
Electricity
Canada
Our energy future
2025 Technology
Trends Report

Contents

Preface: Letter from the Chairs

Electricity Canada's Technology Committee is pleased to present its *2025 Technology Trends Report.*

Our energy future calls for a utility shift from traditional, ego-centric operations to responsive, circular energy models. As government regulations and customer expectations rapidly evolve, Canadian utilities are adapting their operations and technology strategies. Electricity Canada's Technology Committee members are acutely aware of the need for digital technology investments to support our energy future. To succeed, they must work closely with utility CEOs and business area leaders to align digital technology investment strategies with overall utility business objectives. Most importantly, there is a shared focus on driving measurable business outcomes. Within this context, the Technology Committee has drafted this report on key technology trends reshaping our industry.

The *2025 Technology Trends Report* explores the following issues:

- **Aligning AI with business outcomes** and integrating AI into corporate strategy
- **Cloud-enabling business innovation** by being Cloud Smart
- **IT/OT convergence** and a more pragmatic approach to gaining alignment and measurable value
- **Data culture** is a critical enabler for digitalization and intelligent operations
- **Technology drives outcomes in electrification** by enhancing grid readiness

The reader will note that while cybersecurity is not identified as a trend, it is a common theme across all five identified issues. This report also goes beyond describing these five technological trends by including a call to actionfor each. The intent is to share lessons learned and ideas to help accelerate the path to value for Electricity Canada members.

Finally, the report includes a section on **Technology risk management**. This section acknowledges that the increased focus on technological investment also has inherent risks that must be managed and mitigated. We have identified the issues and opportunities and called for action to reduce these risks.

Electricity Canada appreciates all the volunteer hours and expertise invested by member representatives in pulling together this report. The opportunity to share and learn from each other has been a driving force for the Technology Committee. Our members have learned that they are not alone in dealing with the pressures and challenges of the national shift towards electrification and the 4Ds (decarbonization, decentralization, digitalization and democratization). We hope this sharing of experience will impact all Electricity Canada members.

Ian Fish
Chair, Technology Committee, Vice President Information Technology, Manitoba Hydro

Humie Woo
Vice-Chair, Technology Committee, Vice President Information Technology, Toronto Hydro

Jennifer Pederson
Vice-Chair, Technology Committee, Director of Business Solutions, SaskPower

About Electricity Canada

Founded in 1891, Electricity Canada is the national forum and voice of Canada's evolving and innovative electricity business. Through its advocacy efforts, the association supports the regional, national, and international success of its members.

Electricity Canada members generate, transmit, and distribute electrical energy to industrial, commercial, residential, and institutional customers across Canada. Members include integrated electric utilities, independent power producers, transmission and distribution companies, power marketers, manufacturers, and suppliers of materials, technology, and services.

Electricity Canada is the national voice for sustainable electricity for its members and the customers they serve as the country works towards a Net Zero by 2050 future.

Acknowledgments

Electricity Canada recognizes the significant contributions of others in the preparation of the *2025 Technology Trends Report*.

A special thanks to all contributing authors and committee leaders: Ian Fish, Vice President of Digital Technology of Manitoba Hydro; Humie Woo, Vice President of Information Technology of Toronto Hydro; Jennifer Pederson, Director of Business Solutions of SaskPower, and the Electricity Canada Technology Committee members, for their efforts in developing this report.

Introduction

The role of technology in electricity companies remains critical as the electricity industry continues to undergo transformative change.

The level of investment required in information technology is beyond what electricity providers have historically seen. The necessary level of investment is driven by the need to replace aging infrastructure and applications, address new capabilities to meet business needs and continue to respond to evolving cybersecurity threats. Efforts to modernize electricity companies for the future have also resulted in a rapid increase in the number of devices that generate and transmit data. With the rapid growth in data created by the electric utility, as digitization efforts grow, efforts must be made to strengthen data management practices.

This report explores several critical emerging and technological trends that will impact electric utilities over the coming years.

It is wise to question the value of Artificial Intelligence (AI). With all its hype, it has yet to deliver substantive return on investment. Cloud services are a continuing trend that must not be ignored and continue to play a critical role in Internet Technology (IT) architecture. We expand the understanding and explore the disconnect between IT and Operational Technology (OT) convergence, an alignment of culture and technology that is truly needed for electricity providers of the future. We emphasize the need to strengthen data culture in a growing digital world and digitalized industry. Electrification is a key enabler to achieving global climate targets. However, electrification itself needs technological solutions to be implemented and managed. Cybersecurity is identified throughout these technological trends as a critical risk that must be addressed and managed, among others that must be considered to establish the future electricity company.

Aligning AI with business outcomes

Aligning AI with business outcomes

Authors:

- Alex Foord, Chief Information Officer, *Independent Electricity System Operator*
- Tony Rizzuti, Chief Information Officer, *ENMAX Corporation*
- Fan Pfifer, Director, Strategy, Architecture and Governance, *ENMAX Corporation*

Artificial Intelligence (AI) has emerged as a powerful driver of innovation and efficiency in the modern business landscape. Organizations across all industries invest heavily in AI technologies, hoping to leverage their potential to enhance productivity, optimize operations, and create new business opportunities. Utility companies have a history of implementing Artificial Intelligence and Machine Learning (AI/ML) models to improve business and operations, which has increased with recent technology advancements and AI 'hype'. Despite these investments, many companies struggle to align AI initiatives with core business objectives, leading to a disconnect between the cost of AI implementations and the business value achieved.

This section explores how organizations can better align AI with business outcomes to unlock new opportunities and successfully integrate AI into corporate strategy.

Opportunities

AI offers a myriad of opportunities for businesses to drive growth and competitive advantage – critical areas for value creation include:

- **Process automation:** AI can automate routine tasks and processes, freeing up human resources for more strategic activities. For instance, AI-driven automation in customer service chatbots to resolve customer inquiries with real-time data for seamless and efficient responses.
- **Data-driven decision-making:** AI algorithms can analyze vast amounts of data quickly and accurately, such as asset inspections for performance management, uncovering insights that were previously hidden or too complex for humans to discern. This capability enables businesses to make more informed decisions, identify new market opportunities, and predict trends and behaviour more accurately.
- **Enhanced security:** In cybersecurity, AI can detect anomalies and potential threats faster than traditional methods, providing businesses with the tools to protect sensitive data and maintain customer trust.
- **Innovation and new business models:** AI enables the creation of new products, services, and business models. From AI-driven healthcare diagnostics to autonomous vehicles and financial trading algorithms, AI opens new avenues for previously unattainable innovation.

