2016 STRATEGIC DIRECTIONS: SMART CITY/SMART UTILITY REPORT

Black & Veatch Insights Group
A NOTE ABOUT DESIGN

The annual Strategic Directions series captures Black & Veatch's global engineering and construction 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 execution, so too does selecting a report theme that reflects the dynamics of change across industries.

For 2016, we continue to explore the theme of distinct yet intersecting galaxies, drawing parallels to the ongoing evolution of utility services. These findings, and the conversations they foster among key stakeholder groups, shine light on the influences guiding the future direction of communities around the globe.

From a design perspective, we seek to inspire the exploration of known entities from a new vantage point, taking readers on an informative and engaging journey. As clarity is gained through the acquisition and sharing of knowledge, the vastness of space is a subtle reminder that there is much more to discover.
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The Black & Veatch 2016 *Strategic Directions: Smart City/Smart Utility* report identifies trends and emerging issues for communities and utilities as the smart infrastructure movement gains momentum. This emerging global phenomena is being marked by the transition from pilot programs impacting the distribution network or customer service initiatives to larger, more diverse and integrated programs.

Utilities are beginning to extract value from years of infrastructure and automation investments. On the municipal side, smart city roadmaps are being developed in collaboration with utilities and the private sector. For both, increased use of data analytics is enabling better informed, more targeted decision-making and a path to sustainability and more quantifiable returns on investment.

It is our view that participation levels in this year’s Smart City/Smart Utility survey reflect an increased interest in, and knowledge of smart infrastructure programs. Municipal and government responses grew by more than 400 percent from 2015. Water, electric and natural gas respondents demonstrated greater knowledge of their respective utility’s priorities and activities, which serves as evidence of increased engagement in data-driven initiatives.

Developing smart infrastructure is not without its challenges. The 2016 *Strategic Directions: Smart City/Smart Utility* report also discusses potential barriers to success along with strategies for addressing issues. At a time when limited resources, environmental concerns, and growing populations are putting pressure on cities and utilities to do more with less, well-planned smart city strategies will set the stage for heightened resilience, reduced costs and efficient delivery of services.

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

Sincerely,

**MARTIN TRAVERS**  |  PRESIDENT  
Black & Veatch’s telecommunications business

**JOHN CHEVRETTE**  |  PRESIDENT  
Black & Veatch’s management consulting business
INTRODUCTION

Martin Travers is President of Black & Veatch’s telecommunications business and Executive Sponsor of the company’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. 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 the Black & Veatch 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.

SMART CITIES

Jennifer James (Smart City Awareness) is the Director of Smart City Solutions for Black & Veatch’s SII. She works with internal domain experts, clients and industry partners to advance smart infrastructure and analytics solutions that enable city systems to be planned and managed more holistically and sustainably. James previously served as Vice President of Marketing for a major energy optimization software company. She also has consulted with technology focused marketing and communications agencies in the United States and Canada. James holds a Bachelor of Commerce and a Master’s in Sustainability and Environmental Management.

Clint Robinson (Smart City Awareness) 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 31 years of experience as a registered professional engineer. He is currently engaged with the U.S. Conference of Mayors, the National League of Cities and the American Council of Engineering Companies as a business partner participating in the discussions on sustainable, resilient and smart city concepts.

Mike Bossom (Smart City Planning) is a Solution Lead for Black & Veatch’s SII service line, leading its Smart City and Internet of Things solutions focused on the intersection of physical infrastructure, communications networks, and data analytics. He has more than 20 years of wireless engineering, project management, and analytics expertise covering network design and optimization, data modeling, visualization, statistics, and real time complex event processing.
Gary Hawkins (Smart City Planning) is a Solution Lead for Black & Veatch’s Smart Integrated Infrastructure business. He has more than 20 years of experience in the wireless and Internet sectors. He has created network deployment cost models and led economic and strategic planning assessments for wireless and IT networks.

Richard Azer (Smart City Funding) 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.

Andrew Trump (Smart City Funding) has more than 25 years of experience working with utility and energy organization in areas of regulatory development and rulemaking, project financial evaluation and business case development. He has a broad understanding of North American energy markets, experience leading business development licensing activities for a major North American merchant power plant developer and expertise in the business and financial evaluation of smart grid and advanced metering infrastructure (AMI) investments.

G. Scott Stallard (Smart City Communications) is a Vice President and oversees asset management services within Black & Veatch’s power 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, Stallard specializes in plant performance, IT solutions and competitive generation practices.

Craig Watson (Smart City Communications) 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 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.

SMART UTILITIES

Edward Sutton (Telecom) is a Principal Consultant and Project Manager within Black & Veatch’s telecommunications business with a focus on grid modernization. His multifaceted background, rooted in power systems and electrical utilities, has cultivated his present focus in developing system level solutions to complex problems facing utility clients. He has thorough experience in leading and managing, from concept-to-completion, a wide array of complex power system and automation projects. His experience ranges from legacy system integration to grid modernization efforts including system-of-systems conceptualization, architecture, and execution through deployment.

David Hulinsky (Telecom) is the Utility Telecom Director for Black & Veatch’s telecommunications business with 20 years of industry experience. Hulinsky’s areas of expertise are thorough knowledge of electric and telecommunication systems and managing complex projects. Hulinsky has also successfully led some of Black & Veatch's largest utility communications and grid modernization projects for leading utilities, such as SDG&E, Hydro One, CPS Energy, United Illuminating and NV Energy.

Curtis Johnson (Automation Programs) 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.

Andy Colman (Automation Programs) is the Director of Black & Veatch’s Integrated Solutions consulting practice. He has over 25 years of experience in energy management software and hardware for both the commercial real estate and electric utility industries. He has assisted office buildings and chain stores in energy efficiency initiatives including Energy Star and LEED certifications, and has helped utilities with grid modernization. Colman is based in San Francisco.
Jeff Buxton (Data Management and Analytics) is an Executive Consultant with Black & Veatch. He has more than 30 years of industry experience with particular expertise in strategic business planning, technology roadmapping, deployment and organization planning, and regulatory support.

Jeff Neemann (Data Management and Analytics) is a Solution Lead for Smart Integrated Infrastructure and Director of Water Treatment for Black & Veatch. He is involved in the development and application of advanced treatment technologies and how to use data to optimize operational performance.

Richard Donohoe (Cybersecurity) specializes in cybersecurity, IT and compliance assessment issues within the Black & Veatch management consulting business. He has experience in completing North American Electrical Reliability Corporation (NERC) critical infrastructure protection (CIP) risk strategies, as well as evaluating critical systems and cybersecurity vulnerabilities for the North American power grid, water infrastructure and pipeline networks.

Mike Prescher (Cybersecurity) is a network architect for Black & Veatch’s telecommunications business and is responsible for data network infrastructure architecture design, while applying best-practice principles for secure data transmission, high availability and virtualization. He has provided consultative expertise to Fortune 500 companies and utilities across North America involving network and application systems designs, many involving implementation projects utilizing multi-protocol label switching technologies.

EMERGING
Jeremy Klingel (Customer Engagement) specializes in the design and implementation of customer-facing and critical infrastructure utility programs that capitalize on enabling technology. Skilled in crafting and integrating energy management, energy efficiency and demand response solutions, Klingel previously founded a practice serving IOUs with specific focus on behind-the-meter product development, time-of-use rate design and progressive customer engagement models.

Paul Rice (Customer Engagement) is a Principal Consultant in Black & Veatch’s management consulting business and is responsible for customer engagement and program strategy and design for Black & Veatch’s clients. Rice has over 15 years experience in product strategy and development both inside and outside of the utility industry, with focus on end-consumer focused solutions that employ connected devices (IoT), digital engagement, behavioral, smart grid, energy efficiency, demand response, distributed energy, payment/rates, and other aspects of modern product and program design.

Dan Wilson (Renewables) is a Consultant in Black & Veatch’s Renewable Energy business unit and leads multiple projects and initiatives related to the deployment and grid integration of renewable energy and distributed energy resources. In recent years, he has supported electric utility clients with streamlining of solar incentive programs and distributed energy resources (DER) interconnection processes, implementation of new software tools for solar program management, grid integration studies for utility-scale renewables and DERs and other renewable policy analysis.

Mike Prescher (Cybersecurity) is a network architect for Black & Veatch’s telecommunications business and is responsible for data network infrastructure architecture design, while applying best-practice principles for secure data transmission, high availability and virtualization. He has provided consultative expertise to Fortune 500 companies and utilities across North America involving network and application systems designs, many involving implementation projects utilizing multi-protocol label switching technologies.

Paul Stith (Renewables) is a Transportation Product Manager for Black & Veatch’s SII service line, specializing in sustainable transportation and energy storage solutions. He has experience in building policies and relationships with key agencies and partners where grid interactive electric vehicles and energy storage assisted in solving pressing energy challenges.

Nicholas Noecker (Renewables) is a Director of Smart Architecture for the Black & Veatch Management Consulting business. He supports smart grid, smart meter and related operational technologies initiatives. Noecker has served as chief architect for several projects in the utility space, leading and managing teams responsible for architecture for applications, data, infrastructure and security.
Brad Hardin (Drones) is Global Chief Technology Officer for Black & Veatch and is responsible for aligning new technology with the company’s business strategy by integrating technologies for products and services. He works closely with Black & Veatch’s business lines to develop the most applicable technology initiatives within the organization. Hardin also provides direction in all technology-related issues in support of the company’s strategy. Hardin has more than 12 years of experience as a LEED-accredited architect and technology integrator.

Brian Melton (Drones) is a Technology Strategist in Black & Veatch’s water business. He engages in development, implementation, support and marketing activities to help understand and promote the impacts of technology on the water business and the industry. He has an extensive background in Building Information Modeling processes. He works collaboratively with water information technology, the corporate CIO’s office, as well as other Black & Veatch businesses and clients. Melton has over 15 years of experience working with the company’s international project teams on mega projects in the infrastructure market.

PERSPECTIVES
Paul Harmer is an experienced utilities and infrastructure engineer with 24 of years professional experience with consulting engineers. He is a Project Director within Black & Veatch, and is the Client Director for UK Power Networks. Harmer has led the work on the £40 million (U.S. $57.7 million) Cable Pit Strategy and Mitigation project, which has developed from a strategy into a six-year programme of site based works.

Paul Hart is an experienced Information Management Consultant with strong geographic information system (GIS), database and scripting skills. In 2015, his expertise was recognized by the Royal Geographical Society when he achieved Chartered Geographer (GIS) status. His professional experience includes custom GIS tool development, spatial analysis, risk analysis, database development, information management and analytics, data capture, application and Web development. Hart has developed a broad knowledge of the GIS workplace, having an expert knowledge of GIS theory and its application in today’s software packages including the use of server, online and mobile technologies.

Anand Pattani is the Country Manager and Managing Director of Black & Veatch Private Limited (BVPL), India. He is responsible for developing client relationships, directing bids and proposals, negotiating contracts and executing projects using global teams. Pattani’s experience of over 17 years includes planning, development, engineering, designing and implementation of nearly 25,000 MW of coal, gas and renewable power plant facilities for utilities, developers, EPC contractors and financial institutions. He is a U.S.- licensed professional engineer and has a bachelor’s degree in Chemical Engineering from the University of Mumbai, India, and a master’s degree in Chemical Engineering from the University of Missouri-Columbia, USA.

Webb Meko is a Regional Business Development Manager for Black & Veatch South Africa. He has provided technical expertise, management and advisory services for more than 20 years to South African and international clients in the energy sector within Africa. His areas of expertise include power system planning and electrical power system design, electrification, project management, program management, feasibility studies, private power projects development and power plant maintenance.

CONCLUSION
Fred Ellermeier is a Vice President and the Managing Director of Black & Veatch’s 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, Ellermeier is an expert in energy management, energy optimization and sustainable design practices.
ELEMENTS of a SMART CITY
The Black & Veatch 2016 *Strategic Directions: Smart City/Smart Utility* report is a compilation of data and analysis from an industrywide survey. This year’s survey was conducted from 15 October through 14 November 2015. The results of the online questionnaire reflect the input of 778 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.

**Organization type**

- **42.5%** Federal/state/local government/municipality
- **50.0%** Electric, Water or Natural Gas Provider
- **7.5%** Smart services provider

*Source: Black & Veatch*

**Utility services provided**

- **53.2%** Electric services
- **53.7%** Water services
- **15.2%** Natural gas services

*Source: Black & Veatch*
Utility type

- **52.7%** Public or government-owned utility
- **25.7%** Investor-owned utility
- **8.7%** Independent/industrial power producer
- **5.4%** Privately held corporation
- **7.5%** Other

*Source: Black & Veatch*

Primary business region

- **10.6%** Northwest
- **8.9%** Rocky Mountain
- **31.2%** Midwest
- **5.4%** New England
- **10.9%** Mid-Atlantic
- **22.4%** Southeast
- **28.1%** Southwest
- **2.8%** Other U.S. Locations
- **1.0%** Mexico
- **3.1%** Global/worldwide
- **5.0%** Canada
- **3.6%** Other Countries

*Source: Black & Veatch*
Population served

Source: Black & Veatch

Job function

Source: Black & Veatch
Technical responsibility

52.1% Engineering
39.7% Planning
34.9% Operational technologies
32.5% Construction services
28.6% Distribution
25.4% Maintenance
25.4% Transmission
23.3% Smart metering
20.9% Data analytics
17.2% Communications
15.9% Operations IT networks
15.9% Field device automation
15.9% Information management
15.9% Corporate IT networks
12.7% IT security
11.6% Generation controls
14.0% Other

Source: Black & Veatch
A global understanding of what it means to be a smart city, along with the foundational role of the smart utilities that serve it, is coming into sharper focus. Black & Veatch’s 2016 Strategic Directions: Smart City/Smart Utility report defines how smart integrated infrastructure makes cities more livable, sustainable and resilient. From major metropolitan areas and small communities to large-scale power suppliers and municipal water districts, the report details the growing awareness that technology can reshape service delivery and raise the quality of life, while better managing energy, connectivity, consumption and our finite supply of water.

However, our report finds the numerous advantages of the smart city and smart utility models are tempered by some familiar foes: tight budgets, justifying return on investment, and the challenge of managing the scope, scale and security of smart systems.

For cities in the United States, and the utilities that serve them, these and other efforts are setting the stage for sustainability in the long term, a priority for survey respondents (Figure 1).

However, the smart community idea is not limited by geography. The 2015 Smart City Expo World Congress drew over 10,000 attendees from hundreds of cities, while showcasing programs and solutions from a range of vendors, and communities across the globe. Host city Barcelona’s 22@Barcelona, innovation district along with citywide intelligent transportation and payments systems are informing similar initiatives in Cape Town South Africa, Istanbul and Boston. Similarly, the success of Charlotte, North Carolina’s smart city accelerator Envision program spurred a national rollout of the program. Envision America is “…issuing a challenge to America’s cities to become smarter by accelerating deployment of innovative technologies that tackle energy, water, waste, and air challenges.”

As smart grids, building energy management tools, smart water meters, and other data-rich technology deployments and upgrades generate more relevant and targeted data in real-time, survey respondents recognize that analyzing and using these new insights will substantially improve city decision-making. One unintended consequence, however, is a more realistic view of the adoption process. Since the 2015 Strategic Directions: Smart Utility report, increased visibility into the magnitude of the undertaking has softened expectations where timelines for the implementation of the smart city model in the United States are concerned. More than a third of government respondents in the United States say they believe it will take six to 10 years before the smart city model gains wide adoption.
What do you see as the primary driver for cities/communities to implement smart city initiatives? (Select one choice) [Government/Municipalities Only]

- Improve efficiency of operations/reduce costs: 42.0% (2014), 30.1% (2015)
- Environmental/resource sustainability: 11.4% (2014), 19.6% (2015)
- Better overall management of community systems: 12.5% (2014), 15.0% (2015)
- Increasing critical infrastructure resilience: 12.5% (2014), 8.6% (2015)
- Attracting business investment: 5.7% (2014), 8.0% (2015)
- Increasing customer satisfaction: 6.8% (2014), 4.3% (2015)
- Increasing satisfaction/attracting new residents: 4.5% (2014), 3.4% (2015)
- Improving safety and security: 2.3% (2014), 3.4% (2015)

Source: Black & Veatch
**SMARTER UTILITIES**

From a utility perspective, the most significant driver of utility support for smart city initiatives is return on investment (ROI) (Figure 2). More than 40 percent of respondents cited ROI as a prime motivator, followed closely by an assessment of how smarter systems would benefit them.

The report reveals some interesting differences in the ways infrastructure providers are adopting smart systems. Water utilities, for example, appear to be relying more on the results of assessments of how “smart” their utility is today and how a smart city program can enhance their position, as compared to their electric and natural gas counterparts (Table 1). This may be attributed to renewed focus on resilience spurred by drought and other weather events, though overall, electric utilities currently outpace water utilities when it comes to existing smart city engagements.

**Figure 2**

*What would be the biggest motivators to get your organization engaged in a smart city initiative?*

- **Strong business case support/ROI for a smart city initiative**: 40.6%
- **Assessment of how “smart” our utility is today and how we can benefit**: 39.1%

*Source: Black & Veatch*

**Table 1**

*What would be the biggest motivators to get your organization engaged in a smart city initiative?*

| Biggest Motivators for Utility Engagement in a Smart City Initiative | By Utility Services Provided |
|---|---|---|
|  | Electric Services | Water Services | Natural Gas Services |
| We are already engaged/involved in a smart city initiative in our region | 24.6% | 15.3% | 32.2% |
| Information from government/municipal officials or initiative leaders to develop real actionable strategies/coherent strategy/roadmap | 21.7% **↓** | 36.4% **↑** | 30.5% |
| Assessment of how “smart” our utility is today and how we can benefit from a smart city initiative | 33.3% | 42.1% | 40.7% |
| Support from internal leadership/shift of priorities/strategic direction from the top | 27.5% | 34.9% | 30.5% |
| Strong business case support/ROI for a smart city initiative | 43.0% | 40.7% | 39.0% |
| Other | 3.4% | 3.8% | 1.7% |
| Not applicable for our organization | 6.3% | 3.8% | 0.0% |

*↑/↓ Statistically higher/lower compared to all other groups combined

*Source: Black & Veatch*
A hallmark of smart systems is the union of data and action. Information gathered by sensors and smart devices is sped across high-speed networks and crunched by sophisticated software.

SMART CITY UNDERSTANDING AND ENGAGEMENT
The utopian ideal of smart cities anchored by futuristic technologies such as robots and flying cars have been replaced by the idea that technology should be used to enrich the lives of people and society in ways that are practical and relatable. A significant theme of this report is the growing popularity of data analytics in which hardware and software enable important changes. A hallmark of smart systems is the union of data and action. Information gathered by sensors and smart devices is sped across high-speed networks and crunched by sophisticated software.

The result is information that spurs cities, utilities and customers to knowledgably take action.

Fortunately, technology advances are making it easier for governments, municipalities and utilities to engage with their constituents and stakeholders on their terms. Not only can they better understand resource use, but some applications also encourage community members to become part of the solution. Examples include social media and online communities, interactive street kiosks and bus shelters, crowdsourcing and more.
LAYING THE TELECOM FOUNDATION

The viability of a smart city/smart utility plan is only as good as its underlying telecommunications infrastructure. Recognizing this, more than a third of smaller utilities (serving populations below 500,000) are planning to invest up to $5 million to replace, upgrade, or build new communications infrastructure in the next three years (Figure 3). Almost half of these upgrades are aimed at supporting capacity demands for future smart initiatives. Similarly, 20 percent of larger utilities anticipate spending more than $20 million to upgrade communications infrastructure.

Figure 3

How much capital budget do you plan to invest in replacing, upgrading or building new communications infrastructure over the next 2-3 years? (Select one choice)

Source: Black & Veatch

EVOLUTION

Getting to “smart” is often an evolution, not a revolution. But as communities and utilities move toward 2.0 implementations, master planning will be critical to smart city strategies. We know that more applications are being developed than will be sustainable. This is a good thing. We will learn from both the successes and the failures. Civic objectives of sustainable and reliable energy, water and communications provide the mandate for smarter systems. The market – comprised of stakeholders at the utility, municipal, industry and consumer levels, all working together – will ultimately decide the business case for prioritization and deployment. We have great optimism that the result will be a more livable world.
As communities and utilities move toward 2.0 implementations, master planning will be critical to smart city strategies.
SMART CITIES

Getting Smarter About Smart Cities
By Clint Robinson and Jennifer James

Although the smart city movement is gaining momentum, confusion and misperceptions persist that point to the need for more effective communication, implementation approaches and mindsets.

In this year’s report, more than 90 percent of government and municipal respondents said they view smart city initiatives as transformational with the potential for long-term positive impacts on cities globally. Yet, more than half of respondents say their organization does not really understand the smart city concept. This points to the importance of municipalities, smart service providers and industry groups converging on a smart city definition and more effectively communicating examples and best practices from successful smart city programs.

SMART CITY PERCEPTIONS
Nearly all respondents understand that the smart city concept applies to both new and existing infrastructure systems. Although there are some greenfield smart city initiatives being built from the ground up, the great majority of projects are upgrades or additions to existing infrastructure. Yet, all too often, municipal leaders overlook the obvious. They view smart city initiatives as new line items on the budget rather than viewing each existing project as an opportunity to add smart segments that ultimately build toward a more cohesive whole. Planned capital improvement projects shouldn’t be viewed as “just building your grandfather’s infrastructure again.”

There are positive signs in this year’s survey that smart city concepts are moving past the discussion phase. More than 60 percent of respondents noted one or more smart city activities in which their municipality is involved. Most of these are planning activities such as assessing readiness, consulting with stakeholders or creating a smart city roadmap or master plan, all vital building blocks for meaningful implementation. Fewer are involved in foundational infrastructure and pilot projects and only 5 percent said they are implementing a large-scale smart city program.

It’s notable that fewer respondents this year believe smart cities will become a widespread reality in the United States in the next one to five years. More believe it will be in the six-to-10-year or 11-to-15-year timeframe (Figure 4). This is likely because as more municipalities move beyond the hype to build master plans and consult with stakeholders, they realize the need for more infrastructure, resources and funding than they originally contemplated. The stronger focus on planning also indicates that smart city programs are starting to be viewed from a more holistic perspective, with larger, more integrated programs that are more complex than initial pilot projects.
PERCEPTIONS of the SMART CITY MOVEMENT

- **91%** Transformational and will have positive long-term impacts on cities around the world
- **21%** Starting with high-profile demonstrations to generate excitement/investment
- **49%** A concept that our municipality is familiar with and understands well
- **39%** Primarily driven by community members to ensure highest value/adoption solutions emerge
- **51%** A new concept that our municipality does not understand
- **79%** Starting with solutions that will provide the highest long-term benefits regardless of the visibility
- **61%** Primarily driven by municipal leaders to ensure coordination across activities
- **9%** A passing fad without long-term substance

Source: Black & Veatch
TIMELINE FOR THE IMPLEMENTATION OF THE SMART CITY MODEL IN THE U.S.

Still, much of the smart city momentum in the past year has been in the form of small-scale pilot projects and accelerator initiatives that are being pushed by non-governmental organizations and the private sector. These projects are generally not being implemented as large-scale integrated smart city programs. However, they are helping the municipalities and government stakeholders make progress toward tangible, incremental results that build credibility and justify further investments.

The year’s survey shows a disconnect between what municipal respondents say project priorities should be versus which ones are actually being undertaken. Nearly 80 percent said cities should prioritize projects that have longer-term benefits and not high-profile initiatives designed to generate support in the short term. However, much of the current smart city investment is in high-visibility projects such as smart street lights and street kiosks that were not rated as priority investments. It is not surprising that municipalities focus on projects that provide a short-term return on their investment with a straightforward business case in lieu of projects that are more difficult to quantify and yield longer-term benefits.

Even though smart city programs are being viewed as transformational, they are still faced with traditional budget, resource and policy hurdles.

The importance of citizen engagement in smart city initiatives has emerged as a hot topic this past year. Still, only 54 percent of municipal survey respondents indicate that customer engagement is a high or moderate priority (Figure 5). The traditional mindset of initiatives being determined by municipal officials based on their knowledge and priorities is also reflected by the 60 percent of municipal respondents who believe that smart city initiatives should primarily be led from the top down instead of from the grass roots level. This points to the need for a paradigm shift to one where citizens are embraced as part of the solution and decision-making team. Here again more education and best practice sharing would be beneficial.

Source: Black & Veatch
PRIORITY OF FREQUENT CONSTITUENT ENGAGEMENT IN SMART CITY PROGRAMS

The majority of respondents expressed an understanding that smart city initiatives create new challenges and the potential for unintended consequences. However, this does not mean municipalities are averse to smart city implementation. It is an acknowledgment that with cutting-edge solutions and new technology there will be issues, and these can be addressed through improvements in products and processes over time. For municipalities, implementing first-to-market innovations requires a new mindset. With the speed of technological progress being made, business models for end-users need to evolve to address the realities, risks and benefits of being a first mover in the smart city transformation (Table 2).

Figure 5
What priority does your organization place on frequent/regular constituent engagement in determining smart city programs? (Select one choice) [Government/Municipalities Only]

Source: Black & Veatch

SMART CITY CONSEQUENCES OR RISKS

Table 2
What (if any) smart city initiative unintended consequences or risks should city/government leaders be most concerned about and/or focused on avoiding? (Pick up to three choices)

<table>
<thead>
<tr>
<th>Smart City Consequences or Risks</th>
<th>By Organization Type</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Government/Municipality</td>
<td>Smart Services Providers</td>
<td></td>
</tr>
<tr>
<td>Disruptions due to technology failure or glitches</td>
<td>56.8%</td>
<td>52.7%</td>
<td></td>
</tr>
<tr>
<td>Job displacement</td>
<td>12.3%</td>
<td>10.9%</td>
<td></td>
</tr>
<tr>
<td>Digital divide</td>
<td>34.2%</td>
<td>43.6%</td>
<td></td>
</tr>
<tr>
<td>Privacy and security concerns</td>
<td>49.3%</td>
<td>29.1%</td>
<td></td>
</tr>
<tr>
<td>Vulnerability to terrorist or hacker threats</td>
<td>31.5%</td>
<td>38.2%</td>
<td></td>
</tr>
<tr>
<td>Cost of living increases/gentrification</td>
<td>18.5%</td>
<td>25.5%</td>
<td></td>
</tr>
<tr>
<td>Negative community social/cultural impacts of top-down design</td>
<td>13.7%</td>
<td>16.4%</td>
<td></td>
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<tr>
<td>Negative environmental sustainability impacts</td>
<td>11.0%</td>
<td>10.9%</td>
<td></td>
</tr>
<tr>
<td>Greater income and social inequality</td>
<td>10.3%</td>
<td>9.1%</td>
<td></td>
</tr>
<tr>
<td>Opportunity cost</td>
<td>26.7%</td>
<td>25.5%</td>
<td></td>
</tr>
</tbody>
</table>

*Cyan shading indicates significantly highest ratings within each group, not between groups.
Source: Black & Veatch
Planning Approaches Reveal Dual, But Not Necessarily Equal, Paths to the Smart City

By Mike Bossom and Gary Hawkins

Deployments of smart meters, sensors and data analytics are allowing communities to change the ways they communicate and consume energy and water. But the importance of planning for these changes is taking on new significance. Adoption of smart city initiatives have kept at bay many cash-strapped cities whose leaders believe smart integrated infrastructure changes are up to a decade away.

Questions of cost appear to be dividing most smart city initiatives into two camps. Some communities with leaner budgets but deep interest in smart infrastructure efficiencies are opting for incremental system add-ons – such as street lights, digital kiosks or electric vehicle charging stations – that produce quicker results.

Other cities, meanwhile, are pursuing some form of root-level master planning, which puts communities on a broad, years-long path and envisions a thorough rethinking of how a city uses its energy, water, communication and transportation systems. Among government responders, more than half were assessing their readiness for smart city initiatives or creating a smart city road map, and another 24 percent said they were in the planning stages with relevant stakeholders (Figure 6).
Strained budgets are familiar obstacles to smart city participation and planning. Nearly 70 percent of government respondents, and 44 percent of smart service providers, labeled budget constraints as an acute inhibitor of smart city initiatives (Figure 7). Concerns also linger over whether governments can, in the future, attract the kind of workforce required to implement and sustain smart initiatives over the long term.

Even as governments express their reluctance based on resources, they are clearly thinking about where they would spend their smart city dollars, and much of that consideration centers on the important building blocks of a smart city.

The highest priority among government respondents to the Black & Veatch survey were high-speed data networks, which are crucial to moving data collected from system sensors that can be analyzed in the cloud and used to adjust consumption patterns and behaviors. Smart energy management systems – which can be critically effective in regulating power-hungry buildings – also rank high (Figure 8).
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?

- **Budget constraints**: 69.8% (2015), 67.0% (2014)
- **Lack of resources or expertise**: 48.6% (2015), 47.7% (2014)
- **Policy hurdles**: 32.0% (2015), 30.7% (2014)
- **Ownership across departments**: 22.2% (2015), 20.5% (2014)
- **Gaining stakeholder support**: 20.0% (2015), 26.1% (2014)
- **Short-term mindset**: 16.3% (2015), 20.5% (2014)
- **Technology availability**: 14.8% (2015), 10.2% (2014)
- **Time constraints/other priorities**: 14.8% (2015), 21.6% (2014)
- **Security concerns**: 13.8% (2015), 9.1% (2014)

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

Source: Black & Veatch
Single-point solutions carry some advantages for cities not yet willing to take the full plunge via master planning. Pilot programs of individual infrastructure pieces can often act as a guide to measuring how well a smart city initiative will scale.

Street light initiatives, for instance, are growing in popularity in larger cities because of their ability to bring relatively quick investment returns. Networked LED lights can provide not only energy savings but information about outages or other anomalies. Lights can be remotely dimmed to reduce burn, or managed by smart devices that detect traffic patterns to make sure lights are used effectively. Lighting is also seen as a viable “platform” on which to build future sensor and communications networks. For example, lights can be connected, but through that same network infrastructure they can communicate with video cameras, parking sensors, environmental sensors, etc.

Ad-funded, interactive digital kiosks offer another example of a single-point, revenue-generating addition which can keep citizens informed about events, emergency operations and information about local businesses.

But, as incremental steps can be significant strides toward a smarter city, there are disadvantages to isolated upgrades. Will pilots and designs of individual pieces sync well with other upgraded systems down the road? One-off upgrades also run the risk of duplicated costs and work that would likely be eliminated as part of a broader approach that accounts for how all systems will mesh.

Think of this approach through three phases: planning, design, and implementation. The initial planning phase identifies the technology options and solutions available, prioritizes each within the city’s current priorities and long-term vision, and most importantly aligns it to the city’s budget, organizational, and process capabilities. The result is a city’s master plan and will be used to guide all remaining work. The design process puts specific plans
Master planning offers a more holistic approach, and communities are increasingly pondering that strategy in their bids to become more efficient, green and resilient.

around the physical infrastructure, hardware and software required to make the city’s plan a reality. And the final implementation phase is the installation, commissioning and optimization of the network that realizes the smart city vision.

Master planning offers a more holistic approach, and communities are increasingly pondering that strategy in their bids to become more efficient, green and resilient. The City of Chula Vista, California, has a long-term, citywide vision and recently embarked on its journey with the Bayfront project. An initial phase is focused on energy efficiency, renewable generation and smart infrastructure for its Bayfront properties, but the long-term plan centers on citywide energy efficiency and smart devices, data analytics and software to revamp the city’s critical infrastructure. The plan includes high-performance buildings and city infrastructure that incorporates energy efficiency, demand response and clean energy generation technologies.

Such a layered master plan gives communities a roadmap forward that conveys to all stakeholders the city’s long-term vision. It transparently projects costs and funding sources well in advance of adoption.

But perhaps the biggest advantage is a kind of future-proofing in which smart infrastructure upgrades and technologies are designed to work together as the plan ages and scales. Master planning is inclusive and anticipates future systems. It arguably carries the biggest payoff.

The “Digital Roadmap” created by Kansas City, Missouri – through a public-private partnership that includes Cisco, Sprint, Black & Veatch and other providers – offers another example of long-term blueprinting that can scale up and wide. Smart lighting, digital kiosks, smart water and other systems are being designed to take advantage of high-speed data deployed in the city’s urban center.
“Smart City” is a nascent concept particularly when compared to electric and gas utility smart grids and other data-integrated infrastructure initiatives.

While most infrastructure planners believe a smart city initiative should enhance safety, resiliency, and economic well-being, there is little consensus regarding strategies, funding mechanisms, or overall programs, which leads to uncertainty about where to begin.

This may explain why 50 to 60 percent of the survey respondents replied “don’t know” to questions regarding the ability of municipalities to fund smart city initiatives (Figure 9), the rate of return needed to justify investment (Figure 10) and the opportunities to create revenue or savings from the data generated through the initiatives (Figure 11). This circumstance is an ironic one considering the plethora of opportunities emerging from the “Internet of Everything.”
Figure 9
Can your municipality/administration self-fund smart city initiatives? (Select one choice)
[Government/Municipalities Only]

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<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>49.7%</td>
<td>Don’t know</td>
</tr>
<tr>
<td>31.1%</td>
<td>No, our municipality cannot self-fund a smart city initiative</td>
</tr>
<tr>
<td>19.2%</td>
<td>Yes, our municipality can self-fund a smart city initiative</td>
</tr>
</tbody>
</table>
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Source: Black & Veatch

Figure 10
What is the rate of return your municipality/administration needs to justify spending on smart city initiatives? (Select one choice)
[Government/Municipalities Only]

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<th>Percentage</th>
<th>Description</th>
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<tr>
<td>59.5%</td>
<td>Don’t know</td>
</tr>
<tr>
<td>15.3%</td>
<td>5%-10% annually</td>
</tr>
<tr>
<td>8.6%</td>
<td>11%-20% annually</td>
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<tr>
<td>8.6%</td>
<td>More than 20% annually</td>
</tr>
<tr>
<td>2.5%</td>
<td>Less than 5% annually</td>
</tr>
</tbody>
</table>
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Source: Black & Veatch

Figure 11
Are there opportunities to monetize aggregate data (infonomics) from smart city initiatives? (Select one choice)

```
<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>61.6%</td>
<td>Don’t know</td>
</tr>
<tr>
<td>29.9%</td>
<td>Yes, see opportunities to monetize aggregate data</td>
</tr>
<tr>
<td>8.5%</td>
<td>No, do not see opportunities to monetize aggregate data</td>
</tr>
</tbody>
</table>
```

Source: Black & Veatch
While several cities have started the development of an integrated smart city architecture, today’s activity tends to be ad hoc – developing one application at a time as opposed to implementing wider, more coordinated long term plans. Project funding is also very much application specific – such as upgrading conventional street lights with network-connected LEDs or establishing a municipal Wi-Fi service. An alternative approach might address integrated technology and system platform opportunities through long-term master planning.

In some cities, particularly those that own utilities, the issues and opportunities associated with smart grid and smart cities are often comingled, with the initiatives competing for the same funds. Moreover, some municipally owned utilities appear poised to launch smart city applications more capably than others. This appears especially true for those developing and implementing smart grid. In fact, smart city initiatives can emerge as an extension and enhancement of the smart grid. Smart grid vendors get some of the credit for bringing some of the vision and incentive to these communities in this regard.

The fundamental question is, “Who pays for this?” Compounding this, the overall cost and return on investments (ROIs) are not broadly understood. These are technology investments that often require pilot projects and testing while competing for funds against more mundane capital and operating projects. Siloed organizations often cannot look beyond their own department budgets.

Black & Veatch has witnessed that there are certain kinds of smart city developments that have a demonstrable ROI using conventional valuation techniques; these are often the projects cities look to first when implementing smart city initiatives.

Retrofitting street lights is one of the most visible examples. If a city replaces sodium street lights with LEDs, electricity usage will likely drop by more than 60 percent, resulting in significant cost savings. Add in network connectivity that allows for adaptive control and another 10 percent in savings can be achieved. The savings in the electricity bills can offset the cost of the retrofit.

Also consider that the lighting district justifies the change to LED lamps as part of a capital-return issue without the prodding of a mandate. An operational cost for energy transforms into a capital cost for the new light fixtures. The question then becomes, “How long will it take for the funds spent on the conversion to start showing a return?”

Applying the monetary savings in this example to other smart technology could also be an organic approach to funding other smart city applications.

Cities look to the results of pilot deployments and implementations to verify results. With tight budget constraints, many look toward the private sector for sources of funding in order to proceed. For investment to roll in, projects need to be justified in terms of their own financial merit, minimizing opportunity for integrated solutions.
Given the fiscal constraints in many communities, it can be difficult to trade near-term pain for long-term gain, especially when the investments entail a high degree of inter-department coordination and a certain level of politics as to which departments win or lose. Being able to trade a slice of the ongoing operational cost of energy in the form of payments to the utility for a one-time capital cost of purchasing new highly efficient light fixtures may seem simple but can actually be pretty challenging.

The ad hoc nature of early smart city development has resulted in a complex variety of funding sources and the rationale behind them.

Another often overlooked aspect to funding new technology is the long-term strain on capital and operations and maintenance budgets, and the long-term cost trends in every area of essential municipal services. Proponents of new technology investment see reasonable ROI associated with new technologies while decision-makers see the full front of emerging budget strains associated with the need to address aging infrastructure, cybersecurity, resilience and population growth.

Meeting this challenge is certainly a question of political will, but here’s a key:

There is an essential aspect in connecting the investments in smart technology to the imperatives of the aging infrastructure that speaks to asset management. Given the advancements in communications, sensor and connectivity technology, assets inevitably become “smarter” as they are replaced with new equipment. The ability to collect, measure, and move data from connected city elements demonstrates the increased value of these assets.

In practice, this means that when utility or city managers talk of replacing gas and water mains, they refer to more than just laying new pipe. The installation of smart infrastructure needs to be part of that capital project so that over time there is the capability to detect methane emissions in the gas system or leaks in the water pipes. And while the streets are trenched, there’s opportunity for the cities to lay fiber optic conduits for city use and generating revenue.

The investments in state-of-the-art technology and the basic pipes and wires are interconnected like never before. The marginal cost of implementing smart city platforms and applications can provide significant value to a municipality’s objectives in resiliency, safety and economic development. Successful enhancements in economic prosperity can increase a city’s tax base, bringing additional funds needed for further development.

These investments still require vision, advocacy, leadership and capital to begin. As public or private entities, that is the challenge we all must address. Ultimately, public-private partnerships may provide the best opportunity to move these initiatives forward that communities expect.

The marginal cost of implementing smart city platforms and applications can provide significant value to a municipality’s objectives in resiliency, safety and economic development.
Communications technologies and data analytics are being adopted by governments and municipalities to address needs beyond those associated with individual smart city initiatives. Increasingly, they are being thought of as foundational systems that not only integrate and streamline city operations but also enable and inform smart city decisions.

As momentum and the desire to design and implement smart initiatives that benefit diverse stakeholders grow, so too do the frequency and volume of inputs into the decision-making process. For municipalities, determining what smart city systems to invest in, when and how, is no easy task. Survey respondents were all over the map in terms of how investment decisions are made and what systems should be focused on first. With all this complexity, attention is turning to how smart communications technologies and data analytics can be used to help shape, define and validate smart city roadmaps. These tools are being deployed ahead of and throughout the planning process because they enable visibility into the systems and processes that support smart cities and into the plethora of investment options.

