The Current State of Smart Grid Analytics

A Utility Analytics Institute Research Study, sponsored by ABB

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Executive Summary

Digitalization. The Internet of Things (IoT). Big Data. Clearly, there is no shortage of business buzzwords to describe the impact of our economy's shift to an interconnected, data-driven information age. Central to this discussion for utilities is the application of more advanced analytics to improve utility business operations. So, how are utilities prioritizing today's technology investments regarding the adoption of advanced utility analytics?

The evolution to a smart grid requires a robust technology infrastructure and the ability to effectively leverage a host of data sources. A "smarter" grid will enable utilities to make the grid more resilient and optimize grid planning, management, and operations. Key components of a smart grid include two-way communications technologies, control systems, cutting-edge software tools, smart meters and other intelligent sensors, relays that recognize and recover from faults, automated feeder switches that re-route power as needed, batteries able to store excess energy, etc. Each utility is at a different place on this journey to the utility grid of the future.

To gauge how far utilities have come, the Utility Analytics Institute (UAI), fielded the "State of Smart Grid Analytics Survey" in January 2017. Sponsored by ABB, the goal of this project is to shed some light on the industry's digitalization roadmap by looking at what projects and initiatives are currently underway and to identify the challenges that early adopters are experiencing.

There are reasons for optimism about the current state of smart grid analytics and the progress that has been made in recent years. From UAI's vantage point, the analytics maturity of the industry has increased substantially. It is equally evident that the industry has a long way to go. Additional investment is needed in the grid's infrastructure, supporting technology platforms and tools (e.g. distribution management systems, intelligent sensors, communication networks) and advanced analytics capabilities — including the necessary people, process and technology foundation required for analytics success.

The business challenges confronting utilities require a more intelligent grid supported by advanced analytics — and while there are signs that a smarter grid is emerging, the pace needs to quicken given the rapid pace of disruptive change being experienced by the utility industry.

Introduction

This report, "The Current State of Smart Grid Analytics," was produced by UAI; ABB sponsored its development. Following a brief overview of the research methodology used, this report begins with an examination of utility business challenges and to what extent analytics can help utilities address those challenges in the eyes of utility representatives. Challenges limiting analytics success are explored and an overall examination of the current state of utility analytics is provided. The report concludes with a deeper dive into smart grid analytics — and where things stand today.

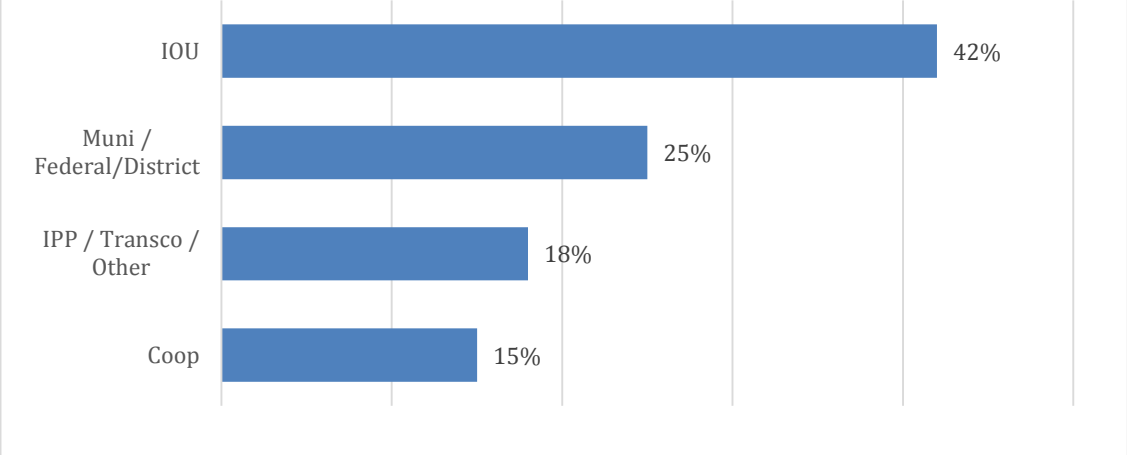
Survey Methodology and Profile of Respondents

The Utility Analytics Institute fielded the "State of Smart Grid Analytics Survey" to collect information about utility business challenges, how and to what degree analytics are being utilized to address those challenges, and the current state of analytics, including a specific look at analytics enabled by AMI and a smart grid. The survey ran from January 19, 2017, to February 6, 2017, and closed with 76 complete responses. Only utility representatives were permitted to participate in the survey.

The demographics of the survey respondents add context to survey outcomes. As reviewed through this report, the unique characteristics of each utility impact the company's analytics strategy, adoption of analytics, deployment of innovative technologies, and analytics practices. Factors such as utility size, the regulatory environment, geography served, and the utility services provided pose unique challenges and present unique opportunities that in turn influence each utility's data analytics needs.

As shown in Figure 1, most survey respondents work for an investor owned utility (IOU). Of the IOUs represented, approximately 60% serve more than one million meters. Over 75% of the total respondent population work for utilities that provide electric service, 27% work for utilities that provide natural gas service, and approximately 18% work for utilities that provide water or waste water services.

Figure 1. What type of utility do you work for? (n = 65)



There is substantial diversity in the job responsibilities of the respondents, ranging from chief operating officers to engineers to analysts and they represent many different business functions. Thirty-one percent characterized themselves to be in a business role, 28% answered operations/field, 22% said planning and 14% replied IT/technical. The remaining 6% answered Other and identified themselves as executives or in quality assurance, regulatory, engineering/design, and sales support positions. Additional respondent demographic information is provided Appendix A: Additional Respondent Demographic Information.

Utility Business Challenges and the Role of Analytics

Challenges

Nearly half of the survey respondents said that their utility's number one business challenge is to improve operational efficiency and reduce costs. No other challenge came close — not challenges related to the integration of distributed energy resources, not selection of implementation of new technologies, and not the stability and reliability of the network/grid.

Mark Johnson, UAI executive director, was asked for his reaction to these findings and said, "These results come as no surprise to me. Economic uncertainty, flat to declining revenues, changing rate structures, the increasing adoption of solar, and evolving utility revenue models explain why survey participants would put improving operational efficiency and cost reduction at the top the list of utility challenges."

People-related challenges were also identified by some respondents and included leadership and collaboration issues, changing culture, and maintaining a qualified staff. Similar sentiments about people-related challenges have been shared in recent months during UAI working group calls and conferences. Grid modernization, solar-related challenges, customer retention and burdensome regulations were also mentioned by survey respondents.

Can Analytics Help?

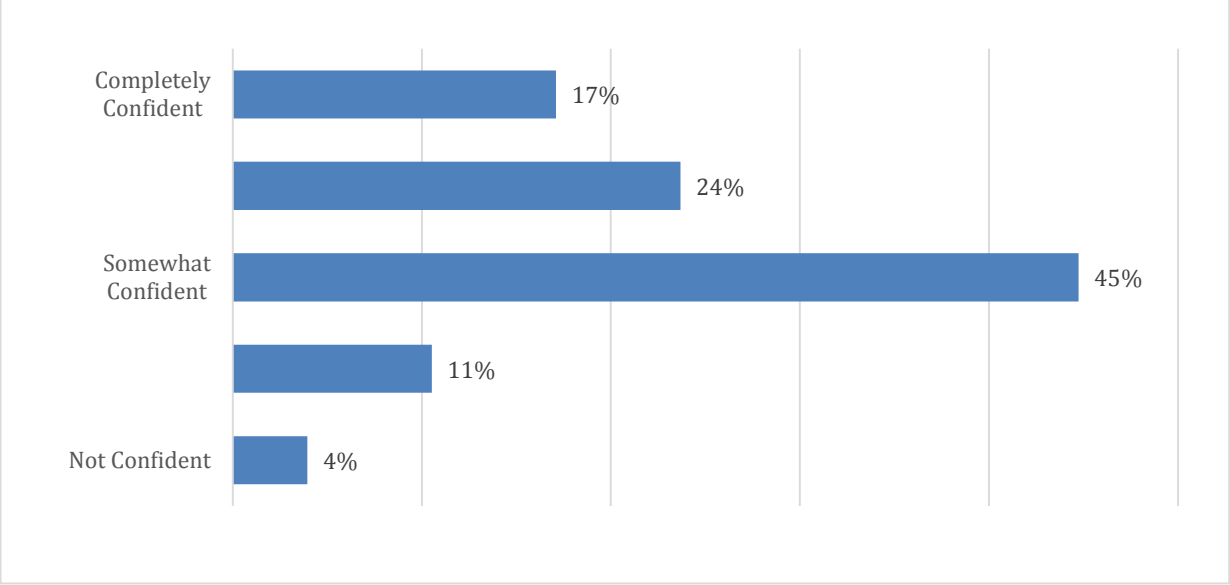
Respondents were asked how confident they are that analytics can help solve the most crucial issue facing their utility using a one to five scale where one is not confident and five is completely confident. Seventeen percent answered completely confident. In this age of digitization, the IoT and predictive analytics, one would expect to see many more respondents select completely confident.

> ***We collect a TON of data that is NOT used. Data analytics can play a huge role in how we address operational efficiencies and better spend our limited capital budget.***
>
> **"Completely Confident" Customer Business Manager**

The good news is that a total of 86% were either completely to somewhat confident that analytics could help to address what they perceive to be their utility's number one business challenge.

It is hard to imagine why 15% have reservations about whether analytics is not at least part of the answer to the primary business challenge that they identify. Analytics challenges are explored later in this document and help explain the skepticism of some survey participants.

Figure 2: On a scale from 1 to 5 with 1 being not confident and 5 being completely confident, how confident are you that data and analytics will help address the challenge you identified in the last question? (n = 76)*



*May not equal 100 due to rounding

The respondent comments below help to illuminate the reasons behind the survey results.

Completely Confident

- Engineer: "We have tons of data but no way of integrating and drawing out useful pieces of information to assist in the challenges."
- Internal audit: "It's one thing to get the data, it's another thing to properly analyze it."

Somewhat Confident

- Strategic planning engineer: "Holes in historical data, accuracy of data, paper-based storage of some data, management question reluctance to 'accept analytics.'"
- Manager of substations and telecommunications: "We have a lot of data but we have not fully utilized our analytics to more efficiently model our system."

Not Confident

- Planning manager: "Systems and tools not geared towards a data mining culture in the business. Data accuracy is an added problem."
- Energy efficiency manager: "Lack of understanding."

After looking at these results, Mark Johnson, UAI executive director, said, "Analytics competence, and confidence in one's ability to leverage data analytics, are essential if utilities are to successfully overcome complex business challenges and adapt to the disruptive changes impacting the industry today. Utilities will find it impossible to effectively manage an increasingly complex grid or navigate the rapidly changing expectations of customers, regulators and other stakeholders without robust analytics capabilities."

