PUB Technical Conference

Business Operations Capital
&
Asset Management
July 20, 2017
Purpose & Disclaimer

• Introduction to MH business & capital practices
• Common basis of understanding & language
• Informal and interactive
• Work in process - journey
Outline

• Manitoba Hydro Operations & Assets
• Asset Management
• Business Operations Capital planning process
• Forecasting Asset Replacement
Glossary

- Black start
- System Stability
- Capacity
- Sustainment
- Reliability
- Effective age
- Economic end of life
- PAS 55
- ISO 55000
- Asset Investment Planning (AIP)
- Corporate Value Framework (CVF)
- Portfolio
Operations & Assets
Supply Chain

Small Number of High Cost Assets

Complex Assets & Assets Spanning MB

High Number of Low Cost Assets

24|7 365
## Operational Objectives

<table>
<thead>
<tr>
<th>System</th>
<th>Objectives</th>
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| Distribution System     | • Existing customer delivery  
                          • New customer connection |
| Transmission System     | • Regional energy delivery  
                          • Electric system reliability |
| Generating System       | • Supply Manitoba load  
                          • Generate revenue from surplus energy |
Supply Chain

TRANSMISSION SYSTEM

Total Supply
- Hydraulic & Thermal
- Generating Stations
- Generating Units

Provincial Demand
- Regional Demand
- Local Demand
- Customer

Generalization
- GENERATION
- TRANSMISSION
- DISTRIBUTION
- CUSTOMER
Generating Unit Duty

- SUPPLY LOAD & REVENUE
- STABILITY e.g. LOAD BALANCING
- OPERATIONS e.g. SYSTEM FLOW
- RELIABILITY e.g. FUEL VARIATION
- BLACKSTART
Example: Operating Context
Example: Operating Context

Diagram showing a generating station with layers indicating Total Supply, Thermal & Hydraulic, Generating Stations, Generating Units, Auxiliary Systems, Structures, and Infrastructure.
Kelsey Generating Station

- Water control: spillway, dams, dykes
- Electrical: switchyard, transmission, local distribution
- Buildings: Staffhouse, camp, shops, storage
- Municipal: drainage, water treatment, wastewater, solid waste management
- Communications: tower, fibre
- Transportation: roads, airport
Supply Chain

Provincial Supply
Thermal & Hydraulic
Generating Stations
Generating Units
Auxiliary Systems
Structures
Infrastructure

Provincial Demand
Regional Demand
Local Demand
Customer

Thermal & Hydraulic Generating Stations

Export

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Generation & Transmission Systems

Regional
- Northern supply
- Southern load
- Province wide delivery
- Varying density
- Remote assets
Adequate Supply
Insufficient Regional Capacity

- Hotspots of growth across Province
- Transmission & distribution system expansion required to serve growth
System Investment

**Distribution**
- Capacity expansion & deteriorating assets
- Highest need for renewal investment

**Transmission**
- Capacity expansion for regional load growth
- Acceptable performance at current investment levels

**Large assets entering middle-age**

**Generation**
- Sufficient capacity to serve load growth
- Acceptable performance at current investment levels
Asset Management
Asset Management Strategies?

**Proactive**
- Replace before failure
- Significant in-service failure consequence
- Monitor degradation
- May defer or advance to smooth demand
- Example: Furnace, roof

**Reactive**
- Run to failure
- Manageable in-service failure consequence
- Life expectancy
- May advance to smooth demand
- Example: Hot water tank, windows
Asset Management is the coordinated activity of an organization to realize value from assets.

– Institute of Asset Management
Asset Management Journey

• Corporate Asset Management (CAM)
  – Centralization
  – Framework for business alignment

• Improvement to capital tools & processes
  – Asset investment planning
  – Capital portfolio management
  – Asset condition assessment
Corporate Asset Management (CAM) Governance Structure

**CAM Executive Council**
- Vice President level committee
- Chaired by Chief Finance & Strategy Officer
- Provides centralized vision and strategic direction
- Asset Owner

**CAM Steering Committee**
- Director level Committee
- Chaired by the **Director of Strategic Business Integration**
- Executes MH’s asset management development strategy
- Business owner for processes & tools
Corporate Asset Management (CAM) Framework

• Phase 1
  – Review Asset Management practices at Manitoba Hydro
  – Gap assessment against industry best practices, PAS 55, and ISO 55000
  – Complete – Appendix 5.1 in GRA

• Phase 2
  – Development of AM strategy and policies
  – In-progress

• Phase 3
  – Development of Asset Management implementation road map
  – To be completed following Phase 2
Business Operations Capital Planning Process
(excludes Major New Generation & Transmission)
Changes to Capital Expenditure Categories

