Arthur D Little

Viewpoint

Digital future of electrical networks

How can electricity utilities tackle the digitalization challenges of their network business?

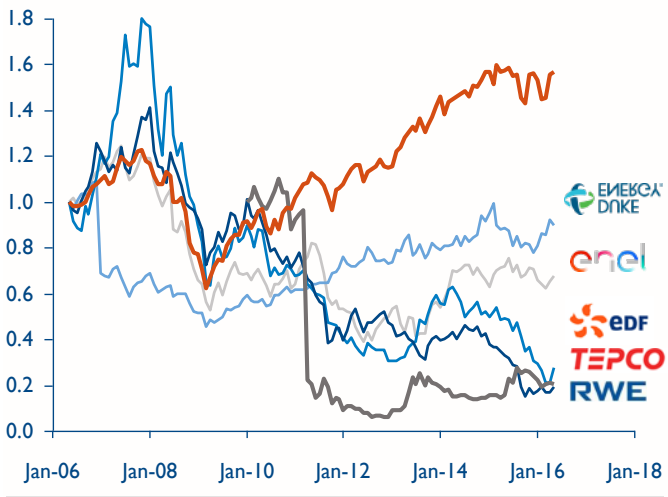
Digital transformation is one of the most important changes the utilities industry faces these days. This transformation is not limited to changing how companies interact with their clients, but also impacts the way they operate internally, as well as where and how value is created. In order to prepare for this landslide transformation, electricity companies must adapt their practices to facilitate such a change.

Key triggers for digitalization of utility companies

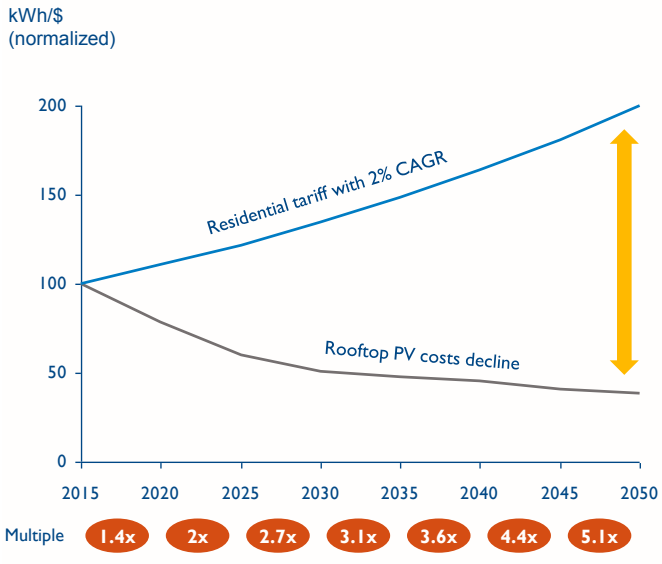
Digital transformation is increasingly impacting businesses around the world. The ubiquity of the Internet and the extremely rapid expansion of disruptive technologies have changed the dynamics within several industries. As mentioned in our recent digital transformation study[1], from entertainment to the car industry, almost no sector of the economy has been left out of the digitalization wave.

Electricity companies are not an exception. Several internal and external triggers should warn utilities that digitalization is vital for their survival.

First, utilities are struggling to deliver healthy financial performances. A constant network cost structure, coupled with the decline in on-grid consumption (mainly driven by the growth of decentralized renewable resources), means utilities are experiencing shrinking profit margins.



Growth of decentralized renewable resources and the consequent decrease in electricity wholesale price were the main drivers for the decrease in market value



Source: IEA, DB report

1 Arthur D. Little, Digital Transformation – How to Become Digital Leader (2015 Study)

Plotting the trends in share-price value from 2006 to mid-2016 has shown that the value of traditional utilities has fallen by 60% to 90% compared to the value of the Dow Jones Industrial Index within the same period.

The trend could worsen, as the current grid parity of residential renewables is no longer considered the final price level in many geographies. In fact, rooftop PV is expected to be almost two times cheaper than on-grid tariffs in 2025, and up to five times cheaper in 2050 (see Figure above), according to International Energy Agency[2] data.

More advanced network management processes will be needed to optimize network capacity to fulfill consumer demand. This can be done at minimal cost only by working with big data analytics, which enable accurate prediction of the impact of distributed generation resources and management of optimal energy flows in the network.

Without such capability the gap between network tariffs and distributed generation costs can increase even more. In the worst case this may lead to an unprecedented boom of off-grid solutions for some end customers, making parts of the network obsolete.

On the other hand, network utilities should also view these future trends as an opportunity to fully transform the network business into a provider of value-added services to end customers and an enabler of efficient use of distributed generation resources via virtual power plants.

