A New Look At Spending Optimization

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Background

Electric utility decisions on where to spend both capital and maintenance cash have historically been driven by system needs viewed through an engineering perspective. Load growth and system efficiency (capacity and reliability) were the primary drivers of investment decisions. Planning activities centered around maintaining adequate voltage, power factor, and system flexibility for outage restoration. “N-1” failure contingency planning was common. “Gold-plating” was acceptable, at times even desirable, based on customer needs and business drivers. In the U.S., utility rates were governed by return on investment and funding was generally available.

However, environmental changes are forcing a new focus on optimizing capital expenditures. Demands for financial integrity, the collapse of the merchant market, and the impact on investor confidence are driving a new focus on efficiency and competing customer demands. In addition, today’s regulatory agencies are equally focused on customer and financial issues. Customers are demanding lower rates and improved reliability. Utilities have less to spend, and shareholders are demanding higher rates of return. As a result, most utilities are no longer driven primarily by engineering needs, but by asset performance and financial returns. Consequently, progressive utilities are separating planned capital spending into strategic and conventional categories in an effort to assist stakeholders in forming a new perspective on the need to optimize limited spending.

To complicate matters, the budget planning process itself is often complex and cumbersome. On average, utilities spend over 70 days in the annual budgeting process creating at least five different versions using a multiplicity of modeling techniques (zero based, activity based, cash flow, historical, etc, but NOT optimization) at a cost of around 1% of annual revenues. The Operations and Planning groups that identify work, and the Financial Group which controls the dollars do not share a common decision making process. Average year end budget variances are generally in excess of 10% and most utilities lack the corporate integration, decision making, and modeling capabilities to generate optimized investment portfolios.

Decision Making

This new environment requires much more rigor by utilities in the decision making processes that govern cash investments. These decision criteria generally include:

- A desire to “sweat the asset” or obtain maximum utilization of plant before replacement while not adversely impacting reliability and avoiding losses on premature asset retirement,
- Maintaining customer satisfaction with asset performance,
- The need to retain margins for shareholder value increase in the form of higher dividends, or investment in current or new growth businesses.
- Rate stability requirements or regulated ROE/ROI.

- Judgmental standards impacted by political decisions (personal needs).

Coupled with the question on how much to spend is the decision on where to spend. Most utilities structure their investment decisions along these general categories:

- Revenue – investing in infrastructure necessary accommodate new load growth,
- Capacity/Efficiency – expanding the load carrying capability of the network to accommodate growth,
- Reliability – investments to ensure that the network responds adequately to natural, electrical, and mechanical forces which impact its ability to provide service continuity. This includes decisions on asset refurbishment, repair, and replacement, before the end of their economical and/or technical life ,
- Flexibility – projects that enhance the ability of the system to respond to abnormal conditions (switching, automatic transfer schemes, effective use of SCADA, etc.),
- Customers – work driven by specific customer needs (relocations, upgrades, etc.)
- Mandated – projects driven by governmental entities such as road projects, and overhead to underground conversions
- Return – where and how (capital or O & M) to invest in a way that enhances financial performance

Thus, the challenge becomes developing a standard set of processes and tools that link financial requirements to operational needs in a way that optimizes the investments. This challenge is complicated by three key issues. First, is the methodology used to select and screen potential project investments. The traditional approach relies on system modeling and field input combined with new customer projections and government mandated projects. While these investment inputs are still part of today's process, they have been complicated by the addition of the asset owner and asset manager roles. ROE, ROI, and other financial measures of asset performance are now included in the decision matrix. This means that more sophisticated opportunity identification and screening processes are needed to validate potential investment options.

The second major concern in today's decision making environment is determining which criteria should be included to evaluate investment options. Traditional evaluation methodologies have focused on basic cost benefit analysis (NPV, IRR, simple payback, etc.) and little else. Today's decisions are influenced by the addition of factors such as customer impact (SAIDI, CAIDI, SAIFI, MAIFI), strategic/business implications (new technology, best practices), and most importantly, risk. This often overlooked factor is now playing an increasingly important role in utility investment decisions.

The last major challenge in the investment decision making process is how to convert all of the potential investment opportunities into an optimized portfolio. But what exactly does "optimized" mean? In the context of investment portfolio balancing, optimized means selecting the group of investment opportunities that satisfy specific criteria (O&M cost, risk mitigation, NPV, customer value, etc.) within a targeted budget range. While these criteria can be similar for every utility, the importance, or ranking, of each will vary between organizations depending on factors such as regulatory environment, current business mode (status quo, growth, isolationism), and funding availability.

Optimization is also influenced by who makes the decisions on what optimizing criteria should be used and how it should be applied. In most mature asset management organizations the asset owner makes the decisions on ranking criteria. These decisions must align with corporate goals and objectives and should be constantly evaluated to ensure conformity with the current and expected operating environment.

One inevitable question that arises in the discussion of optimizing investments is why bother. Discretionary spending for most utilities is limited anyway so is optimizing 20-30% of the annual budget really worth it? The answer is a resounding “yes” and here’s why. Optimizing:

- Ensures alignment between the asset management and financial (CFO) sections of the business.
- Provides an auditable trail that can be used with business counterparts and regulatory agencies.
- Can be used to asses the true benefit of “mandatory” projects.
- Means that the optimal portfolio can be one that does not use the entire budget.
- Ensures that the highest value investments are the ones selected. (value being determined by the Asset Owner’s optimization criteria otherwise known as the strategic objectives)

Current State

Our experience indicates that utilities fall into one of three general categories based on the sophistication of their internal decision making and modeling capabilities:

Novice (Most companies)	Learner (Some companies)	Expert (Few companies)
The 'Technical' View	The 'Economic' View	The 'Strategic' View
Process: Building and maintaining poles, wires, transformers, etc. to ensure high reliability and quality of supply - mature practice, common in most utilities. Tools: Typical budget analysis and reporting	Process: Effective capital rationing through robust financial assessment of options (hurdle rates, NPVs etc) – adolescent practice, being truly integrated in some utilities at present Tools: Financial modeling (NPV, IRR) and cash flow	Process: A holistic view of the asset's lifecycle to plan the optimal operational and maintenance strategies required to achieve business outcomes, commercial goals, and customer satisfaction, supported by integrated processes and systems – infant practice, being developed in a few utilities at present Tools: Financial modeling, cash flow, optimization

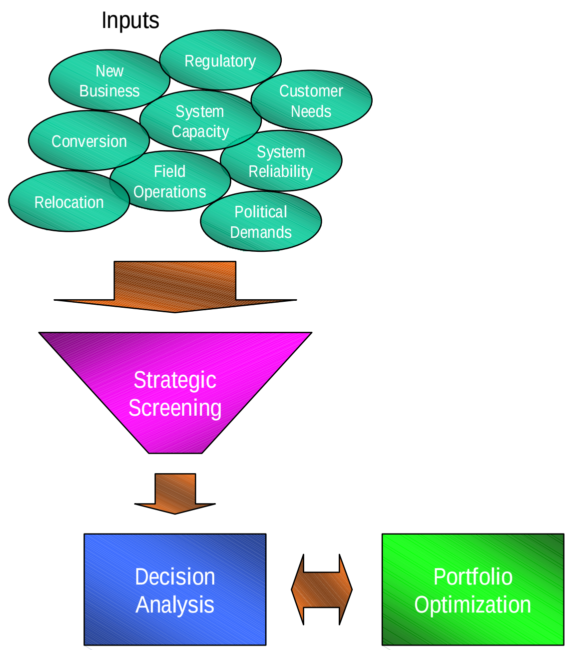
Novice companies use traditional planning and budgeting methods. Engineering and operations groups identify projects based on system and customer needs, generally without detailed justification. Finance groups crunch the numbers and determine that the selected group of projects is too expensive. The budget returns to the engineering and operations groups for revision. The process is circular until some form of agreement is reached.

Learner companies start with the same approach but add detailed financial analysis to justify projects. Budget items are then ranked in NPV or IRR order and summed until the expected budget limit is reached.

Expert companies integrate financial, operational, customer, business drivers, and risk into the project selection process so that identified projects are screened and analyzed simultaneously through portfolio optimization. This provides the financial/operating link necessary for sound investment decisions.

Spending Optimization

One possible solution to the development of optimized investment portfolios is the integration of an efficient process with sophisticated modeling tools. The diagram shows the basic spending optimization process.



The **Inputs** Process collects project investment needs to make sure that all appropriate avenues for input have been given due consideration.

The **Strategic Screening** process serves as a funnel to manage the variety of project input options in terms of duplication, practicality, feasibility, and probability of implementation.

The **Decision Analysis** process evaluates potential projects in terms of their ability to satisfy drivers such as financial cost benefit, customer impact, business and strategic implications, and risk mitigation (the strategic objectives).

The **Portfolio Optimization** process takes outputs from Decision Analysis process and develops the optimal balance of investment opportunities. The process is iterative since refinements made in the Decisions Analysis process will effect final optimization, and portfolio optimization can point to flaws in the Decision Analysis process.

While the optimization process is straightforward the ability to incorporate all of the various subprocesses, decision criteria, strategic objectives and mathematical modeling is not. One process solution developed by UMS Group is supported by an analytical tool that takes full advantage of the mathematical decision and modeling capabilities of desktop tools. Three types of analysis are incorporated in a spending optimization model to support the vast array of decision-making scenarios.

Financial – Financial components of the process are measured in terms of Net Present Value, Internal Rate of Return, and Project Payback using cost/benefit analysis (or other methods acceptable to the finance organization). The figure shows a sample C/B analysis.

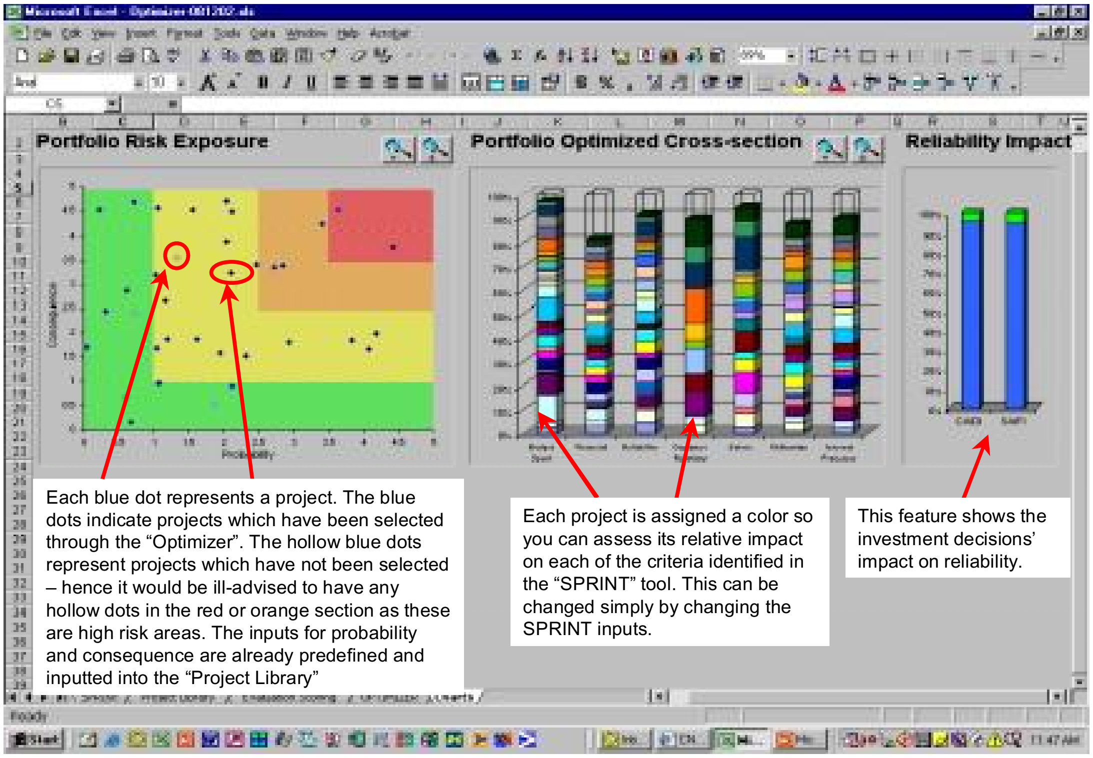
Annual escalation rate: 0.50%								Payback (years): 5				
Discount Rate (for NPV): 8.00%								Net Present Value: $1,307,151				
NPV payback (years): 20								IRR: 22.77%				
Year		Costs					Benefits					Net
#	Actual	Capital	Operating	Maint.	Admin.	Other	Operating	Maint.	Admin.	Revenue	Other	Cash Flow
1	2002	$1,000,000	$15,000	$25,000	$12,500	$5,200	$55,000	$150,000	$32,500	$12,000	$35,000	($773,200)
2	2003		$15,075	$25,125	$12,563	$5,226	$55,275	$150,750	$32,663	$12,060	$35,175	($545,266)
3	2004		$15,150	$25,251	$12,625	$5,252	$55,551	$151,504	$32,826	$12,120	$35,351	($316,192)
4	2005		$15,226	$25,377	$12,688	$5,278	$55,829	$152,261	$32,990	$12,181	$35,528	($85,973)
5	2006		$15,302	$25,504	$12,752	$5,305	$56,108	$153,023	$33,155	$12,242	$35,705	$145,397
6	2007		$15,379	$25,631	$12,816	$5,331	$56,389	$153,788	$33,321	$12,303	$35,884	$377,924

