Reliability Initiative: Distribution Investment Planning

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December 2000

Agenda

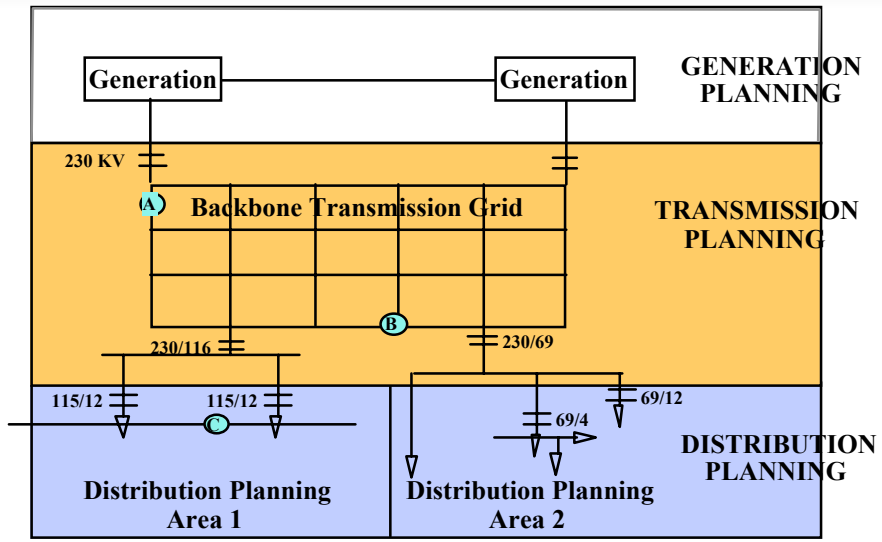
- Background
- What learned from R&D
- What learned from Assessments

Background

- R&D
  - Assessing Customer Needs
  - Measuring and Valuing Reliability
  - Prioritizing Distribution Projects
  - Managing Aging Assets
- Assessments: Com Edison, Con Edison, Duke
  - Detailed planning practices
  - Peer group practices
- EPRI R&D reports
  - Reliability of Electric Utility Distribution Systems: EPRI White Paper, TR-1000424
  - Customer Needs For Electric Power Reliability And Power Quality: EPRI White Paper, TR-1000428
  - Managing Aging Distribution System Assets: Research Status Report, TR-1000422

Distribution Business Planning is Mostly About Solving Investment Problems

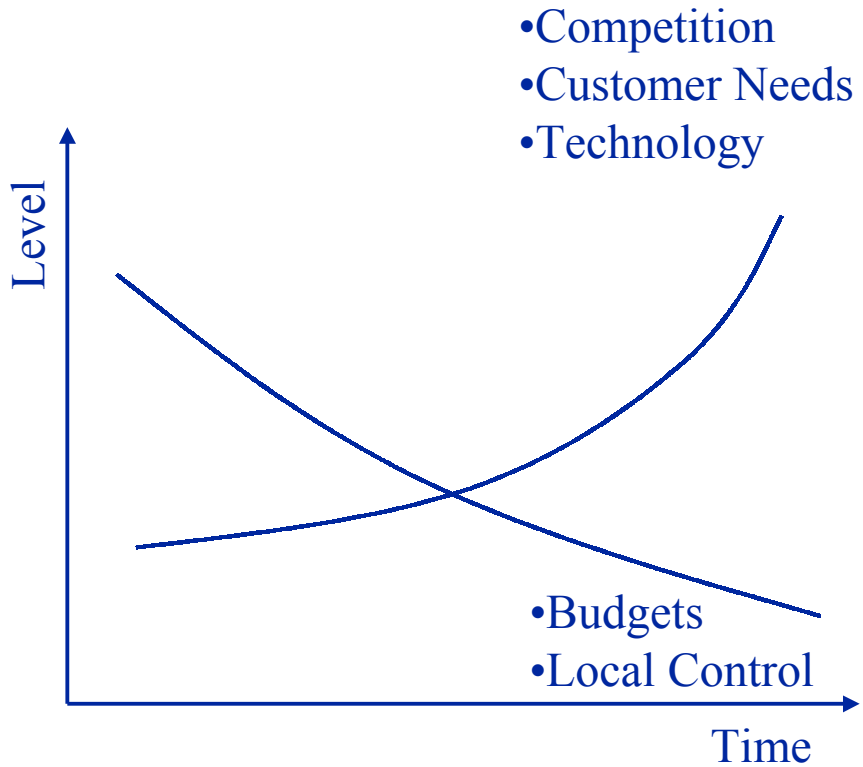
- 40% to 50% of electric utility net investment
- Business issues
  - Minimizing investment costs
  - Having "right" infrastructure to meet customer needs
  - Making money
- Key strategic needs
  - Managing assets
  - Linking investment decisions to customer needs



