PLATFORM - The OST Oil & Gas Platform Decommissioning Decision Support Tool:

User Guide

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Prepared for: CALIFORNIA Ocean Science Trust

Connecting Science to Ocean Management

Bringing clarity to difficult decisions
Introduction

The PLATFORM Oil & Gas Platform Decommissioning Decision Support Tool is a multi-attribute decision analysis framework to enable decision makers and stakeholders to choose among viable alternatives for decommissioning oil & gas platforms. The framework applies utility theory in giving the decision makers the ability to quantify the desirability of certain alternatives. It organizes the decision options into a hierarchy, identifying the main decision options at the top, with variations of each decision at lower levels. It allows the decision maker to make decisions about how to decommission platforms individually or as a group.

PLATFORM offers a range of outputs to evaluate results, including the total decommissioning cost by platform, avoided costs based on decommissioning alternative selected, and a multi-attribute score for each alternative. It takes as inputs the user-selected decommissioning option for each platform, platform-specific decisions about reef enhancements, shell mound removal and the use of explosives, as well as quantified inputs such as decommissioning costs and biomass estimates of marine species.

PLATFORM is highly interactive and supports rapid changes to key assumptions, to explore their effects on key outputs. It supports sensitivity analysis to compare the effects of alternative assumptions, including tornado diagrams to compare the effects of changes to key inputs.

This document

This document is a draft User Guide. It describes the input data and controls, the outputs it generates, and the assumptions underlying its calculations. Please contact Lumina if you have any questions, find problems, or have suggestions for the User Guide or the decision support tool. As a general rule, Lumina recommends that PLATFORM users go through the Analytica Tutorial before using the tool. While this is not mandatory, it will help the user navigate the tool with greater ease and confidence.

System requirements

You can run the model on any personal computer running Microsoft Windows since Windows 2000. You will also need the free Analytica 4.2 Player to run the model. If you do not have this, email support@lumina.com to obtain a license code and link from which to download the latest version of Analytica Player.

How to contact us

If you have any question or comments regarding this draft User Guide or model, please contact Surya Swamy at:

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  Email: support@lumina.com

Starting up the model

This section introduces the general structure and layout of the model. Start up the model by double-clicking on the Platform DA model file. You will see the main user interface window, looking like this:
The next few sections of this User Guide describe the key sections of this user interface page.

**Platform Decommissioning Options**

The top left section of the user interface lets you select a number of scenarios (projects) to consider, as well as which platforms to consider for selected scenarios. It also allows you to control key aspects of the decommissioning process, including for e.g. which removal alternative to consider for a given platform and whether or not to allow for shell mound removal.

<table>
<thead>
<tr>
<th>Platform Decommissioning Options</th>
<th>Multi Attribute Utility Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select scenarios to consider</td>
<td>Range weights by attribute</td>
</tr>
<tr>
<td>Define selected scenarios</td>
<td>Attribute ratings by level</td>
</tr>
<tr>
<td>Shell mound removal option by platform</td>
<td>Weights by attribute</td>
</tr>
<tr>
<td>Use explosives on jacket piles for selected platforms</td>
<td>Attribute rating by option</td>
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<tr>
<td>HLV required for project (tons)</td>
<td>Multi-attribute score</td>
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<tr>
<td>Decommissioning options by selected platforms</td>
<td>Equivalent cost weights by attribute</td>
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<tr>
<td></td>
<td>Cost weights by attribute</td>
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<tr>
<td></td>
<td>Equivalent cost by attribute</td>
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<tr>
<td></td>
<td>Total equivalent cost</td>
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<tr>
<td></td>
<td>Equivalent cost break-even</td>
</tr>
</tbody>
</table>

**Select scenarios to consider**
The **Select scenarios to consider** edit table lets you select a number of scenarios to consider. It is possible to select either single or multiple platforms for decommissioning within each scenario. If no platforms are to be considered for decommissioning in a particular scenario, then please uncheck (de-select) that scenario.

The **Define selected scenarios** edit table lets you choose a removal option for each platform, for each selected scenario:

- **1 Complete platform removal**: Selects complete removal of the platform
- **2 Partial platform removal**: Selects partial removal of the platform
- **No action**: Implies the platform is not being considered as part of the decommissioning project

### Other top-level decommissioning options

The **Reef enhancements for partial removal** table lets you make individual decisions about reef enhancements for platforms for which partial removal is selected. Note, if partial removal is not selected for any platform in the selected scenarios, then this screen will appear blank.
The *Shell mound removal option by platform* table lets you make individual decisions about shell mound removal for platforms for which complete removal is selected. Note, if complete removal is not selected for any platform in the selected scenarios, then this screen will appear blank.