There is also recognition that in order to get utilities, businesses, regulators and constituents on board, establishing and communicating the value proposition is key. Enhancing the connectivity between diverse groups and using data analytics and visualization to compare and communicate the benefits and risks of different investments, serves to accelerate this process.
WHAT’S DRIVING SMART CITY INITIATIVES?

Data promises smarter decisions that lead to sustainable solutions

- **53%** LONG-TERM VISION
- **44%** Cost pressures
- **31%** Environmental protection
- **28%** Demand from community
- **33%** Economic development

SMART CITY ROADMAP

Overcoming obstacles in a smart city transformation

VALUE-ADDED INITIATIVES FOR BOTH CITIES AND UTILITIES

- **Greater Efficiency** in Using Resources
- **Healthier** Lifestyles
- **LESS** CONGESTION
- **Benefiting** the Utility Network

SMART CITY EFFORT
In addition, as individual pilot initiatives conclude, there is a greater understanding of the limits of testing. Many “first mover” communities are entering a second phase; convinced that the individual pieces work, they are now moving toward scale. Communications and data analytics tools allow stakeholders to track individual projects and benefits within the context of a larger program to further advance and identify synergies between initiatives.

These large-scale projects are increasingly beginning with a roadmap, further underscoring that long-term goals are driving second-phase initiatives (Figure 12).

In today’s environment, there is a move away from communications technologies and analytics being tied to specific initiatives. Instead, they cover larger ideas and long-term needs. It is interesting that long-term vision is seen as the top driver because it underscores that it takes vision to prioritize foundational tools that provide across-the-board yet difficult-to-quantify benefits. It also underscores that, by and large, municipalities are acknowledging their responsibility to spearhead the smart conversion.

Cost pressures are also of great concern. Here, transparency of options impact financing. Data analytics allow that visibility. For municipalities that are looking to partner with utilities, they are better able to explain the realistic financial implications of their involvement in smart city programs and activities. In the past, that level of insight was challenging. Now, adaptive, scenario-based planning tools are enabling broader and deeper views into the many smart city opportunities and the associated tradeoffs. Engaging vendors in the road mapping conversation makes the process inclusive and exposes planning to a greater degree of collaboration. This process places an emphasis on engagement and incent participants to develop plans that are actionable and meet their return on investment goals.
While community demand ranks lower for respondents, it is an important driver because it informs implementation approaches. For municipalities, smart city planning can resemble a largely top down approach. Community-driven initiatives tend to be bottom up.

The importance of roadmaps cannot be overstated. They take an objective and identify an opportunity pathway to get there. The Smart Cities Council and similar groups highlight one of the key benefits of roadmaps saying that they, “...can help you overcome obstacles to a smart city transformation – motivating disparate groups to work together toward common goals.” Infusing analytics into the roadmap development process stands to make these plans smarter and more adaptive with greater stakeholder buy in.

**Figure 12**

*What are the major forces driving your community to adopt smarter communication technologies and data analytics? (Select three choices)*

- **53.3%** Long-term vision/proactive governance
- **44.3%** Cost pressures
- **38.6%** Crisis avoidance/mitigation
- **33.3%** Economic development
- **30.5%** Environmental protection/preservation
- **27.6%** Demand from the community
- **20.5%** Regulations and mandates
- **16.2%** Competitive pressures

*Source: Black & Veatch*
The modern electric distribution system is dramatically evolving towards an intelligent integrated system-of-systems. The traditional one-way, static distribution grid is rapidly developing into a two-way, highly complex, and dynamic necessity of modern life. With the influx of distributed energy resources, integration of renewables and the embedding of digital technologies and automated systems into all aspects of modern life, the necessity for advanced grid communications and applications that enable highly reliable and efficient electric power has never been more profound.

The convergence of traditional power systems and operations with information and security technologies will provide an optimal data platform and framework that will fundamentally alter the future of our digital day-to-day life. The benefits are both holistic and discrete with many yet to be realized.

The convergence itself is as much driven by necessity as by cultural need. The capability for the common utility to monitor and control the electric grids at sub-second intervals, using intelligent feedback loops, increases the reliability of the electric system while generating value.
Utilities and third parties must determine how their business models can adapt and extract value, while still providing the reliability and empowerment that the customer expects, if not requires.

Natural gas and water utilities will also benefit from robust communications networks, even though they do not compete with alternative suppliers as the electric utilities do. Modernized technology and systems will allow gas and water providers to detect leaks in real time and monitor usage patterns in greater detail.

This advanced energy marketplace is an empowering construct and an equally daunting architectural pursuit. As new third-party service providers are integrated into the electric utility markets, a unique and sometimes ad hoc exchange of power and information governs a network of complex relationships. Utilities and third parties must determine how their business models can adapt and extract value, while still providing the reliability and empowerment that the customer expects, if not requires.

To a certain extent, utility managers are at a loss as to how to go about this, despite the understanding that it is necessary.

For example, approximately 17 percent of utilities will invest more than $10 million in their communications infrastructure over the next two to three years to address the reliability demands and market trends. However, just six percent of survey respondents are not planning to invest in their communications infrastructure to address these new requirements (Figure 13).

Figure 13
Aging physical and communications infrastructure is a significant issue for electric, water and natural gas service providers. How much capital budget do you plan to invest in replacing, upgrading or building new communications infrastructure over the next 2-3 years? (Select one choice)

- 39.1% $5 million or less
- 10.2% Less than $5 million to $10 million
- 7.0% Less than $10 million to $20 million
- 3.1% Less than $20 million to $50 million
- 27.3% More than $50 million

Source: Black & Veatch
In addition, nearly 13 percent of utilities that are investing in their communications infrastructure will also require a greater than 25 percent increase in their operations and maintenance budget to sufficiently support operations of the telecommunications networks (Figure 14).

At the same time, non-traditional players are looking to impact the utility-customer relationship, such as solar providers who require customer usage and power demand information in order to participate in the electricity supply business.

That contention is becoming a critical point as seen in recent regulatory hearings, such as the recent California Public Utilities Commission-mandated Distribution Resource Plans. Information regarding where the distribution system can best be utilized from a value perspective for localized generation and storage is now required to be publicly available in an increasing number of jurisdictions.

The entirely new marketplace of transactive energy opens up when the utility has a plug-and-play-and-pay environment on the distribution system. It is a radical concept that could force some traditional utilities to become irrelevant, while progressive-thinking utilities capitalize on these new market trends. The core of this capitalization is dependent on robust communications systems that provide a sturdy, secure platform to monitor and control the electric grid.

Wholesale market activity based on capacity, availability and the day-to-day buying and selling of energy, is common place in the electric transmission and bulk power space. This same concept is now being introduced to the electric distribution arena. Adding advanced controls and reliable communications enables the electric distribution to be aggregated into one large asset to support virtual power plants and targeted demand response.

However, the level of complexity grows exponentially now that hundreds or thousands of devices need to act in a coordinated system response. A level of complexity is developing that requires a monitoring, control and analytics infrastructure that traditional supervisory control and data acquisition (SCADA) systems do not have the capability to provide.

The scale is changing and highly advanced technology is emerging. Storage and larger solar deployments at the commercial, industrial and community levels are aggregating entire neighborhoods. Markets are evolving that have the ability to produce revenue for different entities and players who previously could not participate. This is economist Joseph Schumpeter’s “gale of creative destruction” at its finest.
A level of complexity is developing that requires a monitoring, control and analytics infrastructure that traditional supervisory control and data acquisition (SCADA) systems do not have the capability to provide.
Utility customers and regulators have routinely demanded higher reliability and lower costs, and the pressure to improve is getting more attention. As a result, utilities are collecting and analyzing data to improve consistency, manage costs and enhance asset performance.

While a tremendous amount of operational customer delivery data is available via advanced metering infrastructure (AMI), most utilities are just beginning to use that data for distribution system modeling and planning purposes. The interval usage data, voltage information, power quality and other operational data are not always readily transferable into modeling programs; however, utilities are laying the foundation for future data integration.

EQUIPMENT AGE AND INTEGRATION CHALLENGES HAMPER AUTOMATION
Old and obsolete equipment and lack of integration of automation into the overall enterprise coupled with reliability mandates have created an environment ripe for the adoption of distribution automation and AMI programs for utilities (Figure 15).

Figure 15
What does your organization see as its TWO most significant gaps in its current smart utility/automation state?

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5%</td>
<td>Lack of integration of automation into overall enterprise</td>
</tr>
<tr>
<td>33.1%</td>
<td>Old and obsolete equipment</td>
</tr>
<tr>
<td>22.8%</td>
<td>Currently focused only on critical circuits or targeting customers</td>
</tr>
<tr>
<td>21.4%</td>
<td>Lack of complete service territory coverage due to size</td>
</tr>
<tr>
<td>20.7%</td>
<td>Proprietary equipment that prevents seamless integration</td>
</tr>
</tbody>
</table>

Source: Black & Veatch
The method by which implementation is taking place is of interest; some 62 percent of responding utilities are approaching implementation as a series of projects (Figure 16). Utilities are realizing that automation projects are not isolated projects but instead are almost always part of larger utility automation initiatives and programs. The value of individual projects is enhanced by the integration of the data and systems into a cohesive enterprise automation platform.

Figure 16
Which of the following statements best reflects your approach to the implementation of smart grid, smart water and automation programs? (Select one choice)

- **62.9%**
  Projects performed separately

- **21.1%**
  Not applicable, we are not implementing smart grid and automation projects

- **16.0%**
  All projects are performed as an integrated program

*Source: Black & Veatch*
This path is most certainly related to the foundational activities that drove the implementation of their automation programs. Given the integrated nature of these projects, it is critical for utilities to develop a strategy and plan on how to transform themselves with the available information and capabilities of these systems. Almost 40 percent of respondents are working from roadmaps that were shared with regulators. Similarly, 31 percent created a telecommunications master plan to guide their initiatives (Figure 17).

Utilities in the process of implementation are hoping to solve both operations and planning challenges while their core business and larger industry undergoes a transition. Incentives for certain applications are going away while regulator and consumer pressure to provide efficient and resilient service affordably mount. Those utilities in California, Hawaii and New England are leading the industry preparation for increased penetration of distributed energy resources.

Figure 17
Which of the following foundational activities did your organization perform prior to implementing your current smart utility/automation program? (Select all that apply)

- Provided roadmap and shared with regulators: 39.1%
- Produced integrated architecture for duration and other related initiatives: 36.8%
- Created telecommunications master plan: 31.0%
- Created data analytics (DA) master plan: 28.7%

*Source: Black & Veatch*
From a financial perspective, nearly half of utilities implementing automation programs are doing so only when there is a positive business case to support the investments (Figure 19). Return on investment can come from either cost reductions in excess of investment or from regulatory approval to recover the investment through rates. To a lesser extent, automation is being added as old and obsolete equipment is being replaced. Fewer utilities are implementing enterprise-wide automation programs where they are not mandated or there is not a positive return on investment, as these programs fight for limited resources.

Figure 18
Which of the following best describes the areas where you are implementing automation programs? (Select one choice)

- 21.0% Enterprise-wide regardless of whether it is mandated or where there is positive business case support
- 49.6% Only where there is positive business case support for new capabilities or services
- 29.4% Where needed to replace outdated equipment

Source: Black & Veatch

Figure 19
What are the TOP THREE primary business drivers for your automation programs?

- 84.0% Operational efficiencies
- 76.8% Improve service reliability
- 34.4% Strategic initiative

Source: Black & Veatch
Collecting data from utility assets has become easier and less expensive. As technology advances and the integration and operational costs for using the advanced technologies decline, an increasing number of utilities are implementing data gathering and automation programs. The value of the data and monitoring and control capabilities captured from automation programs will help to make the case for investment. More advanced utilities have begun to combine AMI data with other operational data stores for long-term planning. Their motivators also include regulator-led reliability performance mechanisms, where the case for investment may boil down to punitive measures for poor reliability (Figure 19). For them, more elaborate distribution automation applications enable more insight into operations. Other utilities in anticipation of similar mandates opt to implement data capture programs in advance of requirements.

When asked about existing automation systems, nearly three-fourths of electric utilities and about two-thirds of water and natural gas utilities have SCADA systems (Figure 20). This is anticipated since SCADA is a mature technology and has been around in various forms for more than 50 years. Following closely are outage management systems (OMS) and energy management systems (EMS). Falling off to below 50 percent are newer technologies such as fault location isolation and service restoration (FLISR), volt/VAR optimization (VVO) and distributed energy resources (DER). These lesser technology implementations will grow as the technology platforms and software solutions become more mature, the business cases are proven and older distribution operations systems are retired or mandated by regulators.

Utilities are feeling pressure from their customers and regulators to increase reliability while at the same time reducing or at least minimizing the increase in costs. These two seemingly conflicting goals can only be achieved through the implementation of advanced data collection and automated applications. While less than 50 percent of all utilities are currently on this path, Black & Veatch believes that the utility industry is on a march toward increased automation. Much like the advancements in personal communications (e.g., smartphones), as the capabilities of technology increase, operational improvements and customer service enhancements are proven and the benefit cases improve, utilities will move forward toward becoming increasingly smart utilities.

