High-Performance Analytics for The Smart Grid

This white paper is the result of a research survey conducted by GTM Research and the SAS. More than 70 North American utility executives responded to this survey.
1 INTRODUCTION

Today, the concept of data is being redefined to express its inherent value. Some have referred to data as “the new plastic”, while others refer to it as a new class of economic asset like currency or gold. Still others classify data as now being one of the essential factors of production, equal in importance to land, capital, and labor.

All of this points to the mounting desire to search data for new patterns, insights, and business value through analytics. This technology evolution is squarely on the mind of executives at the leading North American utilities who are actively involved in on-going, large-scale smart grid deployments.

No matter how one defines data or how often the term big data is used, the true power of this data across all areas of the smart grid, ranging from consumer management to grid operations, has yet to be capitalized upon. The utility industry remains very much in the early years of the seeking and deploying high performance analytics for the smart grid.

Utilities are increasingly grasping the potential of analytics and being more proactive in decision-making, adjusting their strategy using predictive analytics. These advancements will allow utilities to side-step potential problems and capitalize on the smart grid investments.

Apart from a growing interest in predictive analytics, the survey presented below confirms that utilities:

- Continue to consider reliability their highest priority.
- Continue to consider data integration, regardless of source, the most critical aspect in implementing and achieving the benefits of data analytics.
- Remain focused and concerned with the fundamental challenges of implementing sound data architecture and data governance.
- See the most momentum in analytics in two primary domains: customer analytics and grid operations analytics.
- Consider the main barriers to a broader deployments of analytics to be availability of budget and the lack of related skills among employees.
- View their own senior management and staff as being attuned the value that analytics can engender.

We will begin by covering the demographics of the respondents and then proceed by presenting the survey results.

1.1 Survey Respondent Demographics

The demographics confirm that this survey reached its intended audience. 70 percent of respondents were senior executives or management, and 66 percent reported having either extensive, in-depth knowledge or a good working knowledge of their company’s existing analytics. In terms of the average size of the utilities, roughly half of our survey respondents represent utilities, which have more than 1.5 million customers, with 2/3 of the total respondents representing investor-owned utilities.
Q: How many customers does your utility serve?

- 250,000 to 749,999: 16%
- 750,000 to 1,499,999: 17%
- 1,500,000 or more: 47%
- Don’t know: 1%
- Less than 250,000: 19%

Q: Which most closely describes your utility?

- Investor-owned: 66%
- Municipal: 21%
- State / Provincial: 6%
- Co-operative: 3%
- Services Vendor: 3%
- Districts: 1%

Q: Which best describes your job level?

- Manager: 43%
- Director: 15%
- Analyst / Staff: 30%
- Sr Vice President / VP: 4%
- C-level Executive: 4%
- Supervisor: 4%

Q: What is the extent of your knowledge regarding your organization’s use & deployment of business analytics software?

- Extensive, in-depth knowledge: 26%
- Good knowledge: 40%
- Limited knowledge: 28%
- Little to no knowledge: 6%
2 HOW UTILITIES DEFINE BUSINESS ANALYTICS

Figure 2-1: The Top 3 Components of Business Analytics

This first section of the survey concerns how utilities understand analytics, and what the term analytics actually means to them. As the results show, prediction and data modeling is the leading component of analytics today, with 63 percent of respondents including this capability in their top three selections. Forecasting, data management and business intelligence (BI) also received high marks. Perhaps most telling in terms of where electric utility thinking currently stands is the fact that data visualization, often seen as a critical component to analytics capabilities, polled rather low with only 26 percent. All of the above points to utilities seeking a more proactive approach to running their business but still having a somewhat limited understanding of the overall potential of analytics.
Moving to the Future from Business Intelligence to Business Analytics

The enthusiasm for prediction and forecasting suggests that utilities are moving from yesteryear’s BI capabilities into the promising realm of high performance business analytics, where more predictive and proactive decisions are being made across a utility’s operations and business strategy. Instead of focusing on what happened, utilities can now use their analytical mindset to focus on a more progressive agenda. This is especially important in light of changing regulation and business models, as well as new smart grid-related applications including advanced demand response programs, higher renewable energy penetrations, energy portfolio planning, and new dynamic pricing models.
Our next survey question focused on the most desired capabilities that utilities are looking for as part of their analytics deployment.

**Figure 2-2: The Top 3 Critical Aspects of a Data Analytics Solution**

Notably, this question, which had previously been asked in survey that SAS had conducted one year ago (2011), generated a number one response consistent with last year’s survey. Namely, the top rank went to the ability to integrate data regardless of source. While this is not surprising to anyone familiar with the utility industries “silo-ed” systems, departments and data sources, it does reinforce the critical importance of solid data architecture as well as strong data governance (which is the #2 response to the question). The issue here, which utilities have rightly noted, and a lesson learned across industry-at-large, is that the results are unrewarding if you try running analytics on low-quality data.