Analytics Challenges

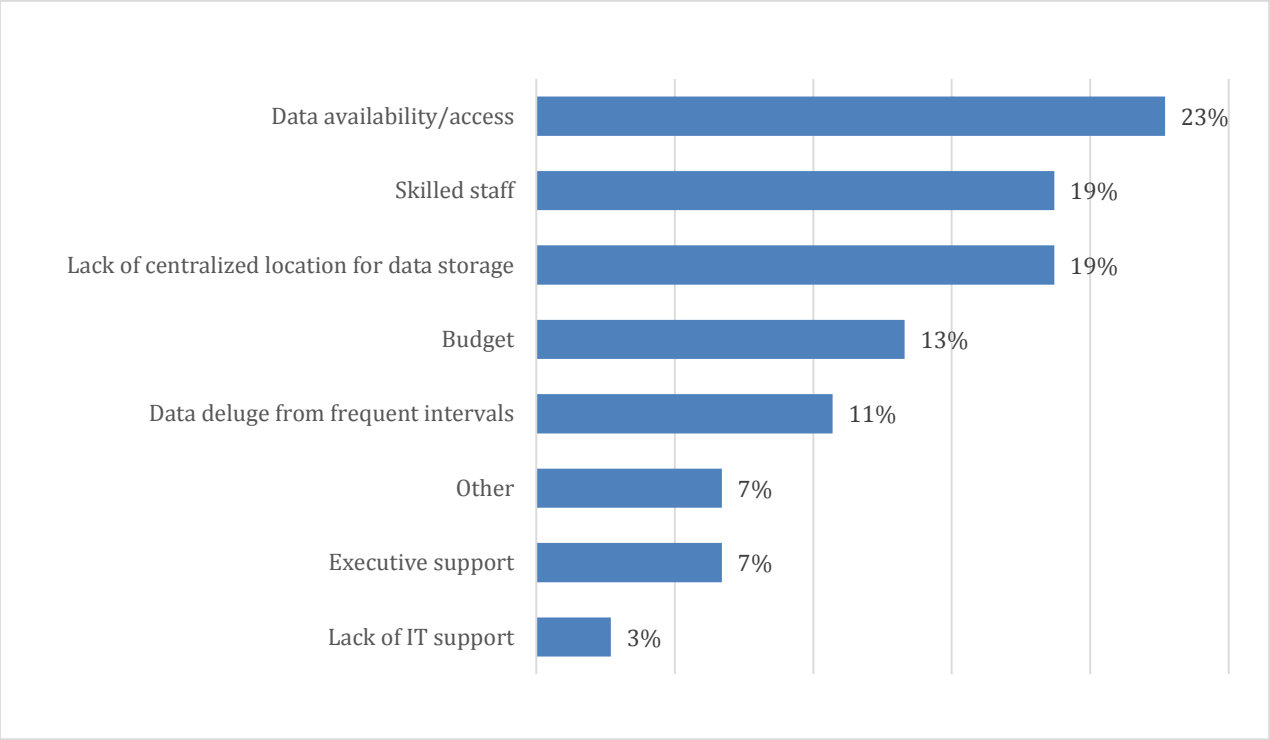
The Biggest Hurdles

Interestingly, for all the press that budget constraints are holding back the implementation of analytics projects, this survey found that four challenges outranked it. Topping the list is data availability/access (23%), followed closely by both skilled staff and the lack of a centralized location for data storage, which each were identified as a top challenge by 19% of respondents.

Only 13% sited budget as the number one challenge for their current analytics projects. Together, these findings indicate that the biggest hurdles for 60% of the market harken back to the current state of the data itself and the shortage of people who know what to do with it.

The top analytics challenges identified here echo respondent comments about their level of confidence that analytics can help address the most pressing utility business challenges.

Figure 3. For the analytics projects you have worked on, what is the number one challenge? (n = 75)*



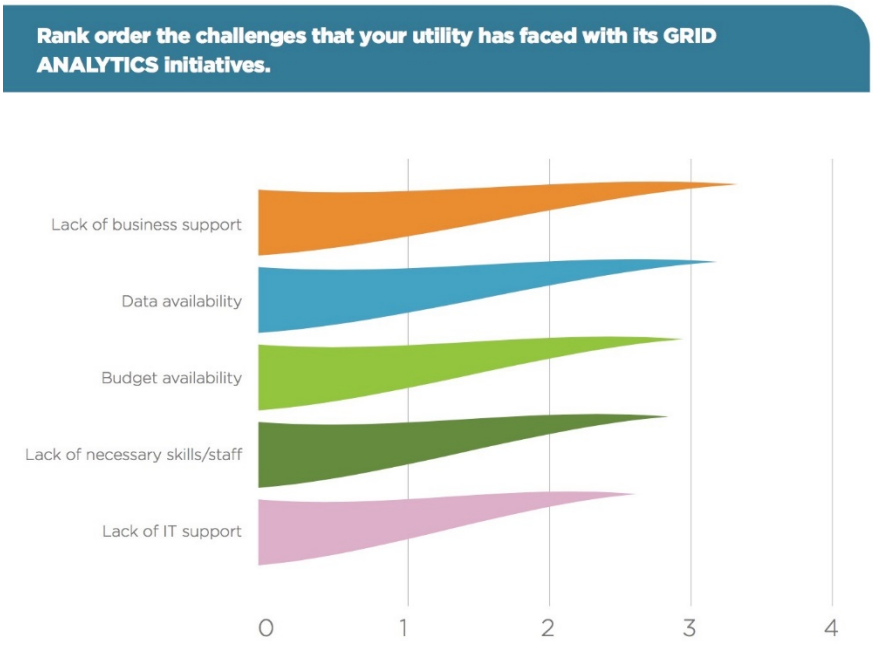
*May not equal 100 due to rounding

The results of this research align very well with other UAI research findings. In mid-2015, UAI fielded a study[1] that asked respondents to rank order these analytics challenges: budget availability, lack of business support, lack of IT support, data availability, and lack of necessary skills/staff.

[1] Utility Analytics Institute. (Dec. 18, 2015). *Utility Analytics in 2015: Part One.*

For grid analytics initiatives, though tightly clustered, the rank order produced is shown in the following chart with budget in the middle of the pack.

Figure 4. Rank order of GRID ANALYTICS initiative challenges based on a mid-2015 UAI research study[2]



Lack of business support was identified as the number one challenge for grid analytics initiatives with other challenges following close behind.

UAI research in 2014[3] found the lack of necessary skills/staff (44%) to be the number one grid analytics challenge (compared to just 24% in UAI's 2012[4] research). Budget availability no longer held the top spot, falling from 34% in 2012 to 22% in 2014 and into second place. This change may be here to stay as most utilities have already made investments in foundational analytics-enabling technologies such as AMI.

[2] Utility Analytics Institute. (Dec. 18, 2015). *Utility Analytics in 2015: Part One.*

[3] Utility Analytics Institute. (March 13, 2014). *Grid Analytics Report 2014.*

[4] Utility Analytics Institute. (February 13, 2013). *Grid Analytics Report 2012.*

Grappling with Analytics Challenges

Given the nexus between the level of confidence in analytics to address business needs and analytics challenges, it is important to understand how utilities are currently addressing these challenges.

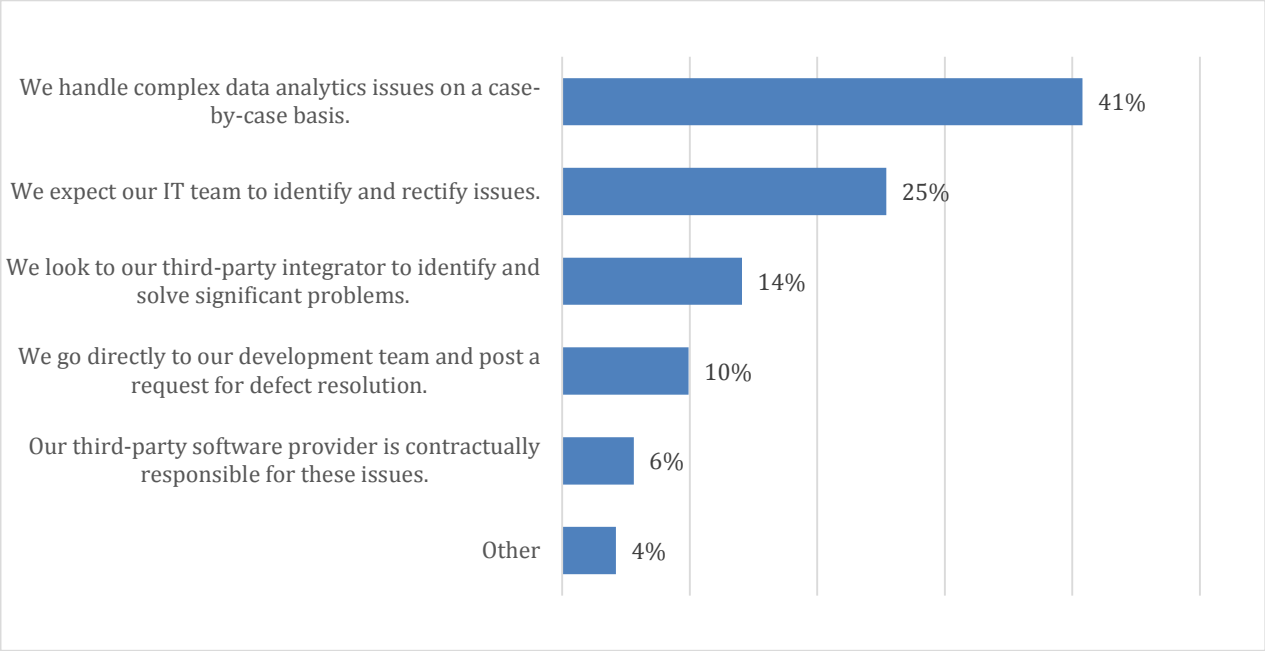
- Forty-one percent say that complex data analytics issues are handled on a case-by-case basis.
- Twenty-five percent expect IT to identify and resolve analytics-related problems (e.g. system issues, data quality issues, process problems, data governance issues).
- Ten percent say that they take analytics issues directly to the development team.

A case-by-case approach to solving analytics challenges seems to reflect the absence of an analytics organizational model or a comprehensive data management structure. Many utilities still look to IT to solve every data-related problem and meet every business need. That approach is not sustainable. IT alone cannot resolve data quality problems. Process owners cannot afford to wait for IT to generate a report to uncover the root cause of an outage or customer service issue, nor is IT staffed to do so. The bottom line is that IT simply cannot address every data analytics challenge of the utility enterprise.

Approximately 20% of utilities look to third-party integrators or software providers for help with complex data analytics challenges. Providers of analytics solutions and services can fill skillset gaps and supplement staffing, especially during the deployment of new analytics programs or systems. These providers enable utilities to speed implementation and avoid lost time related to the learning curve that often accompanies modern technologies. While utilities may ultimately decide to staff support of analytics programs in-house due the strategic value of the data asset, it is not always practical to add utility staff in the short term. UAI's Mark Johnson put it this way: "Utilities often bring in outside experts to help them learn to ride the analytics bike but eventually they want to understand and manage the data asset so they can ride the bike without assistance — or perhaps even build their own bike."

UAI has observed more leading utilities implementing new organizational models to support the utility's analytics strategy and to address analytics challenges, ranging from data access and availability to data governance. Some examples of the organization structures being adopted are described in the following section.

Figure 5. When we encounter complex issues with our analytics systems, we are most likely to begin resolving them by taking the following action. (n = 71)



The Current State of Utility Analytics

Analytics System/Program Deployment

The organizational models employed to support analytics vary. This research study and previous UAI research[5] show that IT owns the responsibility for analytics within some utilities. For others, that responsibility is shared by a cross-functional team. For still other utilities, multiple groups/some number of individual business units typically including IT are responsible. Sometimes, individuals who UAI refers to as "analytics champions" step up to drive the adoption and use of analytics. These individuals are agents of change, with job titles that vary from executive to analyst, and they can be found in various parts of the utility enterprise.

To more effectively leverage the data asset, more utilities are taking steps to define and execute an enterprise analytics strategy, create analytics roadmaps, and implement robust organizational structures to support analytics and address the analytics challenges previously identified. Analytics centers of excellence are being established and data governance councils are being formed, especially by the larger

[5] Utility Analytics Institute. (January 20, 2017). *Analytics Maturity Assessment 2.0.*

utilities. And, along the lines of what is happening in other industries, Exelon Utilities recently filled a vice president and chief analytics officer position.

