ESTIMATE THE COST OF OFFSHORE FIXED JACKETS USING NODOC

July 2014
Without having Cost Estimation Model

you are putting your Project on a Big RISK
Drive your project with an appropriate Cost Estimation System to mitigate Risks.
Plug your project to Our NoDoC Database and Cost Models and Get Instant Estimates
NoDoC as One Source for all Cost Estimation Techniques

Only in Five Steps

Step 1- Select Class

Step 2- Select Estimation Domain

Step 3- Select Technique & Input Project Parameters

Step 4- Connect NoDoC Get Online Costs

Step 5- Add to BOQ Items

You
NoDoC Cost Estimation Content

Resource Database
Assemblies For Components
Cost Models For Complexes
Market Research Results
Feature Perspective

- **PAST**
  - How Did I Get Here?
  - Centralized Local Database

- **PRESENT**
  - Where Am I Now?
  - Online Database + Cost Models

- **FUTURE**
  - Where Do I Go From Here?
  - Real-time Estimates + Intelligent Flow diagrams

Flow diagrams:
Sustainability Success

SPEND LESS

SAVE MORE

SUSTAINABLE FUTURE
Think KISS

Keep It Short & Simple
Offshore Jacket Cost Model

In this session we will discuss about

The main factors influencing the Cost Estimation of Fixed Jackets

The most important factors affecting the size of the Platform

Jacket Weight as a Function of sea water depth

NoDoC Cost Model For Offshore Fixed Jackets

Side Effects of high jacket Weight

Other Factors on Offshore Cost Estimations
Question: which Parameters should be considered in Cost Estimation of Offshore Projects?
The main factors influencing the Cost Estimation of Fixed Jackets are:

- The **Utility** Requirements,
- Return Period
- The sea water **Depth,**
- The lateral and vertical **Dimensions** resulting from the environmental factors
- The lateral and vertical **Dimensions** resulting from fluid-structure-soil system (restoring forces, soil resistance)
- The fabrication techniques,
- The Transportation, Towing and Installation Methods
- The aspects of maintenance and reliability
Size & Weight Of Deck

- Environmental Factors such as wave, wind, forces, earthquake,...
- Fluid-structure-soil system
- The Fabrication Techniques
- Transportation, Towing and Installation Methods
- Sea Water Depth
- Aspects of maintenance and reliability
Cost of Jacket = \( F(\text{Size & Weight Of Deck} + \text{Sea Water Depth} + \text{Environmental Factors such as wave, wind, forces, earthquake,}... + \text{Fluid-structure-soil system} + \text{The Fabrication Techniques} + \text{Transportation, Towing and Installation Methods} + \text{aspects of maintenance and reliability} + \text{Risk Factors and Contingencies}) \)
The **Utility Requirement** is reflected in the size of the superstructure needed to support the necessary equipment for drilling and production.

Therefore, the most important factor affecting the size of the deck structure is the number of and the productivity of the wells.
Major Types of Offshore Structures based on Utility Requirements
Major Types of Offshore Structures based on Sea Water Depth

- Jacket
- Jack-up
- Semi-submersible
- Drilling ship
- TLP
The structural weight and thereby the capital cost of a fixed steel platform increase exponentially with the water depth. In the following figure, the weight of jackets installed in different offshore regions is plotted as a function of the water depth.
Jacket Weight as a Function of sea water depth

- Mediterranean Sea
- Persian Gulf
- Gulf of Mexico
- North Sea

Weight (10^-4 Kg) vs. Sea Water Depth
Technical and Economical limits can arise from the installation techniques, especially in connection with platform leveling, underwater construction joints, guidance and alignment during installation and difficulties in driving large diameter, long piles in greater water depths.
Main Important Parameters for the COST Analysis of Marine Structures Are:

**Wind:**
- Mean Wind Speed
- Mean Wind Direction
- Wind Power Spectral Density Function
- Variation of Wind Speed above the Sea level

**Wave:**
- Significant Wave Height
- Mean Wave Period
- Wave Amplitude Spectral Density Function
- Mean Wave Direction
- Wave Directional Spreading Function
- Identification of effect of currents, seabed topography and other factors likely to modify the above parameters

**Current:**
- Surface Current Speed
- Surface Current Direction
- Current Profile (speed and direction)
- Tidal Current Speed and Direction
- Identification of low frequency components in current velocities

**Tide:**
- Astronomical Tide
- Storm Surge

**Ice:**
- The extent of snow and ice accumulation

**Marine Growth:**
- The extent to which marine growth may form on the submerged sections of the marine vessels
Sample Environmental Data for Designed water depth of 35m

