Master Planning for a Smarter Grid
A practical guide for utilities addressing the challenges of grid modernization

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EXECUTIVE SUMMARY

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The dramatic changes in the utility industry are continuing to transform the requirements being put on utilities, the work that utility do and how they perform their activities. This revolution comes on top of the natural evolution of a highly technology-focused industry that has historically deployed continuous changing tools, devices, and systems. Many of these are highly integrated solutions that in addition to providing enhanced value, also add to ever increasing complexity of the utility operational technology landscape. Adding to the technological advances and the increased complexity of this integrated solution architecture, the various systems are aging and reaching end-of-life or requiring upgrades and investments in an uncoupled fashion.

The issues that this situation present, coupled with the expense of these capital-intensive projects, make it critical that utilities develop a near and long-term plan on what the optimum course of action is. Given the criticality of this effort, rather than doing this in an unstructured fashion, Black & Veatch recommends that utilities adopt a Grid Modernization Master Planning approach to answers their technology, implementation and investment needs. Some of the questions that must be answered include:

- What are our priorities for system replacements?
- What will the future look like and how can we prepare?
- Can new programs and technology allow us to introduce new services to increase revenues?

While most utilities will be looking at similar questions and have similar sets of systems and core technologies, every utility has a unique set of specific current solutions, corporate goals, funds and priorities.

The desired goal of the master planning activity is to provide a documented plan that provides a roadmap for current focus and future investments. The roadmap defines priorities, gaps, risks, uncertainties and other key aspects of the plan. As with every good plan, it will change over time so it must remain flexible. Without this plan, utilities are challenged with identifying the optimum path to pursue.

Creating a Grid Modernization Master Plan is the First Step in the Evolution to a More Intelligent Grid

Most utilities have made significant investments in operational systems over the years, but now the following fundamental questions are being asked:

- Where do we go from here to allow us to meet our goals?
- How do we get more value out of what we already have deployed?
- Can we add new programs and new services to our current systems?
• Have we properly planned for the continuing expansion of the distribution renewable revolution?

• What are the gaps in which we need to investigate and assess new technologies?

• As we look out 10 years into the future, what are our most pressing needs regarding core grid infrastructure investments?

• Will our aging communications infrastructure support our future needs?

These questions are simple, but the answers to these questions require complex analysis.

We created an approach to assist utilities with their Infrastructure Modernization Master Planning. This approach has evolved with key lessons learned from completing both technology assessments as well as scores of actual technology-related projects over the last several decades. Our approach comprises a proven methodology supported by relevant artifacts and leveraging our deep understanding of past, current, and future utility solution architectures. Our approach considers the people and process aspects as well as the technology components.

The core Infrastructure Modernization Master Planning focuses on the technology building blocks while targeting a combination of how best to evolve existing technology or improve the use of existing technology. It also examines what and how best to add new programs, services, processes, or products offered by utilities, as well as new tools. The master plan also focuses on the users, with an emphasis on maximizing the use of the software and organizational change management, while also keeping a close eye on the overall planned capital expenditures and the future maintenance and integration approaches.

While utilities have evolved at different rates and been driven by differing goals, there is a common evolutionary path the utilities have taken in the evolution of their systems. Figure 1 provides a high-level graphical narrative on the common technologies and solutions that utilities have deployed in the past 15 years or those we envision will be the focus of a majority of utilities in the next half-decade. This 20-year view provides an illustrative example of the evolving solution and technology landscape confronting utilities.
WHY DEVELOP AN INFRASTRUCTURE MODERNIZATION MASTER PLAN?

According to industry reports, the costs of utility infrastructure upgrades over a 10-year planning window could exceed a billion dollars for large utilities and into the tens and hundreds of millions of dollars even for mid-sized utilities. An infrastructure master plan is about spending money as wisely as possible while focusing on supporting the utility’s goals and initiatives. During the initial smart utility phase, we start to see more cross-departmental decision making with advanced metering infrastructure (AMI) driving the technology collaboration process. However, we still have limited AMI transformation across the utility with AMI implementation decisions often made at the department level and with department level budget limits. As the number of options continues to expand, a significant change to the smart utility path becomes challenging to determine the types of investments to make. The technology and subsequent programs have a variety of objectives, such as the following:

- Power supply maximization with the introduction of improved software.
- Enhancing customer engagement and offering new programs and services while targeting specific customer segments.
- Targeting rate stabilization and rate re-structuring to complement renewable growth.
- New technologies to deliver reliability improvements.
• Programs that focus on employee cultural changes, with an emphasis on the increased speed of delivery and being customer-centric.

Many utilities are evolving along the smart utility path. If less than optimal technology decisions are made, the impacts 4 to 8 years from now will be even more significant. The following are additional reasons to complete an infrastructure master plan:

1. Improved Linkage with The Utility’s Strategic Plan:

The Infrastructure Modernization Master Plan is designed to have a clear link with the utility’s overall strategic plan. Without a master plan, the traditional departmental budgeting process can sometimes lose the focus of the strategic plan.

2. Evaluation of Benefits Goes Beyond Economics:

AMI was relatively easy to, as many major business processes with manual meter reading greatly improved, post-AMI. When we evaluate many of the new programs as we further progress along the smart grid path, the non-quantifiable benefits such as reliability improvement, grid resiliency, less carbon output, revenue preservation, etc., become increasingly difficult to assess and evaluate.

3. Get More Value From Existing Automation Investments:

Before jumping ahead and just focusing on new opportunities, the master plan will also take a close look at how best to extend the life of existing investments, how to increment investments to achieve more value out of existing systems, how to make business process improvements and further leverage existing systems, and where to find staff efficiencies with maintenance of existing systems.

4. Cross-Utility Buy-In:

In our view, the Infrastructure Modernization Master Plan should have a cross-utility/cross-department executive team, a stakeholder team, and user teams all providing input into the master plan. Without clear stakeholder and executive buy-in, many plans will fail before they even start. For utilities that offer other services beyond electric (water, gas, or broadband Internet), it is also important to consider the needs of all business units and seek real buy-in versus a “forced” buy-in.
5. Improved Customer Rate Forecasting:

When the utility’s finance group has a well thought out 10 year forecast of the infrastructure investments that are planned, this input is extremely valuable in the rate modeling process.

6. More Efficient Annual Budgeting:

The amount of time put forth to prepare the annual capital technology budgets and the competition for approval has become an internal battleground. An infrastructure master plan, which is refreshed once every 5 years with smaller incremental modifications, greatly mitigates the annual preparation time and supports multi-year infrastructure budgeting.

7. Improved Functionality and Usability:

One of the disappointments of initial smart utility programs is that many of the systems’ core software capabilities were never deployed or, in many cases, users weren’t properly trained and thus the business processes weren’t maximized. An infrastructure master plan will also include investments for organizational change management, job redesign, training, and, in general, transformational use of the new technology across the utility.

8. Maximize the Deployment Effectiveness Through the Creation of a Deployment Governance Plan:

The master plan will also lay the foundation for the creation of an ongoing deployment governance discipline that we refer to as the Solution Design Authority (SDA). The SDA will provide ongoing oversight after the master plan is approved to best assure the deployment initiatives are being optimally implemented.

HOW CAN THE INFRASTRUCTURE MODERNIZATION MASTER PLAN REMAIN FLEXIBLE?

The Infrastructure Master Plan must remain flexible for each utility. For example, some utilities technology positioning is targeting at being an early adopter of new technology while others are either late adaptors or fall somewhere in the middle. What’s important is that the project team accountable for technology decisions needs to understand their corporate positioning on where they want their technology migration to be over the next five years from a technology adoption standpoint. The figure below reflects the common life cycle technology differences. Where a utility prefers to be at will have an influence on some of the eventual programs in the Master Plan and the later impacting the technology procurements.
WHAT ARE THE COMMON STAGES IN CREATING AN INFRASTRUCTURE MODERNIZATION MASTER PLAN?

We have created an 8-step process for completing an infrastructure modernization master plan. These steps are explained below.

### STAGE 1: FORM THE PROJECT TEAM

This first step will be critical to the overall success of the outcome. We suggest a 3-level structure consisting of a single Executive Sponsor and the cross-functional executive team representing the entire utility. This team would typically have some initial involvement in a working session with the executives who will be sharing the overall utility’s strategic plan with the consultant’s team. The second team, the most active utility group participating in the various meetings, will be the core team. The core team would typically consist of a manager to director-level employees (with application-level knowledge) and your staff (with deep hands-on users of technology). This team would also have information technology and communications infrastructure representation. The third team is a user team, which would be less active and mostly involved early in the project when the requirements are being gathered. The user team will also come back into the project and sit in on technology review sessions in Stage 2 when topics are relevant to their discipline. For example, a user team member that has a background in demand response would participate in a work session relating to new types of demand response programs under evaluation but would not participate in sessions not related to their discipline.

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Black & Veatch’s Eight Stage Methodology
STAGE 2: PRESENT STATE ASSESSMENT

This stage involves a deep review of the present state situation. Some of the information to gather and the document includes a close review of the present software systems. Typical assessment questions include the following:

- Based on the current position of your present technology lifecycle adoption, do you want to make any tactical changes? For example, if you’re positioned as a late adaptor, do you prefer to migrate to the late majority or early majority?
- What systems are multiple releases behind or out of vendor support?
- What systems are functionally or technically obsolete or at vendor-defined end-of-life or will be soon?
- What systems have more life but require major upgrades?
- What systems are missing that should preferably be in place now but are not? This could be a system like an asset management systems, advanced distribution management solutions (ADMS), etc.
- Are the systems that exist integrated together in a logical, effective manner?
- How effective is our current communications infrastructure for our present needs, and do we face end-of life-concerns with some of the communications technology as well?
- What staffing shortfalls or surplus areas exist now for maintaining the technology we presently have in place?

- Where is the utility positioned with key metrics (i.e., reliability, customer satisfaction, rates, headcount in relationship to meters, other metrics) compared to its peers?
- Where is the utility positioned with customer product offering (i.e., prepaid metering, time of use rate options, demand response, energy web tools, etc.) compared to its peers?
- What level of functionality exists with core systems (i.e., customer information system [CIS], supervisory control and data acquisition [SCADA], OMS, MWM, GIS, asset management, AMI, MDM) compared with both peers and progressive utilities?
- Is the amount of distributed energy resources (DER) triggering the need for a distributed energy resource management system (DERMS)?
- How effective are our core business processes for the high-volume workflows? What areas might it make sense to study more closely for possible improvements in the future?
- What staffing shortfalls or surplus areas exist now for maintaining the technology we presently have in place?
STAGE 3: FUTURE STATE ASSESSMENTS
(PROJECT TEAM EDUCATION)

This stage starts with an understanding of the utility’s overall strategic goals and then evolves into how technology and systems can support strategic goals. The stage further evolves into identifying new applications and improving and enhancing systems to deliver new applications or major features to be added from existing systems to new programs or entirely new software. The overall strategic plan will influence the high-level direction for the Infrastructure Modernization Master Plan. For example: if the utility’s reliability results sit in the lowest quartile compared with peer utilities with the strategic plan listing reliability improvement as a top objective, programs and investments with reliability improvement would likely be weighted higher. Consequently, project time would be allocated to assess proven and new approaches for improving reliability while factoring costs, staff time, and other factors.

Regardless of the level of adopted technology in place at a given utility, there will always be a long list of new technologies, applications, offerings, etc., to consider in the future. With a cross-departmental team of 10 to 15 individuals, the knowledge level for a specific subject matter will vary greatly depending on the discipline. We have found it very beneficial to conduct a project team educational session time of about 1.5 to 2 hours for each new technology being considered for the future. Listed below are examples of common topics covered by our subject matter experts.

When creating the scope of work, we will plan to narrow down this list and make it most appropriate for a given utility. The objectives of these sessions are to seek input from our clients on their level of interest with the possibility of adding these programs or applications in the future. We often find that after completing the educational sessions, some programs that had very low initial department interest raise up invisibility and make the list to assess further in the next stage, many remain viable and of strong interest for future considerations, and some programs or technologies may lose interest and appear to be long shots for the near or mid-term. Sometimes this step is referred to as “ideation” or “scoping.”

We also typically find that utilities in the mid-market with meters between 35,000 to 350,000 often select a few major systems to closely assess as part of the Infrastructure Modernization Master Plan. For some utilities, their next big new system might be an asset management system. For others, their CIS is lacking or their AMI is 12 years into its lifecycle and starting to show its age. We prefer to identify this up front and then, as part of the master plan, spend time on the major systems that are of the highest interest. Ten (10) years ago, the major next system was often AMI, but now we are seeing the next major system being asset management or ADMS.

