A system-centric approach to infrastructure asset management planning

Sergio Coelho, LNEC
Diogo Vitorino, Addition
Helena Alegre, LNEC
• High levels of deferred maintenance and rehabilitation and overwhelming investment needs in urban water services infrastructure demand wise spending and innovative, efficient planning.

• Rather than component-centric AM approaches, the complexity of the problem must be addressed by system-centric methods that ensure the best possible compromise between performance, risk and financial effort.
Infrastructure asset management

• ....the “art of balancing performance, cost and risk in the long term”.
  – Brown and Humphrey (2005)

• Systems, not collections of assets

• Long–term evaluation: as a whole, these infrastructures have an indefinite life
IAM at each planning level

• A PDCA loop

- From level above
  - Objectives > assessment criteria >
    > metrics > targets
- Diagnosis
- Produce Plan
- Implement Plan
- Monitor Plan
- To level below
Through decisional levels…

Strategic planning
- Utility mission, values
- Objectives > assessment criteria > metrics > targets
- Diagnosis
- Produce Plan
- Implement Plan
- Monitor Plan

Tactical planning
- From Strategic
  - Objectives > assessment criteria > metrics > targets
  - Diagnosis
  - Produce Plan
  - Implement Plan
  - Monitor Plan

Operational planning
- From Tactical
  - Objectives > assessment criteria > metrics > targets
  - Diagnosis
  - Produce Plan
  - Implement Plan
  - Monitor Plan

alignment
people involvement empowerment
feedback
Focus: objectives -> metrics -> targets

- Time frames: planning horizon, analysis horizon
The planning process: problem-driven

Define...

- Objectives
- Criteria
- Metrics
- Targets

For the current system...

- Formulate
- Model
- Diagnose
- Evaluate

For each planning alternative...

- Formulate
- Model
- Diagnose
- Evaluate
• An organized assessment environment where planning solutions or competing projects are measured up and compared.

• A portfolio of performance, risk and cost metrics and analysis tools for diagnosis and sensitivity gain.
The AWARE-P software

• Integrates all the necessary data
• Oriented to system response
• Capable of system-level metrics and component-level metrics (within the system)
Current toolset

- NETWORK – model-enabled network analysis envmt.
- PLAN – the central planning framework
- PI – Performance Indicators
- PX – Performance Indices
- FAIL – Poisson and LEYP, pipe failure prediction
- CIMP – component importance (impact of its failure on nodal consumption).
- UNMET – reduced service estimation.
- IVI – Infrastructure Value Index
### Folder: Alternative O Status quo

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Modified</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 0</td>
<td>Epanet INP File</td>
<td>2012/04/04</td>
<td>83 kB</td>
</tr>
<tr>
<td>Alternative 0 Comp Imp</td>
<td>Component Importance Table</td>
<td>2012/04/04</td>
<td>0 rows</td>
</tr>
<tr>
<td>Alternative 0 emergency</td>
<td>Epanet INP File</td>
<td>2012/04/04</td>
<td>83 kB</td>
</tr>
<tr>
<td>Alternative 0 emergency Pmin</td>
<td>Performance Index Table</td>
<td>2012/04/04</td>
<td>14,251 rows</td>
</tr>
<tr>
<td>Alternative 0 Failure analysis</td>
<td>Failure Analysis Table</td>
<td>2012/04/04</td>
<td>11,481 rows</td>
</tr>
<tr>
<td>Alternative 0 IVI</td>
<td>Cost Table</td>
<td>2012/04/04</td>
<td>459 rows</td>
</tr>
<tr>
<td>Alternative 0 PI</td>
<td>Performance Indicator Table</td>
<td>2012/04/04</td>
<td>45 rows</td>
</tr>
<tr>
<td>Alternative 0 Pmin</td>
<td>Performance Index Table</td>
<td>2012/04/04</td>
<td>14,251 rows</td>
</tr>
<tr>
<td>Alternative 0 Risk</td>
<td>Risk Assessment Table</td>
<td>2012/04/04</td>
<td>457 rows</td>
</tr>
<tr>
<td>Failures database</td>
<td>Work Order Failures</td>
<td>2012/04/04</td>
<td>1,959 rows</td>
</tr>
<tr>
<td>Pipes database</td>
<td>Work Order Pipe</td>
<td>2012/04/04</td>
<td>11,481 rows</td>
</tr>
</tbody>
</table>
Selected parameter: Alternative 2 Failure analysis

This chart shows a transpose of the cumulative distribution for the selected parameter. Click and drag the vertical guides to adjust the map scale.

- Click here to get equal intervals on the x-axis (20% quantiles of the set of links)
- Click here to get equal intervals on the y-axis (equal intervals in the values of the variable)
- Reverse colors
Technology, at a glance

- Web-based
- Modular, made to grow
- Client-server
  - cloud / corporate / local
- Multi-user
- Multi-platform
  - PC, Mac, iPad, linux
  - Laptop, tablet
- Compatible with existing SI
For more info...

- The AWARE–P project: www.aware–p.org

- The software: www.baseform.org