COST ENGINEERING OF PIPELINES FOR FLUID TRANSPORT

by

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PIPELINES

- Pipelines are made up of sections of line pipes welded together.
- They are generally the most economic way to transport large quantities of fluid and other products over land.
- Compared to other means of transportation, they have lower cost per unit and higher capacity.

TYPES OF PIPELINE - BY FUNCTION

- Flow Lines
- Gathering Lines
- Transmission Lines
- Distribution Lines
- Service Lines
Nigerian pipelines accounts for 0.47% of the world’s pipeline network
ALTERNATIVES TO PIPELINES

- Road Transportation
- Rail Transportation
- Sea Transportation
- Air transportation
FLUID PRODUCTS YOU CAN TRANSPORT USING PIPELINE.

- Crude Oil
- Natural gas
- Refined Hydrocarbon Products
- Bio fuels
- Hydrogen
- Water
- Beverages etc.
Cost engineering is concerned with the application of scientific principles and techniques to problems of cost estimating, cost control, business planning and management science.
Cost estimating is a well-formulated prediction of the probable cost of a project, operation or any activity.

For a project, cost estimates are improved and updated as the project moves from feasibility studies to detailed engineering/design.

The key determinates of pipeline construction costs are:
- Pipeline Diameter
- Pipeline length
- Operating pressure
CAPEX

Other factors are:
- Terrain
- Climate
- Local Labour Cost
- Safety/Environmental Regulations
- Population Density and Right of Way (ROW)
CAPEX-MAJOR COST COMPONENTS

ONSHORE CONSTRUCTION

- Linepipe
- Freight (Ocean and Overland)
- Miscellaneous materials (Valves, fittings, etc)
- Cathodic Protection (CP)
- Coatings (FBE, 3-layer PE)
- Compressor/Pump Stations
- Metering Station
- Communication Infrastructure/Equipment
- Insurance
- Construction (Survey & inspection, ROW, hauling & stringing, laying, special crossings, etc)
- Project management
- Engineering/Design
- Expected completion time
CAPEX-MAJOR COST COMPONENTS
OFFSHORE CONSTRUCTION

- Linepipe
- Freight (Ocean and overland)
- Miscellaneous (buckle arrestors, tie-ins, anodes, valves etc)
- Insurance
- Construction (survey, trenching, installation, shore crossings etc)
- Coating (concrete, corrosion)
- Project management
- Cathodic Protection
- Engineering/Design
- Expected completion time
OPERATIONAL EXPENDITURE (OPEX) / MAINTENANCE COST

OPEX

- Fuel cost (for Compressor/Pump and Metering Stations) and other consumables
- Other Utility cost
- Operating staff cost
- Land lease cost, if applicable
- Insurance and taxes

MAINTENANCE COST

- Inspection cost
- Labour cost
- Equipment/Material replacement and repair cost
Cost control involves the use of special techniques in controlling cost associated with a project, operation or any activity.

Below are some cost controlling techniques during project construction phase:

- Planning and budgeting
  - As a baseline guild.
- Keeping track of cost
  - To monitor project cash flow
- Effective time management
  - To keep project within budget
- Project change control
  - To manage anticipated or possible changes to scope
- Use of end value
  - For reliable evaluation of work progress
Below are some cost controlling measures during operations and maintenance phase:

- Use of energy efficient equipment
- Efficient use of utilities and consumables
- Preventive maintenance approach to facility/asset management
Two NIPP projects with different cost factors would be considered as a case study.

This case study considered only the CAPEX of the pipeline project.

Cost factors considered:
- Diameter
- Length
- Onshore/offshore
- ROW
## NIPP CASE STUDY

<table>
<thead>
<tr>
<th>COST FACTOR</th>
<th>PROJECT</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Ihovbor</td>
</tr>
<tr>
<td></td>
<td>Calabar</td>
</tr>
<tr>
<td>Diameter (inches)</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Length (KM)</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>107</td>
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<tr>
<td>Operating pressure (Bar)</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>35</td>
</tr>
<tr>
<td>Terrain</td>
<td></td>
</tr>
<tr>
<td>Onshore/Offshore</td>
<td>Onshore</td>
</tr>
<tr>
<td></td>
<td>Onshore/offshore</td>
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<tr>
<td>Climate</td>
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<td>Local labour cost</td>
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<td>Safety/Environmental laws</td>
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<tr>
<td>Population density</td>
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<td></td>
<td>Low</td>
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<td>ROW Issue</td>
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<td>Ok</td>
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<tr>
<td>Total Project Cost</td>
<td>$20.4 million</td>
</tr>
<tr>
<td></td>
<td>$151.8 million</td>
</tr>
</tbody>
</table>
NIPP CASE STUDY

Pipeline Project Cost

- Engineering: $0.65
- Procurement: $12.3
- Construction: $63.8

Cost in $(million)
The CAPEX of Calabar project is higher than the Ihovbor project by 86.6%.

Cost factors – Diameter, Length, Onshore/Offshore and ROW;

- Pipeline diameter of Calabar project is 24 inch while Ihovbor project is 18 Inch.
- The length of Calabar project is greater by 74.4 %.
- Calabar project has onshore and offshore elements.
- Though ROW acquisition cost for Ihovbor was more because of higher population density, other factors (diameter, length & onshore/offshore) increased the total cost of Calabar project.
SUMMARY

- The total cost of fluid transportation using a pipeline is the sum of CAPEX and OPEX/Maintenance cost, and this is calculated considering the entire life cycle of the pipeline.
- The CAPEX of a pipeline project is a function of key cost factors.
- The impact of key cost factors are less significant in OPEX/Maintenance.
- Cost estimations are important for economic and investment decision.