A NOTE ABOUT DESIGN

The annual Strategic Directions report series captures Black & Veatch’s global engineering and thought leadership expertise across key elements of the critical human infrastructure market. Just as advising our clients requires mastery of design, strategy development and project construction and execution, so too does selecting a report theme that reflects the dynamics of change across industries.

For 2015, the idea of the universe, which encompasses distinct yet overlapping galaxies, stood out as analogous to the continuous evolution of utility services. Interdependence and convergence, as illustrated by ongoing conversations about the energy/water nexus and consumer and utility technologies, are tangible examples.

From a design perspective, what you see reflected in the report’s cover and in the graphic elements found throughout its pages, is purposeful art. Our aim is that this creative approach produces reports that are informative and engaging resources for its readers.
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INTRODUCTION

Welcome to Black & Veatch’s 2015 Strategic Directions: Smart Utility report. This report represents the evolution of Black & Veatch’s inaugural Strategic Directions: Utility Automation & Integration report, with an expanded focus on automation and integration and utilities’ efforts to harness data to make operations and service delivery more efficient. This iteration of the report moves from primer to prescription, providing insights and solutions based on a survey of utility, municipal, commercial and community stakeholders who are planning the next steps in their connected journey.

The Black & Veatch 2015 Strategic Directions: Smart Utility report captures thoughts and planning concepts from utilities that are upgrading legacy infrastructure to help manage traditional operational concerns and respond to new challenges from reshaped markets and rising customer expectations. Topics addressed include devices, telecommunications networks and automation technologies used to meet new service requirements and provide greater integration with smart city programs.

As utilities strive to upgrade their systems, municipalities, in turn, are tasked with ensuring that their business community and citizenry thrive. As this report shows, achieving balance between opportunity and cost will require cooperation and compromise. This report addresses the role utilities and non-utility stakeholders play in the advancement and adoption of the smart/connected city ideal and the challenges and opportunities they will face along the way.

We welcome your questions and comments regarding this report and/or Black & Veatch services. You can reach us at MedialInfo@bv.com.

Sincerely,
MARTIN TRAVERS | PRESIDENT
Black & Veatch’s telecommunications business

JOHN CHEVRETTE | PRESIDENT
Black & Veatch’s management consulting business
EXECUTIVE SUMMARY
Fred Ellermeyer is a Vice President and the Managing Director of Black & Veatch’s Smart Integrated Infrastructure (SII) service line. This service line leverages distributed infrastructure development capabilities with a high-end analytics platform to address the areas of asset management, operational efficiency, reliability and sustainability for a wide variety of clients. With more than 20 years of experience, Ellermeyer is an expert in energy management, energy optimization and sustainable design practices.

UTILITY TELECOMMUNICATIONS
Dean Siegrist is the Director of Black & Veatch’s utility telecommunications business line. With more than 20 years of experience, Siegrist leads the development and execution of utility telecommunications projects, including a continued focus on the impact of smart grid programs on utility telecommunications infrastructure.

Craig Watson is the Network Services Manager of Black & Veatch’s telecommunications business and oversees all group functional activities, from project execution to resource management. With more than 17 years of experience in the information technology (IT) and engineering industry, Watson has in-depth experience working on improving all phases of data and cybersecurity life cycles and providing network design architecture expertise and on-site field project support.

UTILITY AUTOMATION
Curtis Johnson is the Utility Automation Director for Black & Veatch’s telecommunications business. He is responsible for client satisfaction, quality, cost and schedule for all utility automation projects and services. Among Johnson’s areas of expertise is a thorough knowledge of the management of complex infrastructure projects, from siting through testing and commissioning, to achieve desired project objectives. Johnson spent nearly 25 years working at multiservice utilities before joining Black & Veatch.

William Biehl is an Automation and Telecommunications Project Manager in Black & Veatch’s telecommunications business. With more than 20 years of experience, Biehl manages projects for electric, water and gas utilities across North America. Biehl has led projects for water utilities in the areas of treatment, distribution and collection specifically focused on automation and supervisory control and data acquisition (SCADA) to improve reliability and efficiency. Biehl leads electric utility projects in distribution, substation automation and telecommunications, improving reliability and security with a planning focus on future requirements.

DATA ANALYTICS
G. Scott Stalviar is a Vice President and oversees asset management services within Black & Veatch’s energy business. He focuses on developing processes, tools and solutions that help power generators better address the technical and financial challenges in today’s market. With more than 35 years of total experience, Stalviar specializes in plant performance, information technology solutions and competitive generation practices.

SMART COMMUNITIES
Richard Azer is the Director of Development within Black & Veatch’s SII service line and is involved in developing smart city initiatives, such as microgrids, distributed renewable energy and intelligent utility networks. Azer has more than 20 years of experience in developing and implementing emerging technologies. He is currently involved in a program to deliver the first nationwide network of high power, fast electric vehicle charging stations.

Kevin Cornish is an Executive Consultant in Black & Veatch’s management consulting business. With more than 25 years of direct experience in the electric industry, Cornish specializes in the integration of intelligent infrastructure systems into the utility enterprise, such as geographic information systems (GISs), advanced metering infrastructure (AMI), meter data management systems (MDMSs) and outage management systems (OMSs), among other areas.

PERSPECTIVES
Robert E. Welch is the Vice President, Operational Technologies and Analytics in Black & Veatch’s management consulting business. His team advises clients in deployment of new processes, architectures and technologies in next generation electric, gas and water distribution environments. Over the last 4 years, Black & Veatch has helped more than 15 clients in the planning and execution of full-scale automated metering initiatives and worked with many of those clients to help them take advantage of advanced planning and operations, including data analytics and business intelligence.

Clint Robinson is Associate Vice President of Black & Veatch’s Government Affairs team and works collaboratively with professionals within Black & Veatch’s businesses, industry stakeholders, association partners and consultants to build relationships with government officials to achieve Black & Veatch’s overall global growth strategies. Robinson has over 30 years of experience as a registered professional engineer. He is currently engaged with the US Conference of Mayors, the National Leagues of Cities and the American Council of Engineering Companies as a business partner participating in the discussions on sustainable, resilient and smart city concepts.

G. “Satya” Sathiamoorthy is the Country Manager and Managing Director of Black & Veatch India. He is responsible for overseeing the company’s operations and spearheading the implementation of the India growth plan for the company in energy, water and telecommunications. Sathiamoorthy is a functional specialist with a vast knowledge of engineering and a career that has spanned nearly 30 years. He is responsible for the successful execution of many turnkey projects in India and around the world.

CONCLUSION
Martin Travers is President of Black & Veatch’s telecommunications business and Executive Sponsor of the company’s SII service line. Travers has led the strategic growth of Black & Veatch’s telecommunications business for more than 10 years. The company’s telecommunications business provides vertically integrated solutions to both public and private network clients around the world. In addition, Travers is a member of Black & Veatch’s Board of Directors.

John Chevrette is President of Black & Veatch’s management consulting business and works closely with clients to address key challenges affecting today’s electric, water and gas utilities. Chevrette has more than 20 years of industry consulting experience and has worked with domestic and international clients in the electric utility, energy technology, gas pipeline, telecommunications and water industries.
The Black & Veatch 2015 Strategic Directions: Smart Utility report is a compilation of data and analysis from an industry-wide survey. This year’s survey was conducted from 15 October through 14 November 2014. The results of the online questionnaire reflect the input of 721 qualified utility, municipal, commercial, and community stakeholders.

Statistical significance testing was completed on the final survey results. Represented data within this report have a 95 percent confidence level. The following figures provide additional detail on the participants in this year’s survey.

**Industry Type**

- **32.0%** Electric utility
- **40.5%** Water utility
- **0.6%** Natural gas utility
- **7.9%** Combined utility
- **12.2%** Local government/municipality
- **3.9%** University/college
- **2.9%** Manufacturing establishment

**Primary Business Region**

- **27.8%** Midwest
- **10.5%** Northwest
- **22.3%** Southwest
- **20.1%** Southeast
- **6.8%** Rocky Mountain
- **7.3%** Mid-Atlantic
- **4.1%** New England
- **5.5%** Canada
- **4.2%** U.S. – Nationwide
- **3.4%** Other Countries
- **2.0%** Other U.S.
- **1.3%** Mexico

**Utility Type**

- **63.7%** Public or government-owned utility
- **23.6%** Investor-owned utility
- **4.8%** Cooperative
- **3.6%** Independent/industrial power producer
- **3.6%** Privately held corporation
- **0.7%** Other

*Source: Black & Veatch*
EXECUTIVE SUMMARY

Making Connections
By Fred Ellermeier

Communities and utility service providers are moving dramatically toward a smart city ideal. The proliferation of smart devices and utility automation efforts coupled with the expanded use of data analytics is transforming the development and delivery of key infrastructure services. These advances are reshaping the customer-utility relationship and making service providers more responsive, efficient and resilient.

Developing a framework for the smart utilities that provide critical infrastructure services is key to defining the smart city. Data in this 2015 Strategic Directions: Smart Utility report indicates consistency in the intent of the smart city, even as a common definition of a smart city remains elusive. For water utilities, smart city meant “smart water” and resiliency planning. For municipalities, sustainability of operations and resources took the lead.

Figure 1
What do you see as the primary driver of smart city initiatives in your region?

- **Improving efficiency of operations/reducing operating costs**: 42.5%
- **Environmental/resource sustainability**: 15.6%
- **Better overall management of community systems**: 8.7%
- **Increasing critical infrastructure resilience**: 7.9%
- **Attracting business investment**: 6.6%
- **Increasing customer satisfaction**: 5.7%

These differing outlooks are reflected in the goals set by companies initiating smart city projects. Improving efficiency and reducing costs are paramount for some respondents (Figure 1). Others seek to satisfy environmental sustainability goals or improve relationships with customers to resist competitive threats.