The *Use explosives on jacket piles for selected platforms* table lets you make individual decisions about explosive severing for platforms for which complete removal is selected. Note, if complete removal is not selected for any platform in the selected scenarios, then this screen will appear blank.

**Intermediate Outputs**

By clicking on the button *HLV required for project* the model informs the user of the HLV size required to perform this work for each selected scenario.
The Decommissioning options by selected platform result displays the list of platforms that are selected as well as their decommissioning option by scenario, to verify the correct platform selections have been made by the user as noted in the above figure.

**Project Cost Analysis**

The bottom left section of the top-level UI presents the cost analysis results from PLATFORM. This section appears on the top-level UI since cost is a key part of the quantitative analysis that the tool enables.

<table>
<thead>
<tr>
<th>Project Cost Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of avoided costs for beneficial use (%)</td>
</tr>
<tr>
<td>Decommissioning and Avoided Costs ($)</td>
</tr>
<tr>
<td>Avoided costs for beneficial use ($)</td>
</tr>
<tr>
<td>Range percentage (as % of inputs) (%)</td>
</tr>
<tr>
<td>Cost tomato sensitivity ($)</td>
</tr>
</tbody>
</table>

**Percent of avoided costs for beneficial use**

The Percent of avoided costs for beneficial use menu controls what percent of avoided costs go toward the State, Oil Companies or other beneficial uses.

<table>
<thead>
<tr>
<th>HLV required for project (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Decommissioning options by selected platforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of avoided costs for beneficial use (%)</td>
</tr>
</tbody>
</table>
Decommissioning and Avoided Costs

The Decommissioning and avoided costs button displays the decommissioning costs for each platform selected. The second column lists the avoided costs, calculated as the cost difference between the complete removal and partial removal options for the platforms considered. These cost results are listed for each selected platform and scenario.

Avoided costs for beneficial use

As described above, the avoided costs for beneficial use computes the amount of avoided costs that go toward the State, Oil Companies or other beneficial uses.

Tornado Sensitivity Plot

The Range percentage (as % of inputs) allows the user to specify the percentages of the input values to be used as the high and low end for input to the tornado sensitivity analysis. The default is set to ±25% of the input values. It is possible to adjust this range individually for each sensitivity variable.

The Cost tornado sensitivity displays the sensitivity of the total decommissioning costs to changes in each input cost category. The fundamental analysis behind a tornado diagram consists of varying only one input variable at a time, keeping all other variables at their nominal values.
Multi-Attribute Utility Analysis

The top right section of the user interface screen lets you evaluate the Multi-Attribute Utility Analysis (MAUA) framework within PLATFORM.

<table>
<thead>
<tr>
<th>Multi Attribute Utility Analysis</th>
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</thead>
<tbody>
<tr>
<td><strong>Range weights by attribute</strong></td>
</tr>
<tr>
<td>Attribute ratings by level</td>
</tr>
<tr>
<td>Weights by attribute</td>
</tr>
<tr>
<td>Attribute rating by option</td>
</tr>
<tr>
<td>Multi-attribute score</td>
</tr>
<tr>
<td><strong>Equivalent cost weights by attribute</strong></td>
</tr>
<tr>
<td>Cost weights by attribute</td>
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<tr>
<td>Equivalent cost by attribute</td>
</tr>
<tr>
<td>Total equivalent cost</td>
</tr>
<tr>
<td>Equivalent cost breakeven</td>
</tr>
</tbody>
</table>

There are two main ways to use the MAUA to assess options to compare decisions on all the key attributes. First, you can simply view the selected option for each platform and its effect on each attribute, using the Attribute ratings by option result, as shown below:

This table shows for each platform, the level of each qualitative attribute on the qualitative scale, Worst to Best. It shows a quantified estimate of the impact for the last three attributes, for fish biomass in kilograms, for increased ocean access in square nautical miles, and for monetary costs in millions of dollars (2007).

To view the description of what these attribute values mean in practical terms, you will need to access the qualitative descriptions provided within each attribute’s module.

The second way is to use scaling and weighting to convert these attribute levels into an overall score for each platform decision option selected. PLATFORM offers two methods for assigning
weights to the attributes to combine them into an overall score for each platform. **Relative weights by attribute** and **Cost weight by attribute**.