Strategic Objectives – These factors (such as customer impact, risk, strategic impact, etc.) are assessed using Analytical Hierarchy Preferencing (AHP or forced pairs ranking) combined with a driver satisfaction matrix. AHP is used to determine the relative importance between each criteria (% weight) and a ranking scale is used to add objectivity to how well an investment option satisfies specific criteria (for example, if a proposed project decreases SAIFI by 25% it might receive a reliability ranking of 3. If it reduces SAIFI by 90%, it might receive a reliability ranking of 5). Two sample matrices are shown below, the first is for customer drivers, the second for business drivers.

	Residential	**Commercial**	**Industrial**	**Wholesale**	**Key Accounts**
Reliability Improvement - SAIFI	70% reduction in SAIFI	80% redustion in SAIFI	60% reduction in SAIFI	50% reduction in SAIFI	30% reduction in SAIFI
60.00%	**25.00%**	**35.00%**	**20.00%**	**10.00%**	**10.00%**
Reliability Improvement - SAIDI	5% reduction in SAIDI	5%reduction in SAIDI	No reduction in SAIDI	2% reduction in SAIDI	No reduction in SAIDI
40.00%	**20.00%**	**20.00%**	**20.00%**	**20.00%**	**20.00%**

	Shareholders	**Employees**	**Regulators**	**Governments**	**General Public**
Efficiency (Cost Reduction)	6 - 5% reduction on operating costs	6 - 10% improvement in operating efficieicies	7 - 20% improvement in PBR metrics	5 - No impact	5 - No impact
70.00%	**25.00%**	**15.00%**	**25.00%**	**20.00%**	**15.00%**
Best Practice	6 - A minor element in improvimg best pracgice implementation	7 - significant impact on best practice implementation	5 - No Impact	5 - No impact	5 - No impact
30.00%	**20.00%**	**20.00%**	**20.00%**	**20.00%**	**20.00%**

Strategic Screening, and Decision Analysis form the basic Spending Optimization process flow, but there still needs to be a way to optimize the spending plan. The final component in the process addresses portfolio optimization and while other methodologies exist, UMS relies on generalized reduced gradient non-linear optimization to determine the optimum balance of projects that satisfy given criteria. For example, optimization can be based on NPV, risk mitigation, reliability improvement, O&M reductions, or any combination of these factors. An optimizer routine evaluates all possible investment scenarios to come up with the portfolio that satisfies the investment criteria.



A second key component of the optimization process is the ability to generate a risk profile based on the projects selected during optimization. In so doing, Planners can easily identify high risk probability projects/investments and then determine whether they should continue to be included in the optimized portfolio.

The third key component of the process is the ability to demonstrate graphically the impact to CAIDI, SAIDI and SAIFI based on the projects selected during optimization. This allows easy comparison with other optimal scenarios to evaluate the reliability impact of each.

A fourth feature of the process provides the Planner with an efficient frontier based on the optimizing criteria selected. The frontier will tell the Planner the maximum possible (NPV, strategic objective score, etc.) for any given budget level. Comparing the selected portfolio against the frontier identifies how far below optimal the selected set of investments falls. This capability is critical in evaluating the impact of mandated projects in the optimization process.

Lastly, one of the key advantages to the process is its ability to remove political influences and subjectivity from spending optimization decisions. All financial and strategic objective criteria must be quantified through a rigorous analytical approach in the Strategic Screening and Decisions Analysis processes. In addition, budget planners can easily see the impact of adding (or removing) "pet" projects do not add value from a financial, strategic objective, risk mitigation, or reliability standpoint through multiple scenario modeling. They can also readily determine the risk profile of various scenarios in terms of consequence and probability.

As utilities struggle to remain financially viable the pressure for optimizing expenditures will continue to increase. New decision making models and support tools must be developed in order to make better decisions on how to spend limited capital. The Spending Optimization process described in this article coupled with an optimizing tool provides one possible solution.