All this can be done, but as mentioned above, hardly without significant digitalization transformation efforts to enable network utilities to manage this far-more-complex business. There is an increasing set of technologies that will allow network operations to become more effective and efficient, and choosing not to adopt them will lead the electricity company to fall behind in this industry transformation.

The impact of digitalization on network management

In most industries, digitalizing is seen as a way to react to new market developments rather than save costs. However, for network companies digitalization also presents several opportunities for cost efficiency. A recent Arthur D. Little case study showed that early digital adopters improved their EBIT margins by up to 8 percentage points compared to the laggard companies within 10 years. Some of the relevant use-case examples include the following:

- The use of **custom-built substations** enables networks to build assets directly on site and optimize space utilization due to custom-built equipment
- The use of **geolocation apps** to pinpoint network events via crowdsourced information from customers enables accuracy and sizable reductions in operating expenses
- The use of a **common information model** to integrate all platforms used in the control center, including the likes of SCADA, OMS, DMS, GIS and CIS, reduces inefficiencies of asset conditions and performance with predictive analytics
- The use of **smart meters** in consumer households reduces energy losses and operating expenses by allowing utilities to provide improved peak-demand management
- The use of **drones** for supervision, inspection and detection of any irregular event can significantly reduce maintenance costs and resources utilized
- The use of **IP cameras** to monitor key assets and worker productivity in real time reduces the need for manual inspection of progress
- The use of **augmented-reality glasses** to provide technicians with assistance during maintenance tasks can reduce costs due to downtime through faster and better maintenance
- The use of **virtual training software** to fully prepare field technicians for all types of maintenance tasks reduces downtime losses

Another opportunity for utilities is increased quality of operations and network performance through digitalization.

- **Advanced control-center software** functionality constantly analyzing the optimal network set-up enables elimination of unnecessary losses caused by overloading
- The use of **self-healing automation** tools and sensors, coupled with **advanced fault localization** methods, enables faster resolution of unplanned outages and minimizes the number of customers impacted
- The use of **live-line robots** enables monitoring of transmission lines and the performance of repair tasks without loss of supply
- The use of **tele-robotics** with steady manipulator arms increases safety of distribution-line repairs, preventing hazardous injuries to field technicians

Whether you look at it from a financial or an operational point of view, the impact of digitalization on networks is already changing the industry.

Identified risks and challenges of digitalization

However, these opportunities may also carry some risks. In ADL's digitalization transformation study, the major challenge to digital transformation turned out to be lack of a sense of urgency. This issue is specifically seen in the network

2 IEA Technology Roadmap – Solar Photovoltaic Energy (2014 Edition)

businesses of utility companies because there is limited competitive pressure, even compared to sales of generation business units. This is potentially very dangerous, especially in markets where there is high potential for distributed generation business. In these markets outdated business models could result in an underperforming network providing rudimentary services.

Another issue network utilities often mention is linked to difficulty understanding the available and future digital technologies. As there is limited standardization and minimum use cases available, it is also difficult for management to decide which technologies they should include in their digital transformation roadmap, and when. Furthermore, the usual "me-too" effect might sometimes lead to adoption of the wrong digital applications because the benefits might be very company specific. For example, it currently does not make much sense for a utility with a reliable underground network to fully automate all of its feeders, since it is impossible to justify costs with very limited benefits.

Electricity companies should also be aware of the risk that lies in the implementation of digital transformation programs. This is, by nature, a very complex and lengthy effort, with a strong possibility of multiple failures that have been unacceptable in this type of business in the past. Digital projects need a risk-taking attitude, and learning from failures is part of the new culture, which can be built by bringing in new digital talent and creating incubators instead of only training existing employees.

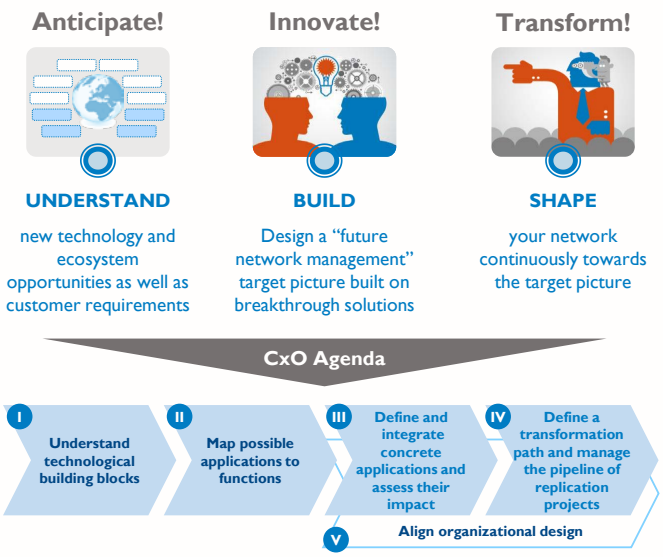
Moreover, utilities will also need to manage external environments while implementing their digital transformations. There is a risk that legislations and regulatory bodies will not recognize the digital efforts of electricity companies in their regulated revenues. Utilities need to keep communication channels open, because managing stakeholders' communication during this transition phase is crucial for a success.

