MONETIZING RISKS
A PRIORITIZATION & OPTIMIZATION SOLUTION

JASON DE STIGTER, P.E.  SENIOR CONSULTANT

SOUTHWEST SECTION AWWA
ANNUAL CONFERENCE
TULSA, OKLAHOMA

13 October 2014
TOP 5 INDUSTRY ISSUES – MIDWEST REGION

Aging water and sewer infrastructure: 4.61
Managing operational costs: 4.50
Managing capital costs: 4.46
Ability to fund capital programs: 4.44
Justifying capital improvement programs/rate requirements: 4.41

B&V’s Project Prioritization and Optimization Process Addresses these Issues

SOURCE: Black & Veatch’s 2014 Strategic Directions in the U.S. Water Industry
PROJECT PRIORITIZATION AND OPTIMIZATION
PROCESS ANSWERS THESE QUESTIONS

Utilities Need to Understand and Manage Risk

- Which projects to delay or accelerate?
- Which, if any, to cut?
- How much risk are we taking on?
- Are we spending capital where it is most valuable?
PROCESS DELIVERS THREE CRITICAL PLANNING RESULTS FOR THE BUDGET PROCESS

1. Project Rankings Based on Financial Efficiency
   ✓ NPV benefit and ‘Bang for the Buck’ metric quantified

2. Project Rankings Based on Planning Criteria
   ✓ Weighted Scoring Approach

3. Optimized Implementation Schedule that Incorporates Budget Constraints
   ✓ Dovetails with Utility Financial Plan for Rate Increases and Financing Needs
OVERVIEW OF PROCESS

• Planning Criteria
• Capital Costs
• O&M Impact
• Revenues
• Preferred Install &

• Financial Template
• NPV Benefit – Avoided Case
• Financial Efficiency
• Balance Scorecard
• Project Ranking /

• Financial Efficiency
  ○ Risk Tolerance
  ○
• Criteria Scoring
  ○ Reg. & Env.
  ○ Safety

Genetic Algorithm
THE AM “10-STEP” PRACTICE MODEL

1. What is the current state of my assets?
   - Develop Asset Registry
   - Assess Condition, Failure Modes
   - Determine Residual Life
   - Determine Life Cycle & Replacement Costs
   - Set Target Levels of Service (LOS)

2. What is my required level of service?
   - Determine Business Risk (“Criticality”)
   - Prioritize O&M Investment
   - Prioritize Capital Investment
   - Determine Funding Strategy
   - Build AM Plan

3. Which assets are critical to sustained performance?
   - Identify Projects

4. What are my best O&M and CIP investment strategies?

5. What is my best long-term funding strategy?
ASSUMPTIONS FORM AND FINANCIAL TEMPLATE = CONSISTENCY, DOCUMENTATION

• Input parameters
  • Capital costs
  • Target installation
  • O&M pre- and post-construction
  • Probability of failure
  • Consequence of failure
  • Revenue generated

Planning Criteria
• Reg. & Env.
• Customer Service
• Safety

Primary Output
Calculation of financial efficiency
Total score based on cost and risk factors
PROJECT BUSINESS CASE IS EVALUATED USING FINANCIAL TEMPLATE TO CALCULATE RISK WEIGHTED NPV

- Capital Cost of Project
- O&M Costs of Project
- Failure
  - Probability of Failure
  - Consequence of Failure
- Revenue Impact of Project

All of the above costs and revenues drive Project NPV.
40-yr NPV Probability Distribution Example

NPV of Cost - Water Tank Rehab/Repaint

- Y-axis shows relative probability
- X-axis shows range of NPV results

Planned Install Distribution

Failure Consequence

Business Case Development
EXAMPLE PROJECT FINANCIAL ANALYSIS

- Project Value based on the Avoided Case
- Process Quantifies the Cost/Risk of Project Delay

Risk analysis is incorporated in NPV results through Monte Carlo Simulation
FINANCIAL ANALYSIS CONSISTENTLY EVALUATES PROJECTS BASED ON PROJECT NPV

- Consistent project proforma used for economic and risk analysis
- Both avoided costs and cash savings/revenue incorporated
- Financial Efficiency or ‘Bang for the Buck’ = Expected Outcome / Capital Cost

