Arthur D Little

Viewpoint

Quenching digital thirst of water utilities

How should water utilities execute their digital transformation ?

Water utilities across the globe are under increased pressure due to challenges posed by rapid urbanization, climate change, aging infrastructure, high network losses, and increasing customer expectations. Innovation and cutting-edge digital technologies are proving critical in helping utilities transform their business across core and noncore value chain elements to enhance their value proposition to customers, employees, shareholders, and other stakeholders.

Digital transformation reshaping water utilities

Water utilities worldwide are embracing the digital revolution to address impending challenges, transform their business, and enhance their value proposition to their customers, employees, and other stakeholders (see figure below). Advanced digital technologies (e.g., artificial intelligence [AI], advanced sensors, and predictive analytics) are increasingly being deployed by early adopters (e.g., SUEZ and Veolia). These technologies allow for significant data availability, creating new opportunities for analytics-based digital solutions.

Such technological breakthroughs have provided water utilities with plenty of options. However, utilities must look beyond technology hype and focus on value generation. The quantity alone of digital use cases does not determine the benefit that an organization can achieve from digital transformation and often leads to inefficient investments. Thus, companies should prioritize digital use cases based on business impact and feasibility to maximize investment capital. Business impact, best captured via strategic KPIs, can be strategic, operational, or financial. Feasibility should consider technology readiness and vendor track record.

Key trends shaping water utilities

Source: Arthur D. Little analysis

In this Viewpoint, we explore top value-generating use cases that leading water utilities worldwide are deploying to solve fundamental challenges across various elements of a utility value chain: asset management, construction, operations and maintenance (O&M), customer service, and corporate support (see figure on next page).

Asset management. Rapid urbanization and climate change place an unprecedented load on the existing water utility infrastructure. Future-proof asset designs and expansion of existing water treatment plants, transmission networks, and distribution networks will help address this challenge. But it is critical to base these designs and expansions on accurate forecasts. Employing a supply-demand simulation software that utilizes data on population, climate information, historical demand patterns, and other parameters can generate robust demand forecasts. Digital adoption in asset management is not restricted to forecasting. Technologies like digital twins that benefit from the plethora of data collected from the network are yielding transformative effects in terms of simulations efficiency and precision. Additionally, AI and machine learning (ML) are increasingly being adopted across various functionalities of asset management (e.g., materials planning).

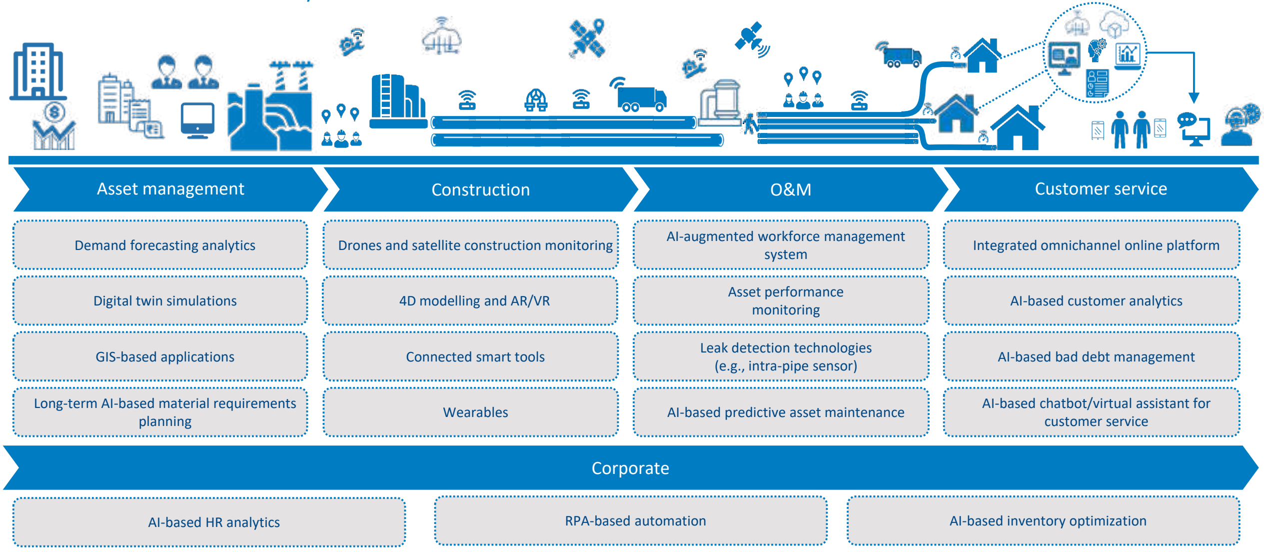
Construction. Construction of desalination and water treatment plants and laying of transmission and distribution networks involves a lot of manual work and may face delays, budget creep, quality issues, and safety incidents. Several use cases can alleviate these issues. For example, satellites or drone imagery can enhance project monitoring and identify potential delays early on. Drones can also improve the safety of field workers by replacing manual inspections on elevated platforms or vessels. Augmented reality (AR)–based constructability reviews, utilizing 4D modeling and AR/virtual reality (VR), can help identify quality defects early on and avoid expensive rework. Smart tools also contribute effectively to construction work quality and inspection accuracy. Finally, wearables can track vitals of employees as well as movements in restricted areas to preempt accidents.

O&M. Day-to-day O&M of water networks are inundated with exigent challenges (e.g., inefficient workforce management, poor water quality, and leakages from aging water networks) often exacerbated by a reactive maintenance philosophy, leading to unexpected asset failure and higher maintenance costs. Many challenges can be addressed by implementing the following use cases on the network and in the field:

- Our previous work shows that workforce management systems play a key role in improving workforce utilization (over 70% in some utilities) and productivity, leading to higher efficiency and lower field-force cost (with potential cost savings of over 30% annual field-force spending), as well as higher responsiveness to customer needs. Recently, many systems have been augmented with AI/ML functionalities (e.g., AI-based work order scheduling for smart assignment of orders). Similarly, online condition monitoring or asset performance monitoring is taking a lead role in addressing water quality issues by leveraging data from online sensors.
- Pipeline leakages is a key issue water utilities face and thus a dominant focus area for utilities globally. Our previous work indicates that many water utilities are plagued with leakages that exceed, in many cases, 25% of total supply. According to Smart Energy International, UK water services regulator Ofwat has mandated water utilities to reduce water leakages by 15% by 2025, while the city of Lille, France, has set a target of reducing non-revenue water from 21% to 15% by 2023. Reducing non-revenue water is achievable by utilizing a portfolio of leak-detection technologies across network assets (see sidebar, "Deep dive").
- Finally, the adoption of predictive maintenance practices is another measure reshaping the maintenance activities of water utilities and improving the bottom line. By leveraging data from the network, AI-based predictive algorithms anticipate failures of critical assets and form a basis for the new reliability-based maintenance paradigm.

Customer service. A main challenge water utilities face is how to exceed rising customer expectations and enhance collection despite the issues associated with an aging network, legacy customer service solutions, and lack of sufficient data on customers. A prerequisite of a successful customer service function is the availability of accurate, elaborated, and integrated customer data sets. This is achievable by creating an integrated omnichannel online platform that synchronizes all customer channels (web, mobile app, email, voice, social media) by consolidating data from multiple internal systems. This allows water utilities to build a 360-degree view of a customer. This view, coupled with AI and advanced analytics, helps formulate actionