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# Optimizing Electric Utility Capital Project Cost Estimating

## A Comprehensive Approach to Digital Transformation

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# Abstract

This white paper outlines a comprehensive framework for improving electric utility owner capital effectiveness by optimizing the gated capital project estimating process. Effective project budgeting is critical for successful project execution and cost control. This paper summarizes the factors needed to streamline the project budgeting process, reduce errors, and enhance overall project delivery efficiency.

These topics apply to any firm involved in managing a portfolio of project assets as well as operations and maintenance projects related to existing assets.

# Executive Summary

For electric utility owners in the current competitive and regulated landscape, initiating a successful capital project hinges on an intuitive digital capture of project scope, objectives, and constraints quickly and accurately. Digitization streamlines the transition to the estimation phase and enhances the quality and consistency of project estimates, which is fundamental for effective gated project development. Digital transformation at the start of a project bolsters planning accuracy, stakeholder alignment, and seamless change management throughout a project's lifecycle.

Estimating teams are often inundated with numerous estimate requests annually and can benefit from an intelligent request management system. Using robust validation processes, owners can reduce manual errors, optimize operational efficiency, accelerate response times, and replace outdated manual Microsoft Excel and SharePoint applications.

Effective team management is characterized by clear responsibilities and visibility into workload distributions, especially with a mix of in-house and external resources. This clarity ensures optimal assignment of a portfolio of estimates, improves communication, and fosters collaboration, which is key for managing scarce resources.

Task management using standard checklists and streamlined processes provides instructive delegation and efficient internal and external stakeholder communication. With comprehensive document management, owners can centralize vital project documentation, providing consistent information access and facilitating transitions between team members.

Estimate development adopts various methodologies, from initial top-down parametric models to detailed bottom-up line items, adapts to project stages, and provides transparency via accurate details. Precision in estimating methods enhances capital efficiency by reducing systemic risks and bias.

Alignment between scope inputs and estimating methods creates an environment where estimate confidence increases, and benchmarking can deliver accurate comparisons and predictions.

A robust knowledgebase that encompasses standardized cost data and smart interviews ensures consistent, high-quality estimates. It also enables easier peer and management review, which is critical for high-level decision-making and external stakeholder engagement.

Estimate analysis identifies cost-saving opportunities using Work Breakdown Structures (WBS), Cost Breakdown Structures (CBS), and Organizational Breakdown Structures (OBS) for detailed assessment. Bundling individual estimates into a cohesive collection for analysis provides a more holistic view of projects or programs, uncovering synergies and avoiding costly future rework.

Data validation and risk management are integral to a risk-adjusted estimate. This process, coupled with peer reviews and optimized approval workflows, ensures accurate, reliable project budgets with appropriate contingencies.
Standardized, comprehensive reports help stakeholders understand project estimates. Supplemental deliverables required by regulators enhance project planning and decision-making.

Benchmarking against historical data optimizes future estimating, with an eye on leveraging AI for continuous improvement. Integrating the estimating system with design, ERP, and PPM systems promotes collaboration, data synchronization, and strategic decision-making, increasing owner competitiveness and agility in the utility sector.



# Background

Electric utility owners face many challenges with estimating and budget development. Given the energy sector's complex and rapidly evolving nature, understanding these challenges can help owners make more informed decisions and improve the probability of successful financial outcomes for projects.

Competitive issues highlight the need for utilities to be innovative, cost efficient, and adaptive to meet the changing demands of the energy sector. The interplay of DOE funding, ISO rules, interconnection requests, and cluster studies reflects the dynamic nature of the industry, where collaboration and competition intersect in the pursuit of sustainable and efficient energy solutions.

Investors are no longer content with long, uncertain payback periods. Projects today must increase the electric utility owners' capabilities and competitiveness in a rate-case environment. Owners must squeeze more dollars from their budgets by increasing the utilization of accurate project estimates that contain the detail necessary to reduce bias for their portfolio budgets wherever possible. Electric utility owners must eliminate wasteful overfunding in project budgets caused by a tendency to overestimate for predictability.

## BACKGROUND

The practice of overestimating, often used to counter poor early project scope definition, undermines capital efficiency, masks systemic risks, and significantly reduces the availability of capital dollars needed for other essential projects in owner portfolios.

Enhanced scope definition and advanced estimating systems that offer clear visibility into cost drivers and project risks are imperative for improving budget accuracy and estimate precision. Improved estimate scope definition and estimate development help eliminate the bias in project budgets and boost estimate accuracy, increasing owners' competitiveness through reduced capital expenditures.

Many owners produce thousands of estimates annually to support their portfolio of capital projects and business planning. Typically, these owners live in a world of unnecessarily high organizational complexity around budget and resource management of their project portfolios.

Owners who are stuck in the past using spreadsheets or ineffective software to manage a high volume of estimates will not be able to compete with owners who have moved to more modern, integrated estimating platforms capable of supporting thousands of estimates across their teams with stage-gated project development processes.

Often these poorly aligned and inadequately equipped organizations cannot react to needs from partner processes like supply chain, resource planning, scheduling, and project controls (earned value management). *Why?* Because their estimates are not granular or consistently aligned to deliver the data needed by project teams for procurement, control, or progress measurement.

The lack of estimate granularity creates an environment where more dollars are poured into estimates to cover perceived scope growth. These coping mechanisms create fragmented and high project costs that are not competitive against owners who can produce better estimates that drive out uncertainty and reduce the arbitrary application of additional cost allocation for scope growth.

Estimating software can no longer just address the numerical estimate—it must also ensure that the project scope is developed and tracked together with the detailed cost items. In turn, these detailed, codified cost items facilitate other internal project system needs to streamline resource planning, optimize procurement and supply chain needs, and empower project controls to measure progress.

Estimating software must also support risk assessment and allow owners the visibility needed to prepare accurate and meaningful schedules, escalations, and contingencies. In addition to modernizing and improving the effectiveness of their project systems, owners must also deal with numerous external factors:

- The need to expand the grid to accommodate the ever-growing energy demands of modern society, including:
  - Additional demands for electric vehicle charging
  - Additional demands for conversion to electric replacements for existing fossil-fueled equipment and appliances (heat pumps, electric stoves, etc.)
  - Additional demands for data centers—exacerbated by Artificial Intelligence (AI), which requires tremendous amounts of computing power
  - Additional demands to power blockchain and cryptocurrency technology
- Expansion of the grid and decentralization of power generation to connect renewable energy sources, such as wind and solar, as well as energy storage systems and microgrids.
- Modernization of the existing grid—in many cases, the infrastructure has exceeded its intended life to operate safely and with resilience—it's at or above designed capacity.
- Hardening of generation, transmission, and distribution equipment against weather, fire, and security threats.

These external factors often serve as catalysts for change in the electric utility industry. Estimating systems must keep pace with these changes.



# Challenges

Electric utilities, like many other industries, face common cost estimating challenges:

- **Optimize the use of capital expenditures.** Utilities must operate with the goal of capital efficiency—the optimization of available funds that target the ideal portfolio of projects to meet rate case demands and strategic objectives.
- **Manage many different types of projects.** Utilities must manage distributed generation, transmission lines, substations, and distribution systems; renewable projects including wind and solar generation, and energy storage; communication, data, and control projects, interconnection projects, and reliability projects.
- **Manage estimates for many projects concurrently.** Owners must estimate many projects with limited resources, often with staff that may not have extensive cost estimating experience while maintaining a perception of estimate accuracy.

- **Managing third-party estimates.** Owners are uncertain of the quality and accuracy of outsourced estimates. Without in-house capabilities to validate third-party estimates, confidence in the resulting scope, quantities, and costs is often low. This uncertainty can lead to adding excessive contingencies, and inaccurate budgets and forecasts.
- P**roduce high-quality estimates that directly support internal stakeholders.** Owners must produce consistent, predictable, and defensible budgets and estimates while dealing with ever-changing portfolio priorities, deadlines, and supply-chain constraints.
- **Reduce organizational complexity and eliminate waste.** Utilities must automate workflows and integrate with upstream and downstream systems.
- **Enable more effective communications and increased transparency.** Utilities must generate deliverables (reports and documents) for internal and external stakeholders.
- **Possess high business agility.** Owners must execute projects with speed – speed – speed and quickly adjust to strategic portfolio changes.
- **Increase competitiveness that is unnecessarily constrained.** Manual methods and archaic tools constrain the organization from achieving their objectives. Unnecessary complexity and workarounds abound. Future capital dollars are eroded by weak processes and inadequate systems.



# Kicking Things Off

Effective project initiation is vital for a successful capital project. A critical aspect of successful project initiation in today's context is the digital management of project scope, objectives, and constraints. There is a direct correlation between project success and the quality and consistency of project initiation.

Digitizing project initiation processes makes it easier to transition to the estimate development phase, resulting in a comprehensive estimate that supports gated project development. It also creates a high degree of alignment with the early project stakeholders and increased confidence in decision support, as well as enabling data hand-off to downstream processes.

While capturing project scope, assumptions, and risks at the initiation stage is important, the ability to trace these initial inputs throughout the project lifecycle is critical for change management, accountability, performance management, and lessons learned.

PROJECT INITIATION

THIS INITIAL DIGITAL TRANSFORMATION IMPROVES THE ACCURACY OF PROJECT PLANNING, ENABLES ALIGNMENT WITH ALL STAKEHOLDERS, ENSURES DATA IS NOT LOST BETWEEN PROJECT APPROVAL GATES, AND SETS THE FOUNDATION FOR A SUCCESSFUL PROJECT.

REQUEST MANAGEMENT

# Managing the Mayhem

Electric utility estimating teams receive hundreds to thousands of estimate requests per year. Seamless request management is essential to ensure that all project needs are properly assessed and addressed. When done well, request management provides inputs into effective estimating manpower utilization.

Effective request management includes robust validation processes to capture required fields, reduce errors, and digitally convey project scope, assumptions, and specifications that support the desired estimate classification or level of confidence.

Real-time updates of estimating activities via reports and dashboards minimize unnecessary information requests, which bog down the estimating team. Replacing manual estimate logs managed in Excel or SharePoint with an integrated solution increases operational efficiency, reduces bottlenecks, and shortens the response time related to incoming requests.

Proper estimate management ensures that a project taxonomy and estimate data are prepared to support project benchmarking (see “Benchmarking” below).

TEAM MANAGEMENT

# Who Is On My Team?

Clear delineation of responsibilities within the estimating team is crucial for effective collaboration. In many cases, electric utilities employ internal estimating, engineering, and project management staff as well as external or outsourced estimating firms, underscoring the need for managed collaboration.

TEAM MANAGEMENT

Visibility into staff workloads is necessary to optimize estimate assignments and notifications, especially with distributed teams. Team management ensures effective distribution of workload, facilitates professional development of estimating staff, and helps avoid staff burnout from overloaded work schedules.

Analyzing the workload of estimating teams across time is vital for efficient resource allocation. Efficient team management improves communication and collaboration within the team and across the organization and helps optimize staff management in an era of limited and remote resources.

EFFECTIVE TASK MANAGEMENT STREAMLINES COMMUNICATION WITH BOTH INTERNAL AND EXTERNAL STAKEHOLDERS, CREATING ORGANIZATIONAL ALIGNMENT AND REDUCED ORGANIZATIONAL COMPLEXITY.

TASK MANAGEMENT

# What Should I Do Next?

Mature organizations implement standard task checklists that ensure the right people are executing the right steps in the right sequence. Task management involves manual and automated processes for task creation, assignment, and status tracking.

Completion of some tasks results in initiating new processes (and related tasks), such as the development of supporting estimates, starting an informal peer review process, or starting a formal approval process.

Task management ensures all aspects of the estimate development process are accounted for and tasks are properly delegated to the relevant teams.

DOCUMENT MANAGEMENT

# So Many Documents

Effective document management is a cornerstone of project budgeting. Every project includes supporting documents required for estimating, including site plans, equipment lists, layouts, vendor quotes, spec sheets, etc. These documents must always be readily available to the estimating team.

PROVIDING A CENTRALIZED WORKSPACE FOR STORING AND ACCESSING CRITICAL PROJECT ESTIMATING-RELATED DOCUMENTS ENSURES THAT ALL TEAM MEMBERS HAVE ACCESS TO THE SAME SUPPORTING INFORMATION.

Document management enables project transparency. It is especially vital when a team member is reassigned and someone else must pick up the related responsibilities. Along with estimate reports, supporting documents are often included in a comprehensive estimate package deliverable.

ESTIMATE MANAGEMENT

# Making the Sausage

The estimate development process varies by project type and project stage. It often involves multiple cost estimate development methodologies. In early-stage estimating, parametric models can guide a user through an interview process, similar to the consumer-level tax preparation interview experience.

Parametric smart models incorporate expert intelligence that ensures compliance with engineering standards and automates generation of estimating scope, quantities, and to some degree, pricing. Smart models act like a senior estimator mentoring a junior estimator or support a design engineer who has limited construction estimating experience. This knowledge transfer is the essence of a well-conceived parametric model interview experience.

As an estimate matures through various stages and gates, methodologies shift to the use of assemblies (compatible units), activities, and line items, along with associated analysis of esources and production rates. Detailed pricing analysis and integration of vendor quotes occur in the latter stages of an estimate development lifecycle.

By accommodating various methodologies concurrently at different project stages, the estimate development process can quickly generate high-quality, adaptable, accurate estimates with generous supporting detail, including assumptions, clarifications, and omissions.

PROPER ESTIMATING KNOWLEDGEBASE CONFIGURATION ENSURES ESTIMATE LINE ITEMS ARE HIGHLY CONGRUENT TO REAL WORLD PROCUREMENT AND PROGRESS MEASUREMENT. THIS, COUPLED WITH AUTOMATED ESTIMATE MANAGEMENT PRACTICES, PROVIDES INCREASED VALUE TO THE ESTIMATING ORGANIZATION AND IMPROVED ACCURACY OF ESTIMATES THAT COMPLEMENT CAPITAL EFFICIENCY.



# Sausage Ingredients

The quality of the sausage relies on high-quality ingredients. Standardization of unit rate details, automation of repetitive activities and tasks, including the use of smart interviews to capture driving parameters, are all fundamental in a construction cost estimating knowledgebase.

It is imperative that estimating teams develop estimates using a common standard to aid estimate analysis, comparison, and risk assessment processes. An organized taxonomy of WBS, CBS, and OBS codes is essential for maintaining cost management efficiency through improved measurement of key project cost and schedule drivers.

A well-designed construction cost estimating knowledgebase facilitates developing consistent, predictable estimate results that enable efficient peer and management review processes. It also drives out estimate uncertainty by directly coupling project scope definition and estimating methods. Knowledgebases require calibration based on as-built information and a maintenance strategy to ensure they provide the most updated cost estimating data to all stakeholders.

Knowledgebase-driven estimates feed standard reports required by upper management, clients, and external stakeholders such as regulators, including regional transmission organizations (RTOs) and independent system operators (ISOs). (See “Reports” below).

ESTIMATE ANALYSIS

# Making Sense of It All

Measurement is key to continuous improvement. In-depth estimate analysis is essential for identifying cost drivers and potential cost-saving opportunities. This analysis encompasses analysis of labor and equipment, key quantities, and the tracking of long lead materials with projected procurement dates.

Estimate analysis leverages WBS, CBS, and OBS codes to slice-and-dice estimates to suit various analyses and stakeholder reviews. Estimate analysis includes tracking and comparing differences between estimate versions as well as comparison of different estimate scenarios (e.g., option A, option B, option C), sometimes referred to as value engineering or value alternatives.

Estimates may need to be analyzed collectively to address the needs of a larger project, program, or future operational year. This includes not only aggregating costs and hours, but aggregating and analyzing labor and equipment resources, key quantities, long-lead items, and schedules to establish a comprehensive, interrelated view of the component estimates.

VALIDATION

# Sanity Check

To be effective, data validation complements good business practices. Validation also helps inform project team members of anomalies or what is required to complete their task correctly.

Data validation plays a crucial role in reducing errors and maintaining data quality. Validation begins at the project initiation stage where initial inputs such as required fields ensure the estimating team has the basic information they need to proceed. High data quality enables future AI/ML initiatives that might be closer than they appear.

Validation should always be executed prior to submitting an estimate for approval and generating a report. When integrating estimating data with other systems, it is critical to minimize errors in data cleanup and normalization. Advanced systems validate the data at the source rather than the target. The data author is in a better position to fix the error versus the recipient.

VALIDATION

Managers can leverage rules-based data validations to check the integrity of an estimate. For example, the system could highlight any data points with a difference of more than 25% compared to the knowledgebase standards. This facilitates a management by exception tactic to streamline the review process and reduce bottlenecks.

A comprehensive validation process is vital in ensuring that the project budget remains accurate and reliable throughout each stage of the project delivery process.

RISKS

# Known Unknowns

Risks need to be managed. Risks diminish when organizational complexity is lower, scope is better defined, project stakeholders are aligned, and project teams have better certainty of their budget during project execution.

All estimates include some level of risk, known and unknown. A structured approach to risk analysis can include stakeholder workshops prior to estimate development to identify potential risks. As the estimate process matures, all team members are responsible for capturing, tracking, and sharing risk information with all relevant stakeholders.

Additional workshops help teams discuss and determine risk impacts (including scope, cost, and schedule) through traditional informal methods (e.g., expert opinions), stochastic simulations (e.g., Monte Carlo Analysis) or advanced methods (e.g., Quantitative Risk Analysis).

The final step of risk management is incorporating those risks into a risk-adjusted estimate that includes the appropriate contingencies, overheads, and other adjustments. The estimating team should provide management with reporting that includes a comparison of the base and risk-adjusted estimates and highlights how risks impact the final estimate.

# Another Set of Eyes

Managing risk also includes peer reviews to ensure team members provide objective feedback before an estimate is submitted through a formal management approval process. The approval process must include approval workflows to support different project types and approval levels.

The system needs to provide notifications to managers responsible for reviewing and approving or rejecting a submitted estimate. Checklists at every step serve to remind submitters and approvers of all the action items they must execute before taking the next step. A transparent approval process keeps stakeholders informed of critical milestones and roadblocks.

A TRANSPARENT, EFFICIENT APPROVAL PROCESS KEEPS ALL STAKEHOLDERS CURRENT AND REDUCES DELAYS IN ESTIMATE DEVELOPMENT.



# The Final Result

Reports provide an efficient view into complex project estimating data. Standardized reports are paramount to the estimate development process.

Stakeholders, such as estimating managers, project managers, and customers, need consistent reports to help them understand and accept the project estimate. In many cases, the organization has been generating reports in a specific format that must be adhered to regardless of the technical solution. In some cases, this format cannot be changed.

Reports are often bundled into estimate packages, including summary and detailed reports organized by multiple breakdown structures (e.g., WBS, CBS, OBS; see “Cost Data” above), labor and equipment analysis reports, key quantities, and long-lead materials analysis.

Supplemental reports, including version comparisons and alternative comparisons, help estimating teams prepare the final reports and provide valuable insights into estimate maturation and variations.

SUPPLEMENTAL DELIVERABLES

# Accessorizing

The best estimates come with excellent supporting deliverables. Often these deliverables are mandates from regulators. This is an area where owners can protect themselves against bad press or audits.

Creating supplemental deliverables, such as the basis of estimate, preliminary schedule, cash flow, and forecasting, enhances project planning and decision-making. For example, an estimate report without a supporting basis of estimate document has low value.

For some clients, every estimate must be supported with a forecast or cash flow that includes allowance for funds used during construction (AFUDC) and escalation adjustments given that the project execution start date is a year or more in the future.

Estimating teams are often tasked with developing preliminary milestone schedules to prepare initial time-phased costs and resources aligned with typical milestones. These assist portfolio managers with their strategic responsibilities in managing capital plans and project managers in their project execution responsibilities.

BENCHMARKING

# Learning From the Past

Benchmarking is a payoff to investing in strong estimating systems, but it is tough to achieve without organizing systems and processes that support its continuous generation. Historical data helps organizations learn from the past and make informed decisions. It can be especially valuable for new staff who lack relevant knowledge of their employer's past projects.

Leveraging internal historical data and benchmarking against similar projects can provide valuable insights into estimated costs versus expected outcomes. Tracking metrics and Key Performance Indicators (KPIs) can serve as benchmarking drivers, bringing attention to potential anomalies and outliers that could result in undesirable outcomes.

This data-driven approach to benchmarking improves scope, quantity, and cost predictions, providing a means of continuous improvement through efficiency gains. It can also help identify cost-saving opportunities and alternative solutions.

BENCHMARKING

Electric utilities can use historical data throughout the estimating process, from supporting conceptual estimating cost modeling to validating data against historical patterns to providing a supporting benchmarking analysis in the estimate review and approval process. Benchmarking can aid in spotting estimate bias, a major project risk, before a final estimate is submitted for review and approval.

Historical data collection is a key component needed for calibrating a cost estimating knowledgebase and supporting future Artificial Intelligence (AI) initiatives. AI models need to be trained and tested before being placed into a production environment. The best data is the company's data. The best time to collect this data was yesterday.

Solid internal benchmarking allows for external benchmarking to measure owner competitiveness and external estimates.

INTEGRATION

# Playing Nice in the Sandbox

Estimating systems increase their value to electric utilities owners by integrating with Design Engineering, Scheduling, Enterprise Resource Planning (ERP), Asset Management, Earned Value Management (EVM), and Portfolio & Project Management (PPM) systems.

Integrated systems are essential for effective collaboration and data management. Integration provides shared and synchronized data across all relevant operational platforms and enhances overall cost management control. Effective integration reduces latent data often found in batch reporting and allows transition to real time information.

Leading firms establish an enterprise data analytics system that aggregates data across operational groups to support analysis and decision making. The estimating system must play its role, continuously feeding data to this system, which is typically a Data Lake connected to a reporting and visualization solution (e.g., PowerBI, Tableau, etc.).

Dashboards and mobile devices display interactive charts and graphs that empower teams to make better decisions using a common set of data without waiting days or weeks for operational reports.

# Conclusion

In conclusion, optimizing the stage-based capital project budgeting process in the electric utility industry requires a holistic approach. By addressing these key components and adopting technology solutions tailored to each stage, electric utility companies can improve budgeting accuracy, reduce errors, and enhance overall project management efficiency.

## Want more information about implementing a stage-based capital budgeting process in your organization?

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