Prioritization Planning for Capital Equipment Replacement for Sustainable Infrastructure

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Commissioning & Operations

Challenges

- Big or small, the challenges are the same

- Alaska Native Healthcare Campus:
  - 375,000 sf 150 bed level 2 trauma center - ANMC
  - Centers for Disease Control - Arctic Investigations Lab
  - 180,000 sf office space
  - 60 room patient Hostel
  - 5 story parking garage
  - 2017 6 story, 200 room patient housing unit

Challenges

- Many organizations across the country are under increasing pressure to remain economically competitive, operating at a very small profit margins
- Of the many complicated issues facility managers and owners must consider, capital equipment replacement often goes ignored, or at the very least is prioritized very low
- Building infrastructure systems are approaching their estimated useful lives

Challenges

- How are decisions made on what infrastructure systems are replaced, re-commissioned?

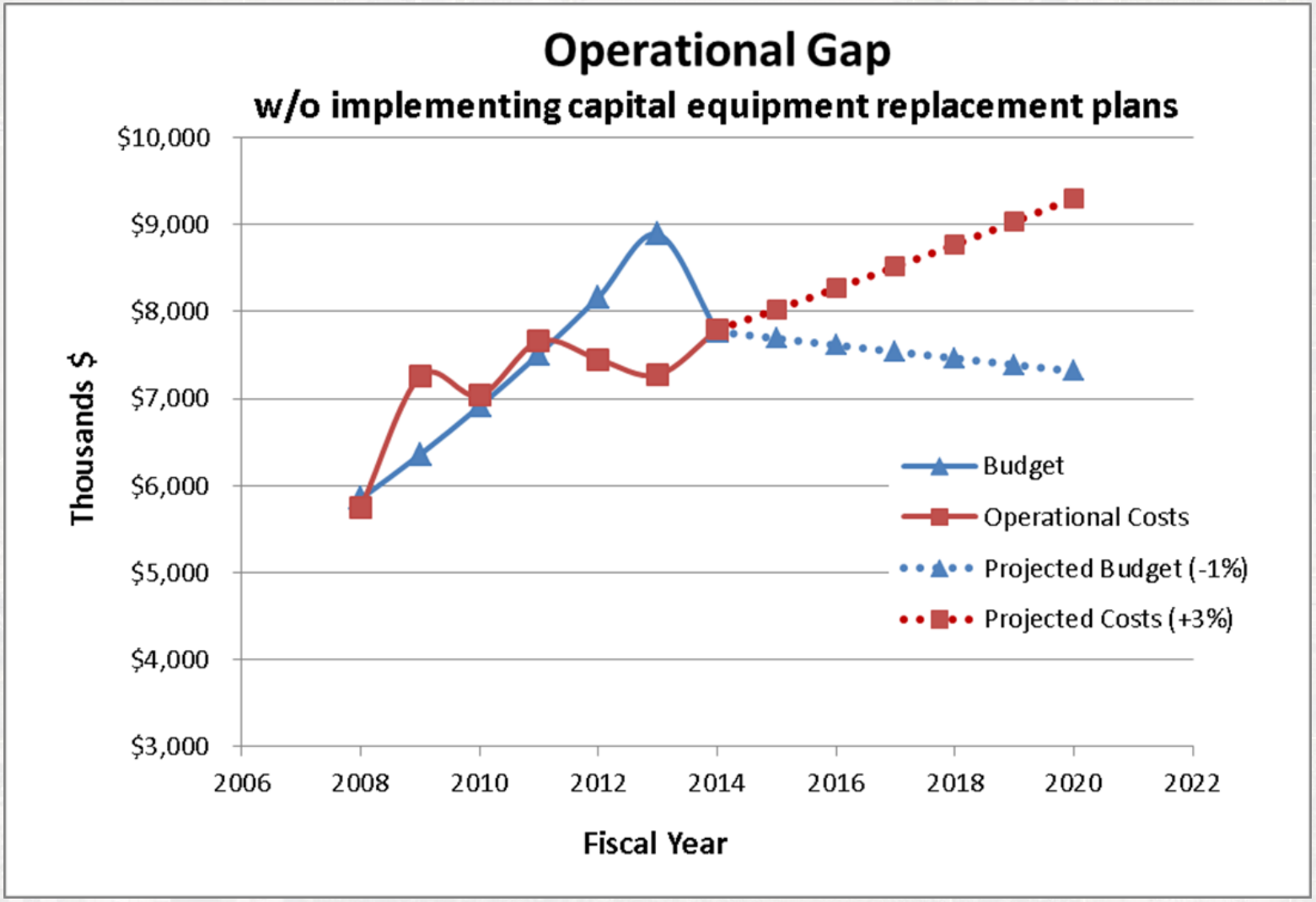
Roofing? Lighting? HVAC Systems?