Net Invest.
Gen. = $8.7B
Tran. = $4.5B
Dist. = $13.5B
Total = $26.7B

Opposing Trends are Changing the Business

- Increasing levels of key drivers
  - Competition
  - Regulatory & Corporate scrutiny
  - Customers demand for reliability and service quality
  - Technology change
- Reduced budgets & reduced local autonomy
- Together these are creating a collection of problems



Specific Problems

Local Area

- Capacity expansion
- Reliability
- Aging assets
- Customer needs & values

Corporate

- Capital budgeting
  - Objectives
  - Budget signals
  - Operating policy & strategy

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R&D - Assessing Customer Needs

- Objective
  - Original intent was to provide exposition on what is known and not known about customer needs for electricity
  - However soon realized that an integrating structure was needed. Thus objective was changed to pull available information together into a *Reliability Valuation Framework*
- Literature Review & Library
- Framework
  - Not a best and final numerical valuation
  - Is a process to provide guidance on how a valuation can be performed
  - How to use customer survey data to put an economic value on reliability
  - Direct the user to data sources that can provide preliminary numbers

Assessing Customer Needs

- Literature Review
  - A lot has been measured and observed but current state of knowledge is fragmented and incomplete
  - In general, customers more concerned about reliability than other attributes
  - Bulk of literature focuses on estimating value of reliability
  - Increasing knowledge of what aspects of outage really matter
- Reliability Valuation Framework
  - Provides a systematic structure for characterizing and quantifying important aspects of electric service on the value of reliability
  - Nine key factors: duration, frequency, time of day, time of week, time of year, warning, advance notice of duration, type of customer, number of customers
  - Framework is a "placeholder" analysis - as new information is obtained, the framework can be easily updated

R&D - Measuring & Valuing Reliability

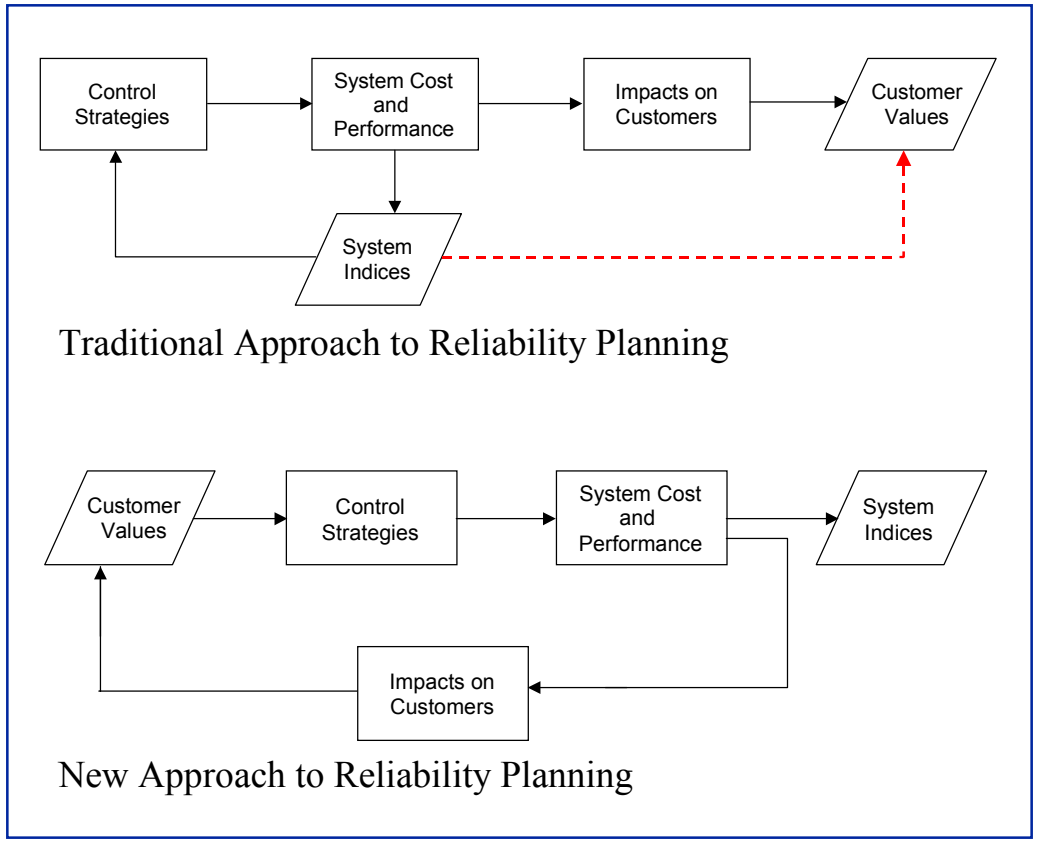
- Objective:
  - Ultimately to provide tools for (1) analyzing and valuing reliability investment decisions, (2) quantifying cost / reliability tradeoffs
  - Interim objective is to document what is known about reliability in distribution systems and determine whether tools exist to perform required analysis for investment planning
- Literature Review and Library
- White paper
  - Library
  - Definitions & Perspectives
  - Measuring (Indices, Equipment Data)
  - Utility Practices
  - Regulatory Issues
  - Power Quality
  - Analysis Methods