AI and ML models can potentially influence the mid-and long-term energy planning process and manage security limits within the power grid. These are just four of many use cases where an investment in AI can provide value to the business and contribute to achieving business outcomes.

Utilities offer various services and products, including regulated wire service, power generation, and energy retail. The industry's strategic vision for AI encompasses the safe and responsible adoption of AI solutions to meet business objectives, including enhancing customer experience and driving operational efficiencies.

Several AI pilot programs have been implemented or are being assessed to demonstrate the transformative potential of Generative AI (GenAI) and other AI capabilities within utility services. For instance, implementing a GenAI chatbot aids customer service agents by providing efficient knowledge search capabilities to enhance customer service interactions. Additionally, machine learning algorithms are being applied to optimize asset lifecycle and system operations to protect the reliability and efficiency of operations. Other pilot programs include AI model development in market demand and pricing forecasts to enable proactive decision-making, optimizing resource allocation and market strategy. Furthermore, personal AI assistants such as Microsoft M365 Copilot are an added application that may foster staff development, unlocking the value of business procedures.

Although AI pilot programs prove technologically feasible, the realization of timely and practical business value is still under consideration by many before full-scale implementation. The applicability of AI reflects the industry's ongoing effort to balance risk with reward.

Challenges and considerations

According to the Gartner Hype Cycle for AI, Gen AI has passed the “peak of inflated expectations” and, in most cases, has yet to deliver on the anticipated business value. The suggestion is that more business value will be derived from other AI techniques.

Several industry trends that highlight this disconnect:

- **High costs vs. realized value:** Many organizations have invested substantially in AI technologies without seeing a corresponding return on investment (ROI). The costs associated with developing, deploying, and maintaining AI systems often outweigh the realized business benefits. This gap is primarily due to a lack of precise alignment between AI initiatives and business goals.
- **Overhyped expectations:** AI hype often leads to unrealistic expectations among business leaders. AI is frequently seen as a silver bullet that can solve all business problems. Organizations can become disillusioned with the technology without clearly understanding its limitations.
- **Integration challenges:** Many businesses struggle with integrating AI technologies into their existing systems and processes. Legacy systems, data silos, user adoption (change management), and incompatible infrastructures make it difficult to achieve seamless integration, limiting the effectiveness of AI initiatives.

Call to action

To bridge the gap between AI investments and business outcomes, utilities should consider the following recommendations:

- **Develop a clear AI strategy aligned with business goals:** Utilities should start by defining a strategic vision for AI adoption that balances risk appetite, investment cadence, and meaningful business outcomes. The AI strategy will be best enabled by a well-defined technology roadmap that leverages industry-proven AI solutions to improve speed-of-value creation and optimize investments.
- **Invest in talent and skills development:** To effectively leverage AI, utilities must invest in developing AI talent and upskilling their existing workforce. This investment will ensure the necessary skills are in place to manage and maintain AI systems to drive better results and ROI. The retained AI skills can also help facilitate organizational and change management required in digital transformation programs.
- **Focus on scalable and sustainable AI solutions:** Rather than pursuing numerous AI projects with similar business capabilities simultaneously, utilities should focus on scalable and sustainable AI solutions that can be deployed across the organization, such as standardized ML and data input capabilities. This approach will enable businesses to realize economies of scale and maximize the impact of their AI investments. Each proposed scenario should be able to stand on its merit concerning investment and business value.
- **Monitor and measure AI performance regularly:** Utilities should establish objectives and key results to measure the impact of AI initiatives on business outcomes. Regular monitoring and evaluation will help identify areas for improvement and ensure that AI projects remain aligned with business objectives.
- **Implementing an AI adoption governance framework:** A governance framework should oversee AI policy compliance, adhere to regulatory and legal requirements, and maximize benefit realization. Additionally, the framework must support organizational change management, ensuring that AI initiatives are aligned with the organization's strategic objectives and ethical standards. Organizations can mitigate risks, enhance transparency, and foster trust in AI systems by establishing a robust governance framework.

Conclusion

The promise of AI in driving business growth and transformation is undeniable and is increasingly achievable with thought leadership. To unlock AI's full potential, utilities must align their AI initiatives with strategic business outcomes. This requires a clear understanding of AI's opportunities, a realistic assessment of current industry trends, and a commitment to building the necessary infrastructure, skills, and governance frameworks.

By considering the recommendations outlined in this section, organizations can bridge the gap between AI investments and realized business value, ensuring that AI becomes a strategic enabler of success in the digital age.

Cloud enables business innovation

Cloud enables business innovation

Authors:

- Andrea Le Pard, Director, Digital, *Manitoba Hydro*
- Geoff Moore, Vice President, Technology, *Nova Scotia Power*

Utility companies face many technology opportunities, such as increasing demand for technology and data, aging infrastructure, cybersecurity threats, and growing customer and employee digital expectations. In many cases, and particularly for enabling innovation, traditional Information Technology (IT) systems and architectures typically do not support these needs as they are often costly, complex, rigid, and vulnerable to disruptions. Innovation is often a fast-paced environment with a try-and-learn mentality, and many traditional systems do not offer this type of flexibility.

Utility companies adopt and implement emerging technology slower than other industries due to lower technology investments and higher cybersecurity concerns. Some catching up is required. Utility companies must continue to embrace digital transformation and leverage the power of cloud computing where it makes sense. They should also drive their organizations forward with data and nimble technology to support innovation and meet customer, financial, and business needs.

Cloud computing is the delivery of computing capabilities over the internet, and it can be classified into three main service models, which differ in the level of control and responsibility that they offer to the users and providers of cloud services:

Service model	Description	Example
Software as a Service (SaaS)	This model uses software applications hosted and managed by a cloud provider, meaning there is no need to manage underlying infrastructure, platforms, or software updates internally; the provider handles these.	Gmail, LinkedIn, Miro, etc.
Platform as a Service (PaaS)	This option offers more responsibility and control over the software. Users can configure, develop, deploy, and run software applications using the tools and frameworks provided by the cloud provider. They do not need to manage the infrastructure (servers, storage, or networks).	Microsoft 365, SAP Cloud, Salesforce, etc.
Infrastructure as a Service (IaaS)	This is the most flexible model, in which the user can provision and use computing infrastructure resources such as servers, storage, or networks from the cloud provider. The user has complete control and responsibility over the infrastructure, including the operating system, middleware, and software applications. This model requires internal resources to manage it entirely.	Amazon Web Services, Microsoft Azure, and Google Cloud Platform.

