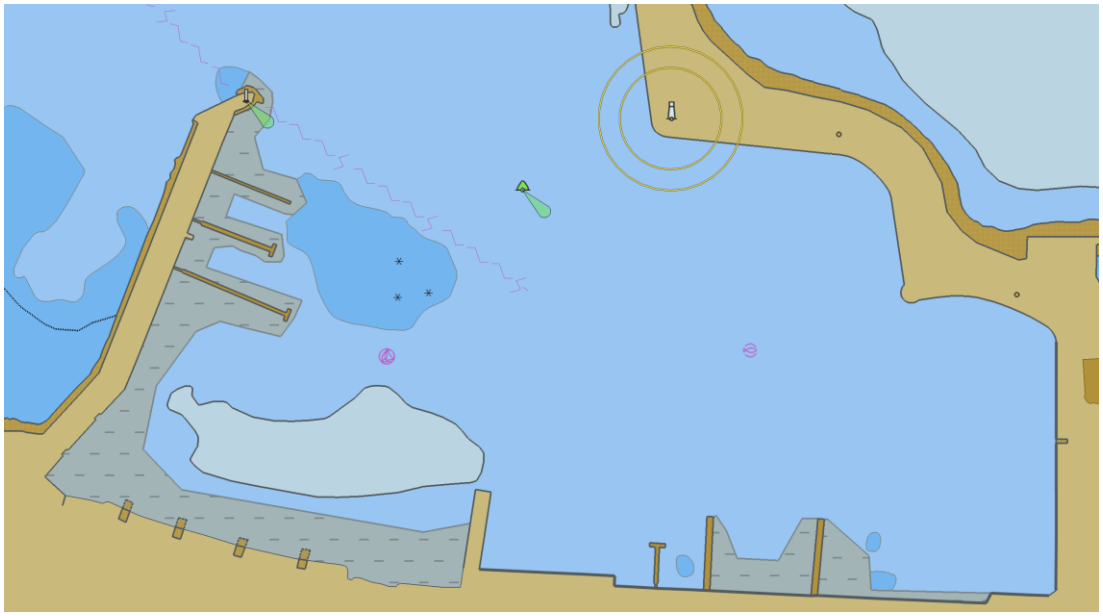

Figure 28 - Molfetta Harbour visualizzation

2. Background cartography: the main levels of the national and regional geoportals are linked in visualization only. This spatial information, which is transparent in order to keep the nautical charts in the main view, allows to verify the nautical information with those coming from the

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Local Authorities and carry out, from the comparison of the layers, any updates and reports. All unofficial cartographic products (Streetmap, Google, etc.) have been excluded from the display layers because they are not an official source and therefore, in addition to being able to mislead the user, would cancel the officiality and the legal certainty in the chart production or administrative act.

Figure 29 - Integrazione tra ENC e WMS regionale (solo strato "ortofoto AGEA 2019")

3. Different user levels have been created in consideration of the system specifications and depending on the permissions to display the nautical cartography.
4. The webgis application's development was done by developing individual functions which can be enabled directly by users with the highest levels of permissions. This modularity allows to intervene on any problems only on the incorrect/working function, leaving unchanged those that are correctly working, minimizing the risk of bugs.

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5. The visualization layout for the application is selected considering that the colors and icons, as the representation in general, are user friendly and intuitive so as to make it easy to treat and manage all the features.

Programming of the GIS Application

The pilot action (WP4.3.9) includes the realization of the GIS application for the view of the italian nautical charts in 2 different modules as follow:

- The first one allows the representation of the nautical cartography available for the Public Administration and for the public Agencies that, for their institutional tasks, have the necessity to expose/examine/evaluate the nautical cartography. This service is provided through the webgis application created in which the user, after the verification of permissions (login for user verification) has the possibility to display on a common web browser the nautical cartography up to the maximum representation scale of 1:100.000. This cartographic representation is condition to provide a cartographic base for all national plans such as the f Marine Spatial plan (MSP), for the Sustainable Ecological Transition of Suitable Areas (PiTESAI) and others.

