DSM System
Operational Expense Variables

Deep Sea Mining Payment Regime
Workshop #2: Developing a Financial Modeling Framework

Thursday, Dec 1 • Friday, Dec 2

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Basis of concept

- Annual production: ... Mtpa
- Mining vessel(s), Collector(s), Bulk carrier(s), Crew vessel(s), Offshore supply vessel(s)
- Nodules delivered to a port ... & Crew change at ...
- One site office in...
- Production start?
Operational aspects
- Environmental conditions [Operational, Storms, Hurricanes]
- Mining path and system dynamics
- Transshipment [Mooring & Off-loading]
- Crewing & Logistics
- Spares & Fuel Supply

Technical aspects
- Mining vessel
- Slurry dewatering, Hopper loading & Self unloading systems
- Mining vehicle and Mining vehicle launch & recovery system
- Riser design & Riser handling system
- Pump modules & Slurry transport
- Umbilical handling system & Waste water return
### DSM Project | Operational Expenses

#### Included for all owned vessels
- Maintenance & repair
- Wear and tear
- Crewing (salary, travel, food, leave, allowance, tax, etc.)
- Insurance (H&M, IV, War, P&I)
- Consumables & communication
- Fuel & Lubricants
- Mining trials or ramp up
- Environmental monitoring

#### Included for all chartered vessels
- Charter rate
- Fuel & lubricants

#### Included for site office
- Personnel (all included)
- General expenses (communication, transport, housing, office rent, etc.)
- Transport for crew to crew vessel

#### Others
- Inflation or escalation
- Financing cost for operation
- Currency risks
- Loss of hire insurance
- Project Insurance (if applicable)
- Bonds
- Taxes, Royalties, port fees or import duties
- Financial Payment for ISA
- Mobilization cost
- Pre and post survey
- Vessel upgrades
- Medevac (other then by crew boat)
- Helicopter services
- Production guarantees
Principles of availability calculations

- Independent & independent delays: iterative calculation
- Failures rates for each major component defined
- Not all failures cause stop of production
- Regular system recovery (planned maintenance) included
### Assumptions

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>recovery mining system</td>
<td>Hours</td>
</tr>
<tr>
<td>deployment mining system</td>
<td>Hours</td>
</tr>
<tr>
<td>ramp down delay</td>
<td>Hours</td>
</tr>
<tr>
<td>ramp up delay</td>
<td>Hours</td>
</tr>
<tr>
<td>ramp production</td>
<td>%</td>
</tr>
<tr>
<td>dewatering losses mining vessel</td>
<td>%</td>
</tr>
<tr>
<td>dewatering losses bulk carrier</td>
<td>%</td>
</tr>
<tr>
<td>abundance</td>
<td>kg/m²</td>
</tr>
<tr>
<td>mining width</td>
<td>M</td>
</tr>
<tr>
<td>mining speed</td>
<td>m/s</td>
</tr>
<tr>
<td>rejection losses</td>
<td>%</td>
</tr>
<tr>
<td>mining path surface efficiency</td>
<td>%</td>
</tr>
<tr>
<td>mining path turning efficiency</td>
<td>%</td>
</tr>
<tr>
<td>horizontal logistics efficiency</td>
<td>%</td>
</tr>
</tbody>
</table>

### Result

<table>
<thead>
<tr>
<th>Result</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total hours /year</td>
<td>hours</td>
</tr>
<tr>
<td>Total 100% operational time</td>
<td>hours</td>
</tr>
<tr>
<td>Total non-100% operational time &amp; delay</td>
<td>hours</td>
</tr>
<tr>
<td>Total virtual production time</td>
<td>hours</td>
</tr>
<tr>
<td>Production during 100% operational time</td>
<td>t/h</td>
</tr>
<tr>
<td>Production non 100% operational time &amp; delay</td>
<td>t/h</td>
</tr>
<tr>
<td>Total amount of unplanned recoveries</td>
<td>-</td>
</tr>
<tr>
<td>Total amount of planned recoveries</td>
<td>-</td>
</tr>
<tr>
<td>Total time riser building</td>
<td>hours</td>
</tr>
<tr>
<td>Total time transshipping</td>
<td>hours</td>
</tr>
<tr>
<td>Total annual riser production (wet)</td>
<td>MT</td>
</tr>
<tr>
<td>Total annual mining vessel production (wet)</td>
<td>MT</td>
</tr>
<tr>
<td>Total annual bulk carrier production (wet)</td>
<td>MT</td>
</tr>
</tbody>
</table>
Regulation &
Technological Change
"Competitiveness, as measured by market share, is based on costs of production, including the costs as regulatory requirements and royalties." (Tilton, 1992)
Cumulative Result vs Investment

- Cumulative benefit - cost
- Excluding Cost of Capital [Equity]

Project year

Cumulative cashflow

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Annual Profit & Loss

- Annual benefit - cost
- Excluding Cost of Capital
  [Equity]
Discounted by 2%
### WACC calculation

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Percentage</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Stage Equity</td>
<td>400</td>
<td>40%</td>
<td>400 ( \times ) 40%</td>
</tr>
<tr>
<td>Pre-Feasibility / Feasibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late Stage Equity</td>
<td>1,200</td>
<td>20%</td>
<td>1,200 ( \times ) 20%</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt</td>
<td>2,800</td>
<td>8%</td>
<td>2,800 ( \times ) 5%</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Investment</td>
<td>4,400</td>
<td></td>
<td>4,400*13%</td>
</tr>
</tbody>
</table>

D/E Ratio during construction: 70/30
Technological Change | Discounting over decennia

Discounted by WACC

Weighted Average Cost of capital (WACC):
- Technological risk
- Institutional risk
- Environmental risk
- Regulatory risk

Discounted cashflow

Project year

Discounted cashflow

NPV
Discounted cashflow

**Discounted by IRR**

- **Project year**
- **Discounted cashflow**

**Internal Rate of Return (IRR)**
- Maximum return whereby NPV = 0
- Needs to be compared to Hurdle Rate – E.g. Other investments

Technological Change | Discounting over decennia
Increasing Environmental, Technical, Economic, Legal & Social considerations

**RESOURCE**

Inferred Resource
- Based on historical, public, private data

Indicated Resource
- Based on exploration cruises to the CCZ

Measured Resource
- Based on exploration cruises to the CCZ

**RESERVE**

Probable Reserve
- Based on desktop studies, ISA regulation [Incl. EIA]

Proven Reserve
- Based on feasibility studies, ISA regulation [Incl. EIA]
Questions?

Thank you