ADVANCING THE IP FRONT

What began as a few connected devices placed on utility networks is now widely recognized as an essential element of the Internet of Things (IoT). Empowered by investments in telecommunications infrastructure, smart utility and smart city efforts provide evidence that we are on the cusp of a new, data-driven future. Legacy equipment continues to cycle out as Internet Protocol (IP)-based technology creates new opportunities to improve system efficiency. As networks converge, comprehensive planning becomes key to ensuring the capability and security of utility networks.
**ESSENTIAL AUTOMATION**

Regardless of type, automation – and the infrastructure on which it is based – delivers value to utilities and end users alike. Supervisory control and data acquisition (SCADA) systems are widely automated; however, despite the significant attention given to greater network connectivity, this report identifies a surprisingly large number of organizations that have yet to move forward with smart infrastructure plans.

Understanding the role of automation is especially important as nearly over one-third of respondents predict that the United States will see the implementation of a smart city model within 6-10 years (Figure 2). The proliferation of smart city deployments will multiply. Hurdles to reaching smart city status are diverse, but overcoming the return-on-investment challenge is essential to improving performance and strengthening relationships with customers.

**DATA ANALYTICS**

Despite a fluid definition of “smart,” institutions face common, age-old struggles: how to pay for these technologies, harness their benefits and quickly recover their costs. Utility leaders see the value of analytics, particularly as it relates to managing their infrastructure assets and planning capital investments, as well as improving customer service, engagement and customer operations (Figure 3).

![Figure 2](source:

When do you believe there will be widespread adoption and implementation of the smart city model across the United States?

<table>
<thead>
<tr>
<th>Time Frame</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the next 1-5 years</td>
<td>10.0%</td>
</tr>
<tr>
<td>In the next 1-5 years</td>
<td>10.9%</td>
</tr>
<tr>
<td>In the next 6-10 years</td>
<td>31.6%</td>
</tr>
<tr>
<td>In the next 11-15 years</td>
<td>25.0%</td>
</tr>
<tr>
<td>In the next 16-19 years</td>
<td>4.1%</td>
</tr>
<tr>
<td>In the next 20+ years</td>
<td>17.6%</td>
</tr>
<tr>
<td>Never</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

![Figure 3](source:

What are the top three business/administrative areas in your organization that would be best served by increased data management and analytics capabilities?

<table>
<thead>
<tr>
<th>Area</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset management</td>
<td>67.1%</td>
</tr>
<tr>
<td>Capital investment prioritization</td>
<td>44.5%</td>
</tr>
<tr>
<td>Customer service/engagement</td>
<td>27.1%</td>
</tr>
<tr>
<td>Customer billing, collections and/or revenue protection</td>
<td>27.0%</td>
</tr>
<tr>
<td>Evaluating strategic options/scenarios</td>
<td>26.8%</td>
</tr>
<tr>
<td>Risk management</td>
<td>24.6%</td>
</tr>
<tr>
<td>Business case development</td>
<td>19.7%</td>
</tr>
<tr>
<td>Rate making or dynamic pricing</td>
<td>14.6%</td>
</tr>
<tr>
<td>Other</td>
<td>1.3%</td>
</tr>
</tbody>
</table>
SMART UTILITY/SMART INDUSTRY
This report includes an overview of what a smart utility might look like as well as the policy implications of data sharing and data security and the financial considerations involved with collaboration. A similar exploration of manufacturing and other commercial stakeholders was carried out by outlining the concerns and opportunities for industry in a smart city scheme.

Recognizing the global implications and need for smart utility and smart city planning, this report also provides insights from India as the country focuses on supporting the needs of a growing urban population.

SMART UTILITIES, SMARTER CITIES
Now more than ever, the increasing use of technology offers utility operators greater understanding of their networks and how customers consume power, water, natural gas and data. Forecasting historically required large teams to examine past operations and create an operations snapshot, often long in the past. Now, predictive analytics, or Adaptive Planning, is redefining how complex systems can be managed through rapid analysis of real-time information.

Such agility is especially important in urban areas, where service demands are placing significant stress on aging infrastructure. Some of the most aggressive moves toward automation are coming from utilities serving large populations. For instance, this report finds that nearly 40 percent of organizations serving populations of 2 million have announced a smart city initiative, a significantly higher percentage than institutions serving smaller areas.

Nearly 40 percent of organizations serving populations of 2 million or more have announced a smart city initiative.

All of these advances will propel utilities and, in turn, help to create smart cities. This 2015 Strategic Directions: Smart Utility report captures a time of exciting change and great challenge as major service providers become more intelligent about their operations and explore opportunities to improve resiliency, costs, safety and resource efficiency. Yet, this report also finds many service providers moving warily, challenged by market shifts, regulatory action and the effects of years of run-to-fail management. While some providers are moving faster than others, it is increasingly clear that technology will have a foundational role in evolving all utilities into smart utilities and creating the foundation for future smart cities.
Change is sweeping through utility telecommunications at a furious pace. This change is challenging utilities to adapt to transformative technologies, place a heightened focus on security and regulation, and manage an aging workforce that is being asked to adjust to, and find efficiencies in, a disruptive environment. Those challenges are not stopping utilities from moving ahead: Black & Veatch’s 2015 Strategic Directions: Smart Utility report finds that nearly 60 percent of providers are planning for replacement, upgrades or new communications infrastructure in the next five years (Figure 4).

Electric utilities are leading the way, with 63 percent of those reporting moving ahead with new systems (Table 1). A key driver is the need to support capacity demands for future smart grid/smarter utility projects. This is a clear sign that providers are developing systems designed to meet today’s communication and asset management expectations while keeping an eye on how these systems will integrate with future expansion.

From the surge in Internet Protocol (IP) deployment to the sunsetting of legacy connections (e.g. frame relay, POTS), this exciting transformation brings the promise of cost savings and agile, speedier networks. But the changes also carry big implications for utilities, even for those that are already moving aggressively. For example: Does a utility have a master plan? Do security concerns occupy an important space in planning? Is the workforce ready? How these questions are answered will go far in determining how change is managed.

Table 1
Are you planning on replacing, upgrading or building communications infrastructure in the next 5 years?

<table>
<thead>
<tr>
<th>Plans to Replace, Upgrade or Build Communications Infrastructure in the Next 5 Years</th>
<th>Electric Utility</th>
<th>Water Utility</th>
<th>Combined Utility</th>
<th>Local Government/Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>63.2%</td>
<td>59.0%</td>
<td>59.6%</td>
<td>471%</td>
</tr>
<tr>
<td>No</td>
<td>18.2%</td>
<td>17.2%</td>
<td>14.0%</td>
<td>241%</td>
</tr>
<tr>
<td>Don’t know</td>
<td>18.6%</td>
<td>23.8%</td>
<td>26.3%</td>
<td>28.7%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch

Figure 4
What are the top three reasons why you are planning on upgrading or building communications infrastructure in the next 5 years?

1. Support smart grid/smarter utility initiatives
2. Support mobile workforce
3. Upgrade obsolete infrastructure

Source: Black & Veatch
IP LEADS THE WAY
At the forefront of these changes is the move to IP, a network protocol standard at the heart of communications networks that provides the basic building blocks that allow seamless integration and compatibility among all devices. IPs are being adopted from multiple angles. One key migration comes with supervisory control and data acquisition (SCADA) programs. Before, remote terminal units monitored and controlled information flows through hardwired serial connections that relied on fixed endpoints.

IPs deliver more flexibility and the bandwidth necessary for handling corporate data and other traffic (Figure 5). The value proposition is high: IP delivers a common, standardized approach to efficiently enable devices and applications to directly communicate with one another through an assigned address. Those benefits, however, can only be realized after a utility considers several key factors:

- Equipment costs and the resources to support the upgrades. Do utilities have the trained workforce required to support and maintain the new technology?
- The need for thorough testing to ensure “proof of concept.”
- Will equipment and systems scale to accommodate future upgrades and equipment changes?

Momentum for wide IP deployments is building, driven by the promise of reduced capital and operational expenses that a single, shared network infrastructure can provide. Some utilities are completely embracing a converged mentality and running everything over a shared infrastructure, while others are moving more cautiously by keeping protective relaying and other mission-critical applications separate from the converged network (Figure 6).

Other advanced technologies, such as multiprotocol label switching (MPLS), offer similar speed and network reliability gains. They offer utility customers the ability to converge networks or systems in a segregated traffic model across a shared infrastructure. Under MPLS, tags are added to packets that speed them along predefined routes according to a network’s quality of service requirements. Black & Veatch recently migrated a large utility to an MPLS scheme, underscoring how providers are willing to retire traditional data management systems.

Figure 5
Select the top two reasons you are considering, planning or currently deploying IP network convergence.

73.4% Increased amount of data and bandwidth capabilities to support operations
62.2% Demand for operational efficiency and lower operational expense
33.9% Security concerns
14.0% Operational expense savings
3.4% Environmental initiatives
2.2% Other

Source: Black & Veatch

Figure 6
What do you see as the two biggest challenges to deploying an IP network convergence solution?

46.3% Need to keep protective relaying and other mission-critical applications separate from converged network
44.0% Ensuring ongoing service and support
36.6% Organizational responsibility of the future network
35.6% Ensuring low financial risk and achieving high return on investment
22.5% Sourcing qualified network architects/installers
2.5% Other

Source: Black & Veatch
SECURITY
The change to IP and other automating technologies comes with a renewed – and federally required – focus on network security. The new systems bring speed and latency improvements but open utilities to new risks that need to be understood and mitigated. Providers that once piggybacked on public-carrier networks to handle network traffic are increasingly initiating, or considering, privately operated networks (Table 2).

Seventy percent of electric utilities said they now operate a private communications network for transmission and distribution, with water utilities not far behind in similar adoption. Public network solutions are still a significant connectivity option for utilities, with 37 percent of respondents saying they use public-carrier cellular networks to help with advanced metering infrastructure (AMI), SCADA and other devices. Utilities increasingly prefer the private option, however, because it gives them control over reliability and access.

That control also lowers the data-leak risks inherent to a network that must accommodate sensitive utility monitoring and control traffic as well as general, user-generated voice and data. It is also notable that more than half (56 percent) of utilities and municipalities serving populations of 2 million or greater say they are installing new or updating communications infrastructure because of cybersecurity initiatives (Table 3).

Utilities must also factor tighter government regulations, such as Version 5 of the Critical Infrastructure Protection (CIP) requirements set out by the North American Electric Reliability Corporation (NERC). Version 5 of the CIP requirements also emphasizes the need for more stringent security controls, awareness and documentation practices of physical and remote cyber access to highly critical operational areas and devices that comprise a utility’s bulk electric system. One such technology that will continue to be adopted and its implementation increased across a utility’s network is video surveillance. Although widely recognized as a crucial component of physical security, this requirement will significantly impact a utility’s available bandwidth. It may also force the creation of new workflows to address who monitors the video and how and where it is stored. Many utilities reported not knowing the impacts of the NERC/CIP Version 5 on their businesses.

<table>
<thead>
<tr>
<th>Operate a Private Communications Network?</th>
<th>Electric Utility</th>
<th>Water Utility</th>
<th>Combined Utility</th>
<th>Local Government/Municipality</th>
<th>University/College</th>
<th>Manufacturing Establishments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>69.7%</td>
<td>59.6%</td>
<td>72.7%</td>
<td>48.1%</td>
<td>53.8%</td>
<td>41.2%</td>
</tr>
<tr>
<td>No</td>
<td>19.9%</td>
<td>29.5%</td>
<td>14.5%</td>
<td>38.0%</td>
<td>38.5%</td>
<td>47.1%</td>
</tr>
<tr>
<td>Don’t know</td>
<td>10.4%</td>
<td>10.9%</td>
<td>12.7%</td>
<td>13.9%</td>
<td>7.7%</td>
<td>11.8%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch

<table>
<thead>
<tr>
<th>Reasons For Replacing, Upgrading or Building Communications Infrastructure</th>
<th>By Population Served</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Under 50,000</td>
</tr>
<tr>
<td>Our communications infrastructure is obsolete or near obsolete</td>
<td>40.6%</td>
</tr>
<tr>
<td>New or updated communications infrastructure is needed to support capacity demands for future smart grid/smart utility initiatives</td>
<td>46.9%</td>
</tr>
<tr>
<td>New or updated communications infrastructure is needed to support future renewable integration projects</td>
<td>15.6%</td>
</tr>
<tr>
<td>New or updated communications infrastructure is needed to support mobile workforce</td>
<td>59.4%</td>
</tr>
<tr>
<td>New or updated communications infrastructure is needed because of cyber security initiatives</td>
<td>34.4%</td>
</tr>
<tr>
<td>To support IP network convergence</td>
<td>21.9%</td>
</tr>
<tr>
<td>Other</td>
<td>12.5%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch
WHAT’S THE PLAN?

Complex systems featuring IP, MPLS and other technologies require thoughtful advanced planning. Above all else, Black & Veatch recommends a master telecommunications plan that acts as a road map for adopting and exploiting these advances. Thorough planning, design and proof-of-concept regimens will ensure that a new system aligns with the utility’s larger goals and is adaptable to change (Figure 7).

Developing conceptual network architecture, identifying system requirements and identifying mission- and non-mission-critical assets are just a few of the factors utilities must evaluate during the planning, assessment and architecture stages. From there comes a smart strategy: developing and documenting operational standards, creating detailed network designs and specifications, and establishing a solid testing phase to help utilities understand these changes and exploit their potential.

Figure 7
Do you currently have a long-range plan for development of your telecommunications networks?

- 16.0% Yes, but it will need updating within three years
- 26.4% Yes, and it extends out beyond three years
- 14.7% No, but we are currently developing a plan
- 12.3% No, and we have no plans to develop one
- 30.5% Don’t know

Source: Black & Veatch

Thorough planning, design and proof-of-concept regimens will ensure that a new system aligns with the utility’s larger goals and is adaptable to change.
Advances in smart grid and automation technologies are prompting operators to upgrade their networks for efficiencies and cost savings. Real-time information, sped to central locations by millions of smart sensors and meters, helps utilities manage abnormalities, reduce outage times and maintain customer satisfaction with little to no human intervention. But Black & Veatch’s 2015 Strategic Directions: Smart Utility report finds a landscape of smart utilities with a high number of cities, privately owned utilities and other providers on the sidelines of the automation movement (Figure 8).

Figure 8
When did or will you start to roll out major changes in the following automation programs?

<table>
<thead>
<tr>
<th>Program</th>
<th>Will Start Next 2 Yrs</th>
<th>Will Start Next 3-5 Yrs</th>
<th>Will Start Next 6+ Yrs</th>
<th>No Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water or natural gas production, transmission, or treatment</td>
<td>7%</td>
<td>3%</td>
<td>2%</td>
<td>13%</td>
</tr>
<tr>
<td>Water or natural gas unmanned facilities</td>
<td>8%</td>
<td>2%</td>
<td>3%</td>
<td>17%</td>
</tr>
<tr>
<td>Water or natural gas distribution main</td>
<td>9%</td>
<td>5%</td>
<td>4%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch

Some utilities, understandably focused on the costs of maintaining and replacing outdated equipment, are unconvinced that smart grid technologies and automation are critical. Others are kept away by investment-return pressures. Those concerns, while significant, carry risk.

Utilities moving aggressively into automation indicate that advanced metering infrastructure (AMI), fault location and restoration, volt/VAR control, demand response and sensors are key factors toward optimizing their networks (Figure 9). Supervisory control and data acquisition (SCADA) systems have seen the most automation changes, with 80 percent of utilities indicating that they have already made substantial changes to the centralized systems used to control remote equipment and monitor its use.
AMI devices, in particular, have moved providers closer to the concept of a smart grid by delivering highly specific metrics on customer use of energy, water, and gas. That information, sent to centralized locations where the data are analyzed and acted on, has produced efficiencies and led to significant gains in measuring consumption and using that data to change behaviors. For example, Black & Veatch joined four other technology companies in late 2014 in providing sensors, analytics software and other technologies to help the Port of San Diego collect energy consumption data. Port operators are acting on the data by adjusting behaviors in ways that are aimed at reducing both energy costs and greenhouse gas emissions.

Customer-side benefits are just as important. End users see more accurate billing, faster service hookups and disconnects, and the perception of a utility on top of its systems. For example, AMI data routinely report outages even before the customer calls the utility to report them.

Black & Veatch finds that a surprising number of utilities, city governments and other service providers have no plans to implement smart grid projects, believing the advances are not applicable to their business model (Figure 10). Many such providers are deploying key first steps, such as SCADA, but are stopping short of fully developed automation systems at a time when overwhelming trends suggest industries as far ranging as banking, retail, health care and others are using information more completely. Still others may recognize the benefits of automation but believe customers would resist paying for both the replacement of aging infrastructure and an automation layer on top of it.

Yet many utilities are making the business case, believing the cost savings and efficiencies exceed automation’s investment. This report finds that more than four in five providers that have developed automation initiatives said operational efficiencies were the top driver, followed by improved service reliability (Figure 11, Table 4). Tellingly, large organizations (5,000 or more employees) said profitability and shareholder value were the primary considerations fueling their automation initiatives, compared to smaller organizations. Regardless of size, distribution automation must be profitable by getting rate recovery in excess of costs or by realizing operational savings in excess of the investment.

Figure 10
Which of the following statements best reflects your approach to the implementation of smart grid and automation programs?

- 34.1% Not applicable, we are not implementing smart grid and automation projects
- 16.4% Each project is performed separately by a focused team
- 32.4% Each project is performed separately but coordinated with other projects
- 17.1% All projects are performed as an integrated program

Source: Black & Veatch

Figure 11
What are the three primary business drivers for your automation programs?

<table>
<thead>
<tr>
<th>Primary Business Drivers for Automation Programs</th>
<th>Electric Utility</th>
<th>Water Utility</th>
<th>Combined Utility</th>
<th>Local Government/Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal, state, or local government mandates</td>
<td>31.2%</td>
<td>20.3%</td>
<td>32.3%</td>
<td>28.1%</td>
</tr>
<tr>
<td>Customer or other non-governmental (NGO) pressure</td>
<td>7.5%</td>
<td>3.8%</td>
<td>7.1%</td>
<td>12.5%</td>
</tr>
<tr>
<td>Operational efficiencies</td>
<td>75.9%</td>
<td>89.8%</td>
<td>78.6%</td>
<td>82.8%</td>
</tr>
<tr>
<td>Improve service reliability</td>
<td>68.3%</td>
<td>72.7%</td>
<td>55.4%</td>
<td>65.6%</td>
</tr>
<tr>
<td>Profitability or other shareholder benefits</td>
<td>18.6%</td>
<td>3.8%</td>
<td>14.3%</td>
<td>10.9%</td>
</tr>
<tr>
<td>Company-initiated conservation/ green goals</td>
<td>8.5%</td>
<td>8.0%</td>
<td>12.5%</td>
<td>7.8%</td>
</tr>
<tr>
<td>Replacement of outdated/obsolete systems</td>
<td>44.2%</td>
<td>65.9%</td>
<td>50.0%</td>
<td>54.7%</td>
</tr>
<tr>
<td>Strategic initiative</td>
<td>30.2%</td>
<td>20.8%</td>
<td>26.8%</td>
<td>21.9%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch

Table 4
What are the three primary business drivers for your automation programs?
OVERCOMING THE RETURN ON INVESTMENT HURDLE

Black & Veatch expects providers to continue setting high bars that automation plans must meet before they are adopted. Investor-owned utilities (IOUs) and municipalities should craft education strategies for skeptical investors and citizen constituents. The investment pressures raised by both groups are genuine: Stockholders expect profitability; customers and regulators demand cost-containment, and both generally resist short-term sacrifices even if system upgrades deliver profits and increased reliability in the future. Simply put, utilities will be challenged to show stakeholders the dangers of not automating, which could be higher both in the long and short term.

Customers have come to expect briefer outages, and utilities that have successfully implemented automation drive these expectations with smart sensors that can detect outages and route power around them. In the long term, automation deployed across the enterprise results in an efficient, balanced delivery system that reduces costs and emissions. Recent environmental mandates could ultimately force these efficiency steps; this is an issue that remains especially acute for electric utilities, which will face pressure to balance resources to support using less energy.

FOR PROVIDERS, THINKING AHEAD WITH AUTOMATION IN MIND

Interoperability, telecommunication and future integration are significant considerations when undertaking an automation plan. For instance, nearly 40 percent of utilities created telecommunications master plans before deploying automation initiatives, while a similar number created integration road maps before getting started. Those are key signs that providers are smartly thinking not only about how AMI and other automation applications will streamline delivery but also about how those technologies will work with both new and existing equipment. Sixty percent of utilities say their biggest gaps in automation (Figure 12) lie with outdated equipment, suggesting that many smart grid deployments must wait out, or work around, the life cycles of aging equipment.

Black & Veatch believes advanced planning for automation, specifically plans that involve enterprise-wide deployment, remains a weakness across the provider spectrum and requires an integrated approach. Municipalities have the most room for growth, with just 7 percent of government providers, and about a quarter of electric utilities, deploying automation in integrated ways. Confining automation to silos brings risks, especially when those solutions cannot easily operate over common, integrated and converged communications networks. A plan that accounts for the entire enterprise is optimal and will lead to the most gains.

Figure 12

What does your organization see as the two most significant gaps in its current automation state?

Old and obsolete equipment

Lack of integration of automation into overall enterprise

Source: Black & Veatch
Rapid advances and convergence in technologies are arriving on the utility landscape just as regulatory changes, new financial pressures and opportunities, and the impacts of an aging workforce are being felt. These forces are combining to reshape how utilities deliver key infrastructure services. Ultrafast networks speed actionable data about customer usage, nimbly anticipate user needs and resolve abnormalities to reduce outages or other service interruptions. They also are becoming essential to managing a workforce that is getting older and increasingly pondering retirement in an improving economy.

Greater automation of distribution operations for electric, gas and water utilities provides a more efficient operating environment, and one that should be less dependent on the craftsmanship of the traditional utility workforce. Populations of key manufacturing nations are projected to fall or increase at marginal rates in coming decades, propelling the hunt for productivity gains as the demographics shift. That is placing new importance on systems that, over time, rely less on human intervention.

Utility executives have a unique understanding of this global trend. They are required, through regulation and stakeholder expectations, to deliver services efficiently, with as little downtime as possible. Efficiency and quality of operations are frequently key measures that impact ratemaking. For service providers who have not yet made the automation leap, it can seem like a mountainous challenge: workers must be trained, aging equipment replaced and customers convinced the changes will benefit them over the long run.
THE PROBLEM OF AN IMPROVING ECONOMY

After Hurricane Sandy plunged much of the East Coast into darkness in 2012, numerous outside utilities made their crews available in the massive power restoration effort. The enormity of the storm overmatched local crews’ ability to deal with the damage, so workers from across the country and Canada gave themselves generously to the region’s recovery.

But the storm underlined a trend that should give all utilities pause. At a minimum, one can draw a dotted line between the extended outages caused by such enormous storms and the steady exodus of experienced utility workers. An outflow of utilities’ institutional knowledge is becoming more real, in part because the improving economy has made retirements more accessible. Departures put off in the wake of the 2008 recession are also palatable again to a large section of the long-term utility workforce.

What does that mean in 2015? While the economic recovery continues and utilities continue to be challenged to provide the labor necessary to meet natural disasters, the drive toward automation is a clear opportunity. In normal environments, intelligent networks can be expected to keep systems moving in ways that demand less of a utility from a labor perspective. The decreasing need for meter readers is a prime example, and automation will bring new opportunities to leverage technology and reduce labor costs.

MOBILE COMMUNICATIONS

It is not news that ubiquitous smartphones have streamlined workflows, but they carry extra meaning as utilities upgrade and maintain smart networks. Data in Black & Veatch’s 2015 Strategic Directions: Smart Utility report include some surprising statistics. Nearly 50 percent of water utility respondents considered their communications infrastructure obsolete or nearly so, with roughly a third of electric and combined utilities coming to the same conclusion.

An outflow of utilities’ institutional knowledge is becoming more real, in part because the improving economy has made retirements more accessible.

Utilities now have the ability to not wait until a transformer fails.

Table 5

<table>
<thead>
<tr>
<th>Reasons For Replacing, Upgrading or Building Communications Infrastructure</th>
<th>Electric Utility</th>
<th>Water Utility</th>
<th>Combined Utility</th>
<th>Local Government/Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our communications infrastructure is obsolete or near obsolete</td>
<td>34.9%</td>
<td>49.3%</td>
<td>35.3%</td>
<td>42.5%</td>
</tr>
<tr>
<td>New or updated communications infrastructure is needed to support capacity demands for future smart grid/smart utility initiatives</td>
<td>74.0%</td>
<td>42.1%</td>
<td>70.6%</td>
<td>50.0%</td>
</tr>
<tr>
<td>New or updated communications infrastructure is needed to support future renewable integration projects</td>
<td>38.4%</td>
<td>33.9%</td>
<td>29.4%</td>
<td>30.0%</td>
</tr>
<tr>
<td>New or updated communications infrastructure is needed to support mobile workforce</td>
<td>38.4%</td>
<td>60.2%</td>
<td>29.4%</td>
<td>47.5%</td>
</tr>
<tr>
<td>New or updated communications infrastructure is needed because of cybersecurity initiatives</td>
<td>50.7%</td>
<td>35.7%</td>
<td>32.4%</td>
<td>32.5%</td>
</tr>
<tr>
<td>To support IP network convergence</td>
<td>19.9%</td>
<td>28.1%</td>
<td>41.2%</td>
<td>32.5%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch

THE OPPORTUNITY OF REGULATION

Utilities across the United States are dealing with state and federal regulations on everything from security and mandated uptime to environmental efficiency aimed at meeting greenhouse gas reduction goals.

Data gathered by Black & Veatch find that many of those regulations play a significant part in moving the industry toward the smart utility ideal. Previously, utilities rarely worried about efficiencies, but a new model of regulation in the states has put performance benchmarks on providers. Utilities are paid based, in part, on how efficient they are in keeping the lights on and outage times down. Automation, as the data show, is seen as a key solution to the manifold problems of efficiency and government regulation.

This is spurring massive change, particularly in asset management. Utilities are committing billions of dollars to replacing grid infrastructure, and they are placing smart technology layers on top of the new equipment to expedite cost recovery. Utilities now have the ability to not wait until a transformer fails. Advanced sensors and networks monitor the transformer’s age, giving the utility the chance to replace it proactively before an event forces its hand. The scenario should sound familiar to an industry that is increasingly compelled to act on its trouble spots before the storm of change arrives.
Previous Black & Veatch Strategic Directions reports covering the electric utility, water utility and natural gas industries highlighted the need to improve energy management and operational efficiency was a recurring theme. As utility operators seek to stretch limited capital budgets, maximize return on investment (ROI), and improve the customer experience, any discussion of how to achieve these goals and build smart utilities or smart cities will eventually focus on data. Specifically, the spotlight is on the use of data analytics to extract actionable system knowledge that will reduce costs and better position leadership to improve their organizations’ performance.

It is important, however, to avoid grouping all data analysis into the same bucket. In many cases, data analytics remains an aspirational resource for utility business and operational leaders. Despite widespread advertising campaigns targeting the business-to-business (B2B) and business-to-consumer (B2C) markets and a high profile role in the 2014 political cycle, talk of data analytics should not be confused with broad utility adoption. According to Black & Veatch’s research, overall utility adoption of analytics programs remains within the margin of error when compared to 2014 survey results. Approximately one-third of respondents still do not know what types of analytics are in use in their organization (Figure 13). On the plus side, executive awareness of analytics programs ranked higher than it did with other respondents, which supports Black & Veatch’s position that analytics programs are being driven by senior leadership. It is also interesting to note that water and combined utilities appear to have more aggressively adopted descriptive analytics programs, while electric utilities are applying more advanced predictive or prescriptive analytics programs in greater numbers (Table 6).

![Figure 13](image)

What types of data analytics does your organization currently use to improve its operational performance?

<table>
<thead>
<tr>
<th>Types of Data Analytics Currently Used to Improve Operational Performance</th>
<th>Electric Utility</th>
<th>Water Utility</th>
<th>Combined Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed-loop optimization</td>
<td>21.9%</td>
<td>35.1%</td>
<td>17.5%</td>
</tr>
<tr>
<td>Descriptive analytics</td>
<td>32.0%</td>
<td>36.4%</td>
<td>45.6%</td>
</tr>
<tr>
<td>Predictive analytics</td>
<td>31.6%</td>
<td>25.4%</td>
<td>24.6%</td>
</tr>
<tr>
<td>Prescriptive analytics</td>
<td>21.5%</td>
<td>18.6%</td>
<td>12.3%</td>
</tr>
<tr>
<td>Don’t know</td>
<td>40.4%</td>
<td>28.9%</td>
<td>40.4%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch
OBSTACLES TO IMPLEMENTATION

Barriers to deploying analytics programs typically fall into two categories: technology and benefit identification obstacles. Despite a growing body of evidence that analytics are critical to making the transition to a smart utility, budget constraints (64 percent) and justifying the ROI (42.2 percent) were identified by respondents as the top barriers to more fully capitalizing on data analytics opportunities (Figure 14, Table 7).

In many instances, it is easy to identify a faulty piece of equipment or the need to replace a leaking pipe, but less clear to ratepayers and regulators are the investments that, for example, provide incremental efficiency gains. This disconnect will remain a hurdle for organizations seeking to move forward with their plans.

Addressing these challenges successfully requires internal and external education campaigns to allow for the prioritization of investments. Fortunately, ongoing progress in understanding portends the breakdown of these barriers in the years ahead. From the technology perspective, cost-effective, scalable cloud-based technology continues to make it easier to address security support and data management issues. As the cost of technology drops, budgetary obstacles fall as well.

The second major development is the realization that foundational analytics programs are demonstrating value throughout organizations versus simply one group or department within an organization. Attempts to purchase technology that will be siloed within an organization, are increasingly hard to justify, but those that can impact the effectiveness of multiple departments shift from the “nice-to-have” to the “have-to-have” category.

Other challenges from aging utility workforces to a lack of in-house resources are discussed in the Perspective: Workforce section of this report.

---

**Table 7**

<table>
<thead>
<tr>
<th>Biggest Obstacles to More Fully Capitalizing on Data Analytics Opportunities</th>
<th>Electric Utility</th>
<th>Water Utility</th>
<th>Combined Utility</th>
<th>Local Government/Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget constraints</td>
<td>59.4%</td>
<td>67.6%</td>
<td>57.9%</td>
<td>68.7%</td>
</tr>
<tr>
<td>Data availability/accuracy</td>
<td>24.0%</td>
<td>26.6%</td>
<td>40.4%</td>
<td>28.4%</td>
</tr>
<tr>
<td>IT/data management infrastructure not in place</td>
<td>34.1%</td>
<td>33.4%</td>
<td>28.3%</td>
<td>35.8%</td>
</tr>
<tr>
<td>Justifying the return on investment</td>
<td>45.4%</td>
<td>42.4%</td>
<td>40.4%</td>
<td>38.8%</td>
</tr>
<tr>
<td>Knowing where to start</td>
<td>12.7%</td>
<td>14.5%</td>
<td>14.0%</td>
<td>14.9%</td>
</tr>
<tr>
<td>Lack of in-house understanding or support</td>
<td>25.8%</td>
<td>34.8%</td>
<td>36.8%</td>
<td>37.3%</td>
</tr>
<tr>
<td>Security concerns</td>
<td>30.1%</td>
<td>27.2%</td>
<td>21.7%</td>
<td>17.9%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch

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As the cost of technology drops, budgetary obstacles fall as well.
THE ANALYTICS CONVERSATION SHIFTS

While analytics adoption rates appear similar to a year ago, the conversation about the role of analytics has evolved. Like the initial deployments of advanced metering infrastructure (AMI) programs, many of the early data analytics efforts focused on the customer. Programs centered on the customer experience, theft detection and improved customer billing/usage information. These programs gave utility leaders a snapshot of what is currently happening in the organization, a trend particularly prevalent in the electric utility industry.

Over the course of 2014, the discussion shifted to the role of analytics in asset management and capital investment planning functions that fall more into the predictive/prescriptive realm (Table 8). These latter examples reflect where leaders are trying to use data to better make future decisions versus gaining a snapshot of what is currently happening in the organization.

Table 8
What top three operational areas in your organization would be best served by expanded data management and analytics capabilities?

<table>
<thead>
<tr>
<th>Operational Areas that Will Benefit Most from Increased Data Management and Analytics Capabilities</th>
<th>Electric Utility</th>
<th>Water Utility</th>
<th>Combined Utility</th>
<th>Local Government/ Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluating operational or maintenance options/scenarios</td>
<td>41.9%</td>
<td>57.7%</td>
<td>45.6%</td>
<td>38.8%</td>
</tr>
<tr>
<td>Identifying issues and losses</td>
<td>23.6%</td>
<td>34.7%</td>
<td>24.6%</td>
<td>26.9%</td>
</tr>
<tr>
<td>Improving/maintaining service reliability</td>
<td>49.3%</td>
<td>45.4%</td>
<td>61.4%</td>
<td>49.3%</td>
</tr>
<tr>
<td>Infrastructure resiliency and recovery</td>
<td>24.9%</td>
<td>22.3%</td>
<td>31.6%</td>
<td>29.9%</td>
</tr>
<tr>
<td>Monitoring performance</td>
<td>38.9%</td>
<td>46.4%</td>
<td>29.8%</td>
<td>53.7%</td>
</tr>
<tr>
<td>Outage management</td>
<td>341%</td>
<td>3.8%</td>
<td>36.8%</td>
<td>9.0%</td>
</tr>
<tr>
<td>Regulatory compliance/reporting</td>
<td>131%</td>
<td>20.3%</td>
<td>15.8%</td>
<td>19.4%</td>
</tr>
<tr>
<td>Resource conservation/operating efficiency</td>
<td>8.3%</td>
<td>26.5%</td>
<td>5.3%</td>
<td>20.9%</td>
</tr>
<tr>
<td>Streamlining projects</td>
<td>9.2%</td>
<td>41%</td>
<td>5.3%</td>
<td>11.9%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch

In 2015, Black & Veatch believes that analytics programs will continue their evolution from those programs focused on customers and individual assets within an organization to programs informing the comprehensive needs of the enterprise. Evaluating strategic options and business case development functions requires more complex analytics systems, or combinations of systems, to help utility leaders plan for an increasingly challenging business environment.

It has been well documented that many electric utilities are facing challenges from increasingly complex regulatory environments and the fundamental threat to their business model from distributed generation, particularly rooftop solar installations. For the first time since the industry’s founding, electricity providers do not control the entire flow of electricity, or the relationship with the customer. For water utilities, the Black & Veatch previous Strategic Directions: U.S. Water Industry report shows that only one-third of water service providers believe their revenue is sufficient to cover all of their operational and debt service needs. Lost revenue from aging, leaking infrastructure compounds their financial crisis.

To more effectively address these challenges, utilities need analytics capabilities that will provide visibility that allows for improved interaction with the customer and understanding of the organization. Armed with a range of options, and likely outcomes, operators can work to avoid collisions with customer needs and build synergies to strengthen their networks while ensuring the viability and service that communities expect.
Moves by utilities to adopt smart grid capabilities are built on the idea that complex technologies can speed information across networks to nimbly anticipate customer needs and lower costs. Technology fulfills its own promise when systems “just work”; the lights come on at the flip of a switch, the water flows at the tap, the furnace or air conditioner springs to life when the temperature hits a certain point.

Ironically, these all too often, taken-for-granted occurrences belie the complex networks behind them. As a result, improving the efficiency of these systems to achieve key operational and environmental goals has become a challenge for utilities in their bid to convince customers of the need for smart utility investments. With service providers increasingly joining the smart systems movement (Figure 15), it becomes clear that Utility 2.0 depends greatly on customer buy-in, either through rate cases or their own installation of smart devices at the home. Deeper understanding of the systems that make next-generation devices a more efficient option is critical. Creative education efforts can place customers in a partnership role with utilities and can help users understand the smart grid’s complexity while placing value on its implementation.

“Smart ______” has become a buzz phrase that means different things to different utility sectors.

Just as important as developing agile network technologies is the education of a customer base still wrestling with, and skeptically questioning, what it means to live in a smart city or draw power from a smart grid. Mass media imagery of perfectly timed traffic lights, advanced interactive video surveillance and other technological advances have tried to sculpt a shared understanding of how a fully connected grid efficiently moves utilities, traffic and data along their way.

However, customer confusion persists, and some utilities are reluctant to push ahead with investments. Multiple utility respondents suggest the term “smart” in a utility context is less than definitive. As referenced earlier in this report, “smart ______” has become a buzz phrase that means different things to different utility sectors.
Most utilities have an accepted understanding of smart systems even if their eventual deployments take different paths (Figure 16). Water utilities, for instance, are deploying advanced metering infrastructure (AMI) and distribution sensors to reduce meter-reading costs, identify leaks and increase resiliency. Power providers employ centralized locations to remotely control and adjust devices, along with two-way communication that sends information between a customer’s meter and the utility. Intelligent devices, deployed along the utility’s systems or inside a customer’s home, gather consumption information in real time and give operators actionable data that can lead to behavioral change.

Figure 15
What systems are you currently implementing?

- **Smart electric grid**: 64.5%
- **Renewable/distributed generation**: 43.6%
- **High-speed data network**: 40.7%
- **Energy management systems**: 39.5%
- **Smart water systems**: 30.8%
- **Smart buildings**: 23.3%
- **Smart transportation**: 22.1%
- **Smart street lighting**: 19.8%
- **Microgrids or nanogrids**: 16.9%
- **Smart water systems**: 11.6%

*Source: Black & Veatch*

Figure 16
Which of the following automation initiatives are you currently implementing?

