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Specific Responsibilities

Joined Smallworld Systems (now part of GE Energy) in 1997. Currently responsible for GE Energy's utility engineering management product line, including long range product planning, product requirements, marketing plans and collateral, and liaison with software development teams.

Past Experience

Over 15 years of experience in the GIS industry, including positions in product marketing in the transportation and government markets, and GIS software engineering in the utility, public safety, and petroleum industries.

Educational Information

M.S. - Applied Geomathematics, Stanford University

B.S. – Geophysics, Brown University

Professional Memberships

GITA

The Benefits of Integrated Design
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Abstract

Graphical design layout tools are now widely used in utilities, but the ability to produce designs that meet customer needs while maximizing cost, maximizing reliability, and accounting for future growth remains an imprecise and subjective process. Integrating design layout with analysis & optimization, long range system planning, and reliability studies provides designers with sophisticated tools for generating designs that are accurate and consistent across the business. The result is a measurable ROI due to low-cost initial construction, the ability to adapt to load growth, and improved reliability for the as-built network. This paper outlines the benefits of an integrated design approach a focuses on how the business process of any utility can be improved by exploiting these tools.

Introduction: State of the Industry

Through our work with utility customers as well as industry research organizations, it is clear that utilities are struggling with a wide variety of business drivers. Deregulation/re-regulation and mergers and acquisitions are compounding the issues that companies are facing. Among the many issues being balanced today, the following are particularly daunting:

- **Customer growth.** Ongoing new residential development and renewal projects translate into increased power generation as well as the need for faster design and construction. Complicating the trend is the large growth in underground residential design (URD), the ever increasing size of residential service, and the need to accommodate more and more special loads. Smaller, high volume jobs can form up to 85-90% of design work in some utilities, and outsourced design and construction is increasing in an effort to keep up with this growth.
- **Operational efficiency.** Driving costs out of the business while meeting the demands of customer growth is difficult. The current business climate imposes severe cost constraints on utilities, often with reduced capital budgets to work with. Utilities have more projects to accomplish than funding, resulting in new challenges across the organization to reduce costs.
- **Regulatory compliance.** Regulatory agencies are focusing on reliability, and are setting performance and reliability standards and imposing penalties on utilities that fail to meet those standards. As a result, utilities must proactively enforce designs that meet stringent safety and reliability criteria while maintaining cost controls.

One of the obvious areas of scrutiny for meeting increased demand, lowering costs, and increased reliability is the design phase of the utility process. Today, many utilities still maintain

generic templates for the design process. These guidelines (e.g., a 3000 square foot residential design) have been passed down from experienced engineers to a new generation of designers who in many cases no longer have formal education in electrical engineering. These “rules of thumb” may or may not be based on sound engineering judgment, and the current staff may not have the knowledge (or the time) to change them to meet the changing requirements.

In addition, a smaller number of designers are being asked to process an increasing number of work orders more rapidly. Those designs are increasingly subject to reliability constraints with penalties levied if they do not meet the standards. These productivity requirements have often caused designers to rely on extremely conservative design methodology, allowing them to process work orders more quickly with confidence rather than take the time to evaluate alternatives that could result in more cost-effective and reliable designs.

Fortunately, utility design software vendors have responded to this market need by developing automated design layout tools, analysis and optimization functions, and other productivity tools designed to help the designer of any experience level to insure the proper configuration at the lowest cost.

The Design Process: Current Technology

Obviously, the need to integrate automated design tools into the utility environment is not a new concept – there are many offerings in the marketplace today, and even a cursory look through previous GITA conferences reveal presentations relating to this topic. And in fact, many commercial vendors as well as utilities themselves have implemented design solutions to solve some of the problems mentioned above. A brief summary of the technologies that have been implemented to assist the designer include:

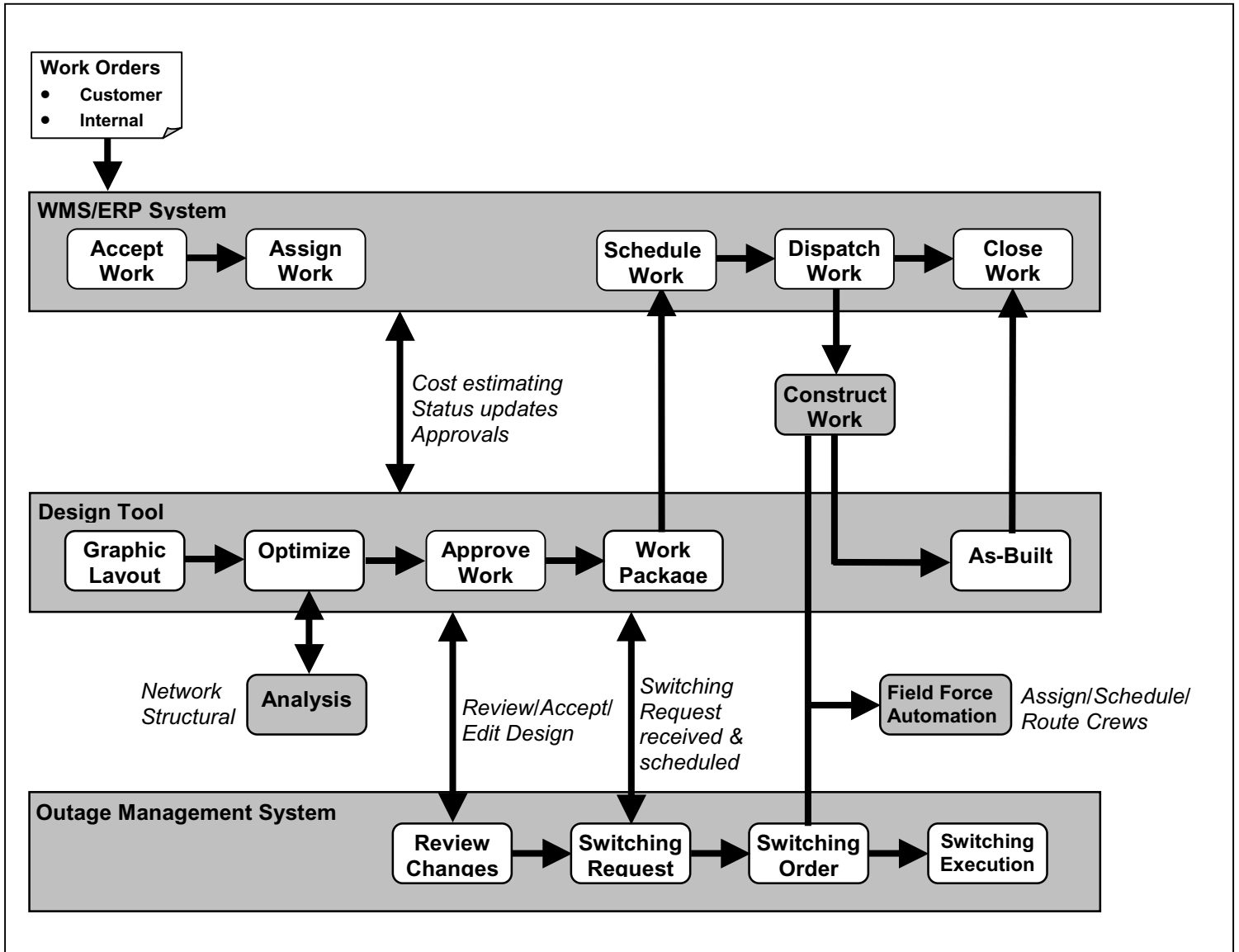
- **Design layout tools in the GIS.** One of the basic enhancements to the design process is the ability to design with automated layout tools directly in the GIS. These tools eliminate double entry of CAD and GIS data, makes the progression from design to as-built states seamless, and enhances the accuracy of the as-built network. With this capability, many utilities have been able to significantly reduce the size of their traditional mapping departments.
- **Integration with Work Management Systems (WMS).** Automated design is made more effective by the integration of a WMS. Integrating design functionality with a WMS provides the ability to develop designs through the utility's workflow process, design by compatible units allowing cost estimates in the GIS, and potentially the automate the scheduling of the construction work.
- **Network analysis & optimization tools.** Today, many utilities are taking advantage of analysis products, providing their designers with more engineering capabilities to insure that designs meet industry standards but are not over-built. With the use of compatible units, various design scenarios can be developed and compared for the least cost, best engineered solution. Challenges remain to insure that the design will be constructed as planned, as construction crews typically do not like wide variety in the construction work.
- **Field design.** True field design – not merely redlining data and bringing back to the office for incorporation - enables utilities to take work requests to the field, prepare designs with a complete set of layout tools, support the workflow process, and ultimately synchronize with the corporate network repository. Working in the field promotes improved data quality, reduces the time required to develop designs, and actually improves safety by providing a more accurate view of the network to the as-built model more rapidly. Customer satisfaction is also improved by enabling the ability to generate cost estimates on site.

The Future: Integrated Design

Despite these significant technology improvements in the utility design process, there is a larger, more comprehensive view held by GE and others regarding a future vision of the “integrated utility”. One aspect of this vision depicts the design function as becoming tightly integrated with not only analysis and optimization tools, but also with other utility processes such as transmission and substation design, operations management, and field force automation to achieve a faster, more cost efficient, and accurate design environment. Further addition of reliability information and predictive information which today is still in many cases relegated to reactive asset management practices will further the efficiency and accuracy of the design process.