**Relative weights by attribute:** The first edit table on the top-right of the user interface screen allows you to select the **attribute ratings by level**. For the qualitative attributes, we map the five levels into numerical ratings from 0 (Worst) to 100 (Best). Note, the default ratings are assigned linearly. You can adjust these mappings for the intermediate levels to suit your views (you must leave worst as 0 and Best as 100, which define the end points of the scale).

The table below illustrates the **relative weights by attribute** approach to assigning weights.
The drop-down menu in the second column titled ‘Weights’ allows you to assign relative weights for attributes, indicating the relative importance of each attribute range from worst to best [5-Best, 1- Worst]. Each weight specifies the relative importance of changing that attribute from its worst to best level. You should start by considering which attribute range you consider has the largest impact. Suppose, that you consider that the range for costs from 0 to $400 million is as or more significant than the effect of changing any other attribute from Best to Worst levels. You should start by setting the weight of that attribute to 5.

Then find the attribute that you consider the next most important. Suppose you decide that the impact on marine mammals is more (or as) important as any other attribute except cost. Ask yourself: What’s the relative importance to you changing the impact on marine mammals from Worst (Explosives are used during complete removal causing disturbance, disorientation and possible death) to Best (status quo) and changing costs from 0 to $400 million. If you consider that this change in impacts on marine mammals is a bit more than half as important to you as the change in costs, you might set the weight for the Marine mammals attribute to 3.

You then repeat this process with each attribute until you’ve set a weight for all eight attributes.

Next, click on the Result button for the Multi-attribute score, based on the weighted sum of scores on each attribute, averaged over all selected platforms for each scenario selected, as shown below.

In the above result, the utility scores for Scenario 2 and 1 are 48 and 40 respectively. To compare the effect of a different removal, select a different decommissioning option from the edit table on the top left hand side of the user interface.

The second method of weighting attributes uses equivalent costs. Click on Cost weight by attribute, which allows you to set the equivalent cost in dollars (or millions of dollars) of changing each attribute from its best to worst level.
By definition, the equivalent cost of the Cost attribute is $400 million, its current worst value. If you consider that the cost of going from the best air quality (status quo) to the worst air quality (Emissions due to a 4400 ton HLV being on-site for 113+ service days, required for complete removal) is $20 million, you should put 20 in the row for Air quality. There’s no reason the equivalent cost of an attribute cannot be greater than the $400 million for Cost.

The **Total equivalent cost** result compares the equivalent costs for all the selected platforms and scenarios. We draw the same conclusion from the below graphs as we did from the multi-attribute scores above.
Total equivalent Cost for Scenarios 2 and 1 are computed based on the weighted sum of equivalent costs for each attribute, averaged over all selected platforms for each scenario selected.

The Equivalent cost breakeven result computes the breakeven or switchover cost weight for a given attribute that would cause the ranking of the scenarios (based on estimated equivalent cost) to change. For e.g. If the equivalent cost for scenario 1 is higher than that of scenario 2 for Platform A, the switchover cost weight computed for a given attribute for Platform A is the modified cost weight which if used in place of the original cost weight of that attribute will result in the equivalent costs for scenarios 1 and 2 for Platform A being equal. Thus, the term switchover or breakeven cost weight. Note, if the breakeven cost weight for a given attribute is INF that only means both scenarios were ranked equally for that attribute and platform.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Platform A</th>
<th>Platform B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality</td>
<td>INF</td>
<td>INF</td>
</tr>
<tr>
<td>Water Quality</td>
<td>-38.95</td>
<td>-40.23</td>
</tr>
<tr>
<td>Marine Mammals</td>
<td>-48.95</td>
<td>-50.23</td>
</tr>
<tr>
<td>Birds</td>
<td>INF</td>
<td>INF</td>
</tr>
<tr>
<td>Strict Compliance</td>
<td>74.48</td>
<td>75.11</td>
</tr>
<tr>
<td>Marine Resource Impact - Benthic</td>
<td>-58.95</td>
<td>-60.23</td>
</tr>
<tr>
<td>Marine Resource Impact - Fish Biomass (kg)</td>
<td>57.9</td>
<td>57.87</td>
</tr>
<tr>
<td>Increased area of ocean access (Sq. na mi)</td>
<td>17.39K</td>
<td>17.64K</td>
</tr>
<tr>
<td>Monetary Costs ($M)</td>
<td>304.6</td>
<td>793.3</td>
</tr>
</tbody>
</table>

Model Details

The bottom left hand section of the user interface screen contains two modules to access the details of the model.