The value of the data and monitoring and control capabilities captured from automation programs will help to make the case for investment.
Figure 20

Which of the following systems is your organization currently have in place for automation and data analytics?
(Please select all that apply for each row. Skip the response if it does not apply to your organization or you do not know)

- Substation/distribution SCADA (Electric and natural gas) - 73.6%
- Pump/pressure monitoring (Water) - 68.9%
- Water/natural gas production/transmission/treatment (Water and natural gas) - 64.5%
- CIS (All) - 58.7%
- OMS (Electric) - 54.4%
- Water or natural gas unmanned facilities (Water and natural gas) - 52.6%
- Water or natural gas distribution main (Water and natural gas) - 50.0%
- EMS (Electric and natural gas) - 47.2%
- AMI (All) - 42.1%
- Load forecasting application (Electric) - 39.7%
- Automated flow control (Water) - 36.1%
- MDMS (All) - 34.7%
- Demand response (Electric) - 32.4%
- IRP (Electric) - 29.4%
- Technology to enable renewable integration (Electric) - 25.0%

Source: Black & Veatch
The Advanced Metering Infrastructure (AMI) deployments of the past decade demonstrate there is tremendous value to be found in the data generated across utility service networks. However, understanding that value exists and capturing value are two different things. While some early adopters are transitioning from using system information strictly for reporting purposes to enabling greater levels of automation and data-driven decision making, most remain in the early stages of the journey. Their challenge remains in figuring out how to build use cases to justify investments in automation and analytics platforms that will create value and improve efficiency.

As previously noted in the 2016 Black & Veatch Strategic Directions: Smart City/Smart Utility report, more than 70 percent of respondents indicated some level of AMI planning or deployment. Similarly, nearly 75 percent of respondents indicate plans to support data management and analytics requirements (Figure 21). Of these, more than 40 percent indicate plans to design, build, own and operate an in-house management and analytics solution. While this is an aspirational response, we believe it may not be reflective of the progression through which most truly actionable programs may be implemented.
PLANS TO SUPPORT DATA MANAGEMENT AND ANALYTICS REQUIREMENTS

Figure 21

How are you or how do you plan to support your data management and analytics requirements? (Select one choice)

- **41.1%** Design, build, own and operate in-house solution based on vendor platform application
- **10.9%** Software as a service with utility developed use cases
- **7.8%** Design, build, run, transfer vendor developed solution and initial use cases
- **7.0%** Design, build, hosted solution
- **3.9%** Full managed service outsourcing

Source: Black & Veatch

Advances in technology, connectivity and software have made an increasing number of tools available to improve utility performance. However, there is a corresponding need to have highly competent knowledge workers who understand both utility operations and the technologies in place to successfully leverage these platforms. Complexities such as use cases reliability, workflow integration, and return on investment hurdles create obstacles to enabling the full value extraction possible. Given this, it is not surprising that nearly 40 percent of respondents have not yet made financial commitments to manage and extract value from their data (Figure 22).

COMMITMENTS MADE TO MANAGE AND EXTRACT VALUE FROM BIG DATA

Figure 22

What commitments has your utility made to create new roles or organizational constructs to manage and extract value from Big Data? (Select one choice)

- **37.8%** No commitments
- **17.3%** Supplementing our analysts with resources and role requirements for new hires
- **7.9%** We have specific management roles focused on data analytics
- **7.9%** Added skilled data scientists to traditional analysts groups
- **7.9%** Created a new group specifically focused on data value-extraction

Source: Black & Veatch
MAXIMIZING DATA MANAGEMENT OPPORTUNITIES: WHERE TO START?

The fundamental question of where to start begins with an understanding of the underlying business model that motivates the optimization of utilities. Utilities deploy capital-intensive assets to reliably and safely deliver services to ratepayers. In exchange, utilities are granted regulated returns on deployed capital and documented operational costs based on rate cases approved by regulatory bodies. Once underlying base rates are established based on expected operational and asset-based costs, shareholder performance can be enhanced when utilities are able to subsequently improve their operational efficiencies while still maintaining the fixed rate base. The same is true for managing capital assets. The more efficiently utilities can deploy capital, the better the return on assets and the greater return to shareholders.

For utilities of all stripes, the goal of increasing asset and operational efficiency through improved data management is fundamentally tied to their underlying business model. Figure 23 highlights that most respondents identified asset management (65 percent) and capital prioritization (53 percent) as those business areas most likely to benefit from greater insights. In addition, Figure 24 shows more than 60 percent of respondents identifying opportunities to examine maintenance options as significant drivers of operational improvements.

The goal of increasing asset and operational efficiency through improved data management is fundamentally tied to their underlying business model.

BUSINESS AREAS THAT WILL BENEFIT MOST FROM INCREASED DATA MANAGEMENT AND ANALYTICS

Figure 23
What are the TOP THREE business/admin areas in your organization that would be best served by increased data management and analytics capabilities?

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Business Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>65.2%</td>
<td>Asset management</td>
</tr>
<tr>
<td>53.8%</td>
<td>Capital investment prioritization</td>
</tr>
<tr>
<td>32.6%</td>
<td>Customer service/engagement</td>
</tr>
<tr>
<td>32.6%</td>
<td>Evaluating strategic options/scenarios</td>
</tr>
</tbody>
</table>

Source: Black & Veatch
OPERATIONAL AREAS THAT WILL BENEFIT MOST FROM INCREASED DATA MANAGEMENT AND ANALYTICS

Figure 24
What TOP THREE operational areas in your organization would be best served by expanded data management and analytics capabilities?

- Evaluating operational/maintenance options: 60.3%
- Improving/maintaining service reliability: 48.9%
- Monitoring performance: 46.6%
- Identifying issues and losses: 36.6%
- Infrastructure resiliency and recovery: 22.9%
- Resource conservation/operating efficiency: 22.1%
- Outage management: 20.6%
- Regulatory compliance/reporting: 16.8%
- Streamlining projects: 10.7%

Source: Black & Veatch
OVERCOMING THE COST CONCERN
By far the greatest hurdle to investing in data management and analytics applications involves overcoming the cost concern (Figure 25) which includes budget constraints (57 percent) and justifying the ROI (45 percent).

BIGGEST OBSTACLES TO BETTER CAPITALIZING ON DATA ANALYTIC OPPORTUNITIES
Enabling definitive ROI is most often delivered through identifying valuable use cases that are able to improve operational efficiency by developing accurate and reliable data analytics which enable new operational processes and automated workflow. These new operational processes are optimized through minimizing unneeded work efforts, improving the efficiency of required work efforts, and automating workflow. Thus, the “Catch-22” of justifying ROI to relieve budget constraints is reliant on testing and optimizing data analytics as part of new business process designs.

Figure 25
What are your organization’s TOP THREE biggest obstacles to more fully capitalizing on data analytics opportunities?

- 57.3% Budget constraints
- 45.8% Justifying the return of investment
- 32.8% Data availability/accuracy
- 31.3% Lack of in-house understanding or support
- 30.5% IT/data management infrastructure not in place
- 28.2% Security concerns
- 15.3% Knowing where to start
- 5.3% This is not viewed as a priority at this time

Source: Black & Veatch
The scalability and more rapid deployment of cloud offerings can create opportunities to start smaller, with more focused applications, and build some quick, easy wins.

**OPPORTUNITIES IN THE CLOUD**

One approach to managing data and applying analytics tools that is garnering much attention is the concept of “Moving to the Cloud” or adopting Software-as-a-Service (SaaS) based offerings. This is viewed as a particularly attractive option for the following scenarios:

- Utilities that cannot or do not want to finance large-scale staff and IT investments
- Utilities beginning their smart initiatives who may not have the infrastructure in place or the competencies needed to quickly develop value adding use cases
- Utilities who want to leverage the pre-developed use cases of existing data analytics vendors who can more rapidly deploy proven solutions to new data sets

The scalability and more rapid deployment of cloud offerings can create opportunities to start smaller, with more focused applications, and build some quick, easy wins. That said, cloud-based business models also include the risk of amplifying dependence on others. The deeper the utility integrates increasingly complex and operational dependent analytics solutions into a vendor’s cloud solution, the harder it will be to transition data analytics to a core competency that is owned, operated, and enhanced by the future utility knowledge worker who will be needed as part of the “Utility of the Future.”

**BUSINESS PROCESSES DRIVE VALUE**

Too often data management tools become a reporting platform rather than an analytics tool. Value enhancing, operational analytics are driven by improving on traditional business processes. It is through improvements in business processes that value can be extracted from smart grid/smart water and other investments. Once the business process is identified for improvement, the analytics can be tailored to support the processes being built. Those improvements in analytics accuracy and reliability, and their ability to then become part of efficient, automated work processes is where the value in data analytics resides.

When considering data management and analytics solutions, it is key to understand that the quality of the analytics is what’s important and that quality is based on the range of available data and the extent to which more repeatable and reliable outcomes can be predicted. There is not a one-size-fits-all solution. Whether the end-solution is cloud-based or own-and-operate is less important from an investment perspective; the key to a successful implementation is to identify the utility business processes from which value can be derived.
Government regulation and news headlines about high-profile security breaches are proving to be powerful motivators for utilities to meet heightened security standards. In 2016, system safety takes on new prominence as the federal government begins enforcing updated standards for physical security and cybersecurity, reliability and resilience, and protection of consumer billing data.

Utilities are approaching the first round of audits aimed at measuring their compliance with version 5 of the North American Electric Reliability Corporation’s (NERC) Critical Infrastructure Protection (CIP) requirements, with April 1, 2016 as the day the standards take effect for high- and medium-impact systems, and April 1, 2017 for low systems. The rules are sparking concerted efforts to identify and address security risks across electric utility system assets and their connectivity points, internal to the utility grid and external to customer touch-points including customer smart grid components such as meters in the household.

**Fully integrated infrastructures, in which a smart city communicates with smart energy or smart water systems, will depend on exhaustive security.**
Cybersecurity has taken on extra importance given the role of data networks in making cities and utilities more efficient and sustainable. Fully integrated infrastructures, in which a smart city communicates with smart energy or smart water systems, will depend on exhaustive security. By getting NERC CIP right today, utilities can support smart cities tomorrow. Responses to the 2016 Black & Veatch survey show that security concerns are increasingly seen as a hurdle to enabling smart city and smart utility communication systems.

One of the biggest challenges associated with the transition from NERC-CIP Version 3 (V3) to V5 centers on the inclusion of smaller facilities that had virtually no CIP compliance requirements in the earlier CIP versions. V5 standards now require a tiered classification system for those electronic systems that control and protect the electric system. Under V3, many organizations’ assets were easily categorized out of compliance because elements of their systems did not utilize a “routable protocol” that allowed them to avoid Electronic Security Perimeter status and thus escape auditability for some components. This had an inherent side effect of slowing modernization efforts toward Internet Protocol (IP) packetization which in turn slowed smart grid evolutions. V5 no longer promotes that sort of escape from classification.

For some operators, the new categorization and complex regulation have increased the number of assets accounted for in their security planning by a factor of 10 or more. For some, virtually all generation and transmission electronic systems will fall into either the low-, medium- or high-impact classification tiers. High- and medium-impact bulk electric systems (BESs) systems must be in compliance as of 1 April 2016, while these low-impact BES systems have until 1 April 2017.
Utilities should explore engaging experienced firms that bring thorough understanding of the NERC guidelines.
The previous year has seen a flurry of activity as utilities hasten their efforts to reach compliance as well and support financial structures through rate increases, bonds or cost avoidance to pay for increased federal mandates. Nearly half of the Black & Veatch survey respondents said their transition process was under way. But with less than 10 percent having completed their compliance activities, increased industry understanding of V5 requirements has seen a dramatic increase in the number of assets that need to be reviewed and remediated, which is driving additional requests for external support.

Though some audits are certain to begin in April for the thousands of utilities across the United States, the three-year window between NERC audits means some utilities will get a practical grace period on V5 compliance. If a utility was audited under V3 rules in 2015, for instance, that utility has some cushion to begin the long and labor-intensive process of shoring up its assets – up to a year or more, depending on the utility’s size.

Resource constraints have prompted many utilities to turn to outside firms to assess the vulnerability of their physical and cyber assets as well as defer risks through new cybersecurity insurance products or outsourcing risk to third parties.

The internal assessments are leading to expansive security upgrades that include improved firewalls, replacement of aging infrastructure, anti-intrusion systems, two-factor authentication and jump hosts, which are machines that terminate remote desktop access from outside the utility’s control system. We also anticipate utilities working to upgrade their overall network monitoring, establish security operations centers (SOC) and adopt large-scale logging requirements that will require new solutions and support. New applications, such as data recorders, have proven to be extremely valuable in utility environments and to open new areas of consideration for security strategy planning.

NERC CIP V5 raises the standards by which utilities sight-monitor their facilities, especially medium- to high-classification sites. How a utility builds and monitors fence lines, doors, access points and badge entry, logging and escort procedures is driving a manifold increase in security steps. A resource-hungry standard under the new rules is video surveillance tied to physical security. These standards have challenged utilities, especially smaller organizations in rural areas.

Utilities have traditionally struggled to achieve the bandwidth necessary for monitoring their plants in real time. Video surveillance bandwidth demands have increased the need for application surveys capable of ensuring that data packet infrastructure can support new security applications inherent in the pursuit of V5 compliance.

