Benchmarking Oil and Gas Pipeline Operations

Abstract

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$M^3$ — Measure. Manage. Maximize.
Solomon Associates began Fuels Refinery Performance Analyses twenty-five years ago and is the acknowledged leader in that field. The company now undertakes similar performance improvement studies for petrochemical, power generation, pipeline and terminal facilities worldwide. This presentation will outline how the principles of comparative performance analysis have been applied to develop a divisor, termed ‘EPC’, that enables operating cost comparisons between pipeline systems of varying scales and complexities. Examples of study outcomes will be presented. The study population comprises 110 oil and natural gas pipelines of which 75 are located in North America and 20 in Europe.

**Defining the Envelope**
As the operating cost structures of pipelines and tank farms are very different, origin and destination tank farms and terminals are excluded from the pipeline system analysis. Operation of these facilities is addressed in a separate tank farm and terminal study. Where possible it is also better to analyse operating data for integral intermediate (breakout) storage separately.

**Finding the Operating Cost Divisor**
Any adequate operating cost divisor will have to take account of a wide range in size and complexities. In making operating expense comparisons it is necessary to analyze fixed and variable (mainly energy) costs separately. Most operators already focus great effort in optimizing energy consumption, which is affected by a variety of technical and commercial factors. Consequently, Solomon’s initial focus has been on a divisor for comparing manageable non-volume related expenditures (MNVE).

Using its experience in establishing a divisor, ‘EDC’, that enables expense comparisons for refineries of varying sizes and complexities, Solomon developed an Equivalent Pipeline Complexity (EPC) divisor that represents a substantial improvement on traditional alternative. A standard method of measuring the robustness of a divisor is by computing the Coefficient of Determination ($r^2$), where r is the Pearson Correlation Coefficient, between the actual and predicted expenditures. The $r^2$ values obtained using EPC and various other divisors were as follows.

<table>
<thead>
<tr>
<th></th>
<th>Oil Pipelines</th>
<th>Natural Gas Pipelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilised Capacity, tonne-km</td>
<td>0.62</td>
<td>0.41</td>
</tr>
<tr>
<td>Pipeline Length</td>
<td>0.62</td>
<td>0.64</td>
</tr>
<tr>
<td>Replacement Value</td>
<td>0.63</td>
<td>0.70</td>
</tr>
<tr>
<td>Diameter, inch-km</td>
<td>0.67</td>
<td>0.75</td>
</tr>
<tr>
<td>EPC</td>
<td>&gt;0.9</td>
<td>&gt;0.9</td>
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</tbody>
</table>

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Equivalent Pipeline Complexity
For any pipeline system EPC can be calculated on the basis of four main parameters
- Liquid type
- Maximum operating power
- Number of input and output stations
- Length of right of way

Using EPC in Comparative Performance Analysis
Both expenditures and work hour requirements per unit EPC can be calculated and the outcomes for each pipeline system are compared with those of peer groups comprising better performing peers, e.g. first quartile or better half. Targets can then be set for the subject pipeline system as a precursor to a performance improvement programme.

Examples of study outcomes will be provided for integrity management and other expenditure subsets, for both oil and natural gas pipelines.

Study Improvements
A study of pipeline operations during 2006 is currently underway. Expected improvements will be discussed.

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