Double clicking on the first module, Multi Attribute Utility Analysis, will open up the underlying influence diagram for the MAUA framework. The second module, Model elements, contains all key modules of the model, as shown below:
Model elements

This module allows PLATFORM modelers and advanced users to explore the detail structure of the model by double-clicking on any of the blue module nodes. Note, most users will not need to do, but the structure is accessible for those that wish to explore it.
Platform Decommissioning Options

This module allows you to select decommissioning options for various platforms. The first input node, **select scenarios to consider**, is the same as that on the top-level user interface. Additionally, this module displays as an output the set of platforms selected for decommissioning. One can also look at which platforms have been selected for complete and partial removal. To access the details of the module, double-click on **Platform Decommissioning Details**.

Input Decommissioning Costs

This module contains the input decommissioning cost tables as part of the project cost analysis. The first set of input nodes relate to the input costs for complete removal.

The **Input Decommissioning Costs** edit table contains the platform complete removal costs, disaggregated by the cost categories, from Proserve Offshore (2010) in 2009$.  

The **Mob/demob costs by HLV** edit table contains the mobilization and demobilization costs associated with each HLV size. Depending on the size of the HLV needed for a given project, the relevant mob/demob cost from this table is shared equally amongst the selected platforms.

The **Permitting & Regulatory Compliance Fixed Cost** is a fixed $2.555M cost that will be shared equally among those platforms selected for decommissioning.

The **Decommissioning Cost Multiplier** table contains multipliers for each cost category to allow the model operator to adjust each cost category up or down to reflect newer data, adjust for inflation, etc.

The **Actual/Estimated Cost Distribution** input variable is a probability distribution of the actual/estimated costs based on data obtained from approximately 40 projects involving 120 structures.
The next set of input nodes in this module are inputs for computing the partial removal factors. Since cost data was only available for complete removal, these factors are used to scale the complete removal costs for partial removal. The HLV by Platform Removal Options edit table specifies the HLV size in tonnes for each decommissioning alternative for all platforms, as specified in the MMS report.

More details on the input decommissioning cost calculations can be found in the Input Cost Details module.
Air Quality

This module contains the details on how air quality impacts have been assessed in the model. There are two parts to the air quality module user interface. The first contains details on the Platform Harmony Emissions Estimates. Due to the lack of credible data, it was not possible to model air emissions for all platforms. However, we have explicitly quantified the associated emissions for Platform Harmony, considered to be a worst-case scenario for air quality.

For the purposes of the multi-attribute analysis, we have also modeled air quality impacts qualitatively. We assume the air emissions from the decommissioning operation are roughly correlated with the level of effort and the time on station of large equipment. Given this, we calculate the impact factor as the product of the number of service days the HLVs have to be on-site for both complete and partial removal and the size of the HLV (tons) selected for the project. We treat the highest and lowest impact factors as the upper and lower bounds on air emissions and divide them into five threshold levels based on the five-point scale.
To read the qualitative descriptions for each attribute level for air quality, double-click on the **Air Quality Attribute Level Descriptions** module. To access the underlying qualitative model, double-click on **Air Quality Impacts** module. Finally, to explore the details behind the Platform Harmony emissions estimates, double-click on **Platform Harmony Emissions Details**.

**Water Quality**

Water quality has been treated qualitatively in the model. The model considers two main impact categories for water quality - accidental spills & discharges and shell mound dredging impacts.

The model user can specify the **cut-off depth** beyond which platforms are considered deep. Depending on the platforms considered for decommissioning, the model uses the cut-off depth and **Platform depth data** to determine whether they are deep or shallow.

For platforms for which complete removal is selected, the model user can control whether or not to incorporate shell mound removals, just as in the top-level user interface.

To access the detailed descriptions for the water quality impacts double-click on **Water Quality Attribute Level Descriptions**. The **Water Quality Impacts** module contains the underlying influence diagram for this module.

**Marine Mammal and Birds**

Impact on marine mammals has been treated qualitatively in the MAUA. For platforms for which complete removal is selected, the model user can control whether or not to use explosive severing on jacket piles. This decision affects what the net impacts on marine mammals are during the decommissioning operation. The impacts on birds are also treated qualitatively in this model.
The Marine Mammals & Birds Attribute Level Descriptions module provides a summary of the attribute level descriptions for the short-term impacts on birds and mammals. The Marine Mammals and Birds Impacts module contains the underlying influence diagrams.

