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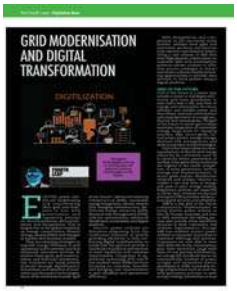

GRID MODERNISATION AND DIGITAL TRANSFORMATION

Disruptive technologies such as AI and big data will become common technologies in the future.

FOURTH LEAP

By Anthony S Rajamanickam

ELECTRIC power utilities are modernising and transforming their grid and business in line with government and regulatory policies on decarbonisation, decentralisation and deregulation. This is largely due to the global emphasis on energy conservation, climate change, sustainability and changes in market and business models.

They are adopting strategies to improve energy efficiency in grid operations and to provide new and enhanced customers services. To achieve these goals, grid modernisation and business transformation initiatives are being actively pursued through digitalisation, automation and adoption of innovative and disruptive technologies. Some of the initiatives include "grid of the future", advanced metering infrastructure (AMI), renewable energy integration, electric vehicle (EV) charging infrastructure, distributed energy resources (DER), demand-side management (DSM), volt/var optimisation, advanced distribution automation and digital platform.

Electric power utilities are therefore migrating from the traditional business of merely providing electricity to fully embracing digital transformation to modernise the grid and provide a multitude of products and services to meet regulatory and customer requirements. Integration of operational technology (OT) and IT has enabled value-added services focusing on customer benefits and bringing vast improvement in grid reliability and operational efficiency.

With deregulation and competition in the electricity retail market, utilities need agile and innovative products and services to be relevant and ahead of others. Using a vast volume of AMI data from digitalisation, information on customer bills and consumption patterns allows utilities to offer new service packages to attract and retain customer loyalty including opportunities to provide data services to third parties using a digital platform.

GRID OF THE FUTURE

Grid of the future is a vision that entails a smart or intelligent electricity grid from generation to end-users with a two-way flow of energy and information for clean, efficient and reliable power and that allows customer participation and empowerment in energy production and consumption. The grid of the future or smart grid enables seamless integration of renewable energy, large scale EV charging stations, AMI, micro-grids, virtual power plants, energy storage, demand-side management and other innovation and technologies.

Grid of the future allows increasing adoption of distributed energy resources by customers such as in Australia where penetration of rooftop solar generation is among the highest in the world. Integration of solar generation, battery storage and implementation of micro-grids require distribution network and market reforms to enable a two-way flow of energy and peer-to-peer energy trading. Regulatory policies are expected to allow open network access and pricing for DER providers while ensuring grid security and reliability.

AMI is a key grid of the future components implemented in many electric power utilities in the US, Europe, Australia and Asia to fully automate the billing process and provide other beneficial services to both customers and utilities. Digitalisation through AMI has enabled electric power utilities to empower and enhance customer offerings and services. Customers are now able to view their daily electricity consumption; plan their electricity usage with time-of-use pricing information; set energy bill threshold alerts; be automatically notified of power outages and restoration status; participate in DSM; renewable energy programmes such as roof-top solar generation and peer-to-peer energy trading. Information is now

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available to customers via mobile apps and web portal.

Integration of smart meter data with advanced distribution management system (ADMS) and geospatial information system (GIS) allows distribution network operators to automatically locate and identify power outages and carry out corrective actions for quick power restoration. Customers need not call utility call-centres to complain or enquire about power outages or obtain updates on power restoration status.

The benefits of AMI implementation in Malaysia was evident during the COVID-19 pandemic lock-down period when manual meter reading and bill rendering activities were halted for several months. While customers with conventional meters were given estimated bills for the lock-down period as the meters were not read, customers who installed smart meters, on the other hand, received actual bills on-time digitally through mobile apps and email. This is an example of the benefit of automation and digitalisation where business processes can continue normally in crisis situations such as that due to Covid-19 lockdown, thus potentially avoiding customer complaints on getting high bills when the process for actual bills resume.