<table>
<thead>
<tr>
<th>Return Period (Years)</th>
<th>60 Yr</th>
<th>1 Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Extreme</td>
<td>Operation</td>
</tr>
<tr>
<td>Design Water Depth (35m)</td>
<td>114.80</td>
<td>114.80</td>
</tr>
<tr>
<td>(LAT)</td>
<td>(LAT)</td>
<td>(LAT)</td>
</tr>
<tr>
<td>Waves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height Crest to Trough, ft</td>
<td>21.42</td>
<td>14.20</td>
</tr>
<tr>
<td>Period, sec.</td>
<td>8.20</td>
<td>6.60</td>
</tr>
<tr>
<td>Wave Kinematic Factor</td>
<td>0.90</td>
<td>1.00</td>
</tr>
<tr>
<td>Apparent Wave Period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest Astronomical Tide (HAT), ft</td>
<td>5.35</td>
<td>5.35</td>
</tr>
<tr>
<td>Mean High Water (MHW), ft</td>
<td>4.53</td>
<td>4.53</td>
</tr>
<tr>
<td>Mean Water Level (MWL, MSL), ft</td>
<td>3.22</td>
<td>3.22</td>
</tr>
<tr>
<td>Mean Low Water (MLW), ft</td>
<td>1.58</td>
<td>1.58</td>
</tr>
<tr>
<td>Lowest Astronomical Tide (LAT), ft</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Storm Surge, ft</td>
<td>1.74</td>
<td>0.43</td>
</tr>
<tr>
<td>Total Tide, ft</td>
<td>6.27</td>
<td>4.96</td>
</tr>
<tr>
<td>Current Velocity, ft/sec. (Inc. Current Factor)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Depth below LAT, ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface</td>
<td>4.76</td>
<td>2.95</td>
</tr>
<tr>
<td>Mid-Span</td>
<td>4.26</td>
<td>2.62</td>
</tr>
<tr>
<td>Near bottom (1m above seabed)</td>
<td>3.77 / 111.5</td>
<td>2.30 / 111.5</td>
</tr>
<tr>
<td>Seabed</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Current Blockage Factor</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Current/Wave Coincidence, Of Current Factor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marine Growth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marine Growth Specific Gravity</td>
<td>(+) 4.53 ft</td>
<td>2.0</td>
</tr>
<tr>
<td>Marine Growth Thickness (in) Profile</td>
<td>(+) 24.60 ft</td>
<td>2.0</td>
</tr>
<tr>
<td>(Level from LAT, EL=0.00)</td>
<td>(Interpolate linearly between elevations)</td>
<td></td>
</tr>
<tr>
<td>Wind Speeds</td>
<td></td>
<td></td>
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<tr>
<td>3 sec. Gust, mph</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>One Minute Sustained, f/s</td>
<td>67.9</td>
<td>44.0</td>
</tr>
<tr>
<td>One Hour Sustained, f/s</td>
<td>56.8</td>
<td>36.4</td>
</tr>
<tr>
<td>Drag and Mass Coefficients for Tubular Members</td>
<td></td>
<td></td>
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<tr>
<td>Initial Coefficient, Cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Above MHW</td>
<td>1.60</td>
<td>1.20</td>
</tr>
<tr>
<td>- Below MHW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drag Coefficient, Cd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Above MHW</td>
<td>0.65</td>
<td>1.05</td>
</tr>
<tr>
<td>- Below MHW</td>
<td></td>
<td></td>
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</tbody>
</table>
Fabrication, Load out, Towing, Installation

Types of Fixed Offshore Jackets

a b c d e
Fixed offshore Jacket Types based on Sea Water Depth
Develop BOQ Items

Start

Select The Cost Estimation Domain

Input Available Parameters

Sea Water Depth
Utility Requirements
Environmental Factors

Foundation Forces

Select Pile Design Method:
* API RP 2A WSD 21ST ES
* DNV RP E303 (2005)

Estimate Jacket and accessories Weight

is Jacket Weight Available?

NO

Data aren't Enough

Change The Cost Estimation Class

YES

Determine Location, Allowances, Risk and Contingencies Factors

Costing

Assemblies/ Cost Models

Local/Online Database

Markup

Reprting

Need Modifications?