- **Enterprise-wide**: 51.2%
- **Asset management**: 48.7%
- **Cyber or physical security**: 36.2%
- **Electric substation**: 29.9%
- **Water or natural gas production, transmission, treatment facilities**: 25.0%
- **Water or natural gas unmanned facilities**: 17.7%
- **Water or natural gas distribution main monitoring and/or control**: 17.7%
- **Water or natural gas customers**: 16.4%
- **Electric distribution**: 14.4%
- **No, we are not currently implementing automation initiatives**: 11.8%

*Source: Black & Veatch*
SKEPTICAL CUSTOMERS MUST BE EDUCATED, CONVINCED

Smart utility rollouts have been plagued by skepticism at the customer level, largely because they are misunderstood. The past year has seen utilities struggle to convince residents of the required cost of smart grid updates and the steps customers can take at home – often with the help of utility-provided devices – to enable their own smarter choices.

Black & Veatch’s research found nearly 58 percent of utilities, cities and organizations had not announced a smart utility or smart city initiative. Perceptions that smart initiatives were not applicable to organizational missions and a lack of education and information about “smart” improvements were among the top contributors to the utilities’ holding patterns (Figure 17).

Figure 17
Why have you not considered a smart initiative?

- Currently investigating/considering
- Perceived as not applicable
- Lack of support or perceived “value”
- NOT A PRIORITY
- Timing is not right
- Organization is not open to change
- Lack of education/information
- Budget constraints
- Lack of resources, including leadership
- Coordination between different entities

Source: Black & Veatch
Many utilities, however, may understand the benefits of smart grid investments but are struggling with how to communicate their vision or simply prefer to let larger institutions make the first moves and demonstrate their effectiveness.

But with mounting evidence that automation and other smart device deployments are reaping significant cost savings and efficiencies; Black & Veatch believes utilities have a unique opportunity to revisit their strategic missions. They can recommit to new, efficient ways of delivering services driven by improved understanding of real-time and historical data (Table 9). At the same time, they can reinforce their bond with customers by educating them about how the changes can save money and potentially reduce greenhouse gas emissions through smarter consumption. A plan that communicates how the utility and its customer base are invested in each other will go far toward incentivizing residents to act as partners.

**Table 9**

*What are the reasons your organization is currently collecting and transmitting field data to a central location?*

<table>
<thead>
<tr>
<th>Reasons for Collecting and Transmitting Field Data to a Central Location</th>
<th>Electric Utility</th>
<th>Water Utility</th>
<th>Combined Utility</th>
<th>Local Government/Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical archiving</td>
<td>44.7%</td>
<td>64.7%</td>
<td>40.7%</td>
<td>48.4%</td>
</tr>
<tr>
<td>Business analytics</td>
<td>46.7%</td>
<td>38.6%</td>
<td>37.0%</td>
<td>32.3%</td>
</tr>
<tr>
<td>Operational analytics (asset management, outage restoration, system performance)</td>
<td>89.3%</td>
<td>87.1%</td>
<td>92.6%</td>
<td>79.0%</td>
</tr>
<tr>
<td>Distributed resource integration</td>
<td>25.9%</td>
<td>19.3%</td>
<td>20.4%</td>
<td>19.4%</td>
</tr>
<tr>
<td>Support of advanced applications such as DMS, VVO, etc.</td>
<td>22.8%</td>
<td>44%</td>
<td>20.4%</td>
<td>3.2%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch

**A STUDY IN CUSTOMER ENGAGEMENT**

Recently, a Midwestern utility made customer education a major plank in its effort to recover the costs of a smart systems upgrade, which was expected to add a small amount to the average customer’s monthly bill in exchange for savings that were projected to eventually be double the cost of the upgrade. Focus groups revealed to the utility that customers knew little about how smart grid technologies would affect them or how their own changes at home could help lower costs.

The utility crafted an education platform that included, among other actions, sending teams of smart grid advocates into the community to educate customers.

Such strategies could be especially valuable for at-risk demographics that may not easily understand the benefits or may fear that a high technology solution could expose their private data.

Black & Veatch believes it will be crucial for utilities pondering an investment in “smart” solutions to develop a comprehensive plan that is tailored to a community’s needs. In addition, that plan must include an aggressive customer education component to instill trust and preempt suspicions about the utility’s motives.

A plan that communicates how the utility and its customer base are invested in each other will go far toward incentivizing residents to act as partners.
Increased urbanization has put pressure on municipalities around the world to provide robust infrastructure to support growing demand for housing, municipal services and efficient transportation. The objective is to make cities more livable, sustainable and resilient. In addition, communities seek solutions to quality of life concerns such as reliable access to water and power, goods and services, and increasingly, broadband access. It is no surprise that many are hoping the promise of utility interconnectivity, data sharing and analysis will be the solution to their challenges.

One of those fundamental questions facing municipal and utility leaders is how does a networked city help private industry thrive? The answer most cited is that it creates environments where investments in intelligent infrastructure, transportation, and public safety serve as incentives for job creation and growth. Supporting that premise, of the systems related to initiatives currently being implemented, 65 percent are smart electric grid (Figure 18). The smart utility, aided by the civic objectives of renewable integration and ubiquitous communication networks, is serving as an entry point to smart cities.

Industry, seeing the potential for new revenue streams and aiming to capitalize on consumer’s interest in all things digital, are eyeing opportunities to engage and collaborate with city decision-makers. Universities and technology companies, such as Amazon, Google and Tesla, are building entire businesses leveraging and extending infrastructure built and maintained by utilities and regulated by local and federal entities. These entities thrive by layering innovative technology advancements onto existing services and continue to push the boundaries of a smart integrated infrastructure.

These entities thrive by layering innovative technology advancements onto existing services and continue to push the boundaries of a smart integrated infrastructure.

---

**Figure 18**

What systems are you currently implementing?

- **Smart electric grid**: 64.5%
- **Renewable/distributed generation**: 43.6%
- **High-speed data network**: 40.7%
- **Energy management systems**: 39.5%
- **Smart water systems**: 30.8%
- **Smart buildings**: 23.3%
- **Smart transportation**: 22.1%
- **Smart street lighting**: 19.8%

*Source: Black & Veatch*
But increasingly, there is perceived competition regarding who is best served by these initiatives. Survey respondents overwhelmingly believe that commercial entities benefit most from municipal-wide smart city initiatives (Figure 19). When asked which city agencies would benefit most from smart city initiatives, respondents cited electric utilities (Figure 20). Clearly, there is work to do to increase the value proposition these services can bring to commercial enterprises.

With commercial interests already assumed to be in conflict with agency priorities, ascertaining who foots the bill becomes an additional concern. Determining the value proposition and effectively communicating those opportunities to stakeholders is a key step in mitigating perception and cost issues. For retail or manufacturing businesses, an attractive return on investment (ROI) includes energy efficiency gains, because a lower electric bill reduces operations costs. For an electric vehicle manufacturer, traffic pattern insights may inform the charging station siting process and bring additional customers to retail in proximity. Universities and shopping centers prioritize Wi-Fi access. While improved services may be a selling point for the public, their concerns about privacy will also have to be addressed.

**Figure 19**
Please rank the following organizations in terms of which organizations benefit most from a municipal-wide smart city initiative.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Organization</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Commercial</td>
<td>4.62</td>
</tr>
<tr>
<td>2</td>
<td>Schools/colleges/universities</td>
<td>4.57</td>
</tr>
<tr>
<td>3</td>
<td>Hospitals</td>
<td>3.70</td>
</tr>
<tr>
<td>4</td>
<td>Manufacturers</td>
<td>3.53</td>
</tr>
<tr>
<td>5</td>
<td>Hospitality</td>
<td>2.32</td>
</tr>
<tr>
<td>6</td>
<td>Homeowners associations</td>
<td>2.26</td>
</tr>
</tbody>
</table>

**Figure 20**
Please rank the following city agencies in terms of which agencies benefit most from a municipal-wide smart city initiative.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Agency</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electric utility</td>
<td>4.66</td>
</tr>
<tr>
<td>2</td>
<td>Transportation</td>
<td>4.09</td>
</tr>
<tr>
<td>3</td>
<td>Water/sewer</td>
<td>3.69</td>
</tr>
<tr>
<td>4</td>
<td>Law enforcement</td>
<td>3.26</td>
</tr>
<tr>
<td>5</td>
<td>Public works</td>
<td>2.94</td>
</tr>
<tr>
<td>6</td>
<td>City administration</td>
<td>2.37</td>
</tr>
</tbody>
</table>

**Source:** Black & Veatch
Once the value proposition is identified, project financing comes into play. It is important to note that there is no “one size fits all” plan to address funding needs. One solution is financing through public private partnerships (Figure 21).

Kansas City has collaborated with technology company Cisco which will deliver several phases of smart city programs. Another option is via grant-based pilots. The University of Chicago and Argonne National Laboratory are currently partnering to collect data from sensors placed throughout the city. The City of Chicago has also defrayed costs for other initiatives by relying on open source software to build out its data platform. Other cities have created plans using a mix of bond measures and government subsidies. Energy savings from initial undertakings, such as light emitting diode (LED) streetlight retrofits, can serve as budget to finance subsequent phases of smart city development.

New York City might be one of the most visible examples of a smart city vision being customized to meet the needs of its business stakeholders. Among flagship projects that showcase this approach to planning is an initiative that integrates data from local government programs, businesses and consumers to provide information through publicly accessible screens and on multiple devices including city kiosks. Applications include real-time information about public and commercial services. ROI for business includes monetization via advertising revenue derived from digital signage. For the municipality, gains in awareness from a public safety perspective along with quality of life benefits for city residents appear to be markers of success. Elsewhere, business and cities alike are closely watching Hong Kong’s Wise City scheme, eager to benefit from lessons learned from an early adopter.