Fire Alarm Systems? Sidewalks & Grounds?

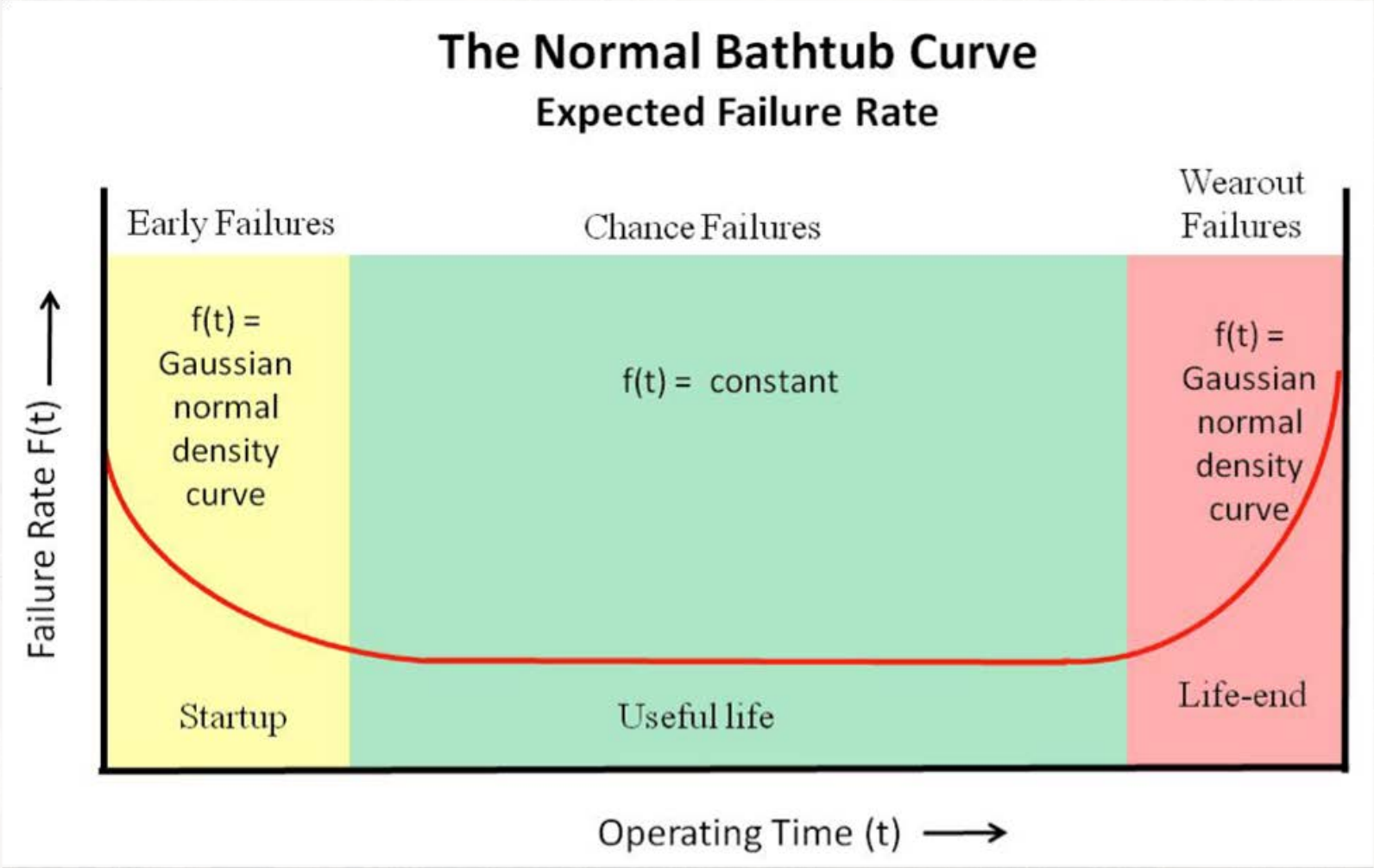
Vertical Transport Systems? Building Controls?