<table>
<thead>
<tr>
<th>Count</th>
<th>Project ID</th>
<th>Expected Outcome NPV $000</th>
<th>Capital Cost Nominal $000</th>
<th>Install Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project G</td>
<td>-36,710</td>
<td>1,419</td>
<td>2014</td>
</tr>
<tr>
<td>2</td>
<td>Project Q</td>
<td>-19,686</td>
<td>2,361</td>
<td>2014</td>
</tr>
<tr>
<td>3</td>
<td>Project X</td>
<td>-10,912</td>
<td>6,401</td>
<td>2015</td>
</tr>
<tr>
<td>4</td>
<td>Project H</td>
<td>-5,636</td>
<td>26,480</td>
<td>2019</td>
</tr>
<tr>
<td>5</td>
<td>Project B</td>
<td>-4,041</td>
<td>5,875</td>
<td>2016</td>
</tr>
<tr>
<td>6</td>
<td>Project W</td>
<td>-3,981</td>
<td>256</td>
<td>2014</td>
</tr>
<tr>
<td>7</td>
<td>Project E</td>
<td>-3,731</td>
<td>8,778</td>
<td>2017</td>
</tr>
<tr>
<td>8</td>
<td>Project K</td>
<td>-3,359</td>
<td>2,199</td>
<td>2019</td>
</tr>
<tr>
<td>9</td>
<td>Project T</td>
<td>-2,392</td>
<td>1,794</td>
<td>2014</td>
</tr>
<tr>
<td>10</td>
<td>Project D</td>
<td>-1,201</td>
<td>2,846</td>
<td>2017</td>
</tr>
<tr>
<td>11</td>
<td>Project I</td>
<td>-815</td>
<td>13,355</td>
<td>2015</td>
</tr>
<tr>
<td>12</td>
<td>Project M</td>
<td>-550</td>
<td>5,586</td>
<td>2015</td>
</tr>
</tbody>
</table>
PLANNING CRITERIA ARE USED WITH THE FINANCIAL RESULTS TO ARRIVE AT A BALANCED SCORE FOR EACH PROJECT

These Planning Criteria Results are used to validate and ‘fine tune’ the CIP schedule decisions.
Example 1: Water Tank Recoating & Repainting

• Options: Pay Now OR Pay MORE Later with short-term cost savings.

• Preferred Option depends on how much MORE and when.

• Case Study in leveraging staff experience.

• POF = Years before next maintenance cycle and experience with changing historical maintenance cycle

• COF = Additional Capital Cost for full replacement of the water tank.
Example 2: Water Distribution Pipe Replacement Program

- Historical Planned vs. Unplanned for water distribution pipeline costs.
- Age Histograms to project future unplanned costs assuming ‘run to failure’ approach and various funding levels.
- Calculate NPV of Cost for each funding level (planned + unplanned costs)
Example 3: Collection System & Consent Order Risk

- **Modeling Approach:** Consent order ‘applied’ to each basin area.

- **POF** = likelihood of repeating SSO in an basin area causing ‘Basin Consent Order’.

- **COF** = Regulator requires ‘ultimate’ solution requiring additional capital projects with potential for the completion of other projects. COF also incorporates value of CIP schedule flexibility.
Example 4: Collection System Growth Project

- Revenue forecast is uncertain. Expected Volumes? Timing of Volumes?
- Used Existing Rates with a discount for other downstream costs associated with new flows to calculate an ‘incremental rate’
- Volumes forecast based on pipeline capacity and growth areas likelihood of success for development.
PROJECTS SCHEDULED TO INCLUDE BUDGET CONSTRAINTS

Annual Capital Costs
NO BUDGET constraint
Installation years determined through Prioritization Process

Annual Capital Costs
WITH BUDGET constraint
Lower ranking projects moved back in schedule to meet budget constraints