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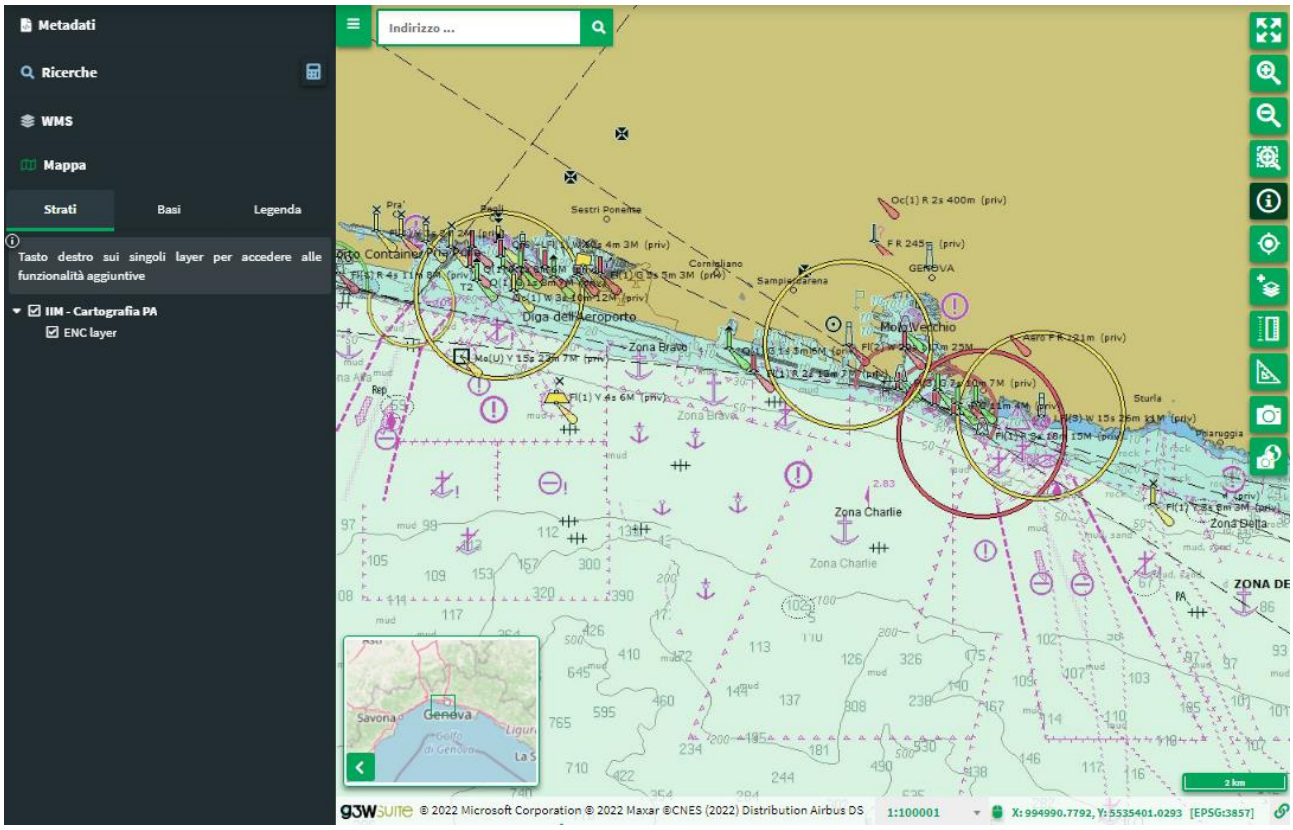

Figure 30 – WEBGIS application screen

- In addition to the first module, a web mapping service has been set up that can be loaded as a background in any GIS application or on geo-servers in order to display nautical cartography as a layer in support of other geospatial and environmental information;