While not required, cloud technology typically offers faster, easier, and more cost-effective innovation and experimentation than traditional IT systems. This is because cloud tools and platforms are generally designed to enable technology and data solutions to be trialled without making significant investments. Utility companies can be more flexible in facilitating innovation if they move forward with cloud-based solutions. Some examples of cloud-enabled innovation include:

- SaaS cloud software, such as a digital whiteboarding tool, allows employees to creatively generate sticky note walls, process flows, and group buckets of content together, such as sticky notes or blocks of text. Colleagues can be provided access to the same whiteboard to enable peer-to-peer collaboration.
- PaaS cloud platforms allow users to configure the platform to meet their specific needs while providing 'do it yourself' (DIY) tools, also called citizen development, for creating new apps, dashboards, automation, and websites. It is no longer the case that only trained IT staff can write code to develop and enhance tools, as modern user interfaces make it simple for lightly trained staff to participate.
- IaaS cloud platforms are the powerhouse of modern IT, bringing the infrastructure components out of a utility-controlled data centre and into the cloud. An example is exposing data in modern data lakes and data warehouses alongside high-powered data analytics tools to unleash powerful analytics and AI processes.

Call to action

Utility companies' opportunities to utilize modern cloud-based technology tools and data to innovate and drive business value are limited by imagination, capacity, and licensing.

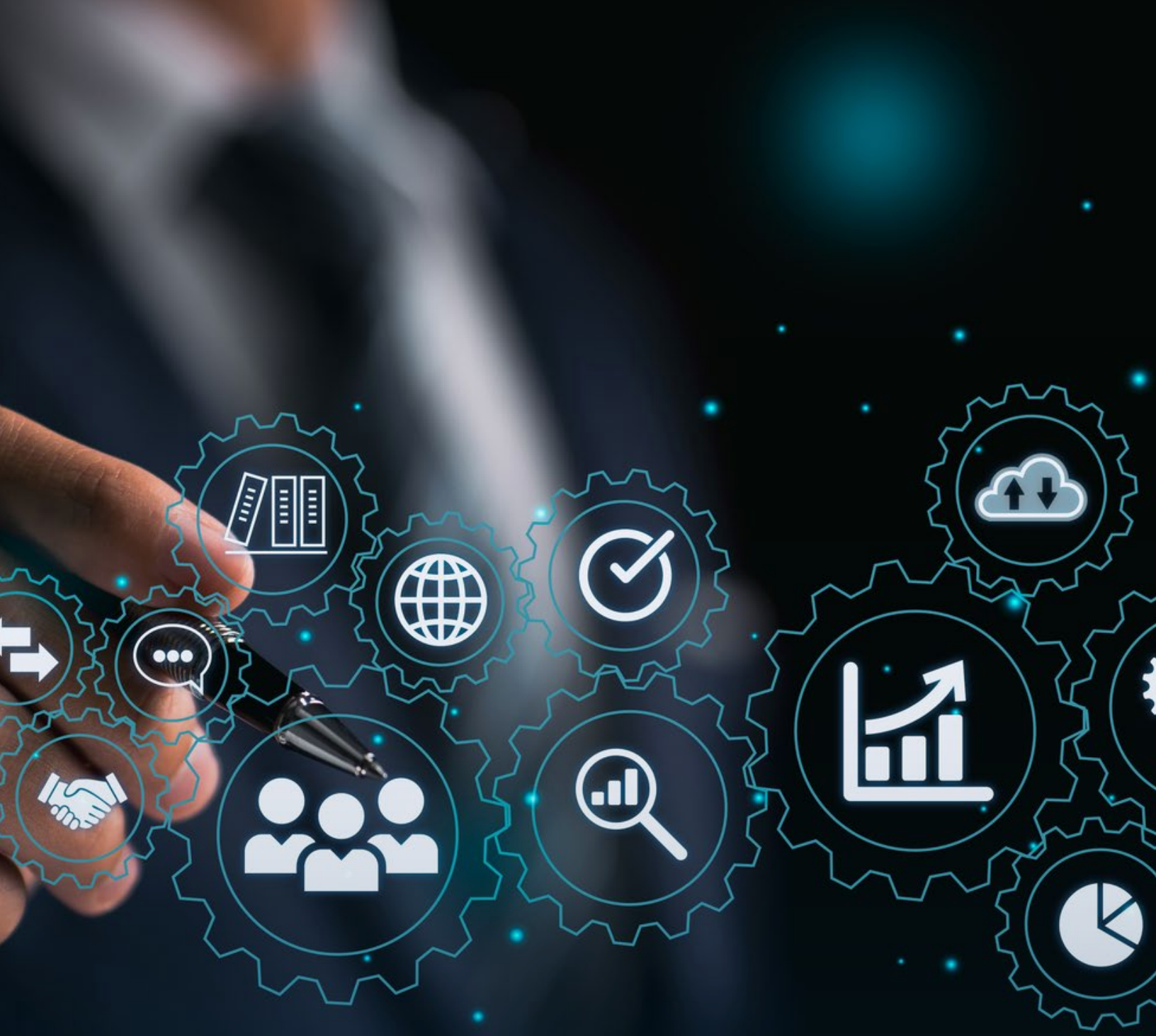
With technology change comes the need to think holistically about the entire IT ecosystem. The key to enabling technology innovation is designing an IT service management organization structure with roles directly responsible for interfacing with the business to identify innovation opportunities, foster a test-and-learn culture, and manage the trialling of innovation while at the same time supporting users across the utility to innovate in a DIY fashion. While traditional IT roles are required to support the overall systems, there is a need for more business-facing staff who can explore, discover, and innovate using an Agile Product Management Methodology. For most utilities and other industries, this approach is relatively new and will take effort to build the organization and the culture to be successful.

Additionally, with cloud technologies, internal IT staff generally do not control the services. This means that all changes, outages, and introduction of bugs released by the cloud provider are passed along to the user. Changes pushed directly from the cloud provider can lead to necessary changes in how users adopt and interact with the tools, which again emphasizes the need for more business-facing enablement and support. Issue resolution is typically also at the hands of the cloud provider, meaning IT staff would only be in control of overseeing the vendor's attention to the problem and providing internal corporate communications but not the technical fixes.

Finally, since cloud services are procured and managed differently, IT teams need to understand their contracts with cloud service providers and hold their providers accountable. Also, in many cases, cloud procurement results in the costs moving from capital expenditure to operational expenditure, which IT and accounting teams need to be prepared for.