While responses to the Black & Veatch survey suggest utilities have a greater understanding of the standards than they did a year ago, they also recognize it is a job that many can’t afford to take on alone. Utilities should explore engaging experienced firms that bring thorough understanding of the NERC guidelines, and associated other federal regulations, how to structure cost recapture as well as roadmaps for bringing physical plants and transmission and distribution into compliance and further securing the grid.
Utilities are placing more emphasis on owning the customer relationship to drive value and meet satisfaction goals. They see increasingly connected customers playing active roles in the connected grid. Challenges, however, come from delivering the right kind of experience for each customer, regardless of platform. Think of it as serving the “Customer of One.”

Numerous factors influence customer opinion of their utility: call center responsiveness, bill accuracy, and, above all else, service reliability. But the prevalence of connected devices has given customers new standing as perceived partners in the power delivery process. Social media is a powerful feedback tool, as well as a cheap information dissemination tool in times of crisis. Mobile apps allow customers to pay bills and gain insights about their consumption habits.

Many organizations are now realizing, however, that the digital ecosystem’s expanding feature sets may be delivering diminishing returns. Even as customers pay their bills over their smartphones or report outages on social media, these devices and digital strategies mask a simple truth about how most customers view the role of today’s utility: Be transparent, be responsive, and run reliably in the background.

**UTILITIES SERVING A ‘CUSTOMER OF ONE’**

Highly tailored customer service and engagement across utilities is necessary for the personalized customer experience.
Utilities clearly crave a true partnership with customers. Nearly two-thirds of respondents to the Black & Veatch survey indicated their utility seeks direct ownership of the customer relationship (Figure 26). Such positioning has far-reaching implications. For instance, with rising numbers of customers adopting self-financed renewable energy and distributed energy resources (DER), utilities are keenly interested in developing partnerships that sustain their role in service delivery over the long term.

Figure 26
When delivering products and services to your customers, which statement best describes your company's position regarding this relationship? (Select one choice)

- 65.6%: Our organization wants to directly own the customer relationship, with our brand front and center
- 14.4%: Our organization is not worried about owning the relationship, as long as the customer receives good product/service
- 7.7%: Our organization wants to co-own the relationship, as long as it’s with the right partner

Source: Black & Veatch

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CONNECTED GRID, CONNECTED CUSTOMERS

Utility respondents rank frequent customer engagement as a HIGH PRIORITY

67% Utility respondents are increasing the number of channels used to reach consumers

67% Online self-service portals/services

49% Mail

45% Phone

42% Social media

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Source: Black & Veatch
Technology plays a leading role here and has undoubtedly provided utilities with invaluable insights and communication tools. But connecting with customers is less about power consumption patterns delivered via detailed data telemetry. More data requires more insights that are easily explained and thus actionable. To be successful and sustainable, utilities should focus on creating a simple and personalized dialog with the “Customer of One.”

More than two-thirds of respondents to the 2016 Strategic Directions: Smart City/Smart Utility report indicated that frequent, sustained customer engagement is a high priority of their utility. In fact, more than 13 percent said it was the organization’s most important goal. The data suggest growing interest in resource and staff investments to accommodate these aims. Corporate communication, social media and marketing wings are becoming standard for organizations whose customers engage across multiple platforms.

Particularly in larger urban areas, such investments will be vital to accommodating a growing customer base that turns first to mobile. Thanks to the growing adoption of and comfort level with smartphones, apps, social media, and real-time “on demand” information, customers are raising the bar for the companies with which they choose to engage. They have higher expectations than ever before, and that is unlikely to change.

Anecdotes abound of responsive engagements between utilities and customers, episodes that underscore the utility’s leadership role while demonstrating its commitment to meeting customers wherever they are. When a wind storm lashed the northwest U.S. in November 2015, a prominent utility created a Twitter hashtag that kept residents updated through a prolonged outage that cut power to roughly 1 million people.

In another example, a number of utilities across the country have begun implementing text alert notifications to proactively inform customers of a power outage at their residence (including estimated repair time), with a follow up text when power is restored. This seemingly small change to how they engage customers is having a significant impact on customer satisfaction. By receiving a text that acknowledges the outage and providing customers with helpful information, it is turning what is typically one of the largest detractors to customer satisfaction (power outages) into an engagement opportunity that contributes to a more positive experience.

Choice, flexibility, real-time information, personalized insights, and high levels of customer service are prized and expected – creating both challenges and opportunities for utilities. They must start with the customer, and define their strategies and goals from this perspective if they are to be successful.
Reaching customers remains an all-channels exercise that utilities must prioritize and balance based on budgets and other resources. Traditional platforms—such as direct mail, phone and web-based self-service channels—remain dominant vectors for utilities to connect with customers. The importance of those legacy streams, coupled with the rising relevance of social media and versatile mobile apps, reflects the variable demographics that require utilities to be in nearly all spaces.

Utilities recognize the opportunity presented by the growing connected device market and are gaining new insights about the customer’s role in a connected grid (Figure 27). Beyond simply the next generation of energy efficiency and demand response programs, the ecosystem of devices (and the data from those devices) both increase the opportunities for and the value of interactions with customers.

If correctly positioned, utilities will be able to layer their unique value proposition on top of these technologies to greatly enhance their level of engagement with customers.

Aside from building the infrastructure, systems, and processes for the “Customer of One” relationship, one of the most significant challenges facing utilities over the next few years will be creating a cohesive and centralized customer engagement experience, with more continuity across services and products.

Today, many of the tools, systems, products, and processes in place to serve customers are standalone and fragmented. Bringing these pieces together to create a single “point of engagement” with the customer—and creating a simple customer journey that sustains engagement and grows the value of that engagement—will be necessary to build and maintain the customer relationship.

**Figure 27**

**What do you envision as your customer’s role in a connected grid solution? (Check all that apply)**

- **58.1%** Receiv feedback, recommendations, and program offers that deliver benefits to the customer
- **52.4%** Engage directly, through connected devices beyond the meter for grid optimization, demand response, and energy efficiency
- **28.6%** Provide customers with options and incentives for adding private generation
- **6.7%** No customer involvement
- **1.9%** Other role/involvement

*Source: Black & Veatch*
Renewables and distributed energy resources (DERs) are critical building blocks for smart cities. Advances in solar and wind generation, small natural gas-fired generation units, electric vehicles, energy storage technologies, and more careful management of electric demand are seen as foundational to helping communities become more efficient and sustainable. A central question in the rise of smart cities will be how utilities embrace these emerging technologies, along with “smart” planning and service provision grounded in technology, to meet both the demands of increasingly sophisticated customers and their desire to lower their carbon footprint.

The growing prevalence of these technologies is reflected in responses to the Black & Veatch survey. More than 70 percent of utility respondents say that solar is the form of DER that will affect them the most in the near term, but other types of DERs are already having an impact and will only grow in importance.

Until quite recently, DERs have had a relatively minor effect on the grid. But utilities have begun to see wider adoption by both residential and business customers. With increasing DER penetration, utilities see a number of challenges, as shown in the 2016 survey results. The top challenge today is the immediate need to ensure the distribution system’s reliability, but others related to planning, modeling, and real-time operations are also gaining recognition.
Utilities will be challenged to integrate renewables with traditional sources.

**Barriers to Entry are Falling**

Cheaper for residents and businesses to adopt green energy.

**72% Solar**

- 32% Battery storage
- 30% Demand response
- 21% Electric vehicles
- 14% Natural gas (micro turbine)

**Challenges Utilities Face**

To supporting a high penetration of renewables:

- 49% System stability
- 34% Planning load flows
- 33% Control
- 31% Forecasting

**Joining Customers in the Renewables Revolution**

As energy options for customers, utilities evolve to keep pace.

Source: Black & Veatch
Because of the challenges for the traditional grid, technology for integration of renewables and DERs is ranked highly among smart city and smart utility priorities. Responses to the 2016 Black & Veatch survey show that among electric utilities that are planning to use automation and data analytics to improve their systems, renewable integration takes the top spot (Figure 28).

Multiple factors are driving utility concern and interest in the adoption of renewables and DERs:

- **Policy and regulation:** Many states are pushing the adoption of renewables and DERs through specific policies such as renewable portfolio standards and tax credits, but a few states with relatively high solar penetration (like Hawaii and California) are now requiring utilities to conduct specific DER planning studies and incorporate the results into their normal resource planning processes. Perhaps the most aggressive effort is in New York, where the Public Service Commission’s Reforming the Energy Vision (REV) proceedings are targeting increased reliance on DERs such as rooftop solar and battery storage, and considering the formation of an independent distribution system operator to manage daily operations and provide a market for third-party DER services.

- **Technology costs:** The price of rooftop solar installations is already entering mainstream affordability, especially with loan and lease options available. On the horizon are anticipated cost declines in potential game-changing technology such as residential energy storage. Companies are showing an increased willingness to cut fat from their margins to encourage wide adoption, and are also driving down hardware costs and “soft” costs for design, permitting, interconnection approval, and customer acquisition.

- **Customer Relationships:** As falling DER costs reduce the barriers to entry, new players like solar and battery storage developers are establishing relationships with utility customers, and there are new concerns that without action utilities will lose their cherished one-to-one customer relationship.

As DER adoption expands, we expect more utilities to wrestle with this emerging dynamic and create new ways to partner with customers in adopting these technologies.

While the growth of DERs is under the influence of factors often outside the control of utilities – such as California’s regulatory “50/50/50 by 2030” plan to increase electricity from renewable sources, cut petroleum consumption and increase energy efficiency in buildings – Black & Veatch sees a window for utilities to embrace DERs and develop new partnerships with customers. The costs and capabilities of these technologies are evolving rapidly, and if utilities do not seize the emerging opportunities, other new market entrants certainly will.
Which of the following systems is your organization currently or planning to use for automation and data analytics? (Select all that apply)

- Technology to enable renewable integration (Electric) 33.8%
- AMI (All) 33.1%
- Demand response (Electric) 27.9%
- OMS (Electric) 26.5%
- MDMS (All) 26.4%
- Load forecasting application (Electric) 25.0%
- Substation/distribution SCADA (Electric and natural gas) 23.6%
- PMU (Electric) 22.1%
- CIS (All) 21.5%
- EMS (Electric and natural gas) 20.8%
- Intelligent relays (All) 20.7%
- FLISR (All) 20.7%
- DMS (All) 19.8%
- BI Software (All) 19.8%
- IRP (Electric) 19.1%
- Water or natural gas distribution main (Water and natural gas) 17.1%
- Sensors (All) 16.5%
- DER (All) 15.7%
- Pump/pressure monitoring (Water) 14.8%
- VVO/CVR (All) 14.0%
- Automated flow control (Water) 11.5%
- Water or natural gas unmanned facilities (Water and natural gas) 9.2%
- Water/natural gas production/transmission/treatment (Water and natural gas) 7.9%
- DFRs (All) 6.6%

Source: Black & Veatch
The interest in drone use by electric, water and natural gas utilities is growing at a rapid pace as reflected in this year’s survey. In fact, this relatively new application for utilities seems to be positioned to eventually become a best practices approach with their use woven into project requirements. However, before this occurs, it will require revisions of current federal requirements concerning the use of unmanned aerial systems. As firms clear this hurdle and as utilities become more comfortable with external drone service providers operating onsite, we expect their use will skyrocket.

More than 60 percent of survey participants view drones as providing value for their construction, maintenance and operations programs. The responses show that utility providers see many opportunities to accomplish projects more economically while furthering safety goals. For electric and natural gas providers, this reflects a strong interest in pipeline and power line project inspections and image capture instead of more costly and time-intensive measures such as using helicopters and line inspection crews.
DRONES ON THE RISE
Utilities planning on using drone technology for future projects

REGULATION CHANGES
New requirements released by the Federal Aviation Administration in 2015

MAX 500 FEET above GROUND LEVEL
NO FLYING Over People
CONSTANT VISUAL LINE OF SITE
LICENSED OPERATORS

TOP 5 FUTURE USES FOR DRONES
In construction, maintenance and operation programs

84% VISUAL INSPECTION
66% IMAGE CAPTURE
50% Safety
36% Data capture
32% Time-lapse monitoring

A GOOD INVESTMENT
60% of utility respondents agree DRONES ADD VALUE to construction, maintenance and operation programs

Source: Black & Veatch
DRONE TECHNOLOGY

The hardware on drones allows for autonomous flight where they can be programmed to inspect miles of natural gas pipeline or power line distribution. However, using drones on large linear projects poses a challenge for utilities due to current Federal Aviation Administration guidelines.

Under current regulations, a commercial drone must always be in the line-of-sight of the person operating it. However, outside of 50 to 100 yards, it is usually not easily visible to the operator. In addition, commercial users currently must have a pilot’s license to operate the drone. Also, a regulation that drones must be less than 55 pounds makes it difficult to add other types of inspection equipment.

Many water service providers’ responses on drone uses may reflect that they are still evaluating the technology and also may see less drone value for smaller water treatment plants. However, time lapse monitoring for water services construction is ranked high in the survey. This is likely a function of wanting to monitor site progress and gaining a better understanding of the facility for future addition and renovation projects.

There is an interesting difference in many respondents’ view of image capture compared to data capture, which has the capability to obtain additional operational and construction information. There are definitely compelling reasons for adding data capture utilizing LIDAR, a remote sensing technology that measures distance by using a laser to illuminate an object and then analyzing the reflected light. This data provides specific value in drone
usage because the detailed 3D point cloud generated from the LIDAR scanning can be directly utilized within many design applications today. This allows designers to leverage accurate information from real-world conditions. It also keeps them from having to start their work with outdated information or a blank screen and generate everything from scratch.