Measuring & Valuing Reliability

- Conclusions
  - Although the theory is well developed, the application of analytical techniques to distribution systems is limited
  - Implementation of theory initiated by Snohomish PUD through University of Washington
    - Model now exists
    - Several organizations pushing new approach based on Snohomish work
  - There are some existing development issues
    - Ignores risk & extreme events
    - Customer value for reliability is not directly incorporated
  - Models for forecasting system reliability (a la Snohomish) are not sufficient - see next section, capital budgeting problem

R&D Suggests Need For New Approach

- Tie together traditional C/B economic analysis with engineering system analysis
- Allow comparison across customer segments
- Indices are ad hoc and do not directly address customer needs
- Planning based on averages is flawed
  - Ignores risk & extreme events
  - Ignores some key customer needs



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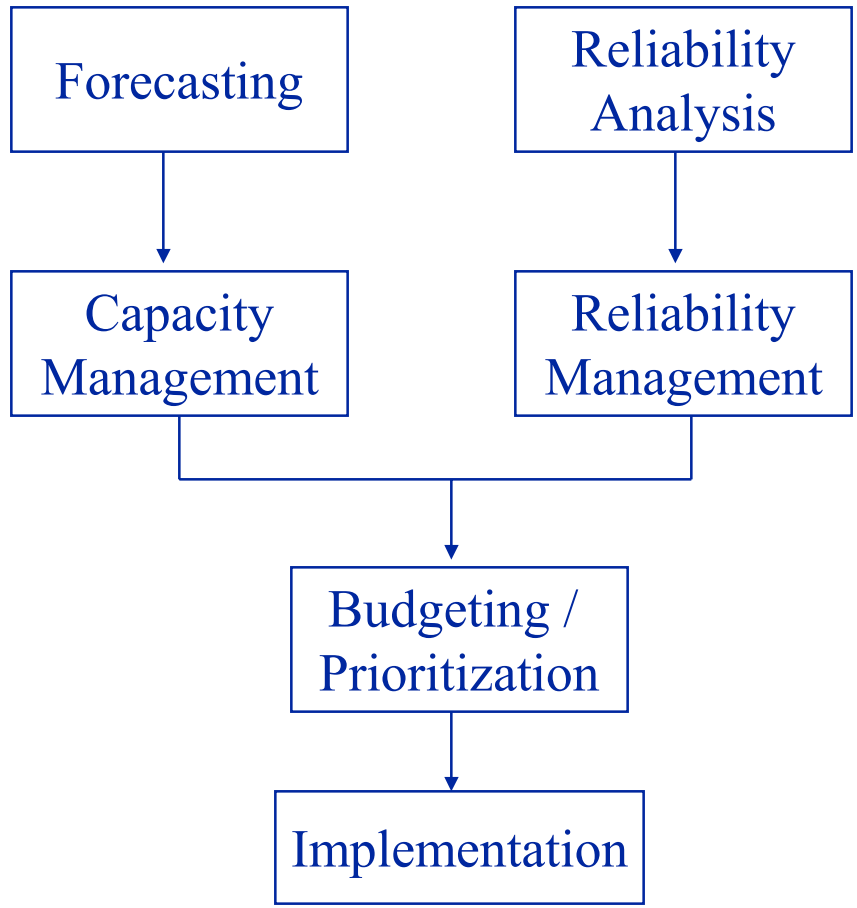
Reliability Assessments - The Process Framework

- Detailed practices at companies
  - Forecasting
  - Capacity Management
  - Reliability Assessment
  - Reliability Management
  - Budgeting / Project Prioritization
  - Implementation
- High-Level practices at peer-group companies
  - Forecasting
  - Planning Criteria & Philosophy
  - Project Prioritization & Budgets