Further, the fact that complex event processing polled so highly indicates that utilities are best at understanding the importance and functionality of analyzing streams of data that have been combined from a variety of data sources in real-time. Complex event processing gives rise to myriad operational benefits ranging from real-time crisis and outage management to dynamic load shifting or “shedding”, and has to be considered fundamental to all grid optimization efforts.
While big data moves quickly into the utility space as millions of new smart meters, synchrophasors, and other intelligent devices are being activated each year, a question regarding how much of that data will be unstructured (any information that is not defined in a database such as email, video, audio, images, document, web, social media, sensor data, etc.) highlights the sea change facing the utility industry. As the above results show, more than half of respondents are expecting unstructured data to account for more than 40 percent (and up to 79 percent) of all data over the next five years.

This points the way for a wave of new technology adoption and investment as well as a trend away from traditional relational databases management systems. Accordingly, we expect new big data platforms such as the open source Hadoop, as well as massively parallel processing (MPP) appliances now provided by a range of global IT vendors, to generate strong interest from utilities.

Notably, while Hadoop has quickly emerged as the big data platform for the web and retail industries, among others (and now is used at scale by Amazon, Facebook, Linked-In, Netflix, American Airlines, the NASDAQ, and utilities such as San Diego Gas & Electric, and the Tennessee Valley Authority (TVA)), there remains hesitation by most utilities to become so-called early adopters. The leading perceived barriers include security, uncertainty and privacy. It is our expectation that as more Hadoop-specific platform vendors emerge, these concerns will quickly be overcome and help Hadoop go even more mainstream, attracting more utility adopters.
And so our investigation of how utilities are defining, conceptualizing and understanding both big data and analytics has them looking for proactive predictive capabilities, while understanding the immense challenge of integration of various source of data, while also recognizing that data itself might be quite different in the coming years.
3 AREAS OF APPLICATION

Despite the increasing number of new smart grid applications, from the utility perspective improving reliability, quality and efficiency of the network stills reign supreme.

Figure 3-1: The Importance of Business Analytics

Utilities are highly risk-adverse and it is clear that they have not lost sight of reliability as their top priority. Dynamic pricing and new products and services also appear to be front of mind for utility executives. (Please note: in the chart above, and all similar charts, the number 5 signifies as the most important or valuable, while the number 1 denotes the least important or valuable).
The next question we asked was which of the utilities’ functional domains currently has the most momentum in terms of analytics solutions. The results confirm that consumer analytics and grid analytics are where the action is today. These responses were hardly a surprise; this has been the primary area of conversation in response to the challenges of how utilities can give more value to consumers, differentiate themselves, and continue to ensure high reliability.

On the customer side, analytics would leverage web portals and data apps, and could provide examples such as budget assistant apps and mobile text alerts (helping customers save money and alerting customers of potential outages and service restoration estimates). Further benefiting utilities would be customer segmentation analytics that would make more efficient use of marketing dollars for new and existing programs - notably demand response - not to mention other possibilities such as revenue protection analytics, which would discover potential fraud or theft occurrences.

On the grid operations side, there are countless operational areas that we expect will be enhanced by analytics. The principal aims will be to maintain high reliability and to optimize both the transmission and distribution grids in the face of higher renewable penetration, shifting regulatory models, extreme weather, and even the possibility of mass adoption of electric vehicles.

Examples of Grid Analytics

- Transformers analytics
- Substations-related analytics
- Fault detection and outage analytics
- Load prediction analytics
- Power quality/power factor analytics
- Network analysis
In looking at the areas that hold utilities back from greater levels of analytical adoption, having the available budget remains the largest barrier (as it was in last year’s survey). Frankly, this is going to remain a major challenge, as IT budgets on the whole are dwarfed by traditional hardware and infrastructure investments. The other economic challenge which respondents selected is determining or proving the payback. This may be seen as the silver lining in the longer term because the ROI that analytics generate can often range between 5X – 10X.

The other major barrier is the talent gap, which in our view will be solved by the ‘rising tide that lifts all boats’ phenomenon. As analytics enters industry at large (that is, across all conceivable verticals) and becomes business-as-usual, we believe that a greater number of individuals will have analytical competencies as part of their overall skill sets. Moreover, there are an increasing number of educational institutions that are now offering advanced degrees in the field of analytics.
Figure 3-4: What prevents day-to-day use of analytics

Unlike the last chart which focused on enterprise-wide adoption of analytics, this question targeted daily usage constraints. Once again, the lack of skills, or more specifically the time needed to gain those skills, was a leading barrier with 41 percent of respondents selecting the option ‘not enough time to learn analytical techniques.’ (Note: multiple selections were allowed). Also garnering attention as a barrier was not having the right tools installed. Missing tools and techniques illustrates that this industry is in the early years of adoption, which matches our view based on our extensive conversations with utilities on this topic.