Building Envelope? Doors?

Challenges


Operational Gap
w/o implementing capital equipment replacement plans
$10,000
$9,000
$8,000
$7,000
$6,000
$5,000
$4,000
$3,000
Thousands $
2006
2008
2010
2012
2014
2016
2018
2020
2022
Fiscal Year
Budget
Operational Costs
Projected Budget (-1%)
Projected Costs (+3%)

Challenges


The Normal Bathtub Curve
Expected Failure Rate
Early Failures
Chance Failures
Wearout Failures
f(t) = Gaussian normal density curve
f(t) = constant
f(t) = Gaussian normal density curve
Failure Rate F(t)
Startup
Useful life
Life-end
Operating Time (t)

Plan for Future Replacement

- Infrastructure Replacement
  - Evaluate capital equipment replacement based on the overall organizational strategy
  - Take into account many key evaluation criterion
  - Develop a systematic process to prioritize equipment for replacement

Plan for Future Replacement

- Develop a Prioritization Process to guide Capital Equipment Replacement within the Framework of the Organizational Strategic Plan
- Integrate Key Metrics into the prioritization process
- Develop a relative ranking, systematic process to prioritize building infrastructure systems for replacement based on criticality

Considerations

- Risk Management
- Engineering Economics
- Environmental Sustainability
- Technology Management
- Organizational Mission, Vision & Strategy
- Facilities Plant Operation, Repair, Replacement