Twenty-four percent, the largest percentage of survey respondents, say, "We are too early in the deployment process for any major changes to our organizational structure, but we do have an ad hoc team that is working on developing our data management strategy." Seventeen percent have developed and published standards for data management and 11% have a cross-functional data council in place. For more information on how survey respondents characterized their company's analytics program deployment, see Appendix B: Analytics Program Deployment.

Analytics Capabilities/Maturity

The survey underlying this report also sought to gauge the overall analytics capabilities and maturity of those utility companies represented by survey participants. The research shows the following:

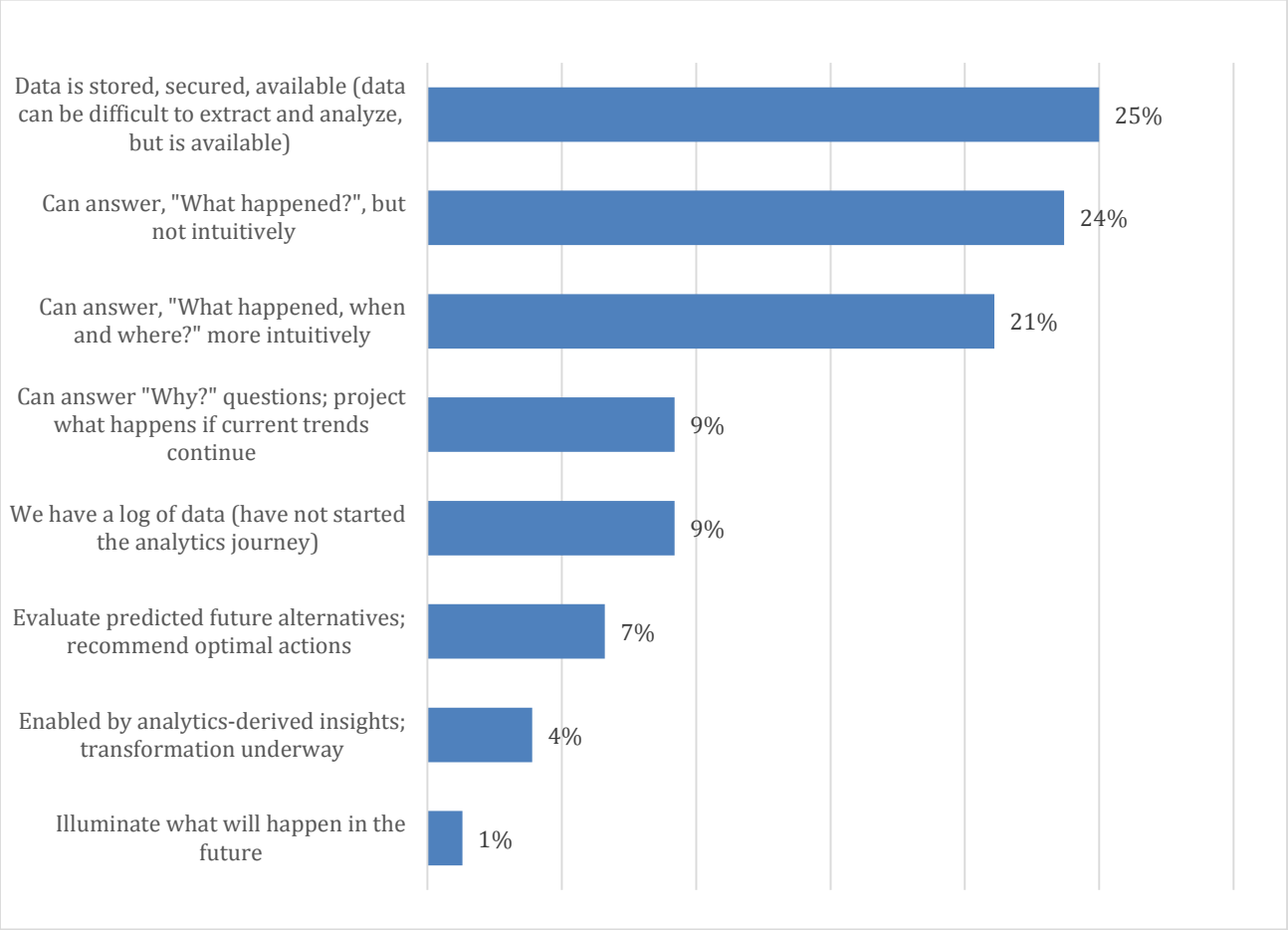
- Twenty-five percent find data difficult to access
- Twenty-four percent rely primarily on basic reporting
- Twenty-one percent depend on business intelligence capabilities
- Nine percent have gone beyond descriptive analytics (data about what happened in the past) to diagnostic analytics and use analytics to answer the all-important "Why?" questions
- Eight percent say that their utility employs predictive and/or prescriptive analytics

The ability to use analytics to drive business transformation is a high bar, so the fact that 4% say that such a transformation founded on analytics-derived insights is underway is impressive. On the other hand, 9% say that their utility has not yet started the analytics journey.

"There seems to be more opportunity to improve efficiencies with processes, projects, etc., but there is a lack of leadership, vision and willingness to move in that direction. Why is this?"

Energy Efficiency Manager

Figure 6. How would you define your utility's use of data and analytics currently? (n = 76)



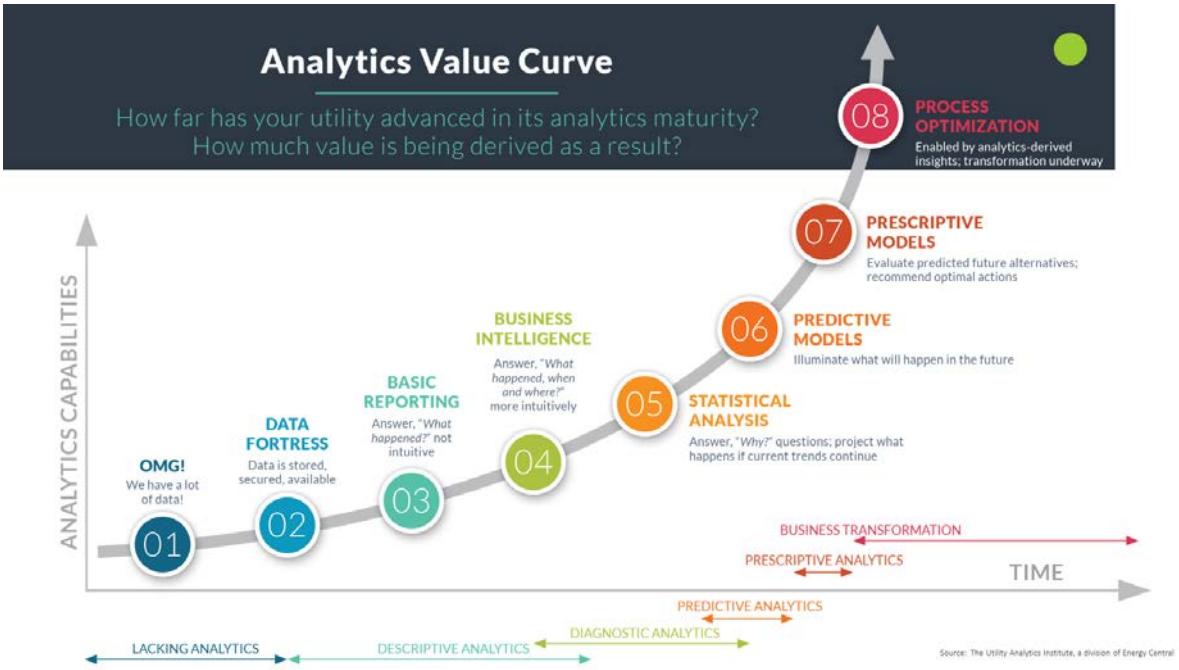
Looking at these results, UAI's Vice President Kim Gaddy said:

"Over the past six years and since the Utility Analytics Institute was founded, we have observed a dramatic increase in the industry's overall analytics maturity. In the early days, it was largely about the business value being produced using descriptive analytics. The analytics success stories of late involve the use of predictive and prescriptive modeling and machine learning. Accompanying these successes are enterprise analytics strategies, new organizational structures, and more comprehensive data management methods.

The large IOUs are generally further ahead though there are exceptions. Some cooperatives and municipal utilities have impressive analytics resumes and some large IOUs lag. Overall, the gap between those at the lower end of the analytics maturity spectrum and those at the top appears to be widening. We, at the Utility Analytics Institute, believe that those utilities that embrace analytics will be best able to weather the disruptive changes underway in this industry."

Comparing the above research results to the UAI's Analytics Value Curve in 7, we see that a substantial majority of utilities are living in the bottom half of the curve.

Figure 7. Utility Analytics Institute's Analytics Value Curve



While plenty of business value can be derived from basic reporting and business intelligence, significant value remains untapped at the top of the curve using more advanced analytics, such as predictive and prescriptive models.

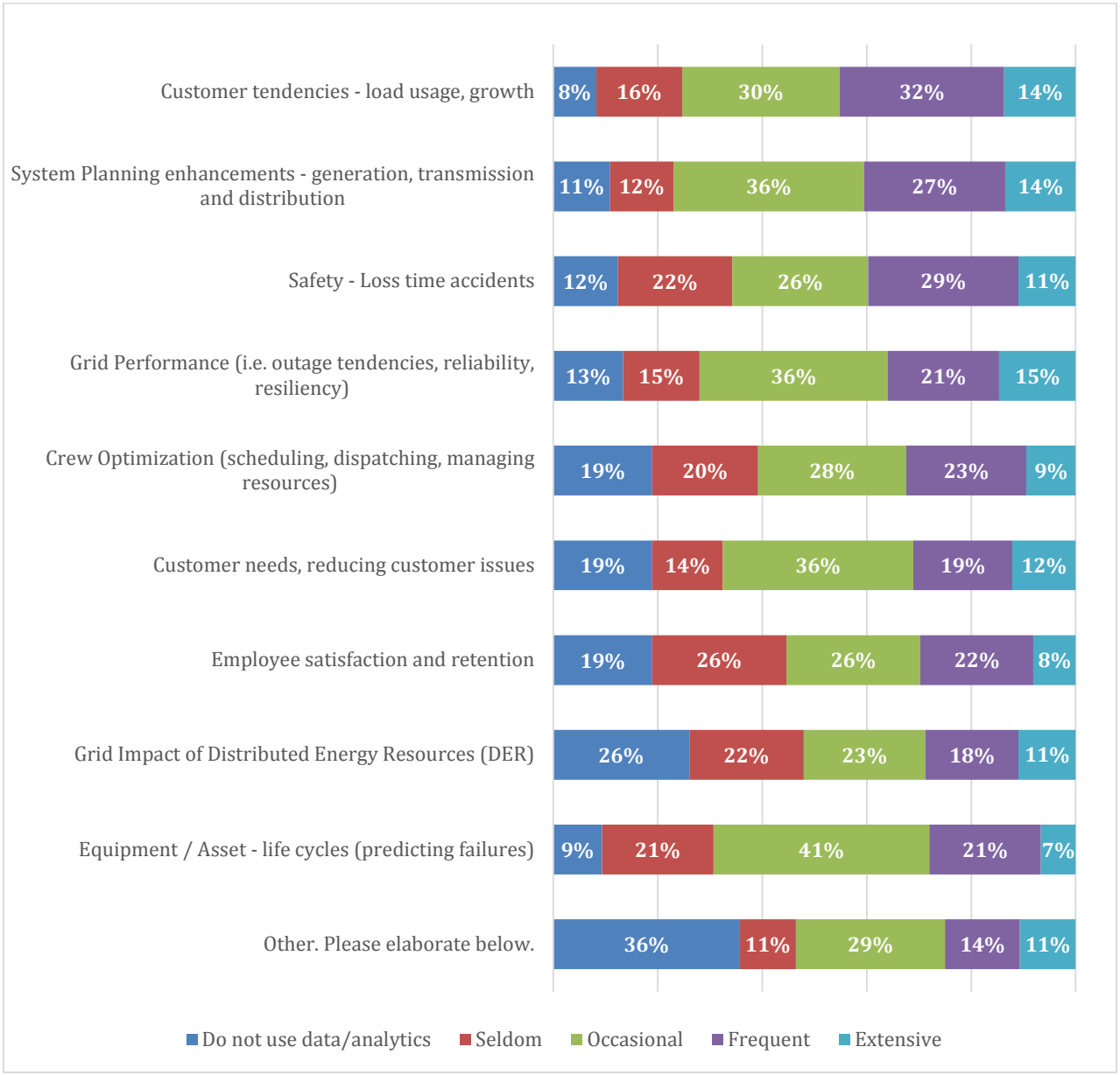
> **"We need a cohesive vision for analytics."**
>
> ---
>
> **Strategy Development Manager**

Analytics Applications

The research then looked a bit deeper, and sought to determine in what domains and to what degree analytics are currently being used. The survey identified common business applications for analytics and asked survey respondents about the relative usage of analytics within these applications. A five-point scale with one being do not use data/analytics and five being extensive use was employed to capture survey participant input.