Where the business and investment community takes the lead on smart city planning, successful cases show the private entity in a funding role. Some employ the “if you build it they will come” strategy of developing hardware and deploying fiber networks and showing stakeholders how they can benefit from new services and technologies.

Organizations such as Cleantech San Diego, the Smart Cities Council and the Top 100 Resilient Cities count members from all stakeholder groups reflecting a best practice approach to ensure that the needs of their stakeholders are met. These organizations facilitate collaboration across a public, private and academic membership to encourage investment in smart city infrastructure and related sustainability initiatives. Black & Veatch partners with several organizations in order to advance the partnership dialogue.

There is no “one size fits all” plan to address funding needs.

What would be the most effective financing model for smart city initiatives?

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Financing Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>69.1%</td>
<td>Public/private partnerships</td>
</tr>
<tr>
<td>42.8%</td>
<td>Tax incentives</td>
</tr>
<tr>
<td>33.0%</td>
<td>Government subsidies</td>
</tr>
<tr>
<td>11.6%</td>
<td>Property taxes</td>
</tr>
<tr>
<td>6.2%</td>
<td>Only municipal funds</td>
</tr>
<tr>
<td>5.3%</td>
<td>Only private funds</td>
</tr>
<tr>
<td>10.9%</td>
<td>I don’t know</td>
</tr>
</tbody>
</table>

Source: Black & Veatch
PERSPECTIVE: POLICY

Smart Collaboration
By Clint Robinson

Smart city collaborations will be shaped and/or stymied by the formal and informal rules that govern multi-stakeholder partnerships. In the absence of a common vision for smart infrastructure, municipal and federal regulations can be at odds with proposed investment strategies. These mandates, when coupled with informal pressures such as electability and shareholder demands, can make it challenging for utilities, municipalities and private industry to realize their common goals. It is no wonder then that survey respondents ranked policy as the third biggest hurdle to overcome en route to managing systems in a more integrated way (Figure 22).

Figure 22
What are the top three hurdles that must be overcome to enable utility, city/community or campus systems to be managed in a smarter, more integrated way?

<table>
<thead>
<tr>
<th>Hurdle</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget constraints</td>
<td>64.0%</td>
</tr>
<tr>
<td>Lack of resources or expertise</td>
<td>36.9%</td>
</tr>
<tr>
<td>Policy hurdle</td>
<td>31.0%</td>
</tr>
<tr>
<td>Gaining stakeholder support</td>
<td>25.6%</td>
</tr>
<tr>
<td>Ownership across departments</td>
<td>18.3%</td>
</tr>
<tr>
<td>Short-term mindset</td>
<td>18.1%</td>
</tr>
<tr>
<td>Security concerns</td>
<td>17.9%</td>
</tr>
<tr>
<td>Time constraints/other priorities</td>
<td>17.7%</td>
</tr>
<tr>
<td>Lack of incentives</td>
<td>14.9%</td>
</tr>
<tr>
<td>Process hurdles</td>
<td>13.4%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch
What is your organization’s biggest security concern regarding management and use of data?

- Unauthorized system access: 38.2%
- Data integrity: 18.6%
- Regulatory compliance: 13.2%
- Maintaining customer privacy: 9.6%
- Data loss: 8.4%
- Data security is not a big concern: 2.0%

Source: Black & Veatch

Frequently discussed are the privacy and data security challenges posed by the data that is collected, stored and analyzed for use in smart city initiatives (Figure 23). These technology projects in particular often fall under a variety of state and federal regulations. From a privacy perspective, regulations may define protected or sensitive data using disparate criteria. In terms of data security, high-profile breaches and infrastructure initiatives have prompted two executive orders in the last 20 months. At the state level, 17 states have adopted or have advanced metering infrastructure (AMI) requirements pending (Environmental Impact Assessment, 2011). Other states have made significant progress in codifying privacy restrictions.

California, for example, currently restricts electric corporations from “sharing, disclosing, or otherwise making accessible to any third-party a customer’s electrical consumption meter data without the consent of the customer.” What this means for collaborators is that any smart city road map must reference and include strategies for meeting and addressing complex regulatory requirements. Another tactic might be proposing and enacting legislation that takes new technologies and the data economy into account.

For utilities, rate recovery also presents a policy hurdle. Public, regulated utilities have to apply for permission to invest recovered capital outlay via the ratepayer. While municipalities have more freedom to adjust rates because they are run by elected officials, that flexibility is hampered because their positions are determined by the ratepayer (i.e., the voter) which often has the effect of making them less likely to raise rates because of electoral issues.

One anecdote that illustrates some of the challenges utilities and municipalities face involves a five-year-long pilot project, initiated by a utility whose aim was to establish the first smart city. Several different technologies were installed with the goal of improved service delivery. However, the pilot’s implementation resulted in cost overruns, which were then passed on to ratepayers.

This particular case is a cautionary example of how the energy portion of a smart city plan will need to have expectations and funding clearly set; especially if an investor-owned utility (IOU) is involved. In summary, the participating municipality believed that the utility overpromised and under delivered on its smart city pilot at the ratepayers’ expense and, as a result, disallowed the utility’s cost of the project during two ratemaking cycles. Further, the city voted to form its own municipal utility thereby terminating the other’s franchise. The ensuing legal battle is expected to last for years.

Thus, a conversation that began with disparate entities sharing the goal of increasing operational efficiencies becomes an exercise in figuring out which methods of data sharing can be done legally and with sensitivity to stakeholder concerns. It is an issue that many cities face.

Getting real and true estimates and building contingencies into budgets that account for expenditures related to compliance and rate recovery will require investing in experts that know how to provide realistic estimates. The project should be defined and then a budget established, not vice versa. Challenges to address might also include defining the rules that govern return on investment (ROI) for public-private partnerships.

Getting smart. Municipalities may need to retain outside counsel to help them understand regulatory, contracting and budgeting challenges associated with smart city initiatives. For utilities, creating compelling rate cases will require clear, data-supported, justification for planned initiatives.

Budgeting wisely. Getting real and true estimates and building contingencies into budgets that account for expenditures related to compliance and rate recovery will require investing in experts that know how to provide realistic estimates. The project should be defined and then a budget established, not vice versa. Challenges to address might also include defining the rules that govern return on investment (ROI) for public-private partnerships.

Being nimble. Collaborators should begin planning with the understanding that goals, timelines and participation may change depending on regulatory and market forces. A plan with built-in flexibility creates opportunities for interested parties to contribute and participate as the initiative evolves.

In terms of ROI, it is Black & Veatch’s experience that cities and utilities that are exploring or embarking on smart city initiatives are driven by potential gains in efficiency and resiliency. Proper planning and knowledge of the mandates governing rate recovery, privacy and data security, along with an understanding of nuanced issues such as shareholder return, will result in stronger initiatives with a greater potential for success.
India’s new government is wise to the potential of digital communications. Prime Minister Narendra Modi sees it as a way to improve public access to government services. The need for visits to municipal offices will be cut as services, which Indians will access with smartphones, are made available online. To make its Digital India aspiration work, the government wants to put a smartphone in the hand of every citizen by 2019.

Equally eye-catching is the 100 smart cities plan. The Indian government wants its smart cities to offer people a good quality of life and secure employment, and to attract investment. This will lead to cities that are competitive centres for doing business and appealing places for people to settle. Ensuring that smart cities are also environmentally and socially sustainable is central to the government’s ambitions.

Making cities attractive places to live and work is vital in India as the country moves from a rural, agricultural-based economy to an urban, industrial one. Currently, approximately 400 million Indians live in cities. Numbers vary, but several estimates anticipate the figure to rise to 600 million by 2030. The 100 smart cities plan is a way of trying to ensure that the growing cities meet the needs of both the businesses and people they become home to.

Creating cities that meet the government’s aspirations encompasses every aspect of urban planning and management. At the heart of any smart city, however, is smart integrated infrastructure (SII); the integrated development and operation of power, water and telecommunications.
The Ministry of Urban Development’s (MoUD’s) Draft Concept Note on the Smart city Scheme outlines attributes the 100 cities need to possess. SII can make significant contributions to achieving many of these attributes including:

**WATER**
- An availability of 24/7 piped water supply.
- 100 percent recycling in the sanitation system.
- Adopt new methods for loss and energy consumption in water networks.
- A stormwater management approach. This includes preserving and maintaining the natural hydrological cycle.
- 100 percent metering will be essential.

**POWER**
- Universal access to electricity 24/7.
- Smart metering at the household level and the establishment of a smart grid and its integration with renewable sources, such as solar, to meet demand.

**TELECOMMUNICATIONS**
- A 100 megabits per second (Mbps) Internet backbone coupled with 100 percent coverage by cell phone towers and a high level of telephone penetration will be essential in a smart city.
- Fibre optic connectivity in each home and Wi-Fi in all public places.

India’s 100 smart cities are unlikely to be purpose-built on greenfield sites. Rather, there will be a modernisation of mid-sized cities and satellite towns of larger cities. Many regional governments have short-listed cities for the initiative, but no locations have been confirmed.

The Ministry of New and Renewable Energy aims to have 20,000 megawatts (MW) of solar generation by 2022. Distributed rooftop generation has a major part to play. A €1 billion (US$) soft loan with German development bank KfW is being sought exclusively for rooftop solar plants. Half a dozen state governments have already introduced net metering for renewable energy to allow the generation of power on individual properties.