As drone use becomes more accepted and implemented, those working to provide design, engineering and construction services to utilities must have drone capabilities. This will spur significant competition in that sector since the cost of drone technology is not a barrier. As a result, just owning the equipment will not be a differentiator. The innovative things you do with the data you capture will create the competitive advantage.

Just owning the equipment will not be a differentiator. The innovative things you do with the data you capture will create the competitive advantage.
PERSPECTIVE

Developments in UK Utility GIS Applications
By Paul Harmer and Paul Hart
Geographic information systems (GIS) allow users to see geographic aspects of a body of data in ways that can be interrogated and manipulated – with a combination of speed, flexibility and detail – that has not been available previously. Consequently GIS brings the ability to visualize, question, analyze, and interpret data; to understand relationships, patterns and trends – sometimes in wholly new ways.

The United Kingdom’s (UK) water companies have large physical asset bases, distributed in varying concentrations, over regions of mixed topography, geology and land use. As a result GIS have a potentially significant role to play in planning and executing capital and operational programs.

These companies are not a homogenous group. Differences in ownership, size, and business goals – for example – influence the way they act. This means levels of GIS maturity differ across water companies. There are, however, some common trends.

Most commonly GIS are being used by teams of specialists. Discrete technical groups familiar with the GIS and how they can help meet water companies’ needs. This currently encompasses groups such as network modelers and asset planners.

It is unusual, but not unknown, for the GIS knowledge within these groups to penetrate far into other areas of the business. Thus it is sometimes the case that parts of the utility which could benefit from GIS expertise are unaware their organization already possess the requisite capabilities. Consequently the business-wide benefits of GIS remain, to-date, largely untapped.

There are, however, examples of water companies with more open access approaches to GIS. One company has made a GIS – highlighting critical assets in close proximity essential public infrastructure such as hospitals – accessible across the business. Thus the location of the most high-risk assets can be ascertained swiftly and widely. Another water company has allowed the GIS team to create its own data sets and specify their contents. The key point here is that the GIS team is empowered to request, from all other parts of the business, the data required to deliver the maximum return on the investment in GIS.
The current pattern of GIS use within UK water companies is similar to other UK utility sectors and comparable industries. As water companies develop formal GIS strategies – deciding things such as who needs access, what they need access to, where and when they need access - a number of factors are influencing how quickly the sector’s use of GIS matures.

Because GIS can be used in many different ways, it is not easy to recognize all of the benefits they offer. The GIS community, and GIS advocates within water companies, need to help the utilities gain a fuller understanding of GIS’ possibilities. Recognizing the benefits tends to drive the best data capture. For example if operations teams see populating datasets as providing the company with valuable information, rather than form filling, the quality and detail of the data they provide increases.

Devising a sound GIS strategy is also difficult because, to realize its full potential, the system will not be the preserve of any single part of the water company. The most effective systems involve gathering, integrating and sharing data across areas of water companies that are traditionally relatively separate: operations, asset management, capital delivery and customer services, for example. This means there are potentially challenging questions regarding organization, implementation and funding.

This brings GIS into the realm of Big Data, which is often defined as pulling together large disparate datasets from numerous sources for a greater use. The concept is applicable to many water companies thanks to their numerous, separate data requirements and collection strategies. The adoption of big data strategies with capabilities such as data mining from across the organization would bring huge benefits to the organization, especially in the TOTEX environment.

One of the most significant developments leading into the UK water industry’s new five-year regulatory cycle, AMP6 which runs from 2015 to 2020, will be the growing role of mobile technology. As the value of GIS is realized more fully across water companies demand will grow. Symbiotic with this increase in demand will be proliferation of GIS apps and datasets. Driving the growth in apps and datasets will be the falling cost of data coverage: a greater availability of map software means utilities are increasingly able to create their own maps – reducing their reliance on costly bespoke data and applications.

Coupled with this is hardware development. Tablet computers are, literally, placing these GIS in the hands of field workers. We have already seen examples of utility employees equipped with two-kilogram water-proof laptops setting aside company equipment in favor of their own tablets. The ability to capture and validate data on-site is following GIS’ move from the modelling suite to the field.
An early example of this has been a project to help a water company prepare for the October 2016 deadline for the adoption of privately owned pumping stations (PPS). This required developing a methodology to identify, locate and determine the condition of PPS. The work encompassed more than 500 sites.

At the center of the project was a single, central database accessible to the entire project team. Innovative use of technology enabled the team to survey up to fifteen sites per day, reducing time on site, increasing the ability to adjust the plan of sites to be surveyed and crucially, allowing more time to be focused on developing the adoption strategy. Survey teams were equipped with global positioning system (GPS) enabled tablets to capture data digitally, directly into the single central database. Office teams supported the process using Google Street View to pre-visit sites, and GPS trackers to keep up to date with the surveyors' locations.

A more current, and significantly bigger, GIS-based survey shows how the technology has advanced. The challenges facing the energy utility client have direct parallels with those experienced in the water sector. This survey had to confirm the location of, and record an initial condition assessment for, 47,000 cable pits in a major city. Records had not kept pace with the changing cityscape. So, before deploying highly trained inspection teams with expensive equipment to assess each asset in detail, a walkover survey of all 47,000 locations was undertaken to confirm pits locations and assess the feasibility of access for detailed inspection.

Initially surveyors were provided with batches of paper maps, based on historic data, on which they would indicate whether the asset was present or absent. The surveyors’ findings were then transcribed to spreadsheet. Return visits were arranged if an asset could not be located. The process was slow and labor intensive.

The quality of the results did not always meet the standard required. Surveyors were often unsure which pit they had located, and lacked the tools to record suitable written and photographic data. It was difficult to calculate the number of pits being surveyed due to the time lag between the site visit and a surveyor’s findings being made available to the project team. The approach was incompatible with the scale of the task.

Black & Veatch’s Information Management and Analytics team addressed this by creating an online platform for managing the surveyors and capturing the data they were gathering. Surveyors were given 3G-enabled iPads allowing them to receive online details of the surveys they were undertaking, and then upload their survey findings in the field.

Innovative use of technology enabled the team to survey up to fifteen sites per day, reducing time on site, increasing the ability to adjust the plan of sites to be surveyed and crucially, allowing more time to be focused on developing the adoption strategy.
Each survey plan was created using a live feed from a database created from historic data. Surveys usually included circa 200 pits. Surveyors received the plan on their iPads as GIS-enabled maps. The process of allocating survey plans to the 10 teams could take as little as half an hour. This saved a significant amount of administration work and improved the quality of allocation process.

Once in the field the iPad’s GPS pinpointed a surveyor’s location. This removed any ambiguity about which asset they were surveying and, because the feed to the map was real-time, the possibility of the same asset being surveyed repeatedly.

Upon reaching a location identified from the historic database, the surveyor uploaded information about the asset – or its absence – and a photo using the iPad’s camera. The data was shared online with the central database, making it available instantly to all surveyors and office-based members of the team. By using customized off-the-shelf software the system could be operated by staff without specialist GIS training. Each survey took around 15 seconds. The teams were able to cover around 2,000 cable pits per day.

Tablet computers are, literally, placing these GIS in the hands of field workers.
The falling cost of data coverage and a greater availability of map software, however, have led to demonstrably rapid advances.

Having a live online connection between database and surveyors allowed the creation of real-time dashboards. Reporting included:

- daily updates by each team: allowing the challenges of underperforming teams to be addressed; breakdown of asset condition: asset data that did not correspond with the historic databases was easy to access; photos helped assess the feasibility of full inspection.
- time out on site: location “pings” returned show how long a surveyor was in the field.

This mobile GIS application would not have been viable six months ago. At that time the technology to enable surveying in this way was not available in a cost-effective manner. The falling cost of data coverage and a greater availability of map software, however, have led to demonstrably rapid advances.

Two more agents of change are also likely to hasten the more widespread use of GIS in UK water companies and other utilities. The entry into the workforce of the first generations of ‘map mature’ graduates will be influential. Many students studying the disciplines sought by water companies are now equipped with a sound grasp of GIS’ potential and an understanding of how to use the systems.

The adoption of building information modelling (BIM) may also spur greater use of GIS. Central to the government’s BIM strategy is compliance with Publicly Available Specification 1192 (PAS1192) which requires infrastructure projects to include a central data exchange – a single data repository accessible to all. A data exchange incorporating GIS will offer much more than one without.

Evolution of GIS use in the UK water industry from the previous five-year spending cycle, AMP5 2010 - 2015, to the current five-year spending cycle, AMP6 2015 to 2020.

**PRIMARY GIS USE IN AMP5:**

- Collecting data
- Adding sensors and telemetry to networks: driven by greater accessibility and falling cost of the technology and the development of smart city concepts
- Creating ‘big data’

**ANTICIPATED GIS USE IN AMP6:**

- Consolidating data through Business Intelligence (BI) into useful, accessible information
- Converting data into available intelligence
- Big data analytics
- Sharing data: encouraged by government bodies such as Ordnance Survey and the Environment Agency making data freely available
- Location intelligence: all water company data relating to location can be leveraged to add an extra dimension to analysis
PERSPECTIVE

India: How to Create 100 Smart Cities
Anand Pattani Country Manager & Managing Director, Black & Veatch India
The world’s most ambitious application of smart integrated infrastructure (SII) is, arguably, in India. The government, or “centre” as it is often called, is seeking to facilitate the creation of 100 ‘smart cities’ through the Smart Cities Mission.

While the mission relies substantively on SII, however, it is not a pure SII undertaking. The plan looks beyond critical human infrastructure – power, water and telecommunications – and seeks to address virtually every dimension of the cities: governance, commerce, social, logistics and environment.

Because the circumstances of India’s cities differ greatly, and the mission covers so many cities, the government has not given a prescriptive definition of a smart city. Rather it has identified common attributes that the mission seeks to foster. Similarly while the centre has urged the consideration of technology, institutional or managerial reforms, and the involvement of citizens in the development of smart cities, it has not provided a detailed plan for creating them.

The core attributes of India’s smart cities include:
- Adequate water supply
- Assured electricity supply
- Sanitation, including solid waste management
- Efficient urban mobility and public transport
- Affordable housing, especially for the poor
- Robust IT connectivity and digitalization
- Good governance, especially e-governance and citizen participation
- Sustainable environment
- Safety and security of citizens, particularly women, children and the elderly
- Health and education.
The absence of a standard formula for creating an Indian smart city has left some asking for greater clarity about what smart cities are and how they should be delivered. This has not, however, hindered the mission’s early stages.

At the request of central government, each state government nominated the urban areas or greenfield sites it wished to be considered for smart city funding.

The number of states’ nominations was based upon the number of statutory cities within the state and the population density. This meant northeastern states and small states like Goa and Kerala nominated one city while larger and more densely populated states like Uttar Pradesh, Tamil Nadu and Maharashtra nominated several cities.

The 472 nominated areas have been assessed against 13 criteria. These included ranking on the Swachh Bharat scale – the centre’s measure of urban cleanliness based upon provision of services such as sanitation and refuse collection; the ability to finance the development of a smart city; and the track record of implementing the previous urban renewal programs of the Jawaharlal Nehru National Urban Renewal Mission.

The process has identified 98 areas for Smart City Mission funding. They include 24 state capitals, 13 cities in Uttar Pradesh – India’s most populous state; and 12 cities in Tamil Nadu, 10 in Maharashtra, six in Gujarat and Karnataka and four in West Bengal and Rajasthan.

In November 2015 each of the 98 areas submitted a detailed smart city proposal to the Ministry of Urban Development (MoUD). Based upon its assessment of these proposals, at the end of January 2016, the MoUD named the first 20 cities to receive money from the centre. A further 40 recipients of central funding will be announced in 2017, with the final 40 being named in 2018.
Estimates of the overall cost per city vary from R10,000 crore to R30,000 crore. The centre will provide viability gap funds of R500 crore per city; with R200 crore allocated in the first year, and R100 crore for each of the subsequent three years. State governments will match the centre’s funding by providing R500 crore for each of the smart cities within their jurisdiction.

The centre expects the remaining investment in the Smart Cities Mission to be raised by the urban local body (ULB) responsible for each smart city. Every ULB, in conjunction with the government of its state, will create a special purpose vehicle (SPV) to lead the program that will deliver the smart city. Funding is anticipated to come from a mixture of direct foreign investment, from the private sector and government agencies, and from the domestic private sector.

Foreign governments’ interest is evidenced by the number of trade missions – from the UK, USA, UAE, Germany, Singapore and France, for example – visiting areas that will receive funding from the Smart Cities Mission. Some countries are targeting specific areas. For instance, the French government has shown interest in partnering with Puducherry, Nagpur and Chandigarh. Finalized deals, however, have yet to emerge.

Although the Smart Cities Mission encompasses virtually all of the infrastructure a modern city requires, commercial interest is being led by what can broadly be described as the information and communications technology sector rather than the construction sector. This is exemplified by the agreements the Confederation of Indian Industry has signed with Hitachi, Siemens, Cisco and INDRA Systems for a national mission to help state governments create smart cities.

At this stage domestic expertise is likely to be from the major multi-disciplinary companies like the Tata Group. Tata Projects has created a division dedicated to the markets it envisages the Smart Cities Mission will generate.