As shown in Figure 8, the frequency of analytics use does not speak to the strategic value generated from those analytics. However, this data does provide a glimpse into the degree to which a data-driven culture is emerging within the utility industry.

Figure 8. To what extent are you using data and analytics to address the following concerns? (n = 75)



The above chart is rank ordered based upon the combination of frequent or extensive use responses, from highest to lowest. The areas with the most frequent or extensive use of analytics are:

- Customer tendencies — load usage, growth: **46%** (32% + 14%)
- System Planning enhancements — generation, transmission and distribution: **41%** (27% + 14%)
- Safety — loss time accidents: **40%** (29% + 11%)

Given the above listed applications, why would the combination of extensive or at least frequent use not be closer to 100%? It may be that some of the analytics challenges described earlier in this document are having a dampening effect on the overall frequency of analytics usage.

The areas with the largest number of responses in either the do not use data/analytics or seldom used categories are:

- Grid impact of distributed energy resources: **48%** (26% + 22%)
- Employee satisfaction and retention: **45%** (19% + 26%)
- Crew optimization (scheduling, dispatching, managing resources): **39%** (19% + 20%)

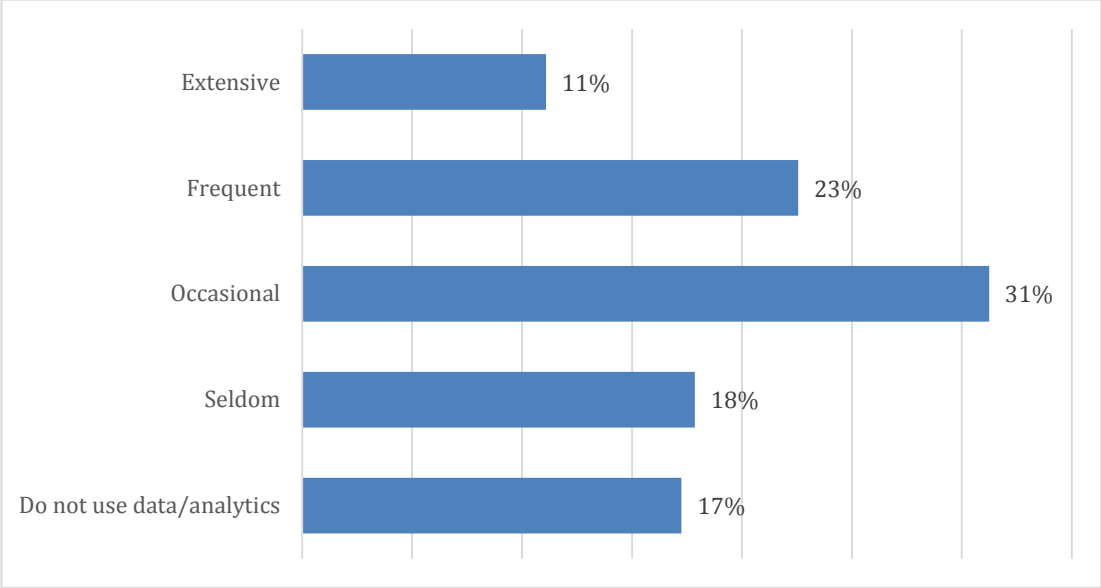
The above data raises more questions than it answers. Why are data analytics not being used more often in these three areas? While the appearance of the grid impact of DER in first place in the seldom or do not use data/analytics category is surprising, it makes sense for utilities with limited or very low DER penetration and the emerging nature of analytics in this area. One would expect to see this number rise along with the increasing growth and adoption of renewable energy sources.[6]

Peeling the onion and examining the grid performance (i.e. outage tendencies, reliability and resiliency) category in more detail, the percentage that selected extensively or seldom use is identical. — both at 15%. For the equipment / asset — life cycles (predicting failures) category, 21% answered frequent and the same percentage answered seldom. Analytics utilization in these areas produce a graph that looks a lot like a bell-shaped curve. The fact that the percentage selecting extensively and seldom use or frequent and seldom use is identical within a given application category suggests that there is a significant difference in the analytics maturity of utilities — at least within individual application areas.

Another way of looking at Figure 8 is to take the question "To what extent are you using data and analytics to address the following concerns?" and look at the frequency of responses in the option categories (do not use data/analytics, seldom, occasional, frequent, extensive) as shown in Figure 9. The data produces a bell-shaped curve distribution once again and shows that over one-third of utilities frequently/extensively use data/analytics to address concerns while roughly another third seldom use or do not use.

[6] The U.S. Energy Information Agency projects that solar power will be the fastest-growing source of renewable energy in the United States, with annual growth averaging 7.5 percent in the period from 2012 to 2040. In 2013, solar generation accounted for 1.8 percent of total renewable generation. In 2040, this is projected to climb to 10 percent. Online March 2017.

Figure 9. To what extent are you using data/analytics to address the concerns shown in Figure 8



Top Three Analytics Initiatives

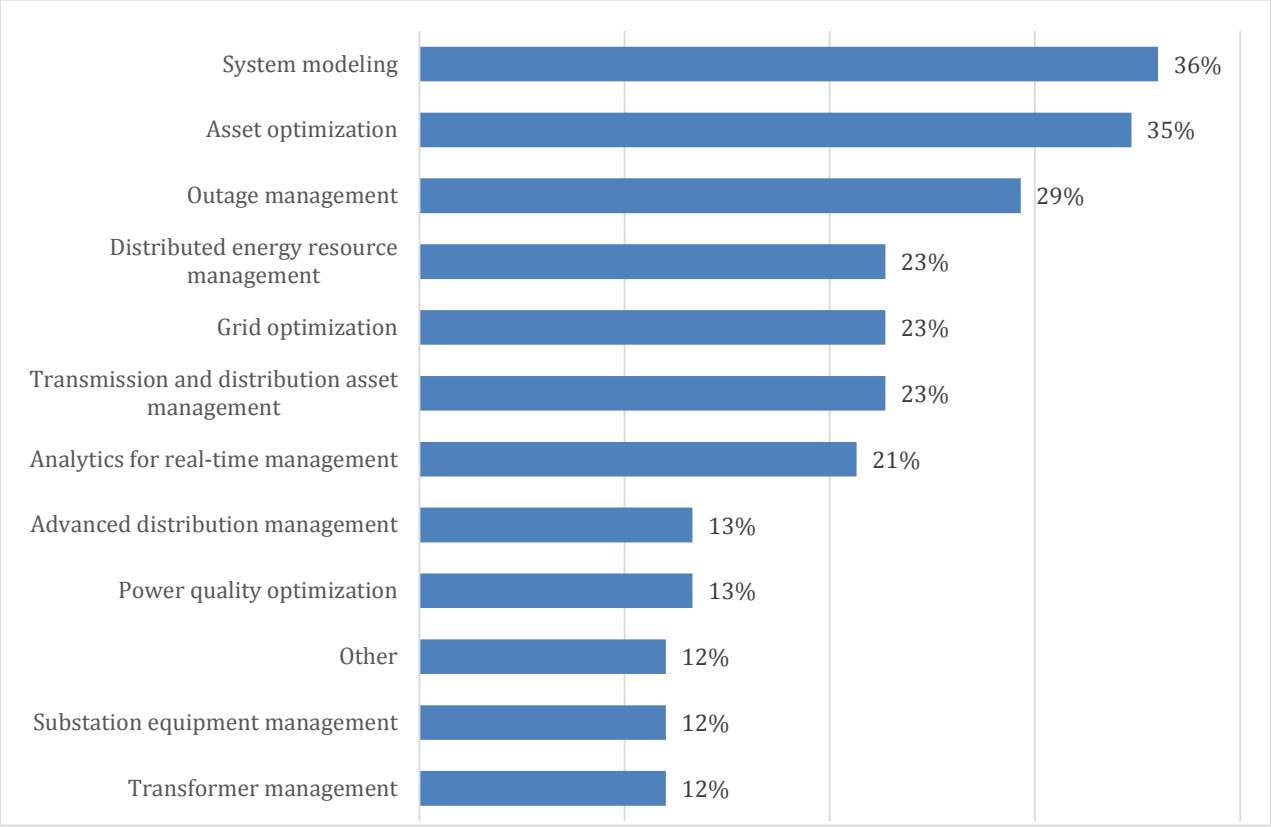
Survey respondents were asked to select the top analytics projects (up to three) being worked on by their group from a list of possibilities. Displayed in Figure 10, it is hard to argue with system modeling, asset optimization, and outage management being on top — all grid-related projects. It is worth noting that all three of these areas are huge drivers of utility operational and capital expenditures given the relationship to what survey participants say is the number one utility business challenge.

UAI defines system modeling as using analytics to model transmission and distribution systems to assist utilities with designing and conceptualizing new grid systems and components, and understanding how those changes will impact existing networks. System modeling has certainly become more complex and more important with the increasing volatility and challenges related to predicting energy supply and demand — especially over the long term.

Given the asset-intensive nature of the utility industry, it makes sense that asset optimization projects are high on the list of utility priorities. The ability to quickly and effectively respond to and resolve service outages has long been and continues to be a vital role of utility companies.

One would hope that most utilities have already implemented analytics projects in those areas near the bottom of the list, although it is likely that a combination of cost, solution complexity and other factors may explain where advanced distribution management projects landed on this list. Respondents that selected Other listed the following projects: building stock assessment, energy efficiency/DSM program management, customer analytics, technology assessment, financials, maintenance and customer segmentation/marketing.

Figure 10. What are the top analytics projects your group is currently working on? (n = 75)



**Respondents were asked to select up to three items*

It is unclear whether any of the above initiatives are being pursued in the context of an overall enterprise-wide analytics strategy or as an answer to a discreet business need, siloed in a specific division. For many utilities, the business strategy itself is still siloed at least to some degree — e.g. the T&D operations strategy and customer service strategy are independent and not integrated. UAI's Mark Johnson said, "Ultimately, an enterprise-wide business strategy that is supported by an enterprise-wide analytics strategy and roadmap will yield the best possible outcomes, whether the goal is to alleviate redundancies in cost and time, reduce business risk, enhance business practices, or unlock new business opportunities."