Then table on the next page is a sample of programs and technologies to conduct educational sessions.
<table>
<thead>
<tr>
<th></th>
<th>Customer Programs and Demand Response</th>
<th>AMI and MDM Applications Beyond Meter to Cash</th>
<th>ADMS and DERMS Assessments</th>
<th>Asset Management</th>
<th>Other Areas of Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prepaid metering</td>
<td>DA and street light control over AMI</td>
<td>Where does utility-owned energy storage fit into our roadmap?</td>
<td>Developing an asset management improvement plan</td>
<td>5G micro-cell site right-of-way planning</td>
</tr>
<tr>
<td>2</td>
<td>Is it time to consider replacing your CIS versus doing the next major upgrade?</td>
<td>Energy theft reduction program</td>
<td>What impact will the retiring coal-based power plants and growing DER and electric vehicle (EV) have on specific substations within our system?</td>
<td>Allowing initiatives to enable an asset management program</td>
<td>Utility grade battery storage industry update</td>
</tr>
<tr>
<td>3</td>
<td>Time of use, critical peak pricing, and/or peak time rebate</td>
<td>Define big data - determine specifically what use cases are desired to be deployed</td>
<td>What software tools and business processes do we use now to manage DER and power quality now? What gaps exist?</td>
<td>Asset management system business case</td>
<td>Distributed generation program reviews</td>
</tr>
<tr>
<td>4</td>
<td>Review of business process flows for high volume work</td>
<td>Cost of service study rate modeling</td>
<td>What is the optimal migration from SCADA to DMS?</td>
<td>Asset management system procurement</td>
<td>Communications technology industry review</td>
</tr>
<tr>
<td>5</td>
<td>Direct load control – W/H, AC, irrigation, C&amp;I, smart thermostat control</td>
<td>Demand response analytics</td>
<td>What are the advantage or disadvantages of the best in class for DMS, OMS, DERMS versus a single ADMS vendor suite?</td>
<td>Asset management system deployment</td>
<td>New Energy: What are new revenue opportunities that exist for electric utilities?</td>
</tr>
<tr>
<td>6</td>
<td>BYOD thermostat</td>
<td>Power quality improvement program</td>
<td>What are the buying triggers for a DERMS?</td>
<td>Introducing new mobile workforce processes</td>
<td>Change management – Why is this critical?</td>
</tr>
<tr>
<td>7</td>
<td>EV commercial charging</td>
<td>Bellwether meter voltage reporting program</td>
<td>What are the benefit categories for DERMS and how can the benefits be quantified?</td>
<td>State of the Industry update on new internet of things applications for utilities</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Inverter-based load control</td>
<td>Improved customer energy use web presentment</td>
<td>In our roadmap, are we better off spending money in the near term on outage prevention or improved outage restoration?</td>
<td>DERMS</td>
<td>Organizational changes to address technology changes</td>
</tr>
<tr>
<td>9</td>
<td>Resell of residential and commercial solar</td>
<td>Home lighting and alarming and street light control</td>
<td>ADMS review</td>
<td>OMS industry update</td>
<td>Integrated system planning study: Next Generation IRP</td>
</tr>
<tr>
<td>10</td>
<td>Industry update on new customer engagement approaches</td>
<td>Developing a Next Generation AMI Migration Plan</td>
<td></td>
<td>SCADA Industry Update</td>
<td>Does a wholesale (3 to 5 customers) fiber optic business have merit?</td>
</tr>
</tbody>
</table>
STAGE 4: BLACK & VEATCH GRID MODERNIZATION ASSESSMENT MODEL

This stage involves the analysis and modeling of possible new technology additions that have been identified in earlier steps and are considered to be generally viable to fill identified gaps and future needs. For the programs in previous table, these are examples of programs or opportunities that would be assessed with our grid modernization assessment model. With the completion of an infrastructure modernization master plan, we have found that a few topics typically require a detailed business case with significant due diligence, but other potential investments and programs can be sufficiently assessed with our grid modernization accelerators. If a detailed business case is desired, the master plan would have completed a higher-level feasibility plan with our use of accelerators and then a detailed business case would be suggested as part of the future roadmap actions.

In the various quick screening exercises described above, we would conduct a combination of conference calls and meetings to walk through the various programs and applications with our client’s project team. For all the possible improvement areas evaluated, we would share the screening results and receive client input on the utility project team’s level of interest in each of the improvement programs.

The following are several improvement programs that are conducive to calculating financial metrics:

- **Annual Operations and Maintenance (O&M) Reduction:** These initiatives identify O&M activities that can be eliminated completely, reduced to lower levels, or executed in an alternative manner that provides overall savings (productivity enhancements) year to year.

- **One-Time O&M Reduction:** Similar to annual O&M reduction but the value can only be achieved once.