Considerations

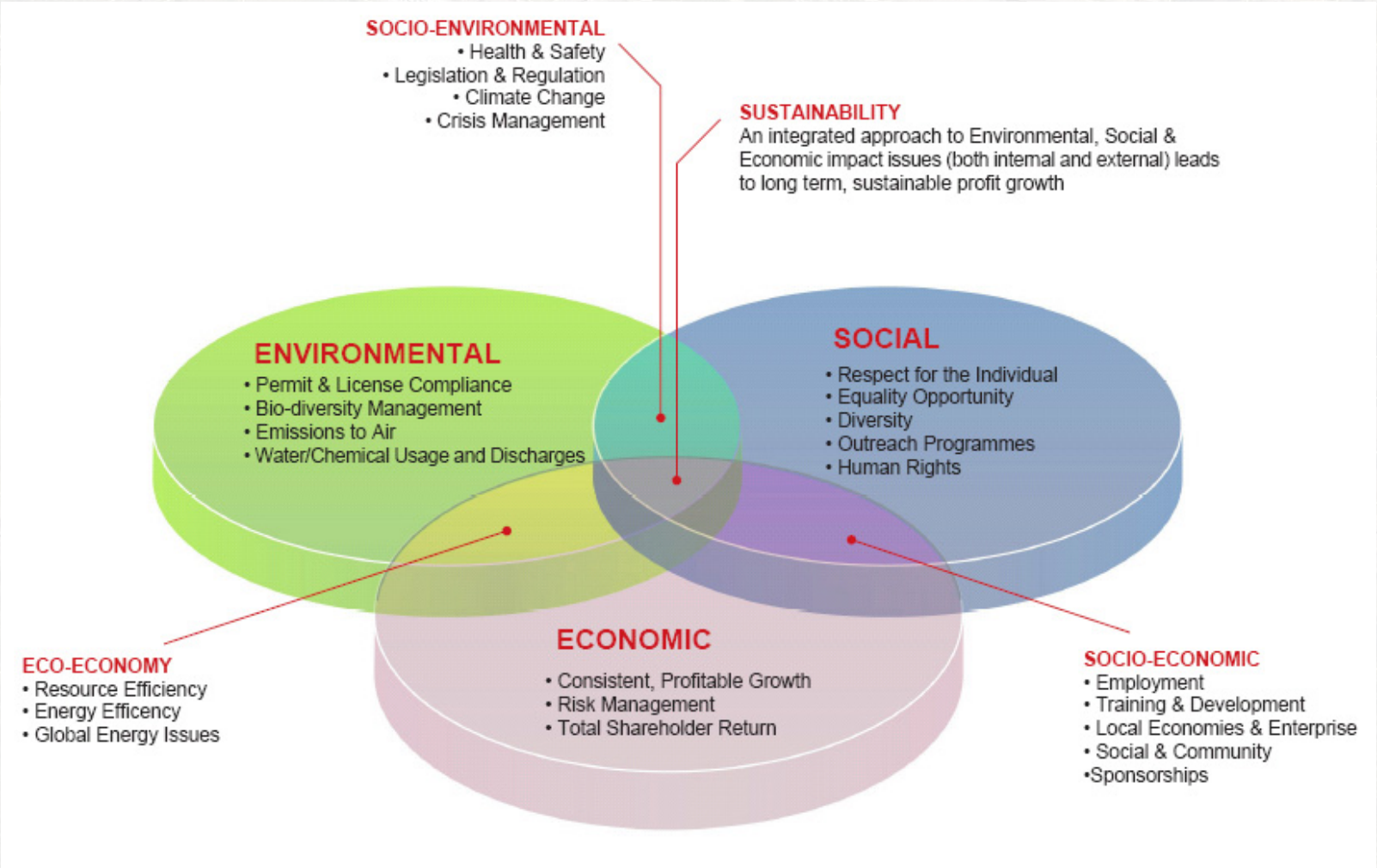
- Must have a Good Inventory of Buildings, Systems, and Equipment
- *Estimated Useful Life*
- *Estimated Cost to Operate*
- *Estimated Cost to Repair/Replace*

Considerations

- Cost
  - Several Engineering Economics methods
    - Equivalent Annual Cost (EAC)
    - Net Present Value
    - Replacement Analysis
    - Budgetary Capital Cost to Replace
  - Life Cycle Costs
    - Capital Cost to Install/Replace
    - Operating
    - Repair
    - Depreciation