Smart integration of critical human infrastructure has a central role in delivering many of the smart cities’ core attributes: adequate water supply, assured electricity supply, sanitation, robust IT connectivity and sustainable environment.

Synergies between many of these attributes can be realized through the use of SII, assured electricity supply and sustainable environment. Solar power, especially rooftop solar, features a much lower environmental impact than fossil fuels and is expected to have a significant role in generating the smart cities’ electricity. According to some estimates solar will account for 10 percent of the new cities’ power.

Such distributed generation strategies, however, can have a profound impact on daily demand curves. SII, in the form of distribution automation, can provide an excellent way to integrate power from renewable and traditional sources, by scheduling each energy source to optimize value.

Generating energy from waste, typically through the anaerobic digestion of solid waste and sewage, is another way of reducing the environmental impact of power generation. Turning waste into a valuable resource also supports the Swachh Bharat agenda. As a result waste-to-energy is also likely to play a meaningful role in powering the smart cities. Meeting the energy demands of an area served by a single fossil fuel power station typically requires numerous, smaller waste-to-energy power stations. SII will be needed to ensure the efficiency and viability of this kind of large scale distributed generation model.
A further way to enhance the environmental performance of the smart cities is through greater use of gas fueled power stations for baseload generation. Compared to the average emissions from coal-fired generation, natural gas produces half as much carbon dioxide, less than a third as much nitrogen oxides, and one percent as much sulphur oxides, according to the US Environmental Protection Agency.

Of the three fossil fuels, natural gas offers power station operators the shortest start-up time. This means a gas-fired power station can quickly provide extra electricity when there is an increase in demand. This makes gas a sound baseload partner for solar generation, with the former able to respond quickly to fill gaps in the intermittent generation profile of the latter by using smart distribution and monitoring systems to match supply with demand.

The use of smart distribution networks will also contribute to the smart city goal of an assured electricity supply by helping reduce transmission and distribution (T&D) losses. India’s T&D losses as a proportion of electricity output are among the highest in the world. Smart metering will help identify the sources of losses such as electricity theft, meter tampering and faulty meters.

Smart metering will also help with the provision of an adequate water supply. Currently 40-50 percent of the water entering India’s distribution networks is lost. This is due largely to leakage and unauthorized connections. As well as wasting a precious resource these losses are also non-revenue water, for which the utility is unable to recover the costs of treatment and supply. High levels of non-revenue water hampers investment in water infrastructure.

Smart metering is a highly successful way of identifying accurately how much water is being lost, where leaks are occurring, and the location of unauthorized connections to the distribution network. This information helps preserve a stressed natural resource and increase the income available to invest in water infrastructure.

While trade missions and expressions of corporate interest abound, concrete manifestations of the Smart Cities Mission are less obvious. This, and the absence of a prescriptive smart city definition, sometimes imparts the undertaking with a sense of opacity. There is no doubt, however, that the mission is gathering momentum. Announcing the first 20 areas to receive government funding will be a highly visible milestone. Behind the scenes, meanwhile, the country mobilising, as TimesJobs’ COO Vivek Madhukar noted in September, “The government’s push to create 100 smart cities comprising modern digitally-connected infrastructure had an impact on hiring activity in India Inc., with a rise in demand for key personnel in the infrastructure industry, and across Tier-II cities.”
In January 2016 the UnionG unveiled the first batch of 20 cities for Smart City Mission.

Following is the list of the cities in order of their ranks.

1. Bhubaneswar, Odisha
2. Pune, Maharashtra
3. Jaipur, Rajasthan
4. Surat, Gujarat
5. Kochin, Kerala
6. Ahmedabad, Gujarat
7. Jabalpur, Madhya Pradesh
8. Vishakapatnam, Andhra Pradesh
9. Solapur, Maharashtra
10. Davangere, Karnataka
11. Indore, Madhya Pradesh
12. New Delhi Municipal Corporation, Delhi
13. Coimbatore, Tamil Nadu
14. Kakinada, Andhra Pradesh
15. Belgavi, Karnataka
16. Udaipur, Rajasthan
17. Guwahati, Assam
18. Chennai, Tamil Nadu
19. Ludhiana, Punjab
20. Bhopal, Madhya Pradesh

Source: Black & Veatch
PERSPECTIVE

Connected Convergence: Opportunities for Africa
By Webb Meko
The convergence of smart cities and smart utilities has no greater weight than in Africa, where planning and infrastructure are both booming and a critical necessity for the continent’s current and future growth.

Africa’s infrastructure is well-positioned to leap forward through the deployment of the most modern technology and advances in data analytics. In short order, Africa could be the smart playground of the future.

Realizing this long-term goal however requires innovative thinking, planning, leadership and investment – a mix that has not yet been realized in many developed countries. Still, opportunities are evident in South Africa, Johannesburg and Cape Town in particular, Nairobi, Kenya, and other development hubs such as Nigeria, Egypt, Rwanda and Ghana where technology is increasingly able to support smart developments.

There are interesting and applicable trends emerging in the smart city and smart utility space that will shape African cities in the future. To adequately make use of integrated smart city and utility thinking in the planning process, a number of key items need to be considered in the African context:

- Advancing high speed tele-communications networks and infrastructure;
- The real assimilation of smart-orientated thinking into policy, master planning and delivery;
- The need for Africa-centric baseline data in key markets; and
- The realization of pilot sites that could guide the establishment of African smart cities and the uptake of smart utility.

The ‘smart’ concept has embedded itself in cities, cars and utilities. Its growing prominence is pushing business and government to re-think how it solves urban problems and improves living standards through the deployment of technology and high-quality physical infrastructure to make urban spaces and utilities run more efficiently.

Finite resources require better resource utilization and environmental management. Data capture and the application of analytics tools utilized by smart utilities enables cities to improve reliability, resilience, availability, cost effectiveness of its resources and spaces, particularly of water and power.

In Africa, both of these commodities are in short supply, and major infrastructure projects are underway to generate and manage water and power supplies. In parallel with these projects, African cities are expanding rapidly, placing added pressure on both planning and infrastructure functionality. The African Development Bank has noted that between 1960 and 2011, Africa’s urban population rose from 19 percent to 39 percent. It projects that by 2040, 50 percent of Africans will live in urban areas. By 2030 urban populations will increase by an additional 350 million people, it projects. In this coming future, Africans, and a rising middle class among them, are going to demand improved services and world class infrastructure that makes their commute, work, consumption of resources and relationships with utility service providers seamless.

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2. Ibid.
The opportunity to develop cities of the future now in Africa, using smart city and utility technology and advances, is compelling.

However, uptake, know-how, cost and other associated challenges – such as the digital divide, privacy and security, and the threat of technical glitches and failure – are as much a challenge in Africa as they are in other parts of the world.

With internet penetration in Africa at around 28.6 percent, 17 percent below the world average, the first achievement would be to ensure broader access to true broadband service. Expansion of 3G, 4G and in the near future 5G wireless services will pave the way for smarter services.

Even in the United States, Black & Veatch survey respondents indicate the primary investment required is in high speed networks, followed by smart transportation, water and electric grid and energy management systems.

Connectivity is the critical base infrastructure needed to advance a smart Africa, and there is no time like the present. Terrestrial fiber optic cable projects in Africa are gaining momentum. This is a first step in the journey to smart integrated infrastructure (SII) for the continent, which combines the utilitarian with the urban.

Lead examples of cognizance of smart cities and utilities are Johannesburg and Cape Town in South Africa, with Durban not far behind. The country’s National Development Plan has identified all the components of a smart city as key developmental points for creating a globally competitive location.

In South Africa’s biggest urban center, Johannesburg, the need for this approach is increasingly obvious – transport, water and power usage and metering, and enhanced telecommunications and connectivity all require more efficient management. In his 2015 State of the City address, Johannesburg Executive Mayor Parks Tau outlined his plans to turn Johannesburg into a smart city.
These include establishing Wi-Fi for the entire Braamfontein node, high-speed broadband access for the area, upgraded CCTV cameras, systems which allow residents to feed any surplus energy back into the grid, and the introduction of smart meters for electricity that can be remotely controlled. In tandem, Johannesburg is set on implementation of smart utilities in a phased approach, as part of its Growth and Development Strategy by 2040.

The City of Cape Town launched the Smart Cape project more than a decade ago, with the goal of ensuring that all residents have free access to basic information and communication technologies. The city will spend R185 million in 2015/16, with additional Western Cape Government funding of R11.8 million for broadband infrastructure and R23.7 million for the Digital Inclusion Project (Wi-Fi). It will also boost 300 Wi-Fi access points by the end of 2016 in an effort to unlock the power of digital economy, infrastructure, government and inclusion.

The advances in South Africa are supported by the increased roll out of fiber optic infrastructure for high speed broadband, the base on which smart cities and utilities will be built.

Such infrastructure allows for the implementation of digital monitoring and advanced metering infrastructure to help South Africa – and other African cities – monitor and detect water leaks and enable customers to manage their power consumption.

As with all advances, demands need to be balanced with the economic resources to fund these costly systems – and change is not simple. It requires integrated thinking and implementation, political will and a tipping point when the public demands tomorrow’s technology today.
For decades, utility operators, city planners, technologists and more have looked towards a future of complex, intuitive infrastructure networks and near-complete resource efficiency. As envisioned, these networks would provide optimal living conditions for increasingly urban communities, fostering new heights of economic prosperity, development and sustainability. While these smart cities of the future remain on the horizon, the 2016 Black & Veatch Strategic Directions: Smart City/Smart Utility report demonstrates that tangible progress is being made across these fronts.

Momentum can be found in key stakeholders around the world leading the push for additional investments and innovation. In late 2015, hundreds of nations were represented at the Smart City Expo World Congress in Barcelona, Spain. Highlighting the increasing focus on smart city program advances, additional events in Austin, Washington D.C., London, Kuala Lumpur, New Delhi, Yokohama aim to foster innovation and share best practices. Leading technology companies like Cisco, IBM, Google, Amazon, GE, Siemens and more are deploying capital to build and expand “smart-focused” technologies and infrastructure. The smart city movement has become a truly global phenomenon.

It remains, however, a legitimate criticism that a standard definition of “smart city” and more specifically, the role that “smart utilities” will play in enabling their development, has not been agreed upon. Still, common themes such as increased sustainability, resilience and improved quality of life have been identified as core elements of smart cities. Building upon these themes and applying master-planning approaches to smart city development will be critical to achieving community goals.

As we look toward these communities of the future, utilities will be central to achieving greater integration of smart city efforts. Greater demand for reliability, reduced or net-zero emission operations and the deployment of advanced technologies to improve efficiency are emerging as goals for municipalities, residential, commercial and industrial consumers alike.

Utilities’ history of innovation and the use of technology to improve operations can provide great insight for municipal leaders. Further, their success with long-term conservation efforts, preparation for the impacts of climate change and steps taken to manage aging workforces and evolving resource needs can serve as primary research for reshaping how city departments operate and communicate.
Just as cities will change, utilities face many of the same hurdles. In their efforts to transform while performing, many are seeking to transition to knowledge-based business models leveraging automation, cloud technology and data analytics. While physical assets will always be required to manage service territories and execute projects, preserving knowledge, automating business processes and embracing data-driven decision making are key mileposts on the journey towards Utility 2.0.

The role of the customer continues to evolve as well. Their demand for products and services that reflect environmental and sustainability beliefs is another catalyst for utility engagement in smart programs. From this perspective, industry is increasingly a target customer and potential challenge for utility service providers. In the United States, microgrids harnessing wind, solar, geothermal, battery storage and localized natural gas resources are being explored by manufacturers and property owners seeking to go “off-grid” or differentiate their commercial properties and capabilities.

Increasingly complex sourcing needs are creating challenges for water-reliant industries from beverage companies to the mining, oil & gas and pharmaceutical sectors. Aggressive efforts to launch self-driving cars, reflected in Tesla CEO Elon Musk’s prediction of an automated vehicle that can drive cross country in 2018, will stretch the capabilities of current communications technologies.

As municipal and utility leaders contemplate the steps necessary to build smarter cities, they should consider progress already made, as technology that drives municipal infrastructure is becoming more common. Fundamental investments in improved telecom networks, traffic management, and advanced metering infrastructure (AMI) of core services represent the first wave of smart city programs. Ironically, these critical programs do not receive the same headline-grabbing attention as data analytics and customer-experience technologies. It is surprising that we don’t see more leaders recognizing that these efforts are in fact “smart” and should be valued as such. Transitioning from a mindset that smart programs are “add-ons” to budget items misses the reality that smart investments should be a component of every budget item.

This transition means it will be important to change certain mindsets concerning “smart” investments. Traditional planning methods are very linear. Components are separate and not integrated. Evaluating risks and benefits can be challenging to identify and models cannot address multiple goal sets at the same time.

Fortunately, leaders are embracing the movement toward planning and road mapping as part of an evolution beyond the pilot program stage. Informing the planning process at the broadest level, then applying data analytics to help determine where an organization should move forward creates a more adaptable and comprehensive process. Data collected by one department can be used to educate, inform and improve the operations of other departments within the same organization and foster greater integration.

The question is not if, but when and how well smart programs will work. What is happening today, and needs to continue, is the development of a better understanding of what the key smart program pieces are and how they come together. This will require cities and utilities to stand closely together to reach their respective goals.
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