Reliability Assessments

- Forecasting
  - Key input in determining future capacity needs
  - Models and processes:
    - Trend based weather adjusted
    - Generally not longer than 5 years and do not address load uncertainty
- Capacity management
  - Plan for capacity to meet peak demand and have contingency plans in place for major component failures
  - Models and processes:
    - Regional managers develop plans
    - Based on forecasts and circuit analysis

Reliability Assessments

- Reliability Analysis
  - Key information for determining capital and O&M spending to improve reliability
  - Models and processes: (1) outage tracking, (2) overload monitoring, (3) inspection programs
- Reliability Management
  - Reliability projects are identified, budgeted and prioritized
  - Models and processes:
    - Various outage management systems (utility specific)
    - Historical overload data
    - Evaluate effectiveness based on metrics such as SAIDI, SAIFI, and CAIDI

Reliability Assessments

- Capital Budgeting / Project Prioritization
  - Projects are evaluated and approved or deferred based on project rankings and overall budget levels
  - Models and processes:
    - No formal analytical processes are used
    - Is both bottom-up and top-down
    - Driven by multiple corporate objectives: financial, safety, customer satisfaction
- Implementation & Feedback
  - Tracking approved projects to insure that they are completed and that they have the desired effects
  - Models and processes:
    - Periodic review meetings
    - Typically no high-level summary data provided to management

Practices at Peer-Group Companies

- Load forecasting practice
  - Forecast peak load using trends and judgment
  - Some formal regression analysis
  - Forecast horizons from 5 to 10 years
  - Some companies have formal algorithms for temperature adjustment
- Discussion
  - Forecasts are for relatively short periods but costs, benefits and risks of investments are longer-term
  - Appropriate scale of investments depend on growth rates and growth uncertainty.
  - Companies tend not to forecast beyond 10 years and none develop load uncertainty forecasts

Practices at Peer-Group Companies

- Planning criteria - practice
  - Investment problem involves conceptually simple trade-off between costs and reliability
  - Reliability is achieved through redundancy and risk reduction
    - Build systems that can lose one or two sources of supply and continue to serve load
    - Remove hazards (tree trimming)
    - Replace components that may not perform to required levels (inspection, testing and replacing)
    - Reduce number of customers impacted by switching & sectionalizing

Practices at Peer-Group Companies

- Planning criteria - cont.
  - Planning criteria are similar among the interviewed companies
    - Design substations so that forecast peak demand does not exceed 100% capacity (continuous rating)
    - Many components have much higher short-term capacity - creates a significant short-term capacity buffer
    - Many utilities noted that they have specific contingency plans at substations based on installed excess capacity, engineering judgment, ability to switch load to other substations, and planned installation of mobile transformers
  - All interviewed companies used standard reliability measures such as SAIFI, SAIDI, and CAIDI
  - Several companies noted that the system design creates differences in reliability - urban versus suburban versus rural

Practices at Peer-Group Companies

- Planning criteria - cont.
  - Several utilities noted that they classify loads wrt criticality and this affects restoration order and contingency plans
- Discussion

Practices at Peer-Group Companies

- Project prioritization & budgets
  - A majority of the companies stated that they have a formal process
  - The process is to rank projects based on the consequences of deferral
  - Respondents defined a formal process as one with a specific set of criteria and a specific process for recommending and reviewing priorities
- Discussion
  - Our interpretation of the interviews is that very few if any of the companies have a consistent quantifiable method for prioritizing projects
  - We found no company that required a specific and consistent set of data as part of the process for proposing projects

Recommendations for Improvement

- Dynamic planning
  - Planning horizons are too short
  - Need to address longer term uncertainties, risk and opportunities
  - Area load forecasting should focus on longer time-horizons and load uncertainty
  - Avoid last minute, reactive decision making
- Metrics
  - Performance indices such as SAIDI, SAIFI and CAIDI have inherent flaws in that they do not measure what customers care about

Recommendations for Improvement

- Project Prioritization
  - More consistent and efficient decisions could be made with formal multi-criteria ranking system
  - Under current project prioritization systems there is a lack of requirements for a specific and consistent set of data as part of the process for proposing projects
    - What is provided do not reflect the attributes that customers care about
    - Do not measure the relative value of the attributes

Recommendations for Improvement

- Key finding
  - Current planning practices served customers well in the past. However traditional practices are unlikely to server customers well in periods of increasingly tight budgets
  - When there is plenty of food everyone eats
  - Need to understand the consequences of doing less
    - Which project to defer
    - What are the risk of deferring
    - What are the consequences of further budget reductions
    - What could be accomplished with more budget
  - Who gets less reliability