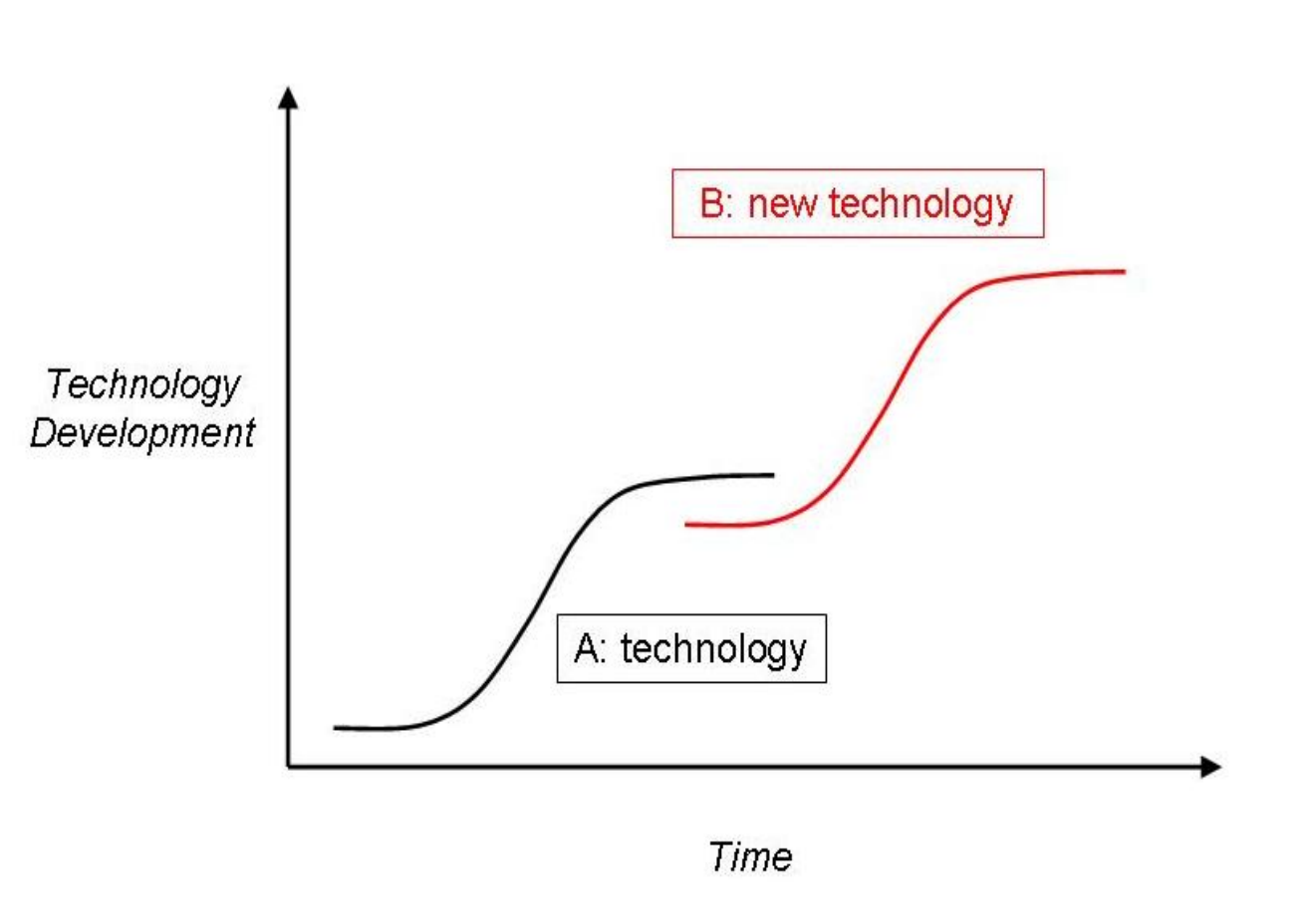
Considerations

- Sustainability



Considerations

- Technology



Methodology & Metrics

- Identify all independent primary metrics
- Determine relative weighting factors for metrics
- Establish relative index ranking systems
- Evaluate all equipment with respect to each metric
- Order the equipment inventory list based on the highest (in most need of replacement) to lowest