- **Analysis & optimization.** Completely integrated analysis provides design validation using proven methods with less training. Moreover, using these tools, accurate designs can be completed faster. Structural analysis insures that local regulations are met for each design without requiring detailed knowledge about local requirements, e.g., automatically selecting the correct pole class or calculating cable length to meet sag regulations. Combining analysis and optimization tools with effective layout tools allow users to efficiently “right size” the network and insure service standards are met related to power quality. This includes the incorporation of traditional load flow, short circuit, flicker calculations, etc. and the addition of an optimization module that automatically selects minimum sized components that allow the design to meet published service standards. Incorporating complete load research statistics will generate more accurate results based on peak loads and estimated load growth.
- **Operations management integration.** Design tools integrated with outage management systems (OMS) can generate a view of the future network to allow switching orders to be executed to be prepared when the designed network is energized. In addition, an integrated design/operations system insures synchronization of the asset and operational models. Once the design is laid out, the OMS can build/update validate the operational circuits, generate the switching request, and schedule the switching order to be executed. Also, there are network changes and updates which are generated by the OMS that must be applied to GIS, e.g., permanent switch status, transformer replacements by emergency crews etc. Having an integrated flow between systems allows work requests to flow easily in either direction, including the generation of switching requests directly from the design system.
- **Field force automation.** In conjunction with field design, field force automation will drive efficiencies throughout the design and construction process by improving the way work is managed and delivered in the field. Integration with field force automation effectively manages the continuum of work orders, from short-duration, high-volume tasks to complex installation, maintenance, and construction projects. In addition, this technology provides a communication platform for field technicians through traditional and new mobile portals and gateways. As a result, field force automation drives faster design creation, approval, and construction by more intelligent scheduling of field resources.
- **Long range system planning.** Planning scenarios can be developed that accommodate projected load growth, rural vs. urban and overhead vs. underground alternatives. Different planning scenarios can then be compared based on cost and capacity, allowing better decision making and overall reduction in cost of supply to the end customer. Integrating transmission and distribution designs and looking at the interplay between transmission, substation, and distribution for purposes of capacity planning, contingency analysis and coordination of protective systems will provide a far more complete and robust design environment by considering all of the potential impacts on the as-built network.
- **Design for reliability.** Sophisticated design for reliability encompasses more than simple cost based optimization; it also includes accounting for the long term performance of facilities. It also embodies strategic analysis and planning that leads to what we call “optimal planning”. This capability allows the use of the traditional analysis tools, along with measurement and projection of reliability, to optimize designs from both a cost and reliability standpoint.

Figure 1. Potential workflow with an integrated design solution



A “Typical” Customer Study

Through GE’s work with utility customers throughout the industry, we have been able to characterize a profile of a “typical” customer for the purposes of understanding the potential benefits of an integrated design system. While the actual budget numbers and the percentage return on investment (ROI) will obviously vary among different organizations, this profile suggests that there is a measurable ROI to be gained by implementing an integrated design environment.

Design Integration Study	% Gain	Without Integrated Design	With Integrated Design	Annual Return
Annual Project Admin Staff Running Costs		\$40,000	\$20,000	\$20,000
Project administration costs are reduced significantly due to digitization of the tasks. (Reporting, Scheduling, Document transfer, and manual record keeping of project deliverables)	50%			
Annual Project Engineering Department Costs		\$1,040,000	\$305,760	\$734,240
Accessibility of data reduces project department costs	30%			
Productivity improvements	40%			
Staff costs reduced through reduced skill level requirement of project staffing	30%			
Savings from Capital and O&M Budgets			\$140,000	\$140,000
Capital Construction Budget – Annual		\$2,000,000		
O & M Budget – Annual		\$5,000,000		
Reduced materials	2%			
Efficient, Optimized Designs			\$1,250,000	\$1,250,000
Number of major projects each year		50		
Average project cost		\$250,000		
Budgeted ROI (months) on projects		12		
Average time (months) to plan a project		2.0	1.8	
Reduction in planning time	10%			
Average time (months) to design & draft the project		10.0	9.0	
Reduction in design, drafting and engineering time	10%			
Annual Cost of Field Design Changes		\$1,500,000	\$1,425,000	\$75,000
Average number of field design changes per year		3000		
Average time to document field design changes per change		2	1.9	
Reduced documentation time on field design changes	5%			
Planning and Reliability Studies		\$1,875,000	\$1,687,500	\$187,500
Ave number of hrs managing third party contractors per year		7500	6750	
Rapid exchange of design data from project team to contractor	10%			
Hourly cost of third party contractors		\$250		
Hourly cost of a field design change review		\$250		
Design Integration with Operations Management System			\$200,000	\$200,000
Productivity improvements by previewing designs in a “future view” for generation and execution of switching orders	10%	1,000,000		
Reduced time by generating work orders from the OMS	5%			
Reduced time by generating switching requests during design	5%			
Total Estimated Savings				\$2,706,740

Summary & Questions

The technology related to engineering design for the utility market has matured significantly over the last several years in response to the growing need for a more integrated design process as part of a larger effort to keep pace with customer growth while reducing costs and improving reliability. Nevertheless, the next generation of utility design technology will require the design process to become even more tightly integrated with other utility business processes, including analysis & optimization, operations management, field force automation, long range system planning, and reliability studies. This development promises to provide further improvements in these critical business areas. As the vision of the truly “integrated utility” becomes closer to reality, the complete integration of data and processes will support efforts to reduce operations and maintenance costs, improve reliability and manage customer/regulator expectations.