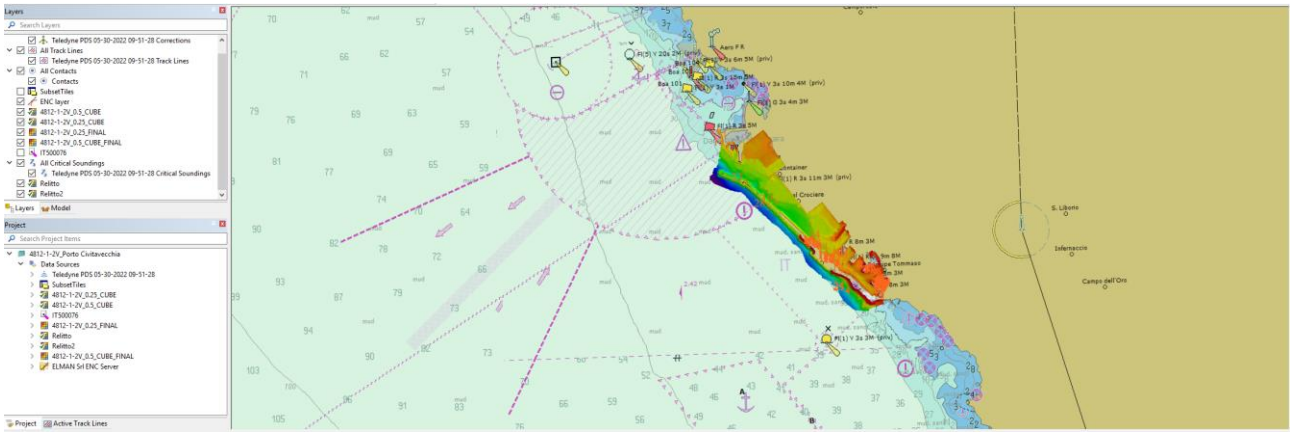

Figure 31 – Nautical Chart through the WMS on a GIS software

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the main module is available at https://geo.istitutoidrografico.it and the access an be obtained sending a mail at iim.utentiup@marina.difesa.it.

The platform used, as mentioned, has two separate modules in order to ensure continuous operation 7/7 and 24/24, thus ensuring, that the service can also operate in degraded order because provided 2 series of independent but interconnected software that provide the conversion of databases from format S57 and the WMS, the first, and the exposure of cartography with data collection the second. Of the first, since there is no freeware software on the market able to guarantee the services requested, several software were tested at the same time and one that provides a WMS/WFS service was chosen, with the possibility to interrogate the single features present on the nautical chart (ENC) and to use a part of this information in order to fill the fields of the form of update of the nautical documentation. For the second module and the programming of the nautical information form a freeware geoserver has been employed that has allowed to generate the required additional modules together with the conversions between the coordinate systems (metric and geographic) mainly used in the nautical and topographic field using the datum, provided for by national legislation, ETRF 2000 (2008) (DPCM 10 November 2011).

The webgis software considered is the G3W-Suite version 3.4 which, as mentioned, is Open Source that works under Mozilla Public License Version 2.0 and is freely downloadable from github. This choice allows you to program freely on the open source qgis platform and then to publish the contents online and make them available to all users.

In order to increase the platform's and the data security, a user access has been provided to identify and diversify users according to the operations they must perform on the platform. It can log in from any web browser independently of the operating system and/or machine language. Only control that is carried out at the level of recognition of the machine that accesses the service and only in the

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distribution of the data through the WMS in which a firewall allows access only of the machines recognized and authorized to this service.

The apllication and the data's exposure have been designed and built in order to be in line with the standards laid down by the OGC and the European INSPIRE legislation.

During the pilot action development the application was tested with a regional geoportal and all informations was compared. At moment the Liguria region is testing the applicationa and compare all the shared information with the nautical chart.

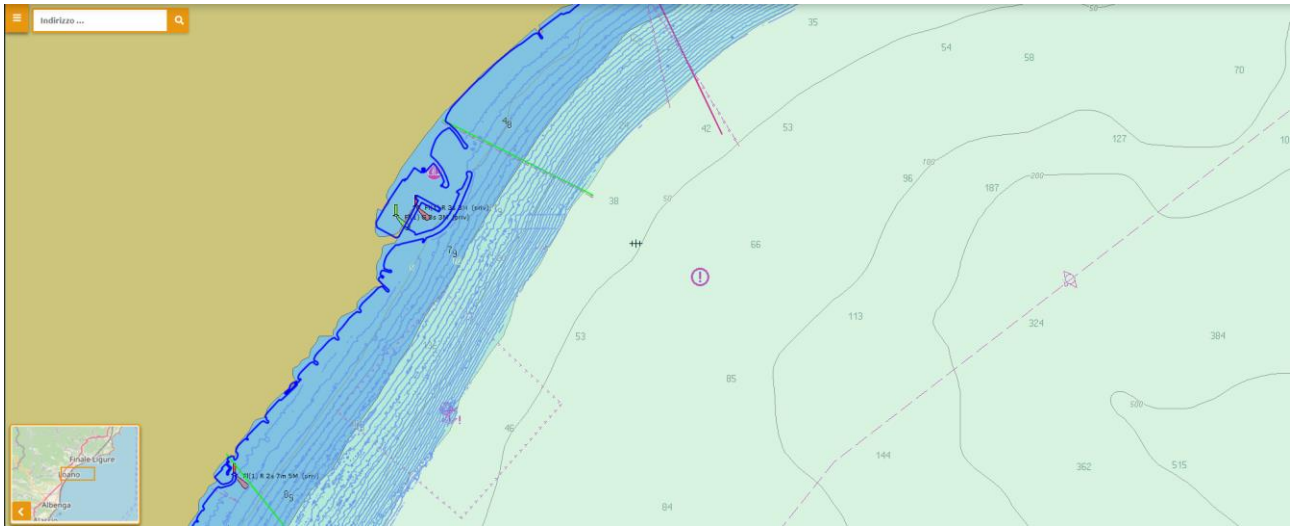

Figure 32 – the regional WMS layers is uploaded on the nautical chart: there are easily showed the difference between the layers/information

CONCLUSIONS

The realization of the webgis application fully follows the technical specifications that have been realized for it.