Optimization Model

<table>
<thead>
<tr>
<th>Year</th>
<th>Asset 1</th>
<th>Asset 2</th>
<th>Asset 3</th>
<th>Asset 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>90.0</td>
<td>10.0</td>
<td>20.0</td>
<td>30.0</td>
</tr>
<tr>
<td>2013</td>
<td>80.0</td>
<td>10.0</td>
<td>20.0</td>
<td>30.0</td>
</tr>
<tr>
<td>2014</td>
<td>70.0</td>
<td>10.0</td>
<td>20.0</td>
<td>30.0</td>
</tr>
<tr>
<td>2015</td>
<td>60.0</td>
<td>10.0</td>
<td>20.0</td>
<td>30.0</td>
</tr>
<tr>
<td>2016</td>
<td>50.0</td>
<td>10.0</td>
<td>20.0</td>
<td>30.0</td>
</tr>
</tbody>
</table>
OPTIMIZATION MODEL

• Develops Portfolio Project Schedule based on a given budget constraint

• Portfolio Scheduling is Optimized through Genetic Algorithm.

• Optimization Value = Minimize portfolio risk weighted NPV of Cost

• Key Questions that are Answered
  
  • Risk Focus: Are we spending capital where it is most valuable?
  
  • Cost Focus: How much Risk are we taking on by delaying projects?
PORTFOLIO OPTIMIZATION RESULTS: RISK FOCUS

- Current CIP Budget Level = Optimized CIP Budget Level
- Optimization decreases overall Portfolio NPV of Cost while Maintaining Budget Levels

![Graph showing the comparison between Run to Failure, Current CIP, and Optimized CIP for Asset Classes A, B, C, and D. The graph illustrates the decrease in average NPV of cost (in millions) across different asset classes with optimization.]
OPTIMIZATION RESULTS: COST FOCUS

- Optimization identified $11 Million in capital project cost for delay outside of 5 Year CIP period with minimal increase in risk
- Additional Delays within 5 Year CIP Period
OPTIMIZATION RESULTS: RISK IMPACT

Value in delaying $11 million in capital projects outweighs future cost risk from system and asset failure.
OPTIMIZATION RESULTS: BALANCED SCORECARD RISK REDUCTION

Investment Drives Risk Reduction
RECAP: PROCESS DELIVERS THREE CRITICAL PLANNING RESULTS FOR THE BUDGET PROCESS

1. Project Rankings Based on Financial Efficiency
   ✓ NPV benefit and ‘Bang for the Buck’ metric quantified

2. Project Rankings Based on Planning Criteria
   ✓ Weighted Scoring Approach

3. Optimized Implementation Schedule that Incorporates Budget Constraints
   ✓ Dovetails with Utility Financial Plan for Rate Increases and Financing Needs
### VALUE OF PRIORITIZATION AND OPTIMIZATION PROCESS

<table>
<thead>
<tr>
<th>Strategic Value</th>
<th>Functional Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <em>Objectively</em> Incorporates Risk Tolerance and Budget Constraints</td>
<td>• <em>Documentation</em> of all project assumptions</td>
</tr>
<tr>
<td>• <em>Defendable</em> Approach</td>
<td>• <em>Quick</em> sensitivity analysis</td>
</tr>
<tr>
<td>• Visual and quantified risk of project delays</td>
<td>• New budget constraints</td>
</tr>
<tr>
<td>• Condition of Asset incorporate</td>
<td>• Easy <em>integration</em> of new projects added to CIP</td>
</tr>
<tr>
<td>• <em>Understanding</em> and quantification of risk</td>
<td>• <em>Quick</em> re-prioritization when assumptions change</td>
</tr>
<tr>
<td></td>
<td>• Communication Between Business Units and Functions</td>
</tr>
<tr>
<td></td>
<td>• Consistency</td>
</tr>
</tbody>
</table>

**Strategic and Functional Value Align to Defend Your Capital Program**
SUMMARY - BALANCING TRADEOFFS

Process helps management balance tradeoffs between budget constraints and risk.

In summary, this prioritization process and model assists utilities with managing the important balance of the following management and budget tradeoffs:

- Performance, Cost, and Risk
- Budget constraints
- Capex vs. Opex tradeoffs
- Risk: Reliability and Outages, Safety, Financial
- Identifies greatest Value Creation projects in portfolio
Building a world of difference.

Together

ANNUAL CONFERENCE
TULSA, OKLAHOMA
OCTOBER 13-14, 2014

Jason De Stigter | Senior Consultant
(913)-458-3433 | DeStigterJD@BV.com

Mat Powis | Senior Consultant
(913)-458-3063 | PowisM@BV.com