Conclusion

Five years ago, the cloud was considered a no-go for Canada's utility companies, primarily due to the desire to keep a strict firewall between "inside" and "outside." Today, utilizing cloud services has become, in many cases, mandatory. The choices come down to private or public cloud, which vendor to trust, what services should be available in the cloud, and when. Being cloud-smart, utility companies can capitalize on the opportunities cloud services provide for innovation and agility while protecting the very heart of our companies: the energy grid.



Why IT/OT convergence has struggled and understanding the path to alignment

Why IT/OT convergence has struggled and understanding the path to alignment

Authors:

- Tony Rizzuti, Chief Information Officer, *ENMAX Corporation*
- Dallas West, Director, Engineering and Plant Operations, *ENMAX Corporation*
- Dawn, Nedohin-Macek, Director, Cyber Security and Enterprise Architecture, *Manitoba Hydro*

The convergence of Information Technology (IT) and Operational Technology (OT) has been touted as a critical driver of industrial innovation. The idea is compelling: by merging IT systems and processes with OT, organizations could achieve efficiency, enhanced decision-making, and streamlined operations across sectors such as manufacturing, utilities, and critical infrastructure. However, IT/OT convergence has largely failed to deliver the anticipated benefits. To understand why, it's essential to define what IT and OT are, explore the reasons for their divergence, and discuss a more pragmatic approach to IT/OT alignment.

Defining IT and OT: More than just acronyms

At their core, IT and OT serve distinct functions within an organization.

- **Information Technology (IT)** focuses on managing data through systems such as hardware, software, and networks. IT is responsible for data processing, storage, and transmission, supporting various business operations like enterprise resource planning, customer relationship management, and cybersecurity. The emphasis in IT is on data integrity, reliability, and security. This system can be thought of in terms of business and operational functions, including data analysis, predictive modelling, input into design, customer interaction, finance and HR systems.
- **Operational Technology (OT)** involves the systems that monitor and control physical devices, processes, and events within an enterprise. OT is crucial in sectors like energy and transportation, utilizing systems such as SCADA (Supervisory Control and Data Acquisition), PLCs (Programmable Logic Controllers), and DCS (Distributed Control Systems). OT systems prioritize availability, reliability, and safety, often controlling critical infrastructure where failures can lead to significant consequences. These systems can be thought of as controlling energy assets, including control and protection, data collection and aggregation.

Challenges and considerations

IT/OT convergence aims to integrate these distinct domains, but several challenges have made this difficult.

1. **Cultural differences**: IT and OT teams often have different priorities and mindsets. IT professionals focus on data management, software development, and cybersecurity,

while OT professionals prioritize machine performance, process control, and safety. This difference can lead to misunderstandings and conflicts. For example, IT might push for frequent software updates for security reasons, while OT may resist such changes due to the potential for disrupting critical operations. OT technicians and technologists often come from a field-related education such as engineering technology, whereas IT employees are typically university or college graduates from programming or engineering backgrounds.

2. **Technological disparities**: IT systems are designed for flexibility and rapid deployment with frequent updates, whereas OT systems are built for stability and longer life cycles. OT systems are often integrated closely with the hardware they are connected to, as they are so asset focused. Integrating these systems can be technically challenging, especially when ensuring that IT systems do not compromise OT systems' reliability and real-time performance.
3. **Security concerns**: IT systems are typically well-secured against cyberthreats. However, many OT systems were designed before cybersecurity was a significant concern and relied on zoning and segmentation to keep systems disconnected from the internet. Connecting OT systems to IT networks can expose them to cyberthreats they are not equipped to handle, leading to new vulnerabilities and increased attack surfaces.
4. **Regulatory and compliance issues**: IT and OT operate under different regulatory frameworks. Information technology is governed by data protection and privacy laws. At the same time, OT, especially in industries like energy and transportation, is subject to provincial and federal regulations such as the Canada Energy Regulator and North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection (CIP) standards. Aligning these regulatory requirements adds another layer of complexity to IT/OT convergence, including reluctance to apply the same extensive regulatory requirements to all assets required for NERC medium or high impact systems.

Call to action

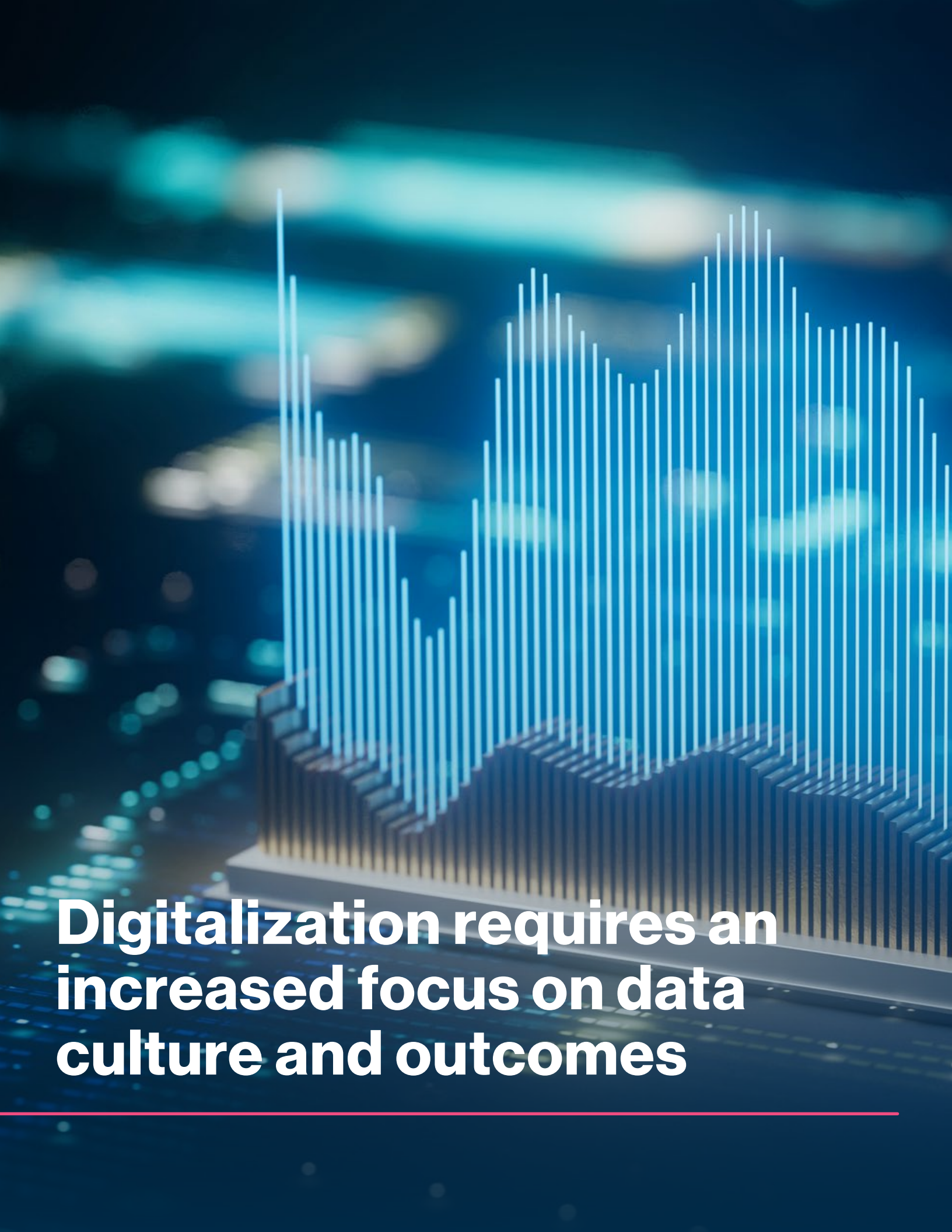
Given these challenges, a more pragmatic approach is IT/OT alignment rather than full convergence. Alignment respects the distinct roles of IT and OT while fostering collaboration and integration where it makes sense.