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The possibility of being able to consult the nautical cartography from part of the Public Amministration or the stakeholder allows to carry out, for example, a wise marine spatial planning or a comparison with the published data in the regional geoportals.

The dual mode of connection allows both to consult the data online, through the webgis application, both to have the nautical cartography through a WMS service on the most common Geographic Information System.

In addition, the possibility to connect external layers through WMS/WFS services allows to align the nautical cartography with the published data on the regional geoportals.

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Testing Phase

Introduction

The platform, before being released, needs an adequate testing period to verify, in addition to the correct functioning, also the compliance with the technical specifications produced that the programmers had to follow during the various stages of preparation of the platform. The programming phases presented system bugs that were promptly resolved by the programmers so that the subsequent testing operations continued continuously and not affected by previous problems.

Testing phase

The testing phase was carried out by asking participants in the PANORAMED OSMOSiS project and a number of Italian stakeholders to participate in the testing, verification and bug research phases that the application could have after the first programming phases. Moreover the produced technical specifications from the Hydrographic Institute were comprehensive of a phase of verification and testing from the Coast Guard office to the aim to verify that how much realized for the WP4.3.9 was in line with previewed how much and answered to the requirements of the two entities. In particular, the platform created for the production of nautical information was to be verified, including the module for the realization of geometries as well as forms for data collection and standardization of information. The test memoranda that have been included in the data sheets and technical specifications have been subject to continuous checks between the staff of the HO and the programmers.

The testers were mainly asked to verify that the application could be userfriendly, compatibility of the platform with what were the initial purposes of the project and the verification of completeness of forms as well as the presence of any system bugs. The main tester of the platform among the participants of the Panoramed project was the French SHOM which produced a test report based on

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a format exchanged with the HO. Between the italian testers has participated to the plan the CNR Of Venice that has tested the platform is from the point of view of the nautical information is, like member of the permanent commission on the italian MSP, for the data sharing for the pubblic entities. There are also the Coast Guard Offices that test and verify the application both in national language that in english: the scheduled test period is longer than 6 months in order to minimise the number of system bugs before the full operation capability of the application as the main information communication system for the production of NtM.

Result

An examination of the reports sent by stakeholders showed that:

- The platform is of particular interest for the sharing of nautical information necessary for the production of ntm. It was highlighted the lack of connection between the application and the portal of Navigational Warnings so that during the issuance of ntm you could communicate the news through a different channel. The link to the Navigational Warning geoportals has been tested to verify the effectiveness of the platform, as well as to all other geoportals through the WMS/WFS services with positive results.
- The structure of the transmission of the information has turned out complete and is evidenced only the necessity, already previewed, of the feedback from the HO on the single report sent from the Coast Guard offices/Stakeholders;
- In particular, everyone appreciated the possibility of seeing the charts seamless, integrated with each other without having to make changes of scale in the display. This configuration allow the chart display at maximunm scale;
- The connection with other geoportals or the possibility of connecting external files has been very appreciated by the testers;

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- One of the problems highlighted is the number of fields for some forms. The amount of information appears to be large for map purposes in S57 format. The required additional fields are used to complete the DB of the HO for the purposes related to the S100 series standards;

All improvement requests or system bug reports were discussed with the programmers and were promptly implemented into the application with obvious improvements and platform stabilization.

Conclusion

The test phase has proved to be a comparison action of the valid application that has allowed to highlight both the merits and the defects allowing the improvement. In particular, the comparison for both WP 4.3.9 and WP 4.3.10 made it possible to highlight the integration operations of the 2 projects and to underline the work done to make the platform userfriendly and connectable with the main international geoportals, national and regional.

The test phases for the verification of possible system bugs have been conducted with a favorable outcome also with the Coast Guard and has allowed to highlight also the employment of the platform from the main stakeholder that supply to the HO the nautical information necessary for the production of NtM

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