Digitisation of distribution network assets, integration with AMI and other grid automation systems enables deployment of innovative applications for improved business processes and operational efficiency. For example, voltage levels are automatically controlled and maintained for optimising distribution network losses and ensuring supply quality by using low voltage network data captured by smart meters as inputs for processing and control by volt/var optimisation systems.

DISRUPTIVE TECHNOLOGIES AND CORE INFRASTRUCTURE

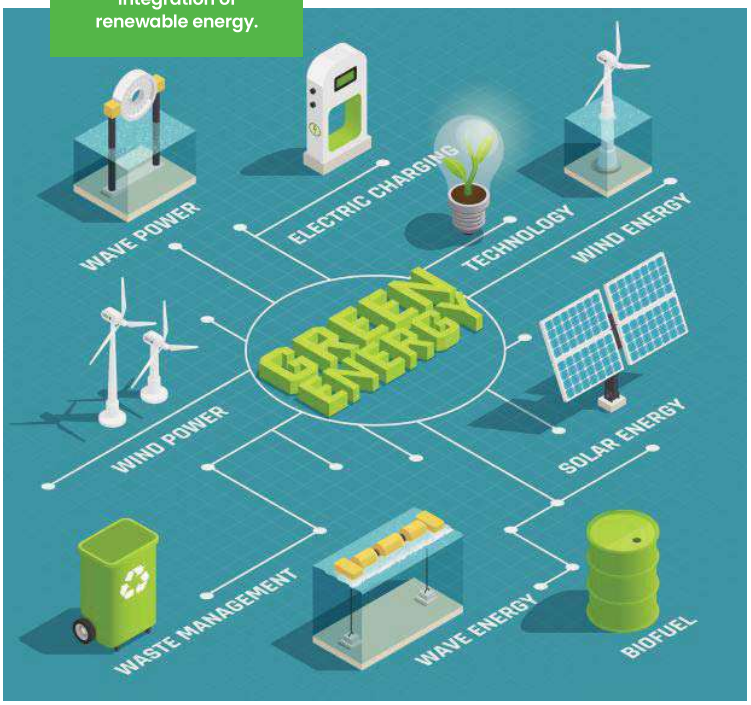
Disruptive technologies such as big data analytics, blockchain, augmented artificial intelligence, predictive and prescriptive maintenance are being used now and will become common technologies in electric power utilities in the future. We see increasing use of drones or unmanned aerial vehicles by transmission network operators for transmission line maintenance, tower-top inspection and/or vegetation management. Accurate real-time data is available to maintenance crew for analysis and decision for appropriate action. Similarly, predictive and prescriptive maintenance techniques are used on grid equipment to detect and provide preventive action before the equipment fails, thus significantly improving network reliability and cost.

A core infrastructure consisting of communications networks and IT systems need to be established, operated and maintained as the basic building block or foundation over which disruptive technologies will be integrated to provide new operational and business services. This core infrastructure collects huge amounts of data from field sensors and devices such as smart meters using various communications networks to data centres for storage, validation, processing and analysis for integration to other systems and applications. A strategic decision is required on selecting the most appropriate communications network technology to ensure it is future-proof, reliable, secure, fit for purpose and cost-effective. A secure, reliable and scalable core infrastructure that supports open integration, operated and managed by a team of well-trained and competent staff is expected.

REIMAGINING UTILITY BUSINESS

Electric power utilities are reimagining their business strategy and operations through digital disruption and business innovation in response to decarbonisation, digitalisation, deregulation and greater customer expectations for new and/or improved service options and reliability. Utilities need to develop a comprehensive long-term grid of the future plan beginning with establishing the core foundational infrastructure for ensuring structured development and realisation of the various initiatives defined in the plan. Huge investment is required that will require regulatory approval as the operational and societal benefits must outweigh the cost with minimal impact to electricity tariff.

The grid of the future or smart grid enables seamless integration of renewable energy.



This article is a contribution by Professor (Adj.) Anthony S Rajamanickam, Advisor, NicheTech Advisory. He has more than 35 years experience in Tenaga National Berhad (TNB), the premier electric power utility company in Malaysia wherein he was responsible for the development of TNB's digital telecommunications network since 1991.