Our approach to addressing the challenges of digitalization

In order to support utilities in digitalizing their networks, we have developed a five-step approach that helps CxOs to deal with this challenge (see Figure below).

First, companies have to understand the different technological building blocks and their potential applications in network management. These building blocks affect different functions and can be categorized in the following manner.

- Data
  - Virtual manufacturing/simulation
  - Augmented reality
  - Predictive analytics



Source: Arthur D. Little

- Connectivity
  - Cyber-physical systems
  - Internet of Things
  - Collaborative robots
- Equipment
  - Additive manufacturing
  - Smart energy systems
  - Advanced machining and material science
- Value chains
  - Converging ecosystems
  - Decentralization
  - Collective intelligence/crowdsourcing
- Products and people
  - Smart, ecological products
  - Virtual workplace/workplace 4.0
  - E-learning

Second, companies need to map the possible applications to the corresponding network functions, which can be segmented into five categories:

- Network planning and engineering
- Network construction
- Network operations
- Network maintenance
- Support functions

After mapping the digital applications to the different functions, the next step is to define and integrate concrete applications in order to assess their impact further. A deep analysis needs to be performed on the financial and operational impact of the selected digital applications on each network function.

Thereafter, companies need to define their digital transformation paths and manage the project pipeline to ensure rapid benefits realization and a consistent, preferably self-financing transformation of the electricity company. This can be done by first identifying the digitalization initiatives, then selecting projects for validation, which will be further launched as pilots. Once the benefits have been confirmed, electricity companies can start the roll-out and industrialization of these successful pilot applications. Finally, after the roll-out has been completed, constructive feedback should be collected in order to maximize the output and reap the benefits of these investments.

As a final stage, companies need to develop organization and governance models for adaptation by establishing appropriate partnering strategies, digital organization units and governance models.

Conclusion

The struggle to deliver a healthy performance, the necessity of optimizing network capacity to fulfill customer demand at minimal cost, and easy access to disruptive technologies are all contributing factors to creating a step change in the way electricity companies look at their network management.

For this reason we believe it is the right time to ask some critical questions. Does your company understand the new technologies and digital transformation opportunities? Can you develop a practical strategy in order to reach your desired digital transformation target picture? And do you have the required capabilities to successfully implement your digital transformation?

Arthur D. Little has longstanding experience in digital transformation in the utilities industry, across developed and emerging economies. We have gained deep insight into the potential consequences of digital applications and their impact on electricity markets. We support clients in devising strategies to transform their companies from the traditional to the digital end of the spectrum, in order to protect their commercial interests.

Contacts

Americas
Rodolfo Guzman
guzman.r@adlittle.com

Belgium
Kurt Baes
baes.kurt@adlittle.com

China
Russell Pell
pell.russell@adlittle.com

Czech Republic
Dean Brabec
brabec.dean@adlittle.com

France
Vincent Bamberger
bamberger.vincent@adlittle.com

Germany
Michael Kruse
kruse.michael@adlittle.com

Italy
Saverio Caldani
caldani.saverio@adlittle.com

Japan
Yotaro Akamine
akamine.yotaro@adlittle.com

Korea
Kevin Lee
lee.kevin@adlittle.com

Middle East
Global Practice Leader
Energy & Utilities
Jaap Kalkman
kalkman.jaap@adlittle.com

Middle East
Lukas Vylupek
vylupek.lukas@adlittle.com

Norway
Diego MacKee
mackee.diego@adlittle.com

Netherlands
Martijn Eikelenboom
eikelenboom.martijn@adlittle.com

Spain
David Borras
borras.david@adlittle.com

Sweden
Nils Bohlin
bohlin.nils@adlittle.com

UK
Greg Smith
smith.greg@adlittle.com

Authors

Jaap Kalkman, Lukas Vylupek, Carlo Stella, Majid Dabbous

Arthur D. Little

Arthur D. Little has been at the forefront of innovation since 1886. We are an acknowledged thought leader in linking strategy, innovation and transformation in technology-intensive and converging industries. We navigate our clients through changing business ecosystems to uncover new growth opportunities. We enable our clients to build innovation capabilities and transform their organizations.

Our consultants have strong practical industry experience combined with excellent knowledge of key trends and dynamics. Arthur D. Little is present in the most important business centers around the world. We are proud to serve most of the Fortune 1000 companies, in addition to other leading firms and public sector organizations.

For further information, please visit **www.adlittle.com**