1. **Promote cross-disciplinary collaboration**: Alignment begins with understanding. Regular communication and collaboration between IT and OT teams are crucial. Cross-training can help each team understand the other's priorities, constraints, and objectives. Establishing cross-functional teams for specific projects can foster collaboration, ensuring that IT and OT perspectives are considered in decision-making.
2. **Pursue incremental integration where appropriate**: Rather than merging IT and OT systems entirely, organizations should identify areas where integration offers clear benefits without compromising the integrity of either domain. Starting with small, targeted projects—such as integrating data and analytics tools to improve operational efficiency—can demonstrate the value of alignment and build confidence for future initiatives.

3. **Enhance security measures across both domains**: Security is a critical concern in IT/OT alignment. Organizations must adopt cybersecurity strategies and governance that address the unique vulnerabilities of OT systems while maintaining the robust protections of IT. This might involve deploying specialized security solutions, conducting joint IT/OT risk assessments and drills, and implementing strict access controls to safeguard digital and physical assets.
4. **Ensure regulatory compliance**: Alignment must also consider the regulatory requirements governing IT and OT. Organizations should harmonize their IT and OT practices with relevant regulations, ensuring that alignment efforts do not introduce compliance risks. Harmonizing tactics may involve consulting with regulatory bodies, conducting regular compliance audits, and developing governance and policies that bridge the gap between IT's data-centric regulations and OT's safety-focused standards.
5. **Leverage technology to facilitate alignment**: Technology is pivotal in aligning IT and OT. Tools that enable data sharing between IT and OT systems while respecting the unique needs of each can help bridge the gap. For example, deploying middleware solutions that translate data between IT and OT systems without disrupting operations can facilitate smoother alignment. Additionally, adopting unified security platforms for enumerating, monitoring, and managing IT and OT assets can improve visibility and coordination across the organization.
6. **Focus on shared objectives**: Alignment is best achieved when IT and OT teams work towards shared organizational goals. Establishing clear, common objectives—such as increasing cybersecurity maturity, improving operational efficiency, reducing downtime, or enhancing customer satisfaction—can help both teams see the value in alignment. Regularly reviewing progress towards these goals and celebrating joint successes can further reinforce the importance of IT/OT alignment.
7. **Align governance:** The complexity of the technical ecosystem and the evolving needs within Utilities suggest that a consistent approach to governing decisions surrounding investments and changes affecting information and/or technology solutions can ensure more effective risk management and drive value from the data and technology investments supporting core operations.

Conclusion

While IT/OT convergence has proven challenging, shifting towards alignment offers a more viable path forward. By fostering collaboration, pursuing targeted integration, enhancing cybersecurity, ensuring regulatory compliance, leveraging technology, and focusing on shared objectives and governance, organizations can achieve successful IT/OT alignment. This approach respects the unique strengths of both domains while unlocking new opportunities for operational efficiency and innovation, positioning organizations to better navigate the challenges and opportunities of the digital age.



Digitalization requires an increased focus on data culture and outcomes

Digitalization requires an increased focus on data culture and outcomes

Authors:

- Alex Foord, CIO, *Independent Electricity System Operator*
- Julia Zhu, Executive Vice President, Chief Digital & Innovation Officer, *Alectra Utilities*

Integrating digital technologies is transforming how utilities operate, manage resources, and serve customers. While digitalization offers numerous benefits, its success hinges on a critical factor: data culture. Without a robust data culture, the full potential of digital transformation cannot be realized. This section explores the importance of data culture in the utility industry and how focusing on data-driven outcomes can unlock new opportunities and drive meaningful change.

What is digitalization?

According to Gartner, digitalization refers to using digital technologies to change a business model and provide new revenue and value-producing opportunities – in essence, moving to a digital business. This involves integrating technologies like smart grids, advanced metering infrastructure (AMI), predictive maintenance systems, and data analytics platforms into day-to-day operations in the utility industry. These technologies enable utilities to collect, store, and analyze vast amounts of data, leading to more informed decision-making and improved operational efficiency.

The benefits of digitalization in the utility industry are vast. Smart grids, for example, provide real-time monitoring and control of the electrical grid, improving reliability and reducing the frequency and duration of outages. AMI allows for more accurate billing, real-time energy consumption tracking, and better demand forecasting, enhancing customer satisfaction. Predictive maintenance systems use data from sensors to monitor the health of critical infrastructure, helping to prevent costly equipment failures and extend the lifespan of assets.

However, successfully implementing these technologies requires more than just the adoption of digital tools—it requires a fundamental shift in how utilities view and use data. This is where data culture becomes essential.

What is data culture?

Data culture is the collective mindset and practices within an organization that prioritizes data as a strategic asset and integrates it into decision-making processes. In a strong data culture, data is collected and stored and actively used to drive insights, inform strategies, and achieve business objectives. Many organizations are data-rich but information-poor, meaning they have vast amounts of data but lack the practices or mindset to turn it into actionable insights.

A robust data culture ensures that data is accessible, accurate, and integrated across all levels of the organization. It empowers employees to make data-driven decisions and aligns digital initiatives with the utility's broader strategic goals. Without a data-centric mindset, the vast amounts of data generated by digital technologies may be underutilized, limiting the potential benefits of digitalization.