- Domestic
- Base & Major
- Business Operations Capital
- Programs
- Projects
- Major New Generation & Transmission
Capital Planning Model
Capital Expenditure Forecast (CEF) is a Snapshot in Time

Potential Investments Portfolio
Projects and Scope Development under consideration

Executing Portfolio
Projects in Flight + Yr 1 Projects Starts + Scope Development

- Project Ending in yr 1
- Project Beginning in yr 1
Capital Expenditures Forecast

• Portfolios:
  – Executing Projects
  – Potential Investments
  – Programs

• For each of:
  – Distributions
  – Transmission
  – Generation
  – Corporate Services (IT, Fleet, Facilities)

• Divided into investment categories
Primary Investment Categories

Capacity & Growth
- Investments required to expand Manitoba Hydro’s generation, transmission, HVDC or distribution assets across the Province
- Provide for future load growth or address existing capacity concerns

Sustainment
- Investments required to sustain the current and future performance capability of Manitoba Hydro’s electrical system
- Address issue of degrading and obsolete assets

Business Operations Support
- Investments that support business operations and are shared or common throughout the corporation
- Ex: IT investments, fleet, tools, administrative buildings
Asset Investment Planning (AIP)

- Asset needs drive capital expenditures
- For immediate operational requirements
- For long term sustainability
- Balancing cost, performance and risk
Objective 1:
Optimize timing and scope of projects

Objective 2:
Forecast long term capital investment requirements

Roadmap is under development

- Build processes, tools & data models
- Populate inventories, collect data
- Calibrate, refine & build proficiency

Asset Investment Planning

Forecast Target

Time

Programs

First Year of CEF

Executing Projects

Potential Investments

Long Term Planning Investments

Target

Build processes, tools & data models

Populate inventories, collect data

Calibrate, refine & build proficiency
Capital Portfolio Management (CPM)

- Based on capital planning model
- Standardization of tools and processes
- Implementation of Asset Investment Planning (AIP) technology - Copperleaf C55
- Development of Corporate Value Framework (CVF)
- Roll out complete by end of 2017
Asset Investment Planning

- Manage Grouped Assets
- Long Term Planning Investments
- Potential Investments
- Executing Projects
- Scope Development

First Year of CEF

Target

Capital

Time

Manitoba Hydro
Programs: Grouped Assets

• Grouped by class or by function
• Examples:
  – Annual replacement for population sustainability
    • Wood poles
  – Life extension
    • U/G cables
  – Run to fail
    • O/H transformers
• Capital expenditures forecasted based on:
  – Population sustainability
  – Projected failure rates
Asset Investment Planning
Planning to Execution
Planning to Execution

Potential Investments
• Multiple alternative solutions under consideration
• Each with:
  – Scope
  – Schedule
  – Budget
  – Value assessment
• No firm start date

Executing Projects
• Selected alternative
• Scope development phase completed, if required
• Confident:
  – Scope
  – Schedule
  – Budget
  – Value assessment
• Firm start date
Capital Approvals & Documents

- **Capital Investment Justification (CIJ)**
  - Replaces Capital Project Justification (CPJ)
  - Funding request for Project, Program or Program Item
  - Authorization to execute

- **Capital Investment Concept (CIC) - new**
  - Request funding for scope development
  - Firm up scope, schedule, budget
Authorization to Spend

- Scope Development
- Capital Project
- Program Items

Key Points:
- Capital Investment Concept (CC)
- Capital Investment Justification (CU)
- POTENTIAL INVESTMENTS
- LONG TERM PLANNING INVESTMENTS

Manitoba Hydro
Portfolio Optimization

- Select alternative and timing of investments
- To deliver the greatest value
- While respecting multiple constraints

Capital Portfolio Before Optimization
Portfolio Optimization

- Select alternative and timing of investments
- To deliver the greatest value
- While respecting multiple constraints

Capital Portfolio after Optimization
Portfolio Optimization

• Select alternative and timing of investments
• To deliver the greatest value
• While respecting multiple constraints

CONSTRAINTS

VALUE ASSESSMENT

Quantify:
• Benefit
• Risk
• Cost

CONSTRANTS

Time
Resources
Money
Corporate Value Framework

Provide safe, reliable and affordable energy to the people of Manitoba.