- **O&M Deferral:** Initiatives in this category defer planned activities in the current (or anticipated) fiscal year to another fiscal year. Typically, these activities have discretion when they are completed but must be completed to operate the business for the long term. An example would be deferring major power generation plant outages.

- **O&M to Capital Reclassification:** These types of initiatives don’t reduce costs; rather, they correctly classify activities to capital that are currently classified as O&M. Many of these activities are classified as O&M for convenience or because of an accounting or historical process misunderstanding.

- **Revenue Increase:** Increase the overall level of revenue through the more efficient collection of receivables or additional generation sales.
There are several areas of analysis that we classify as non-economic that are equally important to the direct financial benefits. Some of the non-economic attributes modeled include the following:

- **Non-Economic Attributes:** Overall value proposition such as: reliability improvement measured in Institute of Electrical and Electronics Engineers (IEEE) metrics, potential customer satisfaction improvement, contribution to renewable energy goals, level of ease or difficulty to deploy and to maintain, level of risks caused by the immaturity of some of the technology being assessed and topics that fit with the utility’s strategic plan.

- **DER Versus Fossil Fuel Power Alternatives:** Many master plans also include an analysis comparing new types of localized DER, impact analysis of retiring coal-based generation, and DER via long haul transmission lines.

### STAGE 5: PROGRAM LEVEL ASSESSMENTS

Given a large number of programs assessed in the earlier stages, now is the time to compare the programs against each other to develop prioritization and begin to assess the deployment timing and whether there are precedents needed. For example, a field area network communications infrastructure is needed before an expansion of a new distributed automation (DA) program. Another example would be an accurate GIS network model that is needed prior to automating SCADA to advanced DMS. On the surface it would seemingly make sense to deploy the programs that have the highest return first, programs with the next strongest return next, and so on. However, even if an unlimited budget exists, a given department or specific technical leads in a given area can only handle a certain number of simultaneous projects involving their attention. Therefore, during the program level assessment stage, clearly evaluating the following items is critical:

On-site meetings and conference calls would be conducted where our team would be sharing the results of the technology screening modeling exercises and the assessment tasks to compare the various improvement programs against each other.
- How do the overall value propositions compare from program to program?
- How does each program rank when evaluating the impacts of both economic and non-economic benefits?
- Do any regulatory mandates exist with a specific timeline commitment?
- Are any legacy systems at or nearing their end-of-life? Do performance-related risks exist?
- What amount of internal critical resources are required for the deployment for each program to avoid a lack of resources to focus on the deployment?
- What is the program management office (PMO) structure for new technology deployments and decommissioning legacy systems?

The diagram listed below reflects an example of a sample project output where Black & Veatch classified different modernization improvement programs based on their potential cost versus benefits.

**STAGE 6: CREATE TECHNOLOGY ROADMAP REPORT AND DEPLOYMENT GOVERNANCE PLAN**

Given the magnitude of analysis completed up to this point in assessing the programs in the infrastructure master plan, now is the time to bring it all together in an understandable matrix. The creation of the roadmap plan requires careful thought as to how to best balance costs, staff resources, areas of critical needs, and possible deployment precedents, so the sequence of deployment is critical. Defining the completed analysis in a detailed written report will best allow for approvals at the various levels (i.e., executive team, the board of directors, regulatory bodies, and others).
The roadmap would consist of a Gantt chart depicting the recommended program by year with the deployment schedule. A second, similar roadmap table would also be created reflecting costs by the program by year. The table below provides a sample format.

<table>
<thead>
<tr>
<th>Programs</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
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</thead>
<tbody>
<tr>
<td>OMS and SCADA Assessment – Best In Class Versus Suite</td>
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<tr>
<td>Complete a technology assessment of migrating to a combined SCADA OMS vendor versus retaining separate vendors</td>
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<tr>
<td>Submit OMS, SCADA and ADMS RFQs</td>
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<tr>
<td>Make technology level decision – Best in Class versus Suite Approach</td>
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<tr>
<td>GIS</td>
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<td>GIS field Inventory for Southern District</td>
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<td>Create Business Process Changes to Maintain Accurate GIS</td>
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<td>Complete integration of GIS to CRM</td>
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<tr>
<td>Substation Modernization</td>
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<tr>
<td>Add SEL RTACs to NC subs @25 per year</td>
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<tr>
<td>Conduct Battery Storage Pilot at 3 Substations</td>
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<td></td>
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<td></td>
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<tr>
<td>Replace legacy communications at 20 substations per year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ADMS</td>
<td></td>
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<tr>
<td>Procure a DRMS from either existing SCADA or existing OMS vendor</td>
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<tr>
<td>Create deployment Release Plan</td>
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<tr>
<td>Deployment of ADMS</td>
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</table>