The above research compares favorably with research that UAI conducted in mid-2015[7] that (among other things) sought feedback on the most important grid analytics focus areas using a ten-point scale. The fact that asset optimization and outage management are near the top of the list aligns well with that research as well as previous UAI research studies. Seeing system modeling[8] in the number one position (versus near

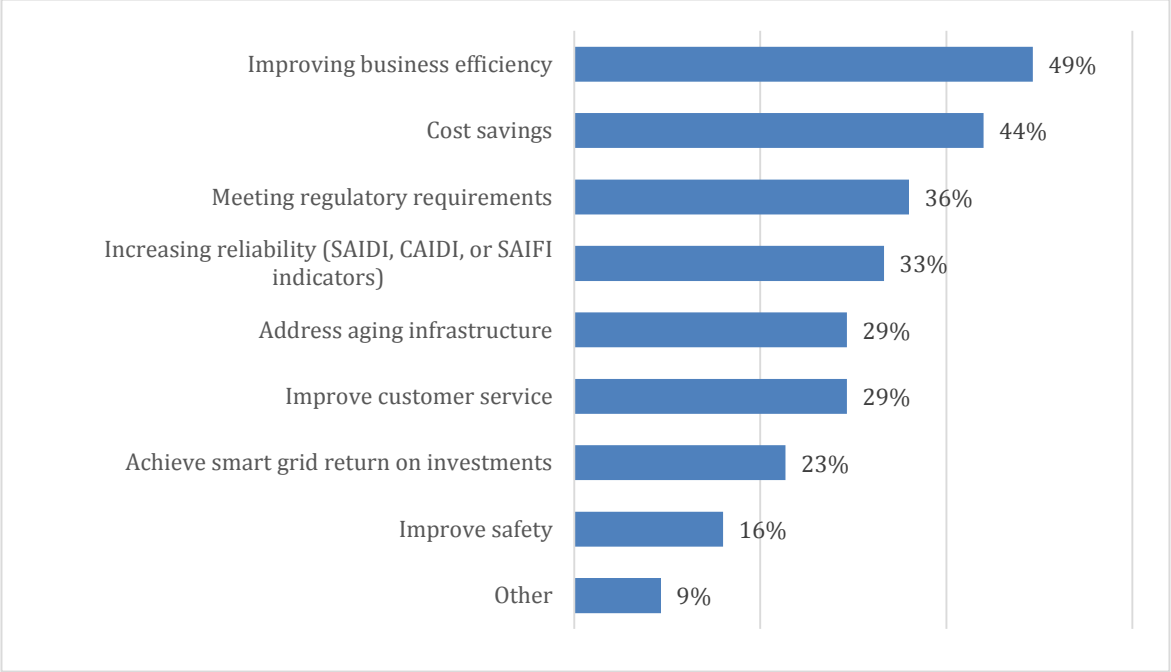
[7] Utility Analytics Institute. (Dec. 18, 2015). *Utility Analytics in 2015: Part One.*

the bottom of the list) is a rather sizable jump that is likely not explained by survey construct or population differences. It is more likely the increasing and vital importance of system modeling given the growing challenge associated with balancing energy supply and demand due to the heightened penetration of DERs and demand-side management programs, reliance on renewable energy sources, the impact of electric vehicles, etc.

It is interesting to note the fourth-place finish in Figure 10 of distributed energy resource management when it comes to analytics projects currently underway. This flips the script when compared to the survey results shown in Figure 8 which put the use of analytics for distributed energy resource management near the bottom of the list. The net is that this industry is dynamic and evolving rapidly and so are utility analytics. The uses of analytics today are likely to be quite different from the uses of analytics tomorrow.

When asked about the drivers behind the analytics projects identified in Figure 11, improving business efficiency (49%) and cost savings (44%) head the list — and are very closely related. The good news is that these two drivers of analytics projects are in lock-step with the clear number one utility business challenge identified by survey respondents —improving operational efficiency and reducing cost. This suggests an alignment between the utility business strategy and analytics initiatives.

Figure 11. What is driving the analytics projects that you answered in question #6? (n = 75)



** Multiple responses allowed*

On the above data, UAI's Kim Gaddy said, "While it is great to see utilities relying on analytics to address the most pressing business challenges, one would hope that utilities are using analytics to drive business transformation and 'step changes' in utility business processes versus the incremental improvement that typically characterizes projects aiming to do the same thing, but more cost-effectively."

While not high on the list of utility challenges, respondents say that meeting regulatory requirements is a key driver of their group's analytics initiatives — as are increasing reliability, addressing aging infrastructure needs, and improving customer service. Respondents that answered Other identified demand-side management, renewables integration, and customer targeting as drivers of their group's analytics projects.

Looking back at research conducted by UAI in 2014[9], increasing reliability, improving customer service and improving performance outranked identifying and implementing cost savings as the key business drivers behind grid analytics initiatives (rated on a 1 to 10 scale from not at all important to extremely important). As noted earlier in this document, in the opinion of UAI, economic concerns, declining revenues and an evolving business model are driving a significant shift in utility priorities with operational efficiency and expense control moving out front.

Analytics Spending

A successful analytics strategy not only requires executive buy-in, but financial backing as well. Several factors determine the total cost of analytics to any individual utility:

- company size
- number of operating utilities
- regulatory environment
- complexity and age of existing systems
- number and complexity of analytics initiatives
- cost to acquire and retain analytics and data management talent
- consultant/advisory services expenses, etc.

Looking specifically at the cost to acquire and retain analytics talent, the national average salary for a data scientist is $113,436[10] not including other employment costs such as benefits and office space. This price

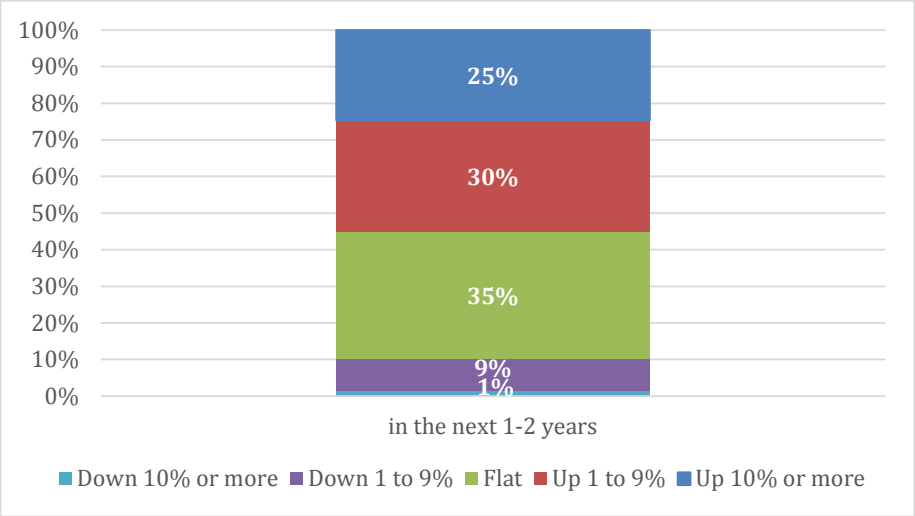
[9] Utility Analytics Institute. (March 13, 2014). *Grid Analytics Report 2014.*

[10] Glassdoor. Data Scientist Salaries. Updated February 25, 2017. Online access March 2017. https://www.glassdoor.com/Salaries/data-scientist-salary-SRCH_KO0,14.htm

tag is a challenge for utilities, and these resources can be difficult to attract and retain talent when competing against the Googles and Amazons of the world.

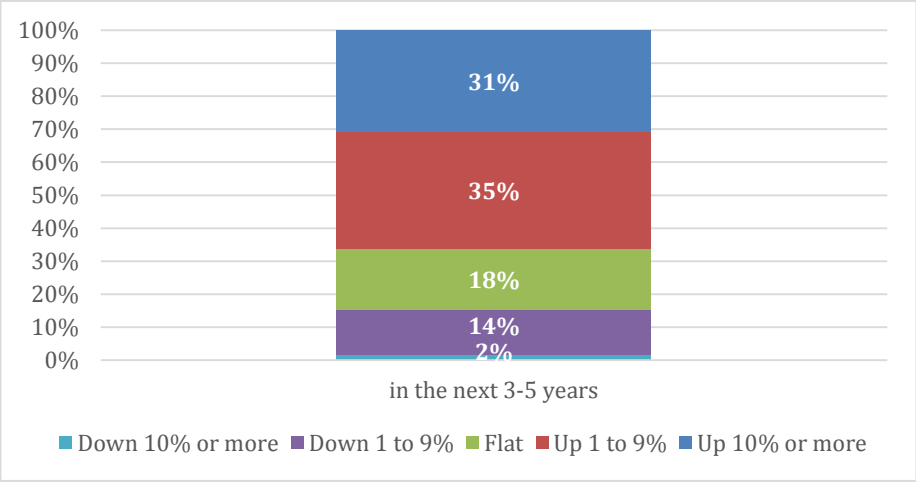
The net of the above is that most utilities are increasing their investments in data analytics. Fifty-five percent say that their utility's analytics budget will increase in the next one to two years, and 25% believe that the increase will be 10% or more.

Figure 12. How will spending change for analytics projects in the next 1–2 years? (n = 70)



A larger percentage (67%) expect that their company's investment in analytics will grow over the next three to five years — and almost one third anticipate the increase to be at least 10%.

Figure 13. How will spending change for analytics projects in the next 3–5 years? (n = 70)



The Current State of Smart Grid Analytics

A smart grid depends on a host of data sources and technology components that provide vital information about the health of the grid and support its efficient operation. ABB defines a smart grid as "an evolved grid system that manages electricity demand in a sustainable, reliable and economic manner, built on an advanced infrastructure and tuned to facilitate the integration of all involved."[11]

Grid Analytics Tools and Data Sources

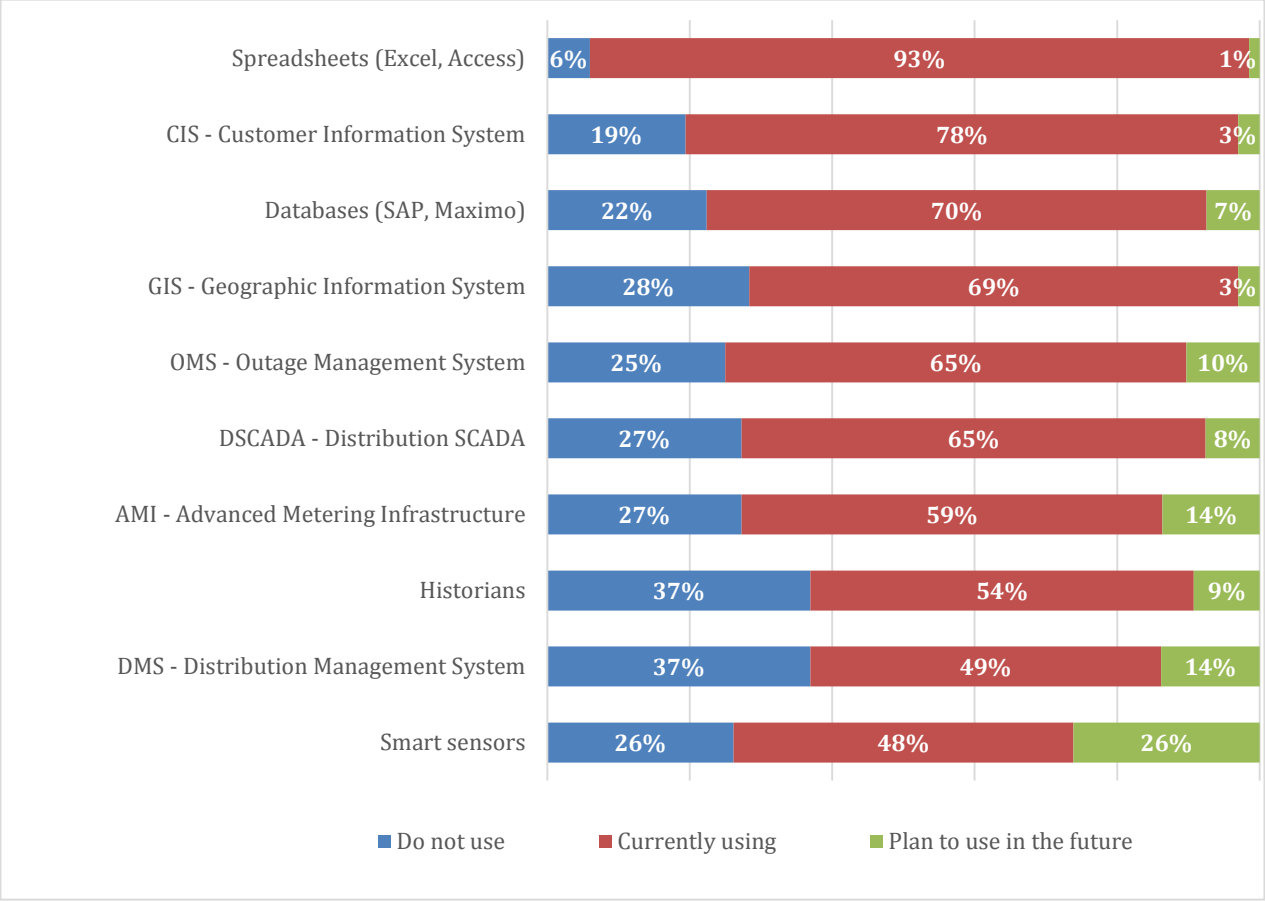
This research study looked broadly at the tools and data sources that survey respondents currently use for grid analytics. The size of the utility organization, budget, the existing technology infrastructure and other factors result in differences from one utility to another. One thing is sure, spreadsheets still rule!