NO

End

YES
Offshore Platform Project Phases Weight Factors

- Design, Engineering for Onshore and Offshore works
- Procurement
- Onshore Fabrication
- Load out and Sea fastening
- Offshore Installation including vessels and subcontracts

Design, Engineering For Onshore and Offshore works
NoDoC Database for Offshore Oil & Gas Development

- Engineering Man-hour Rates
- Fabrication Man-hour Rates
- Equipment Lease Rates
- Structural Material Rates
- Consumable Rates

- Location Factors
- Allowances Factors
- Safety Factors
- Regional Risk Factors
- Material Suppliers and Rankings

- Offshore Barges
- Service and Utility Boats
- Anchor Handling Tugs
- Offshore Subcontractors Rates
- Offshore Vessel Suppliers Data

- Offshore Market Data
- Offshore Economical Indicators
- Offshore Regional Geology Data
- Offshore Petro physics Data
- Offshore Geochemistry Data

- Offshore Drilling Data
- Offshore Enhanced Recovery
- Offshore Marine Data
- Offshore Rig Data
- Offshore Services Data
NoDoC Cost Estimation Techniques for making Cost Models of Offshore projects

- Parametric Models
- Analogy Models
- Step Counting Methods
- Resource Based Models
- Real Time Data Models
Example Parametric Method:

\[ C = 0.45E + 0.1C_i + 0.19C_n + 0.26D_i \]

where

- \( C \) = Construction Cost
- \( C_i \) = civil engineering Cost
- \( C_n \) = site engineering Cost
- \( D_i \) = design Cost
Caution

- All cost do not necessarily relate the true make-up of costs for any particular piece of equipment or plant; nor the effect of supply and demand on prices.
Analogy Method

- An approximate estimate of the capital cost of a project can be obtained from a knowledge of the cost of earlier projects using the same manufacturing process.
Example Analogy Method

- $C_2 = \text{capital cost of the project with capacity } S_2$,
- $C_1 = \text{capital cost of the project with capacity } S_1$.
- The value of the index $n$ is traditionally taken as 0.6; the well-known six-tenths rule.

\[ C_2 = C_1 \left( \frac{S_1}{S_2} \right)^n \]
Caution

- If for any location, indexes and historical exchange rates are available, it is probably better to convert costs to the local currency using the rate of exchange ruling at the date of the costs and update using the local index:
2- Step counting methods

- Step counting estimating methods provide a way of making a quick, *order of magnitude*, estimate of the capital cost of a proposed project.

- The technique is based on the premise that the capital cost is determined by a number of significant processing steps in the overall process. Factors are usually included to allow for the capacity, and complexity of the process: material of construction, yield, operating pressure and temperature.
THE FACTORIAL METHOD OF COST ESTIMATION

1- Lang factors
2- Detailed factorial estimates
• Capital cost estimates are often based on an estimate of the cost of the major equipment items required for the process.

• The other costs being estimated as factors of the equipment cost.
1. Lang factors

- The fixed capital cost of the project is given as a function of the total purchase equipment cost by the equation

$$ C_f = f_L C_e $$

- $$ C_e $$ is the total delivered cost of all the major equipment items: storage tanks, reaction vessels, columns, heat exchangers, etc.,

- $$ f_L = 3.1 $$ for predominantly solids processing plant
- $$ f_L = 4.7 $$ for predominantly fluids processing plant
- $$ f_L = 3.6 $$ for a mixed fluids-solids processing plant
2- Detailed factorial estimates

- To make a more accurate estimate, the cost factors that are compounded into the “Lang factor” are considered individually.
Direct-cost items

1. Equipment erection, including foundations and minor structural work.
2. Piping, including insulation and painting.
3. Electrical, power and lighting.
4. Instruments, local and control room.
5. Process buildings and structures.
6. Ancillary buildings, offices, laboratory buildings, workshops.
7. Storages, raw materials and finished product.
8. Utilities (Services), provision of plant for steam, water, air, firefighting services (if not costed separately).
The contribution of each of these items to the total capital cost is calculated by multiplying the total purchased equipment by an appropriate factor.
The accuracy and reliability of an estimate can be improved by dividing the process into sub-units and using factors that depend on the function of the sub-units.
Indirect costs

1. Design and engineering costs, which cover the cost of design and the cost of “engineering” the plant: purchasing, procurement and construction supervision. Typically 20 per cent to 30 per cent of the direct capital costs.

2. Contractor’s fees, if a contractor is employed his fees (profit) would be added to the total capital cost and would range from 5 per cent to 10 per cent of the direct costs.

3. Contingency allowance, this is an allowance built into the capital cost estimate to cover for unforeseen circumstances (labor disputes, design errors, adverse weather). Typically 5 per cent to 10 per cent of the direct costs.
The capital cost required for the provision of utilities and other plant services will depend on whether a new (green field) site is being developed, or if the plant is to be built on an existing site and will make use of some of the existing facilities.
And The innovation Method:
Real time Cost Estimation technique that is a combination of parametric functions with real time Resources data :

\[ TC = a \times E + b \times P + c \times C + d \times I + \ldots \]

Where

E , P , C, I are indicators for Engineering, Procurement, Construction and Installation respectively

a , b , c , d are coefficients that are as a function of the project type and could be exponential, power, or multi power functions

And E,P,C,I are as a function of parametric and real time data!
Thank you

Contact us: info@dioneoil.com