Opportunities

The benefits and opportunities are significant when organizations successfully combine digitalization with a strong data culture. Many industries are improving customer engagement by providing targeted outreach and personalized experiences. The healthcare industry, for example, uses patient data to offer customized treatment plans to improve patient outcomes. Utilities can apply this approach by analyzing AMI data to provide tailored energy-saving recommendations to enhance customer satisfaction.

A data-driven approach allows for enhanced grid management through real-time data analytics, leading to better load balancing, reduced outages, and optimized energy distribution. Predictive maintenance enabled by data analytics helps prevent equipment failures, reduce maintenance costs, and improve service reliability.

Digitalization also opens opportunities for innovation. Utilities can explore new business models, such as demand response programs, which incentivize customers to reduce energy consumption during peak times. Data-driven insights also enable utilities to better integrate renewable energy sources, improving the stability and sustainability of the grid. Utilities can enhance their decision-making capabilities, improve operational efficiency, and drive customer satisfaction by better-leveraging data.

Challenges and considerations

Despite the clear benefits, utilities must address several challenges and considerations when implementing a data-driven digitalization strategy. One of the primary challenges is overcoming resistance to change. Employees accustomed to traditional decision-making processes may hesitate to adopt processes with tasks determined by data-driven analysis. Effective change management strategies, including clear communication, developing data literacy within the organization, employee support, and showcasing benefits, are essential to overcoming this resistance and ensuring a smooth transition.

Data quality and integrity are also critical challenges. Utilities often deal with large volumes of data from diverse sources, including legacy systems. Inaccurate or inconsistent data can lead to flawed analysis and poor decision-making, undermining the effectiveness of digitalization efforts. Utilities must implement robust data governance frameworks that include data validation processes and regular data quality audits. Identifying the appropriate business stewards for the different data sets and reinforcing enterprise-wide responsibility for proper data governance is also essential to ensuring organizational commitment to data management.

Call to action

To fully capitalize on the opportunities presented by digitalization, utilities must prioritize the development of a strong data culture. This requires strong leadership commitment, investment in data literacy and training, determination of data stewardship, an enterprise-wide responsibility for proper data governance, and the establishment of robust data governance frameworks. Utilities should align data initiatives with their strategic objectives and continuously measure progress to ensure that data-driven initiatives deliver meaningful outcomes.

Utility companies can establish a "data office" to better support their organizations. This central team can utilize a federated model that balances control and freedom to drive data initiatives while continuing to enhance the company's overall data maturity.

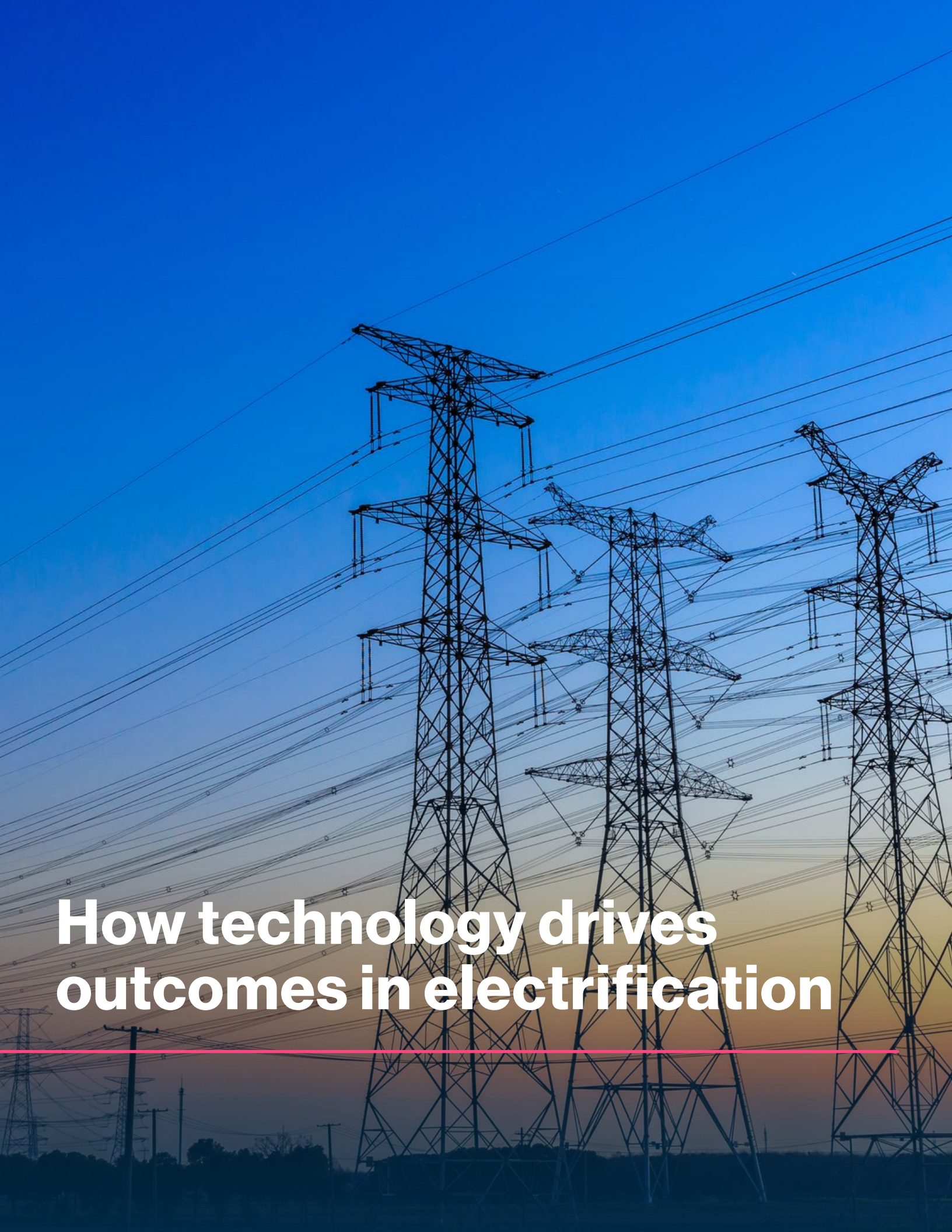
Establishing a centralized data function that stewards the data governance framework (policy and processes) and provides guidance and expertise to the organization's data stewards. Implementing a data catalogue to digitalize the governance framework and continued training on data and data visualization will enhance data management throughout the organization.