Resistance to change often plays a significant role in the failure to implement or use innovative technologies, including analytics tools, even if the potential benefits are substantial. Advanced systems offer many advantages that include enhanced data analysis, better data visualization and decision support capabilities. Ease-of-use benefits also accompany many new platforms enabling users to fend for themselves. An effective change management methodology is paramount if utilities are to successfully deploy new grid analytics technologies and evolve to a smart grid.

Figure 14 on the following page is rank ordered based upon those currently using the data source indicated from highest to lowest. Looking at the data, nearly 50% or more of utilities use each of the data sources identified to support grid analytics. A rather sizable percentage (26%) do not today but plan to use smart sensors as a data source in the future. Smart sensors provide utilities with more granular data and a deeper level of insight into grid operations — and are fundamentally important to the realization of a smart grid. These devices will permit utilities to move from centralized grid management and decision-making to de-centralized grid management to take advantage of operational benefits.

[11] *What is a smart grid?* (2017, March 24). Retrieved from: http://new.abb.com/smartgrids/what-is-a-smart-grid

Figure 14. What data sources do you use for grid analytics initiatives? (n = 69)



**May not equal 100 due to rounding*

For 10-15% of those surveyed, AMI, DMS and OMS remain future possibilities but are on the radar. Over one-third do not currently use data historians or a DMS as a data source and more than 25% do not rely on data from OMS, AMI, GIS, DSCADA, or smart sensors. The absence of these data sources certainly make it difficult to effectively operate a utility grid — much less a smart one.

AMI Meters

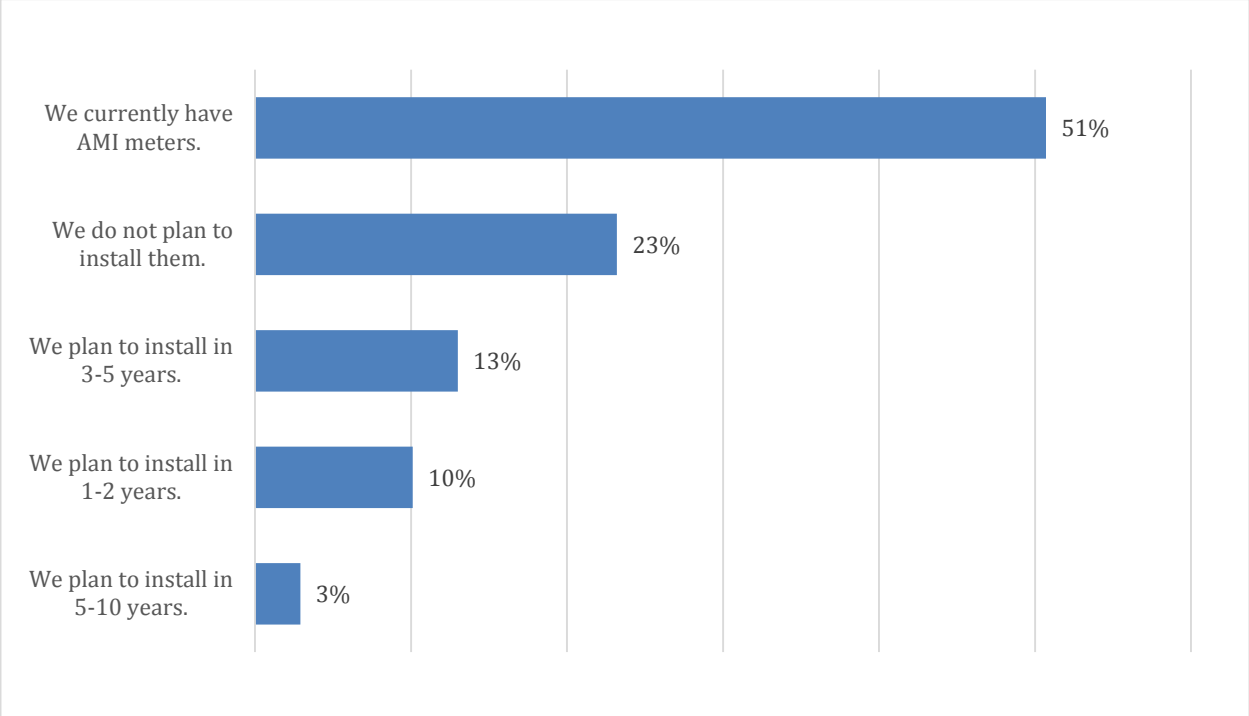
AMI is an important component of a smart grid. The deployment and use of AMI meters has grown substantially in the past few years. The Institute for Electric Innovation projects that the installation rate of smart meters will continue to increase in the U.S. and could reach 90 million by 2020.[12] Over half of the

[12] Cooper, Adam. "Electric Company Smart Meter Deployments: Foundation for a Smart Grid." The Edison Foundation, Institute for Electric Innovation. October 2016. Online March 2017. http://www.edisonfoundation.net/iei/publications/Documents/Final%20Electric%20Company%20Smart%20Meter%20Deployments-%20Foundation%20for%20A%20Smart%20Energy%20Grid.pdf

survey respondents say that their utility has installed AMI meters. Twenty five percent say that their utility plans on installing AMI meters at some point in the future, virtually the same percentage say their company does not plan on installing AMI meters.

The installation of AMI meters requires a good deal of capital, a reasonably sized customer base to produce a positive ROI, and the support of the governing regulatory body. Most of those indicating that their utility does not plan to install AMI meters work for utilities that serve less than 50,000 meters.

Figure 15. Do you have, or plan to install, AMI meters? (n = 69)



Years AMI Meters Installed

It is hard to fathom that 10% of survey respondents say that they have had AMI meters in place for over 10 years and for another 18% it has been five to seven years! The funding provided by the American Recovery and Reinvestment Act (ARRA) of 2009 supported the deployment of AMI and the installation of many smart meters. Thirty-six percent say that AMI meters have been in place for less than three years. See Appendix C: AMI Deployment and Utilization.

One would expect that by now utilities would have uncovered a thousand ways to use AMI data. A variety of AMI-enabled analytics use cases have been shared by UAI utility members and include: detection of overloaded transformers, correction of connectivity model errors, distribution transformers operating

over or under voltage parameters, theft detection and prediction, near real-time identification of meter and infrastructure damaged or destroyed in a major storm, electric vehicle impact assessment, and demand-side management analytics.

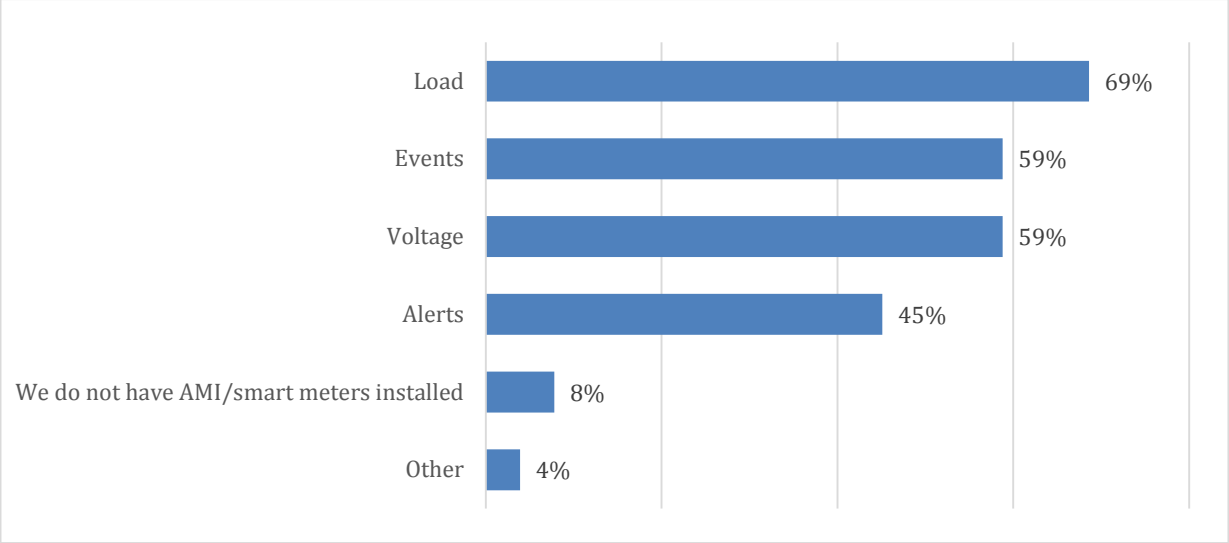
Utility companies can benefit from sharing AMI analytics successes and lessons learned and by working with leading analytics solution providers to build on proven, value-delivering use cases. Why repeat the mistakes of the past? Why not take the quickest path to unlocking the value of AMI meter data and analytics?

AMI Data

It is interesting to see what survey respondents say about the data either currently being gathered or that they plan to gather to support AMI-enabled analytics use cases. Load data is number one (69%), followed by a tie between event and voltage data (59%), and alert data comes in at 45%.

In terms of the frequency of data collection, forty-nine percent indicate that they are or plan to bring back data daily and another 41% of utilities say that they are or plan to collect AMI data in real-time (i.e. 15-minute intervals). See Appendix C for more information. It is unclear how much of this 15-minute interval data is today or is expected to be stored in an enterprise database in the future.

Figure 16. What data are you bringing back or planning to bring back for analytics purposes? (n = 51)



**Multiple responses allowed*

Respondents selecting the Other category indicated that they are bringing back CCF data[13], (oil) pressure data and temperature data, as well as revenue protection-related data.

In terms of how that data is being used, 48% are using AMI data for transformer loading, 44% for volt/VAR[14] optimization, 38% for outage management, and 29% are using AMI data to address network connectivity needs. Most interesting are the additional uses identified by the 25% of respondents that selected the Other category. Those uses include: marketing, predictive plant failure, M&V (measurement and verification) for DSM industrial projects, rates and pricing, forecasting, energy efficiency, etc. A few respondents said that the data is not being used — at least not within their group. See Appendix C for additional information.