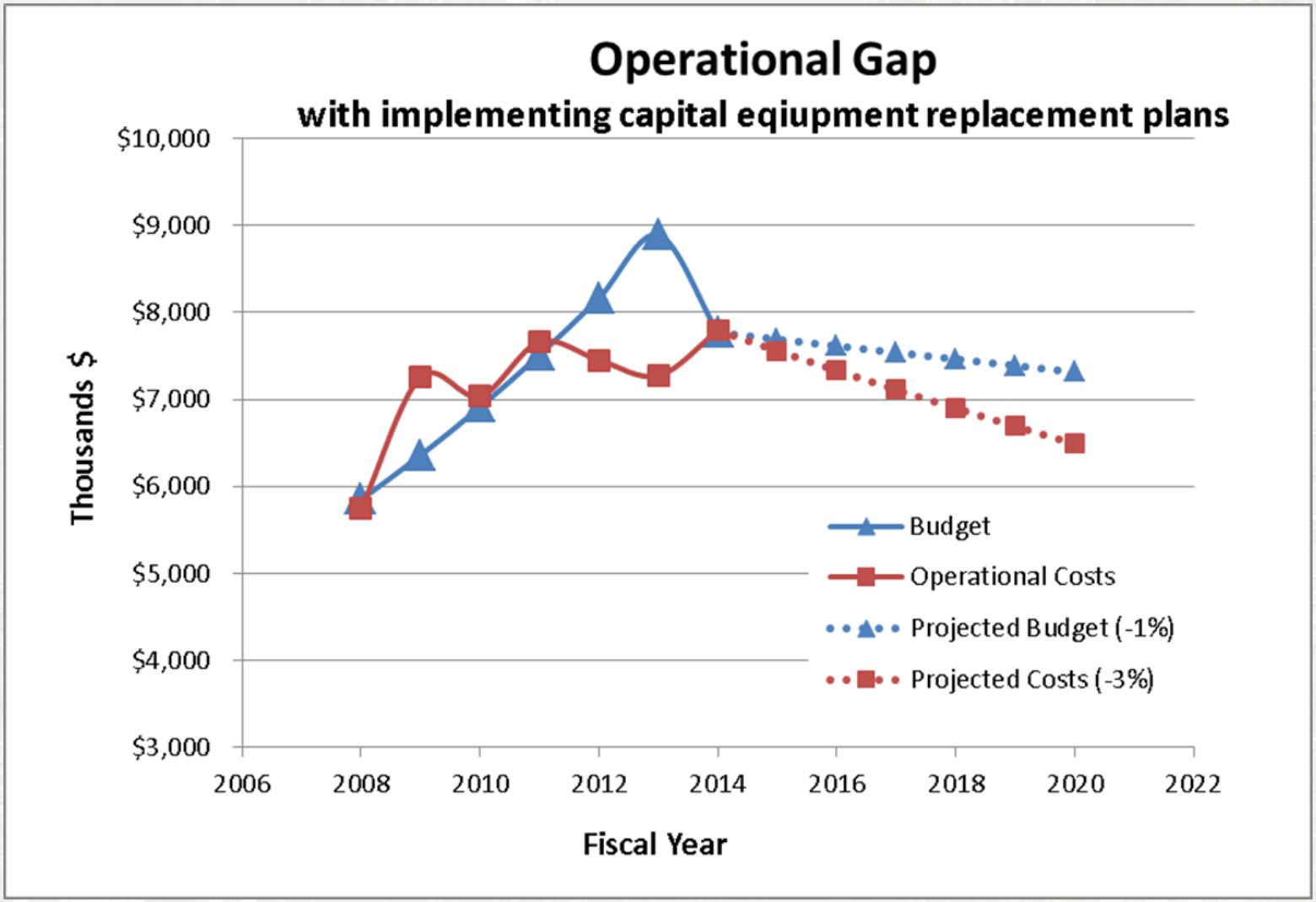
Methodology & Metrics

- Equipment Criticality Replacement
  - Metrics to Consider
    - Probability of Failure
    - System Age
    - Estimated Useful Life
    - System Complexity
    - Use Factor
    - Impact
    - Code & Accreditation
    - Back System

Results

- Prioritized list of systems to be replaced
- Estimated Funding
- Which Systems are most critical to replace
- Which systems provide the best reduction in operational cost, Simple Payback, Internal Rate of Return, etc
- Integrated Decisions into Commissioning Activities

Outcomes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Projected Budget (-1%)
Projected Costs (-3%)

Outcomes

- Plan for Repair & Replacement before failure
- Invest in your buildings early on
- Develop system to determine which systems and equipment to replace that can stand the test of time
- Decide which systems are most critical to replace
- Decide which systems provide the best reduction in operational cost, Simple Payback, Internal Rate of Return, etc

Thank You