- **Financial**
  - Maximize cost savings
  - Increase efficiency

- **Reliability**
  - Maintain customer service
  - Increase customer satisfaction

- **Corporate Citizenship**
  - Public perception

- **Environmental**
  - Environmental stewardship

- **Safety**
  - Safety first for employees and community
### Corporate Value Framework

#### Value Measures

<table>
<thead>
<tr>
<th>Value Measure Categories</th>
<th>Value Measures</th>
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</table>
| **Financial**            | • Capital Financial Benefit  
                          | • O&M Financial Benefit  
                          | • O&M Costs  
                          | • Financial Risk*  
                          | • IT Capacity Risk*  
                          | • Lost Generation Risk**  
                          | • Export Transfer Capacity Risk*  
                          | • Productive Workplace Benefit  
                          | • Risk of Project Execution (non-ITS)  
                          | • Risk of Project Execution (ITS)  
                          | • Varying Cost or Revenue Benefit  
                          | • Generation Revenue Benefit  
                          | • Investment Cost  |
| **Environmental**        | • Environmental Benefit  
                          | • Environmental Risk*  |

<table>
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| **Reliability**          | • Transmission Reliability Risk*  
                          | • Electrical Delivery Capacity Risk*  
                          | • Gas Delivery Capacity Risk*  
                          | • Import Transfer Capacity Risk*  
                          | • Blackstart Delay Risk*  
                          | • Distribution Reliability Benefit  
                          | • Distribution Outage Recovery Benefit  
                          | • Gas Distribution Reliability Benefit  |
| **Safety**               | • Safety Risk*  
                          | • Security Risk*  |
| **Corporate Citizenship**| • Compliance Risk*  
                          | • Public Perception Risk*  
                          | • Customer Service Benefit  |
Optimized Portfolio

- Considers net value (Value – Cost)
- Considers value gained per dollar (Value/Cost)
- Considers multiple project alternatives
- Considers different program levels
- Considers the effects of project deferral
Optimized Portfolio

**Executing Portfolio**
Projects in Flight + Yr 1 Projects Starts + Scope Development

**Potential Investments Portfolio**
Projects and Scope Development under consideration

![Diagram showing Executing Portfolio and Potential Investments Portfolio](image-url)
Forecasting Replacement
Run to Failure

- Non critical asset
- Short time frame for replacement
- Low cost/common stock items
- Failure consequence acceptable
- Optimized life cycle is run to failure
- Example: pole top transformers
Proactive Replacement

- Risk assessment and prioritization

- Risk = Probability of Failure (POF) x Consequence (Criticality)

- POF is calculated from the Health Index of your assets and “Effective Age” rather than chronological age

- Replace when RISK COST > REPLACEMENT COST

- Economic end of life
Obsolescence as End-of-Life

• **Functional Obsolescence**
  – Asset no longer meets performance criteria
  – Example: protection equipment does not meet increasing fault levels

• **Technical Obsolescence**
  – Asset no longer supported by the vendor
  – Spare parts no longer available
  – Example: digital equipment

• **Regulatory Obsolescence**
  – Asset no longer meets regulated minimums
  – Environmental (PCB Content)
  – Safety (Clearances, Fault Currents)
Asset Condition Assessment

• Assessment of physical condition
• Methodology customized by asset class – “how to measure condition”
• Condition parameters and weighting factors
  – Measurement points
  – Visual inspections
  – Operating tests
Asset Health Index (AHI)

• Asset Health Index (AHI) adds context to asset condition

• Gives an assessment of
  – Remaining life
  – Probability of failure
  – Degradation over time

• Based on:
  – Specific asset characteristics
  – Current condition assessment
  – Operating context
Risk Assessment

Condition Assessment → Asset Class Characteristics

Industry Experience → Asset Class Characteristics

Asset Utilization → Asset Class Characteristics

MB Hydro Experience → Asset Class Characteristics

Operating Context

Asset Health Index → Degradation Curve

Remaining Life / POF → Risk Assessment

Criticality

Degradation Curve

Risk Assessment
Asset Analytics

• Uses asset health and degradation curves to forecast asset risk in time

• Assesses changes in risk for varying levels of investment
Forecasting Asset Replacement through Condition Monitoring

• Limited to assets with:
  – Large capital replacement cost
  – Significant consequence of in-service failure
  – Measurable condition
  – Predictable degradation & probability of failure
Program Analytics

• Uses asset health and degradation curves to forecast aggregate asset population risk in time

• Assess changes in risk for varying levels of investment
Renewal investments may be forecasted through analytics.
Forecasting Capital Expenditures

• Timing of asset failures is uncertain
  – Operating context may change
  – Risk mitigation or life extension works
• Scope of replacement uncertain due to potential changes in:
  – Technology, codes/standards, methods
• Costs uncertain
  – Market conditions
• Forecast uncertainty increases further into the future
SUMMARY

• Manitoba Hydro Operations & Assets
  – Complicated supply chain
  – Broad mix of assets
  – Regional load growth challenges
  – Concerns with degrading distribution system asset populations
SUMMARY

• Corporate Asset Management (CAM)
  – Centralization
  – Framework for business alignment

• Improvement to Business Operations Capital tools & processes
  – Asset investment planning
  – Capital portfolio management
  – Asset condition assessment
SUMMARY

• Forecasting Asset Replacement Expenditures
  – Limited in its application
  – Forecasts uncertain