Conclusion

The business of utilities will evolve with the increasing cost-effectiveness of renewable energy sources, the growing penetration of DERs, emerging technologies and new data sources, rate design reform, and rising customer expectations[15]. A smarter grid is needed if utilities are to adapt to the influence of all these factors and more.

As the march to a smart grid continues with the implementation of foundational smart grid capabilities, it is vital that utilities develop and execute an analytics strategy to take advantage of the additional information at their fingertips. Regulators expect a return from smart grid investments. Grid management is becoming increasingly complex. Customer expectations continue to rise, and they have new choices to meet their energy needs. Simply put, analytics excellence is a strategic imperative.

A comprehensive analytics vision and strategy is necessary for utilities to maximize the potential of data analytics and the same is true for data generated by a smart grid. The first step is recognition that data is a strategic asset and should be managed as such.

Development of an analytics roadmap will help define, communicate and guide implementation of the utility's analytics strategy. Identification, valuation, and prioritization of analytics use cases are a key component. An analytics capability assessment and plans to address identified gaps should be included, whether technology, process or people-related. A supportive organizational model is essential to analytics

[13] Natural gas is commonly measured by the cubic foot, and customers are typically billed by hundreds of cubic feet (CCF) to thousands of cubic feet (MCF).

[14] VAR, or volt-ampere reactive, is a unit used to measure reactive power in alternating current.

[15] Bade, Gavin. "The top 10 trends transforming the electric power sector." UtilityDIVE. September 17, 2015. Online March 2017. http://www.utilitydive.com/news/the-top-10-trends-transforming-the-electric-power-sector/405798/

success and the roadmap should include a description of that model including key roles and responsibilities. A data management process, including a data governance program, will be required and an overview should be provided. A communications plan and change management should not be forgotten to gain and sustain support for the analytics strategy and roadmap.

A comprehensive list of use cases demonstrate that utilities are putting smart grid data and advanced analytics to work and a few of those are described below.

- **Preventative maintenance**: Predictive models uncover issues before they result in service interruptions. Proactive equipment replacement shifts work from unplanned to planned, reducing cost and minimizing customer impacts.
- **Load management**: Loading issues are identified in near real time and operational solutions are quickly implemented.
- **Volt/VAR optimization (VVO) and conservation voltage reduction (CVR)**: VVO and CVR yield improved power quality, loss reduction, and substantial savings.
- **Workforce optimization**: Access to and analysis of near real-time grid performance data is increasing the productivity and performance of field service personnel.
- **Fault isolation and automated problem resolution**: Faults are analyzed and power is automatically rerouted, minimizing the effect of an outage.
- **Storm restoration:** Better resource allocation, both people and materials, is resulting in faster service restoration.
- **Automatically generated fault maps**: Leveraging smart grid telemetry points, the probable location of the cause of momentary power outages is identified more accurately and much more quickly.
- **Revenue protection and theft detection**: Meter and transformer analytics are transforming these important processes.
- **Transformer management:** Use cases include identification of overloaded transformers, assessment of transformer replacement needs driven by electric vehicles, detection of potential transformer issues based on abnormal voltages.
- **Transactive control system:** Electricity supply and demand is monitored and when demand exceeds supply by a specific threshold, the demand response system adjusts smart thermostats of customers participating in program.

The above use case examples make it abundantly clear how far the industry has traveled since the Utility Analytics Institute was formed six years ago.

This research study also demonstrates that there are many reasons for enthusiasm about the growing analytics maturity of the utility industry though that quickly gives way to how much untapped potential exists and how much work remains to do. The top three takeaways from this research are:

1. A very sizable majority are at least somewhat confident that analytics can help address their utility's number one challenge which most said is to improve operational efficiency and reduce costs.
2. Data availability and access-related challenges, a shortage of skilled analytics resources, and the lack of centralized data storage are the major factors limiting analytics progress.
3. The top applications for data analytics today are: customer tendencies (load usage, growth), system planning enhancements (generation, transmission and distribution), and safety (loss time accidents) and those at the bottom of the list right now are grid impact of distributed energy resources, employee satisfaction and retention, and crew optimization (scheduling, dispatching, managing resources).

Smart grid analytics success stories vary from utility to utility. Understanding the successes, experiences, and challenges encountered by other utilities can help expedite the realization of business value enabled by smart grid analytics. It will be interesting to watch how these priorities shift in the coming years.

Appendix A: Additional Respondent Demographic Information

Figure 17. How many meters do you serve? (n = 63)

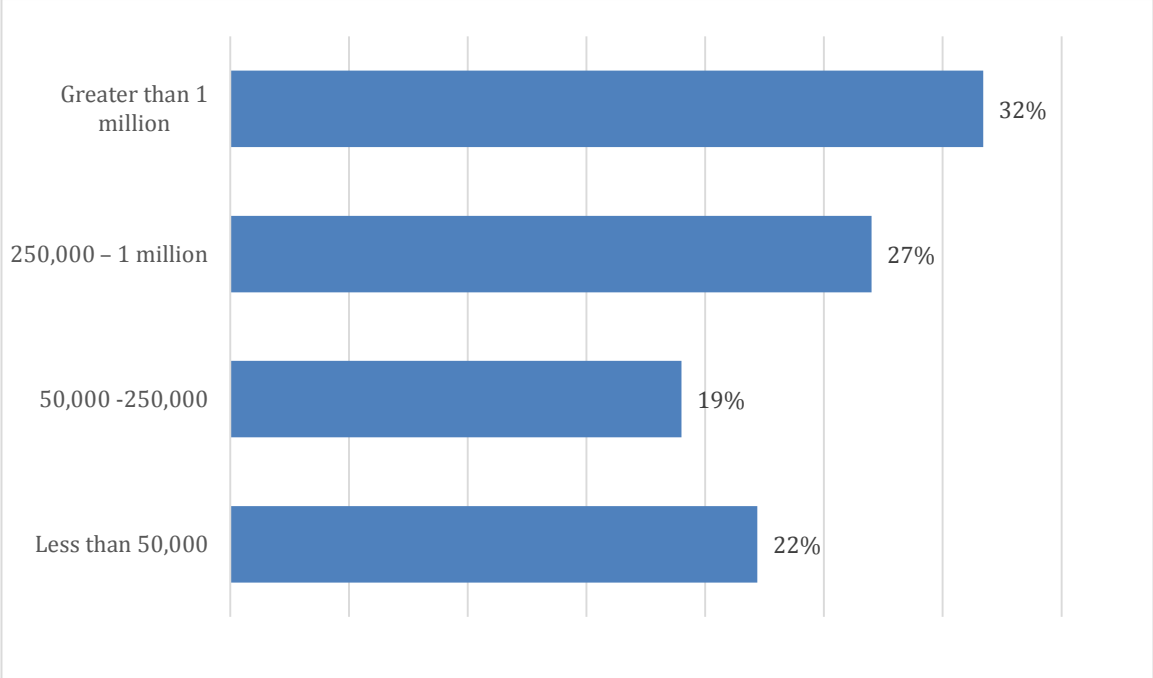


Figure 18. What services do you supply? (n = 65)

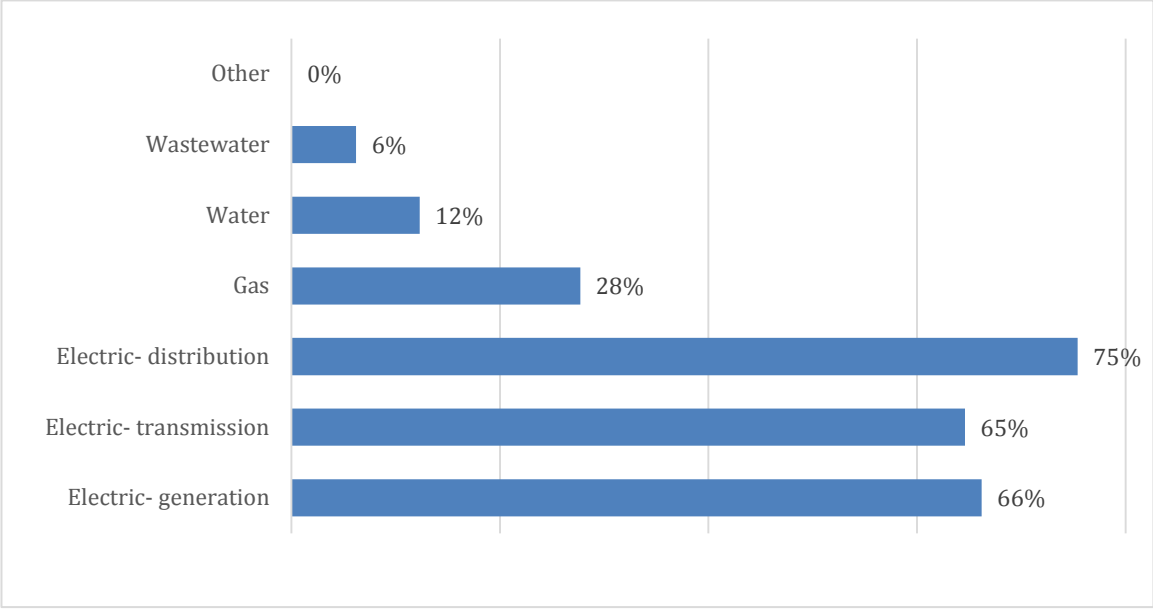
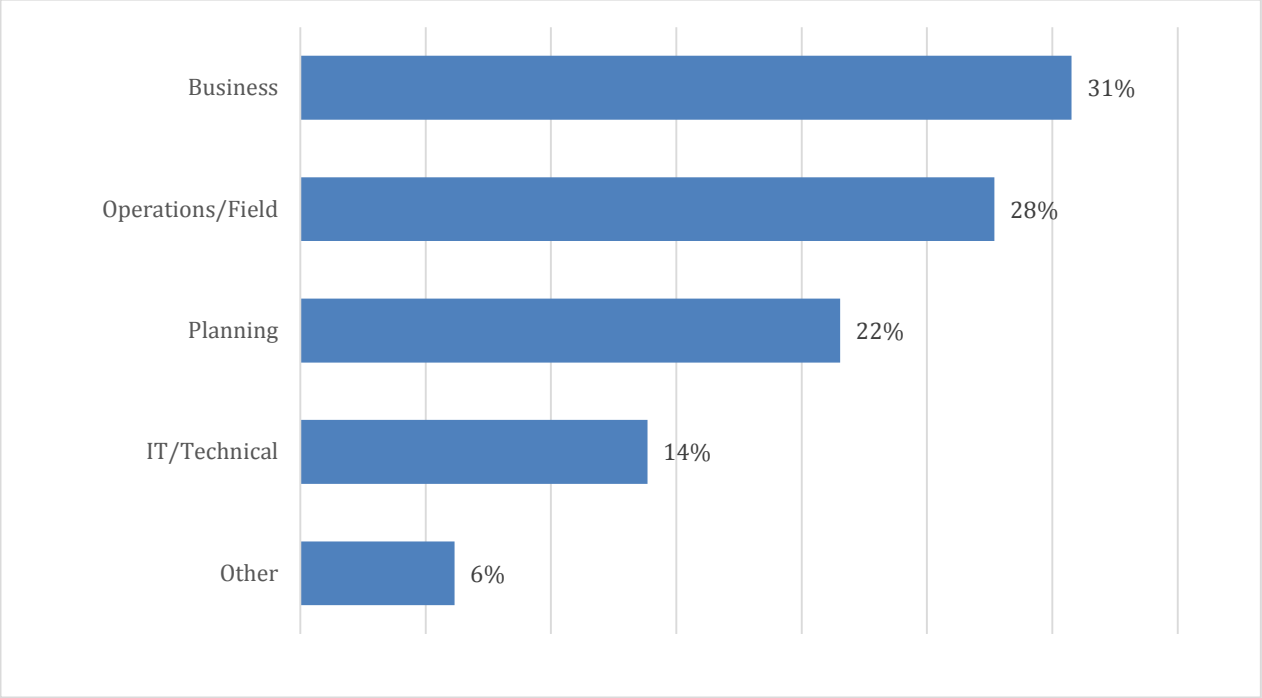


