

Consulting Services to Support Asset Management Decision Making

Statement of Capabilities and Products
VMN Group LLC and S.Chapel Associates

We provide the best in analytical methods and software to aid electric utilities in making sound asset management business decisions. What is unique about our products and services is that they actually provide practical solutions to asset management problems, as well as providing clients with new asset management decision capabilities. In short, our methods work. We provide both software and the training required to use the software to the advantage of our clients. We specialize in solving asset management problems by:

- Assembling and managing the right technical teams, supplementing the client utility's expertise with our technical capabilities
- Applying decision science principles and methods and advanced software engineering to the specific problems of asset management
- Transferring the problem-solving technology we develop to the client by providing training and state-of-the-art software

Asset management is about solving two decision problems: (1) *Managing Aging Infrastructure* and (2) *Project Prioritization*. If these two technical problems are solved correctly, then asset management works and adds value to electric utility operations. If these two problems are not solved correctly, then no amount of so-called asset management, which is very often actually reducible to non-technical internal processes, is worth very much at all. VMN Group and S.Chapel Associates have jointly attacked these two decision problems for over ten years. Our experience and technical backgrounds have given us the skills and understanding required to create and apply successful methods to solve these two problems.

Lessons learned: Managing Aging Infrastructure

Managing aging infrastructure is about answering a fundamental question: what should be done right now with an existing piece of equipment (repair it, replace it, test it, do nothing to it) based on what is known about it (including its age, present condition, manufacturer, service history, repair history, previous test results, ...)?

The fact that there is risk involved with the fundamental decision about any piece of equipment is what makes solving the aging asset question tricky and interesting. (The risks include uncertainty about the occurrence of a costly equipment failure and uncertainty about the true condition of any equipment.)

The first lesson we learned about the problem is that proper problem formulation is essential. Everyone knows that the asset management problem involves risk. The technical issue is how the risks are analyzed. Problem formulation and mathematical modeling are the key ingredients to the risk analysis. S.Chapel Associates and VMN Group LLC have arguably done more problem formulation and technical model development work in this area than any other organizations working on electric utility aging asset

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problems. We have developed methods that handle the risk problem correctly. Our experience in this area can be a valuable asset to your organization.

The second lesson we learned is that the decision problem cannot be adequately handled without sound analytic tools. Ordinary methods are inadequate to solve the asset management problem correctly. This is because the best asset management policy must combine the effects of the dynamic behavior of equipment with the risk of the occurrence of failure and the uncertainty about the true condition of the equipment. We have developed the specialized tools that combine all the relevant aspects of the problem.

The third lesson we learned is that client data is a key element of the analysis and the solution, but that utility data is often incomplete. We have special expertise that allows clients to combine existing data with expert judgment to provide the critical inputs to the analysis.

The fourth lesson we learned is that new methodology cannot be successfully integrated into utility management practice if that methodology is viewed as a black box. Therefore, an essential aspect of successful asset management is the training required to transfer the technology to the utility. Our objective is to hand off the software to the client so that the client will be able to perform the required analyses in the future.

We implement these four lessons in our practice. We deliver working, client-customized software that solves the asset management problem and we help the utility client to become proficient in the application of that software and the solution of the problem.

Lessons learned: Project Prioritization

Similarly to managing existing infrastructure, project prioritization is about answering a fundamental question: which projects can be safely deferred and which projects should be done immediately?

Once again, the first fundamental lesson we learned about prioritization is that proper problem formulation is essential. Our formulation of the problem is dynamic: we ask what we ought to do *this year*, subject to budget constraints (money, personnel, capacity,...), to add the most value to utility operations over the foreseeable future? The dynamic formulation immediately suggests the deferral approach (*what can wait until next year?*), rather than the more traditional ranking by benefit/cost ratio, which tends to miss the dynamic opportunities of deferral.

The second lesson we learned about prioritization is that it is fundamentally important to measure the values that the utility assigns to the various changes provided by projects of all kinds. The power of a successful project prioritization method is that it can select among all projects—distribution, transmission, generation, information technology, customer relations, ...--in a transparent, explainable,

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justifiable, and repeatable way. We approach this aspect of the work by creating, together with the utility client, a precise mathematical representation of projects that translates the real-world changes provided by any project into a consistent measure of value provided by those changes to the utility. Building such a *value model* is neither overly burdensome nor time consuming but requires special skills, which, arguably, most consulting firms do not have. VMN Group and S.Chapel Associates have created special methods, honed by experience, to create value models.

The third lesson we learned is that the value model must be built before the software that solves the prioritization problem is implemented. We have created customizable software for solving the prioritization problem because no single software package is generally applicable. The key issue is customization based on the structure of the value model.

The fourth lesson is, as above, that the project prioritization methodology cannot be viewed as a black box by the utility clients. Senior management must support and in fact require the use of a formal, mathematical approach to the value measurement problem and they must also approve the structure and parameters of the value model. The technical staff of the utility must view the value model and the prioritization methodology, including the recommendations of the deferral criterion, as completely credible and explainable. Our experience in building value models and prioritization systems for electric power companies has allowed us to create an approach whereby we work closely with both the technical staff and management. This approach allows us to produce a system that actually measures value to the organization and that has credibility within the organization.

As in our work in managing aging infrastructure assets, our prioritization practice is guided by the lessons we learned. We begin a prioritization effort by creating the client-customized value model. We then deliver working, client-customized software that solves the project prioritization problem. We provide the training necessary to enable the client to apply the software to future prioritization analyses.

In both these problem areas, our objective is to provide problem-solving technology and train the users in the use of that technology. We are available as needed for future work, of course, but our fundamental aim is to provide solutions that are usable directly by our clients.

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Our Team

S.Chapel Associates and VMN Group have had a long history of working together to provide practical analytic methods to electric utilities that support infrastructure management decision making

Mr. Stephen Chapel

Mr. Chapel, formerly of EPRI and now heading S.Chapel Associates, created the original analytical asset management group at EPRI and spearheaded the efforts for over twenty years. Chapel has expert knowledge of utility business analysis methods and has proven problem solving and analytical capabilities. He is well known for his ability to take projects from the conceptual stage to a practical implementation. Working with VMN Group LLC, Chapel led the development of analytic methods for (1) repair / replace decision making of T&D infrastructure and (2) utility project prioritization and project portfolio management.

Dr. Charles Feinstein

Dr. Feinstein is Associate Professor of Operations and Management Information Systems at the Leavey School of Business, Santa Clara University. Dr. Feinstein is cofounder of VMN Group LLC, a quantitative consulting company. He also teaches in the Department of Management Science and Engineering at Stanford University and in the Department of Industrial Engineering and Operations Research at the University of California, Berkeley. Dr. Feinstein has over 25 years of experience in research, teaching and application of mathematical methods and modeling. His areas of expertise include optimization methods, dynamic systems analysis, and probabilistic modeling.

Dr. Peter Morris

Dr. Morris is the Co-founder of VMN Group LLC. He is also a Consulting Professor in the Department of Management Science and Engineering at Stanford University where he teaches the art of mathematical modeling and probabilistic systems. He served as Chief Executive Officer of Applied Decision Analysis, Inc. until ADA was acquired by Pricewaterhouse Coopers in August, 1998; then he served as Managing Partner of the ADA subsidiary until May 31, 2001. Dr. Morris is an expert at solving problems that do not fit standard textbook patterns. He is recognized for his ability to provide practical solutions through the application of probability theory and decision science methods.

Chapel, Feinstein, and Morris have worked together starting in the mid 1980s. Recently they worked as a team to implement the EPRI Project Prioritization System at over 15 large electric utilities. A key part of their team effort was developing the project valuation system (value modeling). This was done in a series of two-day workshops with some follow-up. Together, Chapel, Feinstein and Morris are expert at developing value models for quantifying the benefits of projects in terms of contribution to corporate goals.

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Software Products

The following products are presently available. Other products are under development.

1. Management of Aging Assets. The software identifies the least-cost policy for managing aging assets. The policy integrates replacement, repair, testing and maintenance. The methodology is based on the formulation of the aging asset problem that includes risks associated with asset failure and uncertainty about asset condition.
2. Value of Spares. Spare assets can provide great value. The software implements a methodology that finds the value of spares throughout a geographically diverse system of assets. Site-specific values are found and the optimal number of spares at each location is identified.
3. Value Model. The software provides a customizable platform for specifying the value model for an arbitrary collection of specific utility attributes, such as reliability, cost, power quality, environmental impacts, customer satisfaction, and any others.
4. Project Prioritization. The software solves the prioritization problem using the value model and budget constraints as inputs. The software implements both the deferral criterion and the benefit/cost ratio ranking to aid decision-making.

Company References:

We have worked with the following utilities in each of the problem areas. Specific utility contacts are available upon request.

Management of Aging Assets	Project Prioritization
MidAmerican Energy (underground cable) Public Service Electric and Gas (breakers) ATC (transmission lines) PJM (transmission transformers; spares valuation) Southern Co (wood poles) LIPA (wood poles) Hydro Quebec (transmission transformers) Consolidated Edison (breakers)	MidAmerican Energy Nashville Electric / TVA Baltimore Gas and Electric Exelon AEP HECO Texas Utilities CPS Energy.