At this stage, we also find it very helpful to seek agreement from the project team on how to best create a plan for the deployment governance once the deployment begins. This will become an ongoing procedure to closely monitor and track the deployment success to best assure the full value is being realized from the deployments. Many utilities are familiar with the PMO model; what is also needed is to have deployment governance coming from an ongoing technical architect with expertise at the application level. Use of the Solution Design Authority (SDA) as illustrated to the right.
STAGE 7: INFRASTRUCTURE MASTER PLAN APPROVALS

Seeking approvals is critical to the success of the master plan. The approval process starts with the core team reaching consensus on the roadmap and budget. Then a review with the executive team often results in some modifications to the plan. What often happens is, after executive team review, the plan for a given program slated in a later year is moved up and another program is moved back. Having programs and costs clearly identified in Excel tables with written materials explaining each program allows for the various approval parties to understand the plan. The writing style is for cross-departmental executives to understand the value proposition for each program without having to be an expert in each discipline.

STAGE 8: ANNUAL UPDATE OF MASTER PLAN

The master plan is best to be updated annually as part of the annual budgeting process. Revisiting the master plan annually will ensure the roadmap remains aligned with the organizational goals and takes into account any significant future events and new opportunities.

WHAT IS THE VALUE PROPOSITION FOR AN INFRASTRUCTURE MODERNIZATION MASTER PLAN?

We can't stress enough the level of importance of having clear alignment across the organization on the technical grid modernization direction given the magnitude of costs with infrastructure modernization. We now have several approaches that can be undertaken to address the new types of operational challenges as utilities migrate along the smart grid path. What is the best direction for one utility even in the same geographic area may be very different from what is best for a neighboring utility. The master plan provides structure to the organization to learn very quickly from a non-biased trusted advisor on the trade-offs, strengths, and weaknesses of various technology alternatives. Most importantly, it brings your cross-departmental team together.

A summary of some of the reasons for completing a Grid Modernization Master Plan includes the following:

1. CROSS-DEPARTMENTAL SUPPORT:

Having a utility-wide infrastructure modernization project team working together and then creating a plan that has collective buy-in and support is the first step towards success.

2. LEARN FROM AN EXPERIENCED CONSULTING FIRM:

We have worked with utilities globally within the traditional power and telecom sectors. We have dedicated professionals working on grid modernization engagements, responding to project requests for new technology, deploying and testing systems, and more. Because of our experience, we can bring these “lessons learned” to our clients. Utilities can complete similar technology research studies as discussed within this paper on their own without consultant involvement but this takes significant time and often relies quite heavily on the vendors for education and this tends to come with some vendor bias.
3. **IT/OT ORGANIZATIONAL ASSESSMENT:**

An important aspect of the grid modernization master plan is the staffing evaluation that is also completed. An assessment will be made on the staffing that will be necessary for the future to design, build, and maintain the new programs/technology.

4. **COST SAVINGS/COST AVOIDANCE OPPORTUNITIES:**

Some legacy systems hold back utilities from progressing and have significant costs associated to maintain and everyone knows it, but migrating away from the legacy systems does come with some resistance. Many opportunities exist to save money, and demonstrating savings is often helpful when requesting new capital dollars for new investments.

5. **THE MASTER PLAN IS A LOW COST COMPARED TO THE TECHNOLOGY BUDGET:**

The cost of completing a master plan typically represents less than a half percent (0.5%) of a utility’s annual technology budget. The benefits far exceed the costs.

6. **MANAGEMENT TEAM AND REGULATORY APPROVAL:**

Most utilities are somewhat challenged with seeking approvals for major grid modernization investments. We can support this important approval process.

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**ABOUT BLACK & VEATCH MANAGEMENT CONSULTING, LLC**

Black & Veatch Management Consulting, LLC provides integrated strategy, transaction advisory, business operations, regulatory and technology solutions for the global power, water, and oil and gas industries. Our highly experienced team of professional consultants bring together combined expertise in advanced analytics and practical business sense with extensive technology and engineering capabilities. We deliver solutions that work best for your program needs, organization, assets, and customers.

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