Figure 19. What is your primary job responsibility? (n = 65)



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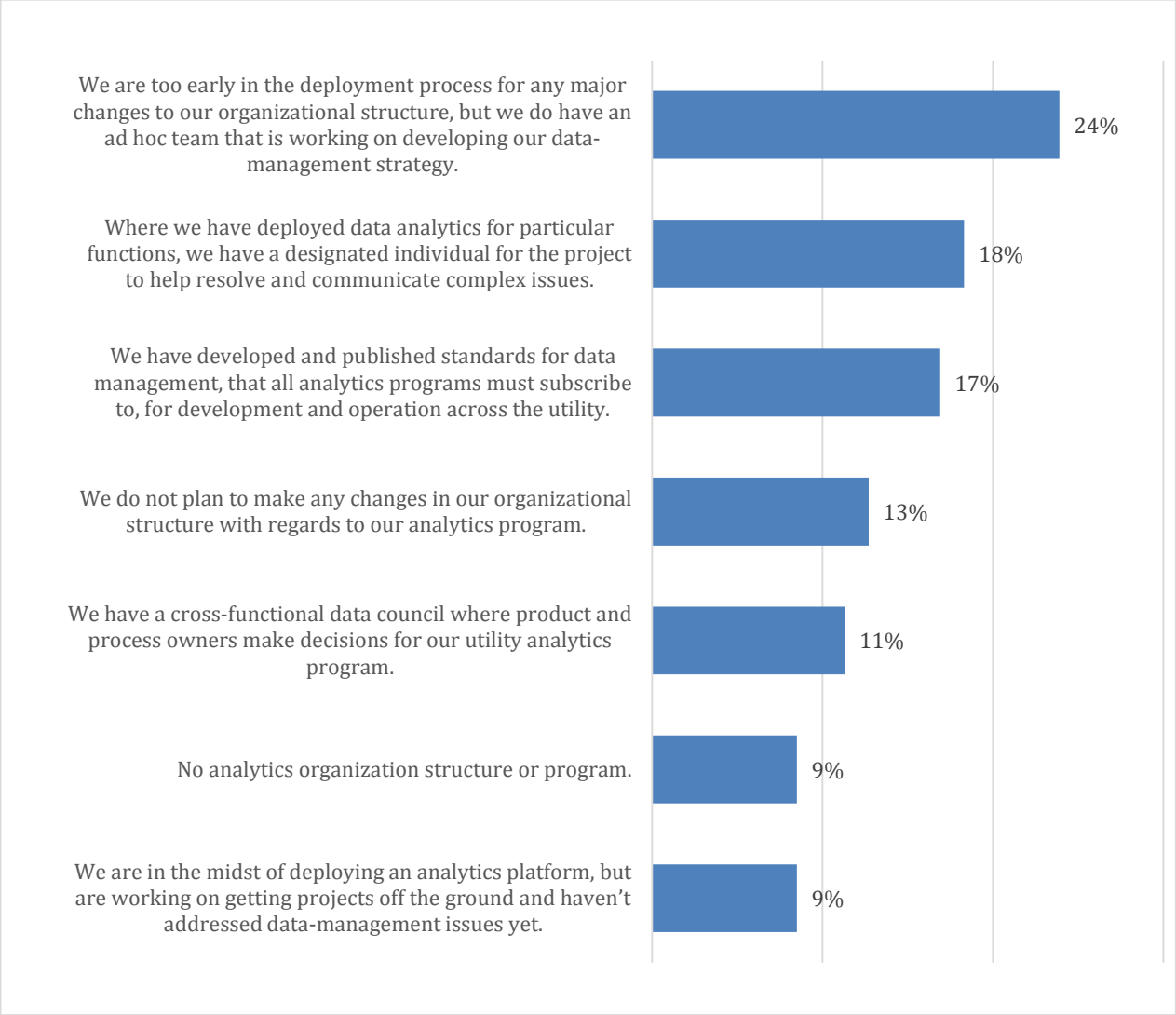
Appendix B: Analytics Program Deployment

Figure 20. Select the best description for the deployment of your data analytics system(s) and/or program(s). (n = 71)



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Appendix C: AMI Deployment and Utilization

Figure 21. How many years have you had AMI installed? (n = 51)

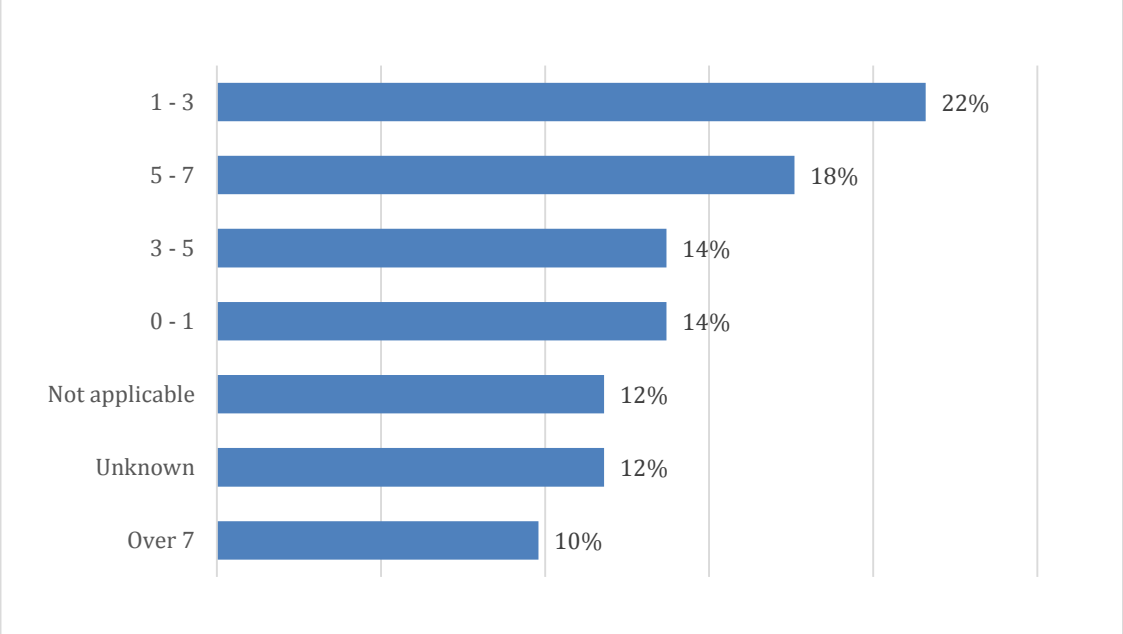

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Figure 22. How often are you bringing this data back or planning to bring it back?

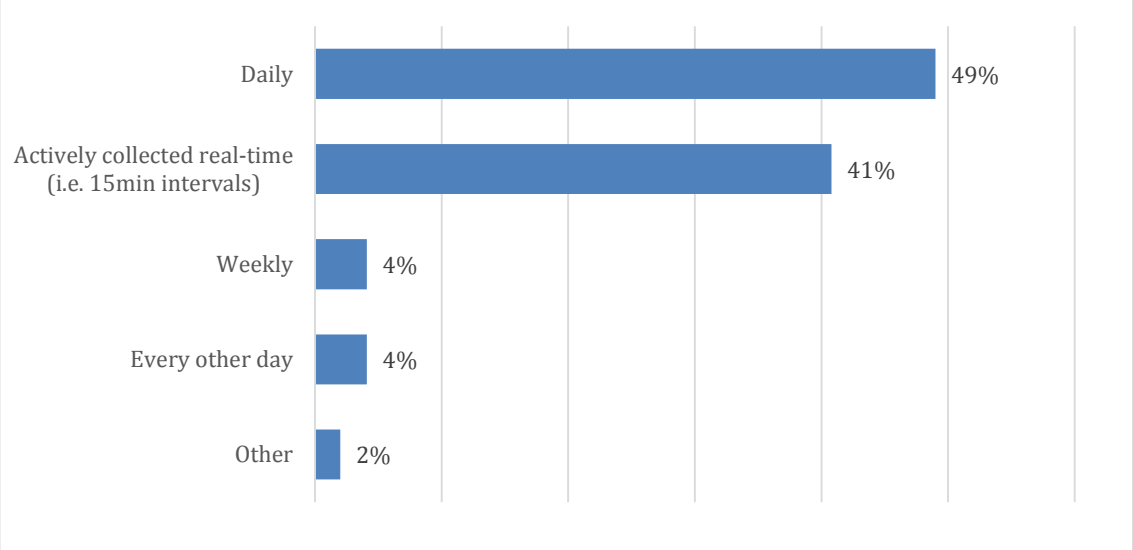
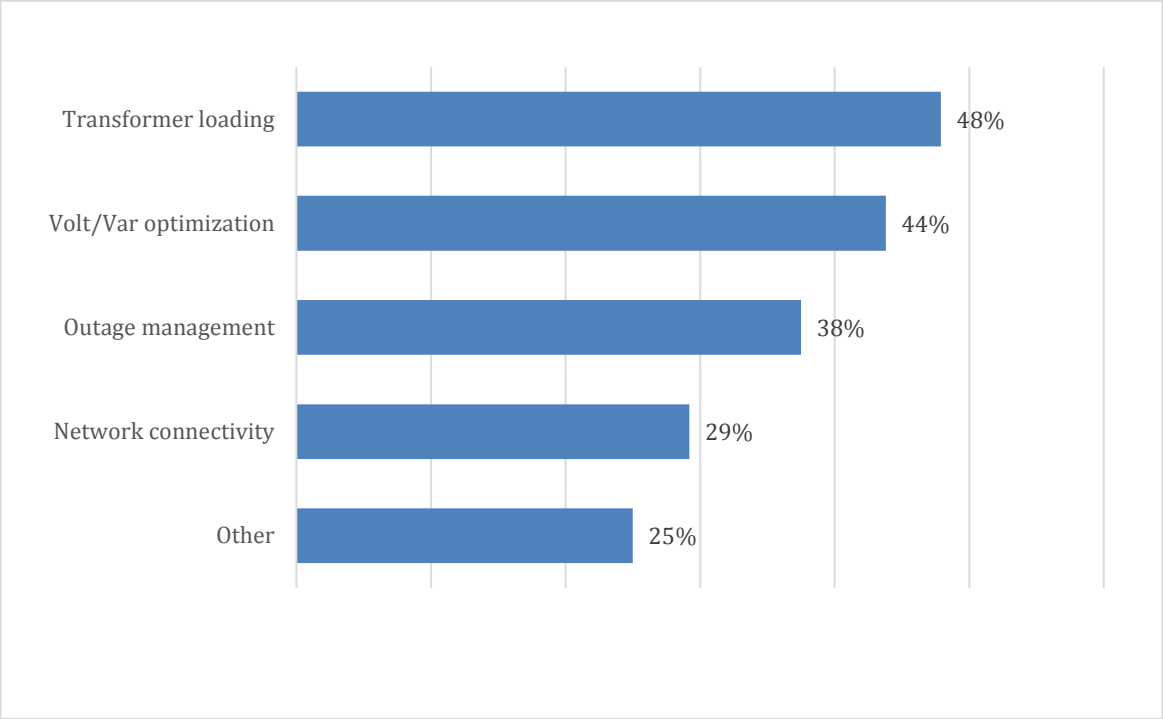


Figure 23. How are you using that data for analytics within your group? (n = 48)



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