By embracing data culture, utilities can unlock the full potential of digitalization, driving operational efficiency and enhancing customer satisfaction.

Conclusion

Digitalization offers the utility industry a unique opportunity to transform operations and achieve new levels of efficiency, reliability, and sustainability. However, the success of digital transformation depends on more than just technology adoption—it requires a strong focus on data culture and outcomes. By cultivating a data-driven culture, utilities can ensure the success of their digital initiatives.

As the utility industry continues to evolve, organizations prioritizing data culture and outcomes will be better equipped to navigate the complexities of digital transformation and emerge as leaders in the new energy landscape.



How technology drives outcomes in electrification

How technology drives outcomes in electrification

Authors:

- Humie Woo, Vice President Information Technology, *Toronto Hydro*
- Julia Zhu, Executive Vice President, Chief Digital & Innovation Officer, *Alectra Utilities*

Distribution utilities face both challenges and opportunities as they transition to a more electrified future. While the utility's traditional role in delivering electricity, maintaining assets, and enabling new connections remains essential, the electrification landscape requires a new focus on grid modernization, cybersecurity, and advanced technologies such as data analytics and AI.

The rapid evolution of electrified and digital technologies is reshaping customer expectations, compelling utilities to adapt quickly and intelligently. Innovation in distributed energy-consuming and producing technologies, such as electric vehicles (EVs), solar panels, heat pumps, and behind-the-meter battery storage systems, are driving widespread adoption by consumers and third-party energy service providers. Utilities must lead the way in enabling these progressive customer experiences and harnessing the energy resources connected to the grid. Utilities must focus on enhancing grid readiness by investing in smarter grid technologies and controls, such as Distributed Energy Resource Management Systems (DERMS) and advanced demand-side management technologies, to stay ahead of the mass proliferation of new technologies. These technologies help manage energy more efficiently. They can ffacilitate a smoother transition to new operational frameworks like the Distribution System Operator (DSO) model and enable adaptive control. It is also crucial for the utility to become data-centric to ensure the grid's readiness, resiliency and reliability.

Data-centric utility and cyber safety

The "Internet of Things" (IoT) gives utilities ever-increasing access to rich, real-time data. By collecting and analyzing large volumes of real-time data, utilities have the potential to optimize operations with insight from that data. Utilities will be able to be more data-centric with more data-driven operations and customer decision-making.

Furthermore, managing the grid efficiently in an electrified world requires more than just adding capacity — it demands smarter, more innovative approaches. Technologies like AI, machine learning (ML) and grid-edge solutions can enable utilities to better balance supply and demand, especially with the increasing integration of distributed energy resources (DERs) like electric vehicles and solar panels. AI and data analytics can allow utilities to predict energy demand, detect potential issues and optimize grid performance in real-time. With these tools, utilities can make decisions faster, anticipate fluctuations, and adjust energy flows more precisely. These innovations make the grid more resilient, flexible and efficient, allowing utilities to manage the growing complexity of electrification while improving reliability and sustainability.

As utilities embark on this electrification journey, they must prioritize cybersecurity as the increasing digitalization of the grid introduces new vulnerabilities. With real-time data flow and the integration of DERs, cyberthreats become more pronounced. Maintaining a robust cybersecurity posture is crucial to protect the digital safety of our grid and customers.

Grid modernization and integration

A vast network of interconnected grid devices enables utilities to enhance both grid flexibility and resilience. Sensors deployed at the grid edge provide real-time data, allowing for better control of distributed resources and quicker response to outages. Advancements in AMI offer even greater opportunities. Many utilities once relied on limited research meters and Supervisory Control and Data Acquisition (SCADA) data for distribution planning. AMI has revolutionized this process, providing a dynamic and flexible means to aggregate load shapes across diverse customer segments. The precise data AMI provides empowers utilities to better manage distribution voltages, troubleshoot power quality issues and assess switching scenarios with greater accuracy.[1]

The advancement of SCADA, AMI, and IoT sensors has significantly improved real-time visibility of the grid. Real-time data and intelligent devices such as SCADA switches and reclosers are driving the adoption of Fault Location Isolation and Service Restoration (FLISR) solutions. FLISR represents a significant leap in power outage management, enhancing utilities' ability to detect, isolate and restore service more efficiently. To effectively implement FLISR, utilities must ensure their systems are equipped with sufficient sectionalizing SCADA switches and feeders connected by multiple paths to substations, allowing for flexible power rerouting. An advanced distribution management system (ADMS) with advanced applications is a powerful tool that gives operators greater situational awareness and coordinates grid automation investments, such as automated switches and tap-changing equipment, AMIs, and even DERs via smart inverters.[2] ADMS plays a pivotal role in improving grid reliability and operational efficiency by integrating digitization, automation, and enhanced communication with field staff.

Enhancing customer experience with technology

As electrification continues, utilities must focus on more innovative, timelier and cost-effective ways to manage the grid and customer expectations rather than just building more capacity. Utilities are now able to actively influence the consumer transition by leveraging customer-centric technologies like Customer Experience (CX) platforms, Customer Relationship Management (CRM) systems and Customer Information Systems (CIS). These tools give customers real-time insights into their energy usage and streamline grid connections. These technologies can also enable managed EV charging programs to help customers charge during off-peak hours, reducing pressure on the grid and saving them money. These platforms are transforming what was once a complex process into a quick, user-friendly experience, aligning with the needs of today’s tech savvy customers. Utilities are also beginning to develop and

[1] U.S Department of Energy, Voices of Experience: Leveraging AMI Networks and Data, https://www.smartgrid.gov/files/documents/VOEAMI_2019.pdf

[2] Advanced Applications in an Advanced Distribution Management System, Ethan Boardman, Pg. 11

publish geospatial tools, such as hosting and loading capacity maps, which can provide customers with valuable insights into grid capacity, enabling smarter portfolio planning by distributed technology companies (e.g., electric vehicle charging station suppliers) and energy consumers.

Call to action

Strategic investments in emerging technologies are critical for utilities aiming to stay ahead in a rapidly evolving energy landscape. To drive electrification outcomes, utilities must prioritize investment in cybersecurity, advanced analytics, and AI. These investments, together with improvements to grid modernization and integration of IT and OT systems, will enable seamless data flow and enhanced efficiency and provide a comprehensive view of grid operations.

IT needs to partner with the business to drive enterprise outcomes through collaboration, champion innovation, and provide strategic direction to maximize technology utilization. Emphasizing agile and collaborative practices is essential, allowing for rapid prototyping, adaptability, and continuous improvement. Additionally, robust IT governance and compliance frameworks are crucial.