The other critical barriers are focused squarely on the data itself, with “not enough data when I need it” and lack of ‘confidence in the data’ coming in as the third and fourth responses, respectively. With regards to both, and as a number of utilities have recently explained to us, utilities feel that they still need to perform some basic work on data architecture and data governance before they can approach more sophisticated applications and analytics. If you refer back to Chart 1, you’ll notice that “advanced data profiling and data quality” was the second most popular choice for the top components of analytics; it appears that getting sound data and having the right amount of data necessary for running analytics is at the moment both a challenge and a tremendous opportunity.
4 DERIVING VALUE FROM ANALYTI CS

Unlike other questions in our survey which pointed toward one or two main conclusions, this question resulted in fairly even responses. This is actually telling in its own way and suggests that there are broad opportunities for analytics across the board. This question allowed for multiple answers, and at least 40 percent of our respondents selected AMI network management, meter data management, asset management, distribution automation (DA), and load and price forecasting as areas that would be improved by analytics. It's difficult to argue with this conclusion, as this is what we have been signaling to the electric utility market for the past several years.

**Figure 4-1: What Areas of Operations Would Most Benefit From Using Advanced Analytics?**

![Bar chart showing areas of operations benefiting from advanced analytics](chart.png)

Source: SAS

When one considers how asset-intensive the electric utility business is, with annual capital improvement budgets for utilities with more than 1.5 million customers often ranging between $1- $2 billion, it becomes clear that asset management will be garnering quite a bit more attention in the coming years as utilities find use cases not only for predictive maintenance analytics, but also for total asset lifecycle management.
The next survey question ‘leads the witness’ by offering several benefits that would result from embedding analytics into decision-making. Interestingly, higher trust in the business strategy and happier customers appear to be the leading responses. With all of the changes that utilities are currently undergoing as a direct result of the smart grid such as new smart meter programs, new pricing programs, new demand response programs, and so on, it is encouraging that they feel that analytics can help their business strategy. Clearly the utility business is becoming a lot more complex in light of these changes, and we would like to believe that utilities will be able to utilize and profit from analytics just like other industries (notably banking, online services, and retail) which have each already benefited tremendously from more strategic decision-making by leveraging analytics.

Further, it’s important to highlight that increased reliability (and safety), which was the voted the most important priority (in Chart 4) is here signaled as a top benefit.
This question looks at how the various stakeholders understand the value of analytics. It is encouraging to see that respondents voted that utilities’ senior management best understands the value of analytics over all other stakeholders. This is especially important because this group has the most power to encourage and invest in the continued deployment of analytic tools and training. We were also encouraged to see managers and staff equally informed, and further to see that regulators actually do have a sense for the value of analytics, which of course is very important for the increased investment in this space.
The last survey question asked utilities to rate their own analytical competencies and does a good job of displaying where the industry is at this moment in time as utilities begin to look for more value from data and analytics. The most popular response, according to mean values, is that efforts are underway to share smart meter data across the enterprise for analysis. This makes perfect sense based on the extensive rollout of smart meters, which has occurred over the past five years. While sharing that meter data with other utility departments (and customers) for analysis is clearly an important first step, it is just that – a first step. In our view, if you read the above answers from left to right, you find the solutions become more comprehensive and sophisticated and point the way to where utilities may be a few years, with operations data being shared across the enterprise, reliability increased and analytical techniques being championed system-wide.

Source: SAS
5 ADDITIONAL GTM RESEARCH FINDINGS

1. While utilities like to claim that they have analytics today – most really do not. Utilities tend to have last-gen BI reporting solutions, as discussed above in Part 2, that they call ‘analytics’. These typically amount to no more than reporting tools or descriptive analytics (primarily based on ‘old school’ database architectures running SQL), as opposed to the real-time and predictive analytics using complex event processing that truly represent analytics.

2. Utilities are beginning to shift their focus from infrastructure to software in 2012. In the leading countries and regions deploying smart grid technology, namely the US, Canada and Western EU, Northern EU, the past five years (2007-2012) have largely been concerned with the installation of the necessary foundational infrastructure to begin and support smart grid such as smart meters and other next-gen hardware (new reclosers, capacitor banks, solar panels, EV chargers, etc). As we round out the first decade of smart grid, utility focus and spending is quickly pivoting to the underlying software layer.

3. We are now in a period of history where data is moving from human scale to machine scale. Sensor data and machine data are in fact two of the fastest areas of big data growth; we expect both to play a large role in the utility space.

This white paper was written by David Leeds, Chief Smart Grid Analyst at GTM Research.

Moving ahead, GTM Research and SAS will continue to offer the leading-edge research and products related to high-performance analytics and big data. For more current information, the above survey results were also covered in a recent webinar which first aired on November 13, 2012, and can be found at: www.greentechmedia.com/events/webinar/high-performance-analytics-new-utility-research-unveiled-about-analytical-c

SAS, the leader in business analytics software and services, helps utilities turn huge volumes of data into new insights that can be used to explore previously unimagined possibilities. With SAS, you can bring all of your information together, ensure its quality, perform advanced analyses and quickly share results. SAS helps utilities manage a flood of smart grid and AMI data; forecast demand; optimize equipment/asset performance; understand customers; identify risks; streamline reporting and more. Since 1976 SAS has been giving customers around the world THE POWER TO KNOW®.

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