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# Site Characterization Data Model and GIS-based Tools for Offshore Engineering Projects

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ABSTRACT

Offshore engineering projects require the management of a huge amount of heterogeneous georeferenced data - among others metocean, geophysical, geotechnical, and environmental, which need a Data Model, data visualization and data analytics features on a common geographic basis. A Digital Data Platform (DDP) has been developed on a GIS ambient with the aim to speed up the engineering design process (i.e. minimization of routine operations), and also prevent misalignment of the data originating from different sources from Owner to Suppliers and any potential loss of information. The proposed GIS architecture is composed by two main components: i) the Data Model geodatabase, and ii) the GIS-Model Toolbar add-in. The proposed development represents a step forward on the definition of a common specification and dictionary for offshore project execution overcoming the current bottlenecking and inefficiency on the design phases between the project owner and the engineering contractor. The paper illustrates "what" and "how", and in particular: i) the geodatabase and Data Model framework, ii) the required parameters to be organized and stored for offshore engineering design, and iii) the widgets implementation (i.e. GIS-based tools). Its application on a case study project with practical examples is presented.

## 1. Introduction

For Oil & Gas and Energy Companies, the availability of data management systems guaranteeing the quality of information is crucial. With reference to the complex offshore environment, it is essential that the data archives & interfaces remain easily manageable, coherent, fully adaptable, and scalable. For this reason, information and data standards for different data sources have been developed in the last decades. Geographic Information Systems (GIS) has gained worldwide acceptance by Operators and now is being the most used platform for the management, mapping, and analysis of geospatial data for offshore engineering projects. At Company Corporate level, GIS has become the central repository for storing all geospatial data. The operational implementation of GIS in support

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of SURF (Subsea Umbilicals, Riser, and Flowlines) field development are relatively new. Marrannes et al. [1] (2012) presented from a Contractor experience and perspective the GIS application used on several large construction projects performed offshore. Savazzi et al. [2] (2015) presented from Owner experience a Ground Model as an integrated high value database to manage, store and use the huge amount of geotechnical and geological data throughout the various project engineering phases.

As common practice in the offshore industries, metocean design parameters are assessed fulfilling internationally accepted recommended practice as DNV-RP-C205 [4] or Standard API RP 2MET [5] which gives guidance for modelling, analysis and prediction of environmental conditions as well guidance for calculating environmental loads acting on structures. Scientific literature on metocean Data Models are very limited. An accurate database of operational metocean parameters was developed by Graaff et al. [3] (2012). The database provided basic information for planning offshore installation and operations, as well as input for design of offshore platforms, pipelines, and structures in general.

Some examples of Data Model to store critical information, analyze data and manage data geospatially in a referenced database are: SSDM (Seabed Survey Data Model) [6] developed by the geomatics committee of the IOGP (International Association of Oil & Gas Producers), ArcMarine [7] (ESRI Data Model) which represents a new approach to archive marine surveyed data, PODS [8] (Pipeline Open Data Standard) developed for asset oriented spatial Data Model, or UPDM [9] (Utility and Pipeline Data Model) which is a geodatabase Data Model template for operators of pipe networks in the gas and hazardous liquids industries.

The development of comprehensive geotechnical database involves: i) collection of borehole data from various reputed sources, ii) validation of data in terms of accuracy and redundancy and iii) standardizing and organizing the geotechnical information for incorporating into the database [3]. A standard form of borehole data was suggested and implemented in a web-based GIS application by Chang and Park [9] (2004). Recently, Sun et al. [10] (2014) highlighted the advantages of an integrated GIS-based system for geotechnical data to reliably predict the spatial geotechnical information with specific application to the Seoul area in Korea. Turer & Bell [11] (2010) presents a method of managing site survey data based on geo-information management. The methodology defined a GIS Data Model for seabed survey data interpretation and satisfies GIS query, visualization, and data exchange purposes. Priya & Dodagoudar [13] (2017) presented the methodology of building a digitally formatted and integrated spatial database using geotechnical data and geographic information system. Another example was given by S. Varnell et al. [14] (2010) in which geological, geophysical, and geotechnical data were added to project GIS database during a feasibility phase.

For offshore projects, the Data Life Cycle process begins at the conceptual phase and ends with decommissioned asset. During this cycle data shall be managed and audited with data/information governance activities to ensure the owner's requirements are always fulfilled. Looking at the amount of data that are needed to be collected is mandatory to reach a common language and data repository from the early beginning of the project among all different stakeholders: owners, suppliers, and subcontractors. All the existing standards and guidance which have been developed to meet specific needs and purposes are undoubtedly necessary for the value chain of engineering projects, however a unified Data Model covering the design basis parameters for offshore projects is still missing. Main aims of this research are: i) to draft an extended Data Model dedicated to design parameters for offshore projects, ii) to give an orientation towards a common dictionary for offshore industry players and iii) to facilitate the entire design data life cycle for exchange and reuse of data to any phase of project development via a GIS unified data platform.

## 2. GIS-based Digital Data Platform

A GIS-based Digital Data Platform (DDP) has been developed with the purpose to pull into a common view, through visualization map and graphical interface, all the data required for engineering design starting from the conceptual phase to the so- called Life-of-Field (Figure 1).

The DDP embraces two main components: i) the Data Model geodatabase, and ii) the GIS-Model Tools (i.e. Add-in) (Figure 2). The former is the repository of all the geographical data and the related information involved in the project: the main purpose is to act as a "single source of truth" for the different phases of the engineering, representing a data source that is consistent, coherent, continually updated during the time and easily shareable among the different actors involved in the project. The latter, through ad-hoc developed GIS widgets, allows these data to be displayed and analyzed in graphical and numerical formats according to different geometries and related properties.

The presented Site Characterization Data Model includes the following dataset (Table 1):

I. metocean data (i.e. wave, current, wind climate and extreme data, weather and hydrology);

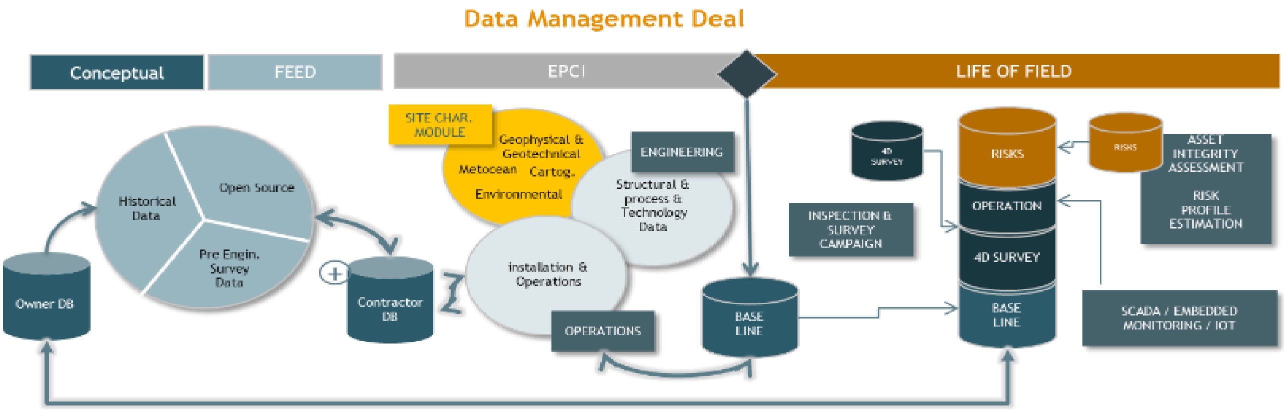



**Figure 1.** Data Management Life Cycle

II. geotechnical, geophysical, bathymetric and topographic data;

III. cartographic data (coastline, orthophotos, coastal structures geometries);

IV. environmental data (i.e. marine growth, water quality, soil quality, habitat mapping);

V. third party interaction data (i.e. combining marine traffic data and offshore asset).

**Table 1.** Site characterization data included into the DDP

| Metocean Data | Geotechnical & Geophysical Data | Environmental Data | 3rd Party Interaction Data |
|---|---|---|---|
| Wave | Seismic data | Marine growth | Fishing |
| Current | Soil parameters | Water quality | Shipping |
| Wind | Seabed features | Soil quality | |
| Hydrology | Geohazards | Habitat mapping | |
| Meteo (Cyclone) | DTM | | |
| Tide/Surge | | | |

The geodatabase is organized as an ESRI File (*.gdb) containing several feature classes for the GIS features, like the coastline, metocean and geotechnical monitoring stations as well as project field layout and facilities; this kind of data is visualized graphically using ArcGIS Desktop (ArcMap).

The engineering data contained in the Data Model geodatabase are organized as a series of “Bitemporal Data” tables, as shown in Figure 3. The main rules for the organization of the data tables are:

- The primary key of each table is a single unique object identifier, independent of any other kind of data; no composite primary keys are used, and no business meaning is stored in the primary key.
- The foreign keys are used only when the external data that is referenced is not versioned; the data consistency is verified mainly using external procedures that validate the data in the geodatabase during the data loading process.
- Two specific fields are used to declare the rows that are valid in a specific time (start and end validity), reflecting the changes to the objects which that data represents.
- Two different fields are used to handle the data corrections (start and end assertion), reflecting the changes made to correct mistakes.

The bi-temporal fields are used to handle the validity of the records in the geodatabase as previously explained and are not used to store any business value related to the meaning of the data itself. Using the bi-temporal fields, it is possible to avoid any data deletion: the new and updated data are added to the system, and the old data is marked as obsolete.

The GIS-Model Toolbar is an ESRI add-in: the generic GIS functionalities of the ArcGIS Desktop platform has been extended through the development of a set of specific software components, accessible directly from the ArcMap toolbar, that integrate all the available operations. The ESRI add-in has been developed using the C# programming language and the Microsoft .NET platform, and it is based on ESRI “ArcObjects SDK for .NET” technology.

The main functionalities of the GIS-Model Toolbar are:

- *Import Functions*: the information can be added (and then updated) using the “GIS-Model Toolbar” import functions. The input data are organized as excel sheets with a well-defined structure, adapted to the needs of the client and the project; the data is then integrated inside the geodatabase in data structures specifically tailored to handle the subsequent operations with the maximum efficiency.
- *Computational Models*: specific Matlab computational models have been developed to process the site characterization and the geographical data stored in the

geodatabase; these models are easily accessible through the GUI (Graphical User Interface) functions of the GIS-Model Toolbar. The results of the elaborations (relational and geographical datasets) are then stored in the geodatabase for the visualization using the GIS and the reporting system, as well for further elaborations.

- *Reporting System*: as part of the ESRI add-in, specific reports have been developed to offer a meaningful representation of the data contained and the elaboration results; these reports can either be dynamic tables or graphical plots and chart, and they are displayed directly inside the GIS environment using the GUI functions available.

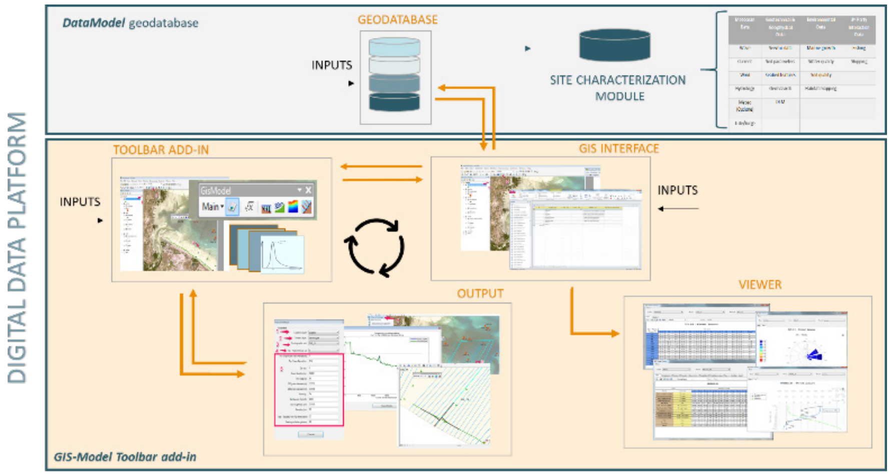



**Figure 2.** Digital Data Platform

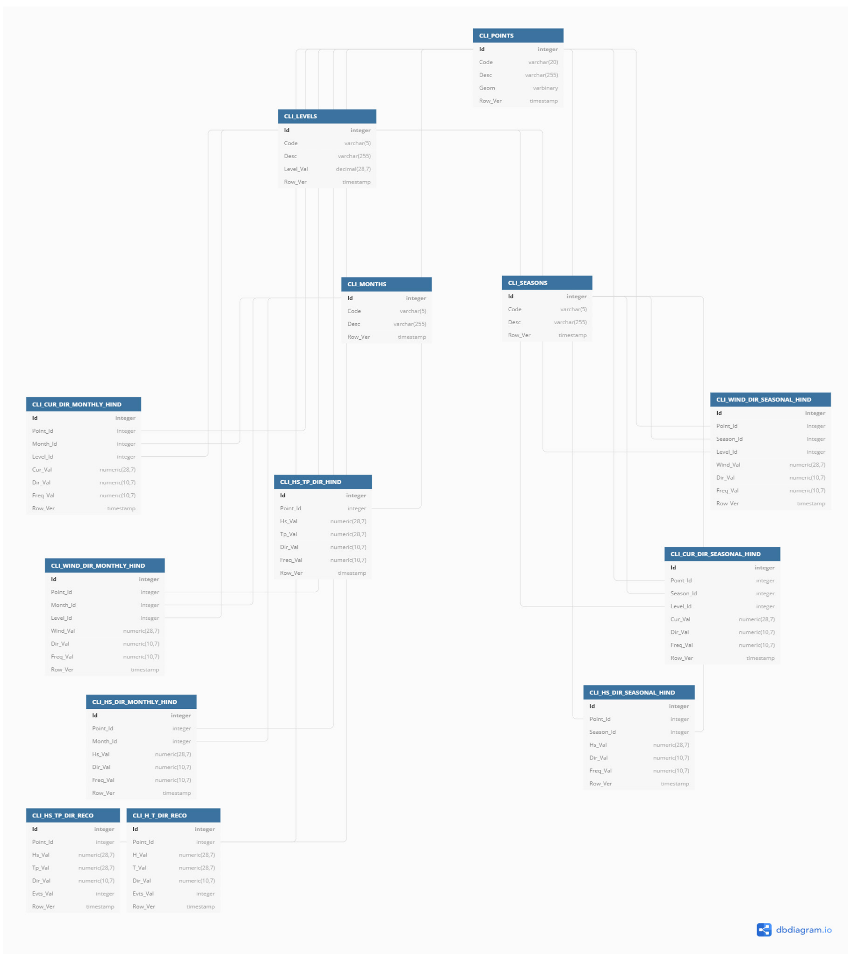


**Figure 3.** Data Model for Metocena data

## 3. Site Characterization Data Model

The Site Characterization Module of the DDP is composed by: i) Metocean Data, ii) Geophysical Data, iii) Geotechnical Data, iv) Environmental Data, v) 3rd Party Interaction Data. All these data represent the basis of any design for offshore projects.

The hierarchy structures of Data Model are based on three different concatenated levels: Level 1 defines the geometrical properties, the Level 2 defines the data typology and Level 3 provides attribute values of the physical parameters.

- **LEVEL 1**: Definition of the Geometry (e.g. point, area or linear element);
- **LEVEL 2:** Definition of the Cluster Type (e.g. metocean/geotechnical/geophysical etc.)
- **LEVEL 3:** Definition of Attribute Values (i.e. Master tables)

Attribute Values for each category of data type have been defined looking at most common International Standards and Recommended Guidelines.

With reference to Metocean Data accepted industry parameters embrace marine current, waves and wind conditions and all meteorological and hydrological parameters. The loads are limited to wind, wave and current and typically representing: i) climate and ii) extremes. The representativeness of the metocean condition to a geographical area is crucial when considering the complexity of the environment. Each Point describes a homogenous area limited by some boundaries. When applied to GIS each point within this area maintains the same conditions. An example is shown in Figure 4.

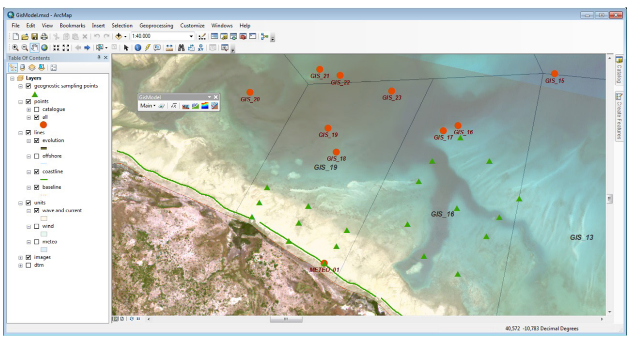


**Figure 4.** Metocean Data homogeneous area selection

The climate is a scatter diagrams of main variables such as Hs *vs* Direction, Ws *vs* Direction, Hs *vs* Tp etc., whereas the extremes represent an event to specified return periods applied for structural verification. For waves these includes: i) sea surface stationary sea state for a duration of 1 hour to 3 or 6 hours with energy spectrum such as those of Jonswap, Pierson-Moskowitz or Ochi-Hubble, ii) single wave H-T representing individual waves for time dependent fatigue assessment. One example of common parameters used to describe the marine sea states are: Hs (m); Tz (s); Tp (s); Tp (s) 5%; Tp (s) 95%; γ; Hmax (m); Tmax (s). Parameters used to describe the wind are the 10-minute mean wind speed $Ws_{10}$ at height 10 m and the mean direction.

Appropriate gust factors are generally applied to convert wind statistics from other averaging periods than 10 minutes depending on the frequency location of a spectral gap, when such a gap is present. Unless data indicate otherwise, a Weibull distribution can be assumed for the arbitrary 10-minute mean wind speed $Ws_{10}$ in each height z above the sea water level. Parameters used to describe the marine current are the Cs "marine current speed" at different level along the water columns. To be noted that the total current velocity at a given location (x,y) should be taken as the vector sum of each current component present, wind generated, tidal and circulation currents. Level 3 Master Tables associated to climate and extremes are listed in Table 2 and Table 3, respectively.

Another example is given for geotechnical data. Customized Master Tables has been developed to collect the geotechnical design parameters necessary to perform foundation design (e.g. shallow or deep) and the pipe-soil interaction analysis. Regarding the foundation design, the first step (Level 1) is the definition of a geometry, i.e. a polygon around the structure locations to be analyzed need to be identified (example shown in Figure 5a). The polygons will be characterized by specific geotechnical parameters, and they will be characterized by a name and a univocal identifier ID. Further step (Level 3) is the collection of the physical parameters. Geotechnical characterization includes a large quantity of soil parameters, specific for the different soil conditions and geotechnical issues (main parameters listed in Table 4). The Master Tables has been designed for all types of foundations, ranging from slender piles and caissons to shallow foundations and rock berms with the purpose of analysis of short- and long-term settlement, verification of stability against horizontal, vertical and overturning failure, installation analysis and liquefaction check.

With reference to soil-pipe interaction, the Level 1 shall be defined through consecutive pipeline sections characterized by homogenous soil parameters as shown in Figure 5b. The geotechnical zonation along the pipeline is generally performed integrating the available geophysical and geotechnical data from the survey results. Physical parameters required for the pipe-soil interaction are listed in Table 5. Main analyses that could be performed are those relevant to the pipeline embedment calculation and the assessment of soil resistances during vertical, axial, and lateral pipe movement.

**Table 2.** Master Table Climate

| | Variables | | Filtering | | | |
|---|---|---|---|---|---|---|
| | **A** | **B** | **1st Level** | **2nd Level** | **3rd Level** | **4rd Level** |
| **Wave** | Hs (m) | Direction (°N) | N/A | All Year / Montly/ Seasonal | Hystorical / Statistically reconstructed | Fequency (%) or No. events |
| | | Tp (sec) | | | | |
| | H (m) | T (sec) | | | | |
| **Current** | Cs (m/s) | Direction (°N) | Elevantion L0 to Ln | | N/A | N/A |
| | | Hs (m) | | | | |
| | | Ws (m/s) | | | | |
| **Wind** | Ws (m/s) | Direction (°N) | Elevantion L0 to Ln | | N/A | N/A |
| | | Hs (m) | | | | |
| | | Ws (m/s) | | | | |

**Table 3.** Master Table Extremes

| | Variables | | | Filtering | |
|---|---|---|---|---|---|
| | **A** | **Vs** | **B** | **1st Level** | **2nd Level** |
| **Wave** | Hs (m) | **One to Multi** | 1y RP | N/A | All Year / Montly/ Seasonal |
| | Tz (s) | | 5y RP | | |
| | Tp (s) | | 10y RP | | |
| | Tp (s) 5% | | 50y RP | | |
| | Tp (s) 95% | | 100y RP | | |
| | γ | | 1000y RP | | |
| | Hmax (m) | | 10000y RP | | |
| | Tmax (s) | | Any other | | |
| | h (m) | | | | |
| | Extreme distribution params | | | | |
| **Current** | Cs (m/s) | | | Elevantion L0 to Ln | |
| | Extreme distribution params | | | | |
| **Wind** | Ws-3” (m/s) | | | Elevantion L0 to Ln | |
| | Ws-1’ (m/s) | | | | |
| | Ws-10’ (m/s) | | | | |
| | Ws-1h (m/s) | | | | |
| | Extreme distribution params | | | | |

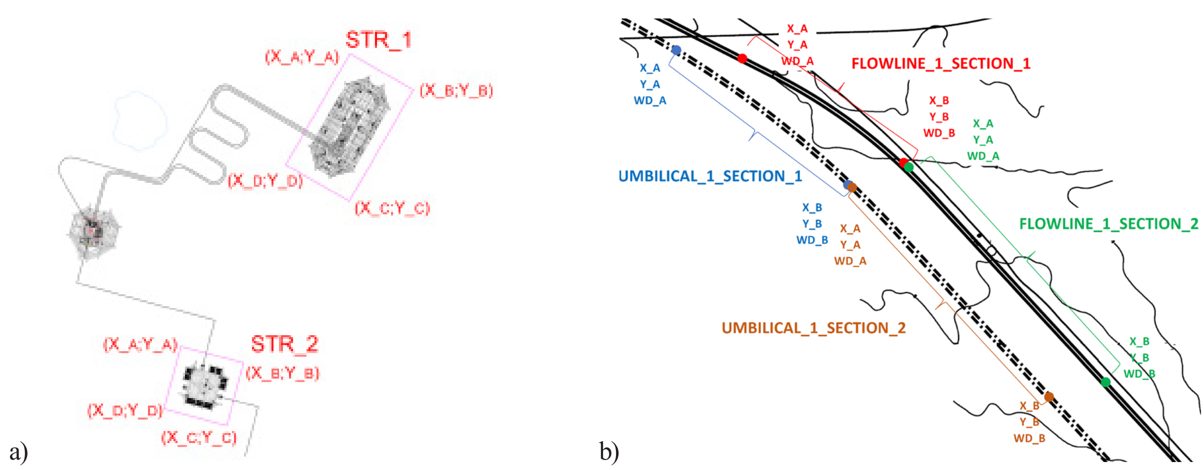



**Figure 5.** Example of a) pipeline soil characterization b) subsea shallow foundation homogeneous area selection

**Table 4.** Main geotechnical parameters for foundation design

| Geotechnical Parameter | Symbol [US] | Geotechnical Parameter | Symbol [US] | Geotechnical Parameter | Symbol [US] |
|---|---|---|---|---|---|
| Submerged Unit Weight | $\gamma'$ [kN/m$^3$] | Rock Quality Designation | RQD [%] | Young Modulus | E [kPa] |
| Relative Density | DR [%] | Total core recovery | TCR [%] | Axial strain at 50% of deviator stress | $\varepsilon_{50}$ [%] |
| Peak Internal Friction Angle | $\phi'$ [deg] | Solid core recovery | SCR [%] | Overconsolidation Ratio | OCR [-] |
| Undrained Shear Strength | $S_u$ [kPa] | Residual Interface Friction Angle | $\delta_{res}$ [deg] | Consolidation Coefficient | $c_v$ [m$^2$/yr] |
| Rate of increase Undrained Shear Strength | $S_{u,k}$ [kPa/m] | Compression Index | $c_c$ [-] | Cone Resistance | $q_c$ [MPa] |
| Sensitivity | $S_t$ [-] | Swelling Index; | $c_s$ [-] | Sleeve Friction | $f_s$ [MPa] |
| Compressive Strength | UCS [Mpa] | Initial Void Ratio | $e_0$ [-] | Pore Pressure | u [MPa] |
| Point Load Index | $IS_{50}$ [Mpa] | Oedometric Modulus | $E_{oed}$ [kPa] | Carbonate concent | $CaCO_3$ [%] |

**Table 5.** Typical geotechnical parameters for Pipe-Soil interaction

| **Main geotechnical parameters for Pipe Soil Interaction** | | | |
|---|---|---|---|
| **Geotechnical Parameter** | **Symbol [US]** | **Geotechnical Parameter** | **Symbol [US]** |
| Submerged Unit Weight | $\gamma'$ [kN/m$^3$] | Rock Quality Designation | RQD [%] |
| Relative Density | DR [%] | Total core recovery | TCR [%] |
| Peak Internal Friction Angle | $\phi'$ [deg] | Solid core recovery | SCR [%] |
| Undrained Shear Strength | $S_u$ [kPa] | Residual Interface Friction Angle | $\delta_{res}$ [deg] |
| Rate of increase Undrained Shear Strength | $S_{u,k}$ [kPa/m] | Drained Interface Strength Parameters | a [kPa$^{(1-b)}$] |
| Sensitivity | $S_t$ [-] | Drained Interface Strength Parameters | b [-] |
| Compressive Strength | UCS [Mpa] | Normally-consolidated residual undrained interface strength ratio | $(s_{u,int,res}/\sigma'_v)_{NC}$ [-] |
| Point Load Index | $IS_{50}$ [Mpa] | Preloading factor/OCR index | m [-] |

## 4. GIS-based Tools

Dedicated widgets have been implemented allowing the user to work within the DDP. Some functionalities are: i) upload project data into the geodatabase according to different formats (shape, raster, table), ii) to visualize them, and iii) to run external models (here so-called GIS widgets) capable of performing engineering analysis. Specifically, the widgets exploit the "loose coupling architecture" on which the DDP is based: they are displayed in the GUI through a tool that has been called GIS-Model Toolbar add-in (Figure 6a, b).

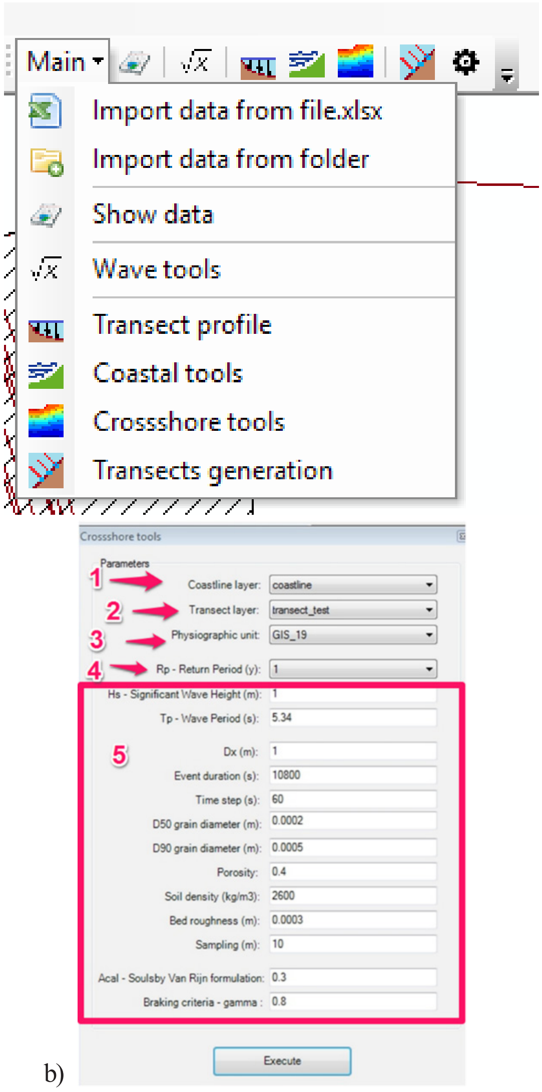


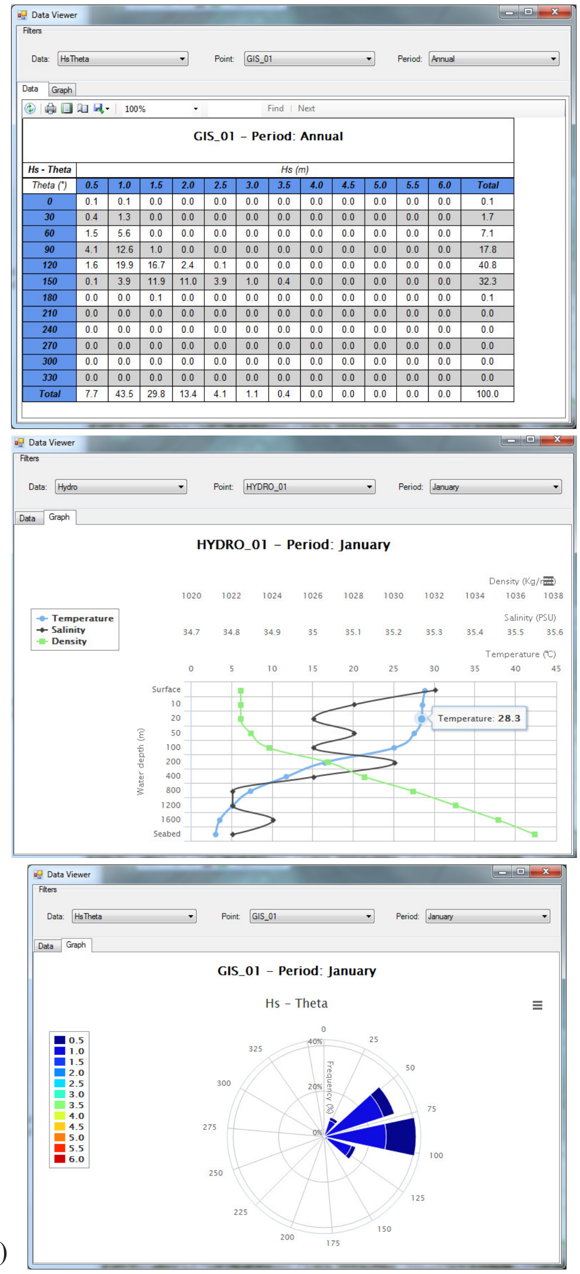

**Figure 6.** a) Application toolbar; b) Example of widget execution

The basic functions on the GIS-Model Toolbar add-in are:

• Import Data button (Figure 6a) which is the tool that allows to import new data in the geodatabase according to a standard-defined structure as described in the previous section.

• Show Data (Figure 7a, b and c) is a tool that allows to show data of different points on map. One example is given in Figure 9. Data can be presented as tabular or graphical formats. For example, data relating to wind (speed, direction, etc.) are structured into time intervals (e.g. months, seasons or all year), distribution, return periods, etc. (Figure 7a, b & c)

Basis of GIS widgets are Matlab scripts dedicated to engineering assessments. Initial tools included in the DDP first release refer to coastal analysis aiming to assess wave and current impact to shore and providing structural analysis. Coastal application widgets include the following models (see Figure 8):



GIS_01 – Period: Annual

| Hs - Theta | Hs (m) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Theta (°) | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 | Total |
| 0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 30 | 0.4 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 |
| 60 | 1.5 | 5.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7.1 |
| 90 | 4.1 | 12.6 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.8 |
| 120 | 1.6 | 19.9 | 16.7 | 2.4 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 40.8 |
| 150 | 0.1 | 3.9 | 11.9 | 11.0 | 3.9 | 1.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 32.3 |
| 180 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 210 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 240 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 270 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 300 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 330 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 7.7 | 43.5 | 29.8 | 13.4 | 4.1 | 1.1 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 100.0 |



**Figure 7.** Examples of Tabular (a) & Graphics representation (b & c)

• ***Wave Models***:

– *Wave Spectrum Model*, based on JONSWAP Wave Spectrum Model [4];

– *Breakwater: Run-Up Model*, to obtain wave run-up for impermeable and permeable slopes [15];

– *Nominal stable diameter for Rubble Mound Breakwater*, to define stable grain size subjected to wave and current loads [15];

– *Wave Kinematics Model*, to calculate Wavelength, Group Velocity, Wave Particle Velocity, Acceleration and Displacement

(Horizontal and Vertical), Subsurface Pressure [4];

- ***Coastal Evolution Model***, solving the Pelnard-Considere's equation [15];
- ***Cross-shore model***, solving the wave energy balance equation and implementing the Soulsby's formulations (1997) [15];

a)
b)
c)

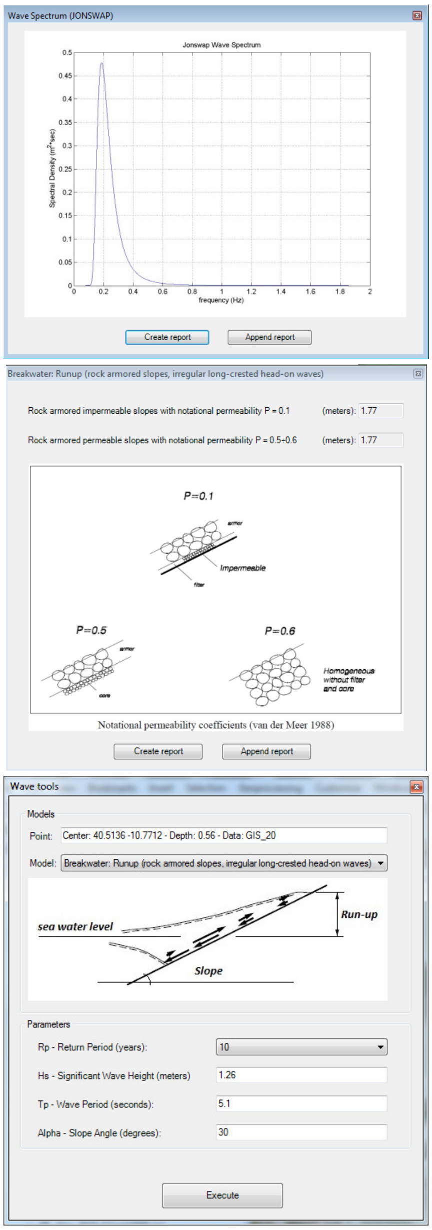



**Figure 8.** a) Wave Spectrum Model; b) Nominal stable diameter for Rubble Mound Breakwater; c) Wave run-up calculation

Calculations are performed as an ordered set of steps that deal with different processing, to generate a geographical feature that represents the results of the processing. The widget execution has been organized in i) pre-processing, ii) execution and iii) post-processing phase. Pre-processing allows operators to set-up all parameters required to execute the model (input data to be able to run the widget are retrieved directly from the geodatabase and refer to the offshore "point" closest to target location: in this way, the data of interest are immediately associated with the widgets), the execution bottom initiate the calculation back to Matlab codes embedded into the platform and the post-processing displays the results directly into the GIS enabling data reading and interpretation. A first application is presented. Data acquired during project feasibility phase have been processed to gain design basis data to be uploaded within the DDP. The geodatabase has been set to have a common repository during project execution whereas coastal models have been applied by operators to assess the short-term and long-term impact of new jetty construction. The Coastal Evolution Model graphically shows how a coastline will be modified by new groin construction. To activate the GIS widget, first step the GIS operator requires to select the coastline and transect layers that should be considered for coastline evolution (Figure 9).

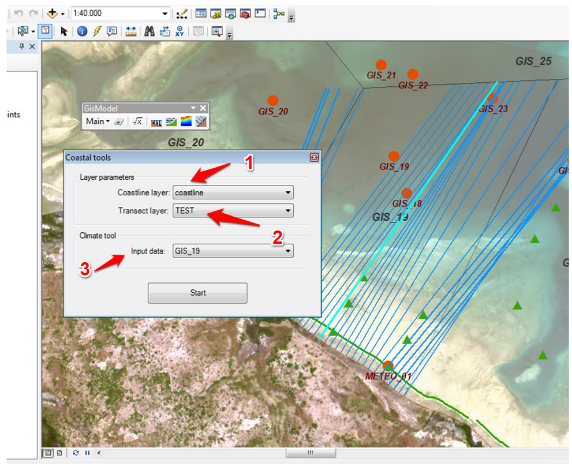
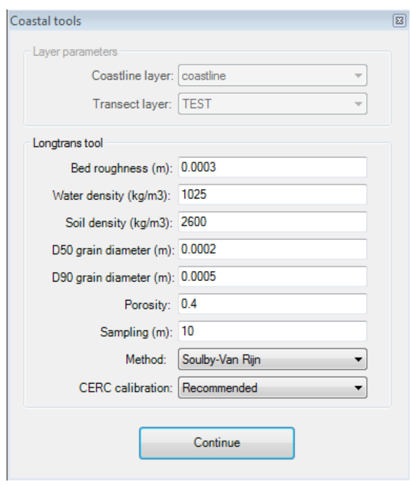



**Figure 9.** Coastal tool execution. Step 1: Definition of coastaline & transect layers

Next step requires the definition of key parameters for longshore transport modelling (Figure 10).

a)



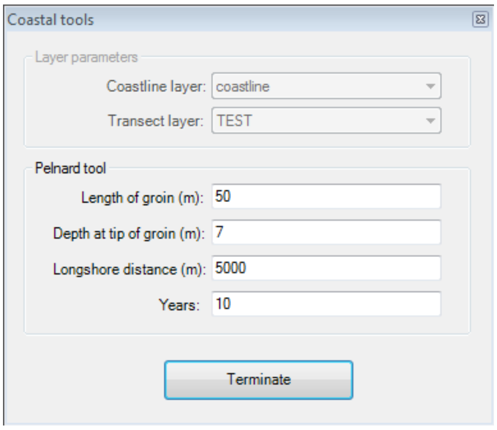
b) 


**Figure 10.** Coastal tool execution. Step 2: Definition of longshore transport parameters (a), Step 3. Definition of structure characteristics (b)

Findings of executions are displayed directly as geographical and georeferenced features with the related geometric properties and associated with all inherent information (Figure 11).

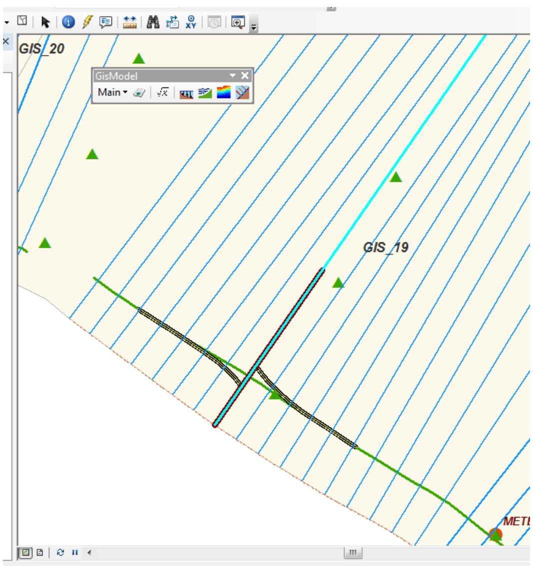



**Figure 11.** Cases studies a) offshore Mozambique

## 5. Conclusions

The proposed development has been established with the main aim to overcome the current bottlenecking and inefficiency on offshore project design phases between the project Owner and the engineering Contractor. The conventional approach which foreseen the delivery of hundreds of documents and scattered data should be substituted in favor of a unified delivery including all the required georeferenced data and studies. A unified technical dictionary for offshore design parameters is still missing in the industry community and the "common language" can be achieved only by the jointly contribution of industrial (owner and contractors) and certification companies. With the proposed development we achieved that data archived within the Digital Data Platform are integrated, stored, analyzed and easily managed during the entire data life cycle of the project. The main peculiarity of the system consists in the customization of a unified Data Model. The digital platform concept is an iterative and dynamic process which needs to be continually updated as new data become available. With reference to developed GIS widgets no limitations are foreseen thus giving an opportunity for further developments.

## Abbreviations & Symbols

Cs (m/s) - current speed
DDP - Digital Data Platform
GIS - Geographic Information System
H (m) - wave height
Hs (m) - significant wave height
Hmax (m) - maximum wave height
RP - Return period
Tmax (s) - maximum wave period
T (s) - wave period
Tz (s) significant wave period
Tp (s) peak period
Ws (m/s) - wind speed
Ws-3" (m/s) - wind speed gust 3"
Ws-1' (m/s) - wind speed gust 1'
Ws-10' (m/s) - wind speed average 10'
Ws-1h (m/s) - wind speed average1h
γ - wave spectrum Jonswap parameter

## Conflict of Interest

There is no conflict of interest.

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