Conclusion

These frameworks ensure a strong security posture, encompassing cybersecurity and disaster recovery while providing leadership in data governance. By aligning IT and business strategies, utilities can effectively leverage existing and new technologies, ensuring a safe, resilient, and efficient grid in a rapidly changing environment.

Technology risk management summary

Technology risk management summary

Authors:

- Colin Penny, Chief Information Officer, *Liberty Utilities*
- Tony Folkins, Vice President Technology, *Emera*

The electric utility sector is undergoing significant transformation driven by technological advancements, climate change initiatives, regulatory changes, and evolving consumer expectations. These changes introduce technology risks that electric utilities must navigate to ensure reliability, security, and sustainability across the electric sector. Below are key trends, assessment considerations, and recommended actions to mitigate these risks.

Issues and opportunities

1. Increased cybersecurity threats

Cyberattacks, which can disrupt operations and compromise sensitive data, are increasingly targeting the electric utility sector. Ransomware attacks and phishing schemes are particularly prevalent. At the same time, the adoption of Internet of Things (IoT) devices and smart grid technologies expands the attack surface, making electrical grids and supporting technology systems more vulnerable.

2. Integration of renewable energy sources

The shift towards distributed renewable energy sources, such as solar and wind, presents both opportunities and challenges. The introduction of microgrids and decentralized energy systems demands new technologies for coordination and control. These systems can enhance resilience but also introduce complexity and security concerns.

3. Regulatory changes and compliance

Regulatory frameworks and government policies are evolving to support decarbonization and resilience. Utilities must be aware of the direction governments and regulators are heading and adapt to evolving compliance requirements while managing associated risks, particularly regarding data privacy and cybersecurity.

4. Data management and analytics

The proliferation of data from smart meters, sensors, and other digital technologies provides utilities with valuable insights. However, managing and securing this data is a significant challenge. Advanced analytics can transform decision-making and business processes and identify business opportunities, but it can also lead to risks if data integrity and security are compromised.

5. Aging infrastructure

Many utilities have aging infrastructure that is not equipped to handle modern technological demands. This can lead to increased vulnerability to failures and cyberthreats. Investment in upgrades is essential, but it must be balanced with cost considerations and regulatory scrutiny.

When considering the above risks and potential mitigation plans, there can be a tendency to overuse qualitative opinion-based assessments. Robust Enterprise Risk Management (ERM) capabilities take this into account with monitoring and control assessments and testing to signal the level of risk exposure in various areas of an organization. Risk metrics such as Key Risk Indicators (KRIs) allow utilities to monitor their risk exposure effectively and proactively mitigate potential issues.

Call to action

As the industry transforms, utilities must leverage technology to meet customer, policy, and stakeholder expectations. Utilities must have a plan for the following items:

1. Enhanced cybersecurity

Most utilities have implemented comprehensive cybersecurity frameworks. The The National Institute of Standards and Technology (NIST) cybersecurity framework provides an effective reference for benchmarking and monitoring. Those frameworks must continue to evolve and become part of the fabric of operating the business. As new technology is introduced, cybersecurity needs to be part of the planning, design, and implementation.

2. Invest in infrastructure modernization

Prioritize investments in upgrading aging infrastructure to enhance resilience, security, and organization agility. Investment planning capabilities must be expanded to include technology lifecycles, which are significantly different from generation, transmission and distribution assets.

3. Strengthen data governance and privacy protections

Develop robust enterprise data governance capabilities that ensure data integrity, security, and compliance with regulations such as the Personal Information Protection and Electronic Documents Act (PIPEDA) and proposed legislation such as the Artificial Intelligence and Data Act (AIDA).

4. Collaboration and knowledge sharing

Collaborate with industry peers, government agencies, and cybersecurity organizations to share best practices and threat intelligence. Evaluate current vendors against future value opportunities and ensure they align with your operational objectives. Participate in industry forums and working groups focused on emerging technology risks and solutions.

5. Adopt agile and flexible technologies

Invest in modern architecture that can adapt to the rapidly changing energy landscape, such as cloud computing and modular solutions that allow for scalable, integrated and secure technologies. Leverage self-serve analytics and artificial intelligence to optimize energy management and improve grid reliability.

6. Focus on workforce development

Invest in training programs to upskill employees in cybersecurity, data analytics, leadership and new technologies. A knowledgeable workforce is essential for effectively managing technology

risks. Foster a culture of curiosity and innovation within the workforce to encourage identifying and developing creative solutions to emerging challenges.

7. Prepare for regulatory changes

Stay informed about evolving regulations and actively participate in shaping policy discussions to ensure that the utility's interests are represented. Develop proactive rather than reactive compliance strategies to reduce the risk of non-compliance penalties.

8. Enhance customer engagement and communication

Educate customers about the benefits and risks associated with new technologies, fostering trust and transparency. Implement feedback mechanisms to understand customer needs and concerns regarding emerging technologies and cybersecurity.

The electric utility sector is at a pivotal point, with technological advancements offering both opportunities and risks. By proactively addressing technology risks through enhanced cybersecurity measures, infrastructure modernization, comprehensive risk management, and workforce development, utilities can position themselves for success in a rapidly evolving risk landscape.

Conclusion

The electric utility sector is undergoing a significant transformation driven by climate change, decarbonization, electrification, increasing customer expectations, and evolving regulatory requirements. This industry shift towards electrification offers utilities both opportunities and risks. Utilities must embrace digital transformation and technological advancements such as artificial intelligence, cloud computing, and data analytics. By fostering collaboration, integrating information technology and operational technology, enhancing cybersecurity, and leveraging technologies to align with strategic business outcomes, utilities can unlock the full potential of technologies to drive operational efficiency and customer satisfaction while ensuring a safe and resilient grid. At the same time, utilities must proactively address technology risks through enhanced cybersecurity, infrastructure modernization, data governance and compliance, and comprehensive risk management. Emphasizing agile and collaborative practices will be essential for innovation and continuous improvement.

Everything must be viewed holistically as a balanced operational system. The electricity industry must be approached with all parts taken into consideration. It is vital not to address one trend in a bubble for fear of ignoring another. Such an action could result in a faltering system. All the technology trends in this report are vital strategic considerations for electricity companies aiming to position themselves for success in the energy transition. The Electricity Canada Technology Committee recognizes that artificial intelligence, business innovation through cloud, IT/OT convergence, a focus on data culture, electrification technology platforms, and technology risk management will lead to successful technological changes and lay the foundation for the electricity company of the future.