In addition to the attributes above, SII has a major role to play in the smart cities’ overarching environmental, sustainability goals by helping reduce consumption of water and energy, and facilitating use of renewable energy. In addition to reducing pressure on resources, greater use of renewables and reduced consumption of power and water will also cut the cities’ greenhouse gas emissions.

Solar power will have a significant role in providing the smart cities with a 24x7, environmentally sustainable power supply. The Ministry of New and Renewable Energy will manage, distributed generation and microgrids.

The task force’s work will inform the 100 smart cities’ development.

Addressing limited spectrum availability is a prerequisite to the development of SII, and by extension, India’s smart cities. MoUD’s Draft Concept Note acknowledges that the extensive use of smart devices requires a “sound communications backbone.”

India’s telecommunications providers, most recently Bharti Airtel and Vodafone India, have made presentations to the government about the allocation of spectrum. Chris Houghton, Head of India Region, Ericsson, also raised the point in The Hindu Business Line “…you invest in a lot of things like smart cities. However, the infrastructure needs to be taken care of. Challenges such as spectrum allocations are there.” This area has to be managed to allow the smart cities to come to fruition. SII also requires the storage and easy access of significant amounts of data. Cloud computing is likely to have a role in meeting this element of the smart cities’ SII needs.

To manage the huge volumes of data generated by AMI, cloud services offer a level of flexibility and efficiency previously unavailable through hardwired connections. It has been suggested that a potential successor to the Jawaharlal Nehru National Urban Renewal Mission could be a centrally funded cloud-based suite of smart city applications.

Smart cities’ attributes, like the technology that makes them possible, are continuously evolving. At less than a year old, India’s 100 smart cities programme is very much in its infancy and, like the concept of a smart city itself, is likely to change. The need for SII is fundamental to India’s vision for the smart city now and in the future.
The past several years have seen an unprecedented level of technology deployments across public and private electric, water, natural gas and telecommunications networks. From internal network functions to insight on how customer behavior is shaping the consumption of power, water and broadband, leaders are harnessing technology to manage complex challenges.

Though benchmark rates for capital in the United States are low, many utility service providers and municipalities find capital resources scarcer and economic pressures greater than at any time in decades. This reality is complicated by tighter regulation that is causing water and energy providers to embark on or consider billions of dollars in new capital outlays. Further, expectations from customers for more and faster response from their service providers are rising as an exodus of experienced workers and shortage of in-house IT skill strain resources.

As discussed throughout the 2015 Strategic Directions: Smart Utility report, the increasing use of technology offers utility operators greater understanding of their networks, other utilities and the communities they serve. Investments in cloud services, AMI and advanced data analytics solutions are shifting how utilities use data to more effectively plan for the future rather than provide a record of the past. Critically, the implementation of predictive analytics used for Adaptive Planning solutions presents one example of how utilities are embarking on the transition to a smart utility.

IMPROVING PERFORMANCE AND REDUCING RISK

Adaptive Planning is a dynamic approach that uses advanced analytics to address interdependencies between asset management, capital investments, market dynamics and operations; outputs from each planning area can be used as inputs into the others. Leveraging cloud-based computational capabilities, Adaptive Planning solutions use data to create, compare and optimize complex planning decisions, including the visual identification of investment priorities using a risk-based approach. A more informed utility is a smarter utility.

Recognizing the potential benefits to customer billing and operational efficiency, most utilities have embraced some level of technology and deployed two-way sensors and supervisory control and data acquisition (SCADA) systems. Yet, as the report shows, in many instances the data collected is limited, or the ability to manage the wave of information generated by the system has not kept pace.

Similarly, due to technological limitations, most utilities have approached distinct operational or planning issues separately. For decades, the development of system intelligence required teams of engineers and process experts to review reams of data to develop a snapshot of a given historical period. This required significant personnel resources to create a report that was limited (at best) in its tangible forward-looking planning value. This snapshot, in turn, was used to inform long-term organizational plans, typically developed independent of resiliency planning or other operational plans.

In contrast, new Adaptive Planning solutions leverage an ensemble of layered data including historical data along with real-time incoming network intelligence from existing sensor networks that allows leaders to effectively address core management functions such as:

- **Strategic Options Assessment**: Advanced scenarios and comparison analytics can be used to evaluate capital investment, maintenance, operations or compliance options against a wide-range of metrics.
- **Asset Management**: Analytics can inform asset investment and maintenance plans with an understanding of risks, impacts and criticality. For example: assessing the implications of changing capital plans on system reliability and demand fluctuations.
- **Operational Planning**: Analytics can project variances between actual and planned performance and reveal improvement opportunities. For example: anticipating how different operating decisions impact regulatory compliance.

The benefits of this agility is important across geographies. Increasing urbanization is placing new stresses on aging infrastructure. Elsewhere, regions with large distributed generation bases are experiencing different, but no less challenging situations.

This ability to model potential market factors has implications for other utilities and essential infrastructure services that rely on energy to function. Given the rapid rate of technological change, volume of data created by utility networks and shifts in business models, it is no longer possible to plan utility operations in isolation and be effective. As operators gain a greater understanding of their businesses, there is a corresponding awareness that utility planning must incorporate sharing information with other utility service providers and local municipal services.

The same is true from the perspective of city managers. Faced with challenges from climate change, aging assets and evolving transportation/workforce conditions, the move towards greater coordination of city resources and the delivery of service among critical lifeline utilities is an essential component of the Smart Integrated Infrastructure systems that enable smart city programs.
In the past several years, vast portions of North America have experienced severe drought conditions and/or flooding. Other cities have faced challenges from combined sewer overflow (CSO) decrees or nutrient control concerns in their water system. The diverse challenges associated with water management are likely key reasons why nearly 50 percent of municipal respondents identified Smart Water programs as the most important systems to invest in first and 75 percent of cities that are investing in smart city initiatives are implementing smart water systems (Table 10). Although the common role that municipalities play as water service providers may also influence these figures, 45 percent also indicated smart electric grid activity underway in their communities. Clearly, the interdependencies between city and utility smart initiatives are evident to those who are actually implementing smart programs.

While much progress has been made over the past several years in terms of making utilities and cities smarter, there is a tremendous amount of work to be done. Municipalities and utility service providers are all too often labeled as slower to embrace or adapt to new technologies than their high-profile counterparts in the retail or financial sectors. The ability to finance smart city investments is reminiscent of the “chicken and the egg.” Customer reluctance to fund efficiency improvement programs is proportional to the success of utilities in providing their core function.

To put it bluntly, customers are less concerned with the complexity of service delivery when their service works. As previously noted, electric utilities in particular and commercial interests in general are thought to be the primary beneficiaries of smart city programs. With this perception in mind, nearly 70 percent of respondents identified public-private partnerships as the way that these initiatives should be financed. To facilitate the greater use of alternative financing methods like public-private partnerships will require municipalities and utilities to take a more active role in educating their residents/customers about the need to invest in technology. It will also require municipalities and utilities to embrace alternative financing methods to obtain the necessary funding.

For organizations that provide essential services, this represents the greatest transformation in utility operations in decades. For the smart city, it will facilitate the transformation to becoming a better place to live and a more friendly and desirable place to do business for generations to come.

Table 10
What do you see as the top three most important systems for a smart city program to invest in first?

<table>
<thead>
<tr>
<th>Most Important Smart City Systems to Invest in First</th>
<th>Electric Utility</th>
<th>Water Utility</th>
<th>Combined Utility</th>
<th>Local Government/Municipality</th>
<th>University/College</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-speed data network</td>
<td>38.1%</td>
<td>38.7%</td>
<td>47.4%</td>
<td>39.8%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Smart transportation</td>
<td>14.3%</td>
<td>22.6%</td>
<td>15.8%</td>
<td>27.3%</td>
<td>14.3%</td>
</tr>
<tr>
<td>Smart water systems</td>
<td>7.8%</td>
<td>47.9%</td>
<td>19.3%</td>
<td>48.9%</td>
<td>17.9%</td>
</tr>
<tr>
<td>Smart electric grid</td>
<td>68.4%</td>
<td>34.9%</td>
<td>68.4%</td>
<td>30.7%</td>
<td>28.6%</td>
</tr>
<tr>
<td>Renewable/distributed generation</td>
<td>27.7%</td>
<td>19.9%</td>
<td>21.1%</td>
<td>15.9%</td>
<td>32.1%</td>
</tr>
<tr>
<td>Smart street lighting</td>
<td>10.8%</td>
<td>4.8%</td>
<td>5.3%</td>
<td>12.5%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Smart buildings (energy/water efficient, smart appliances)</td>
<td>31.2%</td>
<td>25.7%</td>
<td>29.8%</td>
<td>28.4%</td>
<td>46.4%</td>
</tr>
<tr>
<td>Energy management systems (buildings, campuses, regions)</td>
<td>45.9%</td>
<td>37.0%</td>
<td>42.1%</td>
<td>40.9%</td>
<td>46.4%</td>
</tr>
<tr>
<td>Microgrids or nanogrids</td>
<td>10.0%</td>
<td>4.8%</td>
<td>14.0%</td>
<td>4.5%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Smart waste systems</td>
<td>3.0%</td>
<td>21.1%</td>
<td>8.8%</td>
<td>19.3%</td>
<td>10.7%</td>
</tr>
<tr>
<td>Interactive kiosks/ community information systems</td>
<td>2.6%</td>
<td>4.1%</td>
<td>3.5%</td>
<td>10.2%</td>
<td>10.7%</td>
</tr>
</tbody>
</table>

Source: Black & Veatch
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What do you see as the three most important systems for a smart city program to invest in first?
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