**Strict Compliance Impacts**

Strict Compliance suggests that oil companies should be required to fulfill the terms of their leases which require complete removal of platforms when production ends. This judgment is strengthened by the long-term memories of the 1969 Santa Barbara oil spill, as a result of which many local stakeholders are disinclined to enable oil companies to achieve cost savings through a partial removal option. This attribute has been treated qualitatively in the model. Click on the Strict Compliance Attribute Level Descriptions to learn more about the attribute level descriptions.

**Marine Resource Impacts**

Marine Resource Impacts include benthic impacts, which have been treated qualitatively, and biological impacts, which have been explicitly quantified in this model.

The first section of the Marine Resource Impacts user interface contains the key inputs and outputs relevant to the biological impacts model.

The **Input Biomass estimates** edit table contains the input biomass estimates and parameters used to model the biological impacts.

The **Biomass stock** table computes the current fish biomass stock, in kilograms.

The **Biomass yield for platforms selected** result summarizes the previous result by summing over all the biomass species for the selected platforms over a four-year time horizon.

The **Total Yield over time horizon** computes the total biological yield for all platforms and scenario selected.

The **Substitute Platforms** table lists the substitute platforms used whenever there is a data gap for a platform selected for decommissioning.
The next section of the user interface pertains to the benthic impacts, which are modeled qualitatively. The model considers three main impact categories for benthic impacts - anchoring impacts, shell mound dredging impacts and jacket removal impacts. To access the detailed attribute level descriptions double-click on the **Benthic Impacts Attribute Level Descriptions**. The **Biological Impacts** and **Benthic Impacts** modules contain detailed models underneath them, which can also be accessed by double-clicking on them.

**Ocean Access Impacts**

This module computes the increased area of ocean access (square nautical miles) due to platform decommissioning. PLATFORM allows the user to select the **use-type for selected platforms**, which determines whether a platform is considered to be “take” or “no-take”. The user can also specify the **use distance limit**, which is the distance from the port beyond which the likelihood of user groups choosing to access this platform is low.
The Ocean Access Impacts Module Details module contains the underlying model details, which can be accessed by double-clicking.
Programmatic Costs

At this point, indirect costs are not being modeled explicitly in PLATFORM due to data gaps. This is an area for future consideration should more credible data become available.

Direct Costs
This module contains the details of the **Direct Costs** which are part of the project cost analysis. It also includes a sub-module for the Tornado Sensitivity Analysis.

**Broader Socioeconomic Impacts**

![Diagram - Broader Socioeconomic Impacts](image)

The model currently does not explicitly quantify or treat qualitatively the socioeconomic impacts. This is an area for future consideration.
Multi-Attribute Utility Analysis

Viewing uncertainty in the PLATFORM Model

You may display the uncertainty about key results using Monte Carlo simulation, by requesting an uncertain view to display, including:

- Mean over the distributions: This will usually be similar but not the same as the Mid value.
- Probability bands
- Cumulative probability distribution
- Probability density distribution

Uncertainty in decommissioning costs

Within PLATFORM, the uncertainty about the input decommissioning costs are characterized by a probability distribution (lognormal) of the ratio of actual to estimated decommissioning costs based on data estimated on approximately 40 projects involving 120 structures. This uncertainty is then propagated downstream so one can view the uncertainty about the output cost results. In the top-level user interface, when viewing the “decommissioning and avoided
costs” result node, it is possible to switch to an uncertain view by clicking on the mid drop-down menu on the top left hand side of the result node, as shown below.

One possible uncertainty view is the cumulative probability distribution (CDF), which one might look at graphically. To switch between the tabulated view and graphical view, click on the bar graph icon to the top left, as illustrated below.

The CDF plots the possible values of the uncertain quantity, in this case the decommissioning costs, along the horizontal (X) axis. The vertical (Y) axis of the graph at each value of X show the probability that the quantity is less than or equal to that X value. For e.g. the graph below suggests that, for Scenario 2 as is defined, there is a 70% probability that the decommissioning cost of Platform C is less than or equal to $16M.
Uncertainty in biological production impacts

The biological production module within PLATFORM calculates the current standing (biomass) stock of each species per platform. It also calculates the future production and standing stocks based on selected decommissioning options. The uncertainty about the standing stock is characterized by a
lognormal distribution given some estimate of the mean fish biomass (grams) and standard error. This uncertainty is then propagated downstream so we can look at the resulting uncertainty in the outputs, such as the “Biomass yield for platforms selected.” As described above, click on the mid drop-down menu to select the appropriate uncertainty view. One option is to select the probability bands view or “confidence bands”, which shows the percentiles from its distribution - for example, 5%, 25%, 50%, 75%, and 95% percentiles. In the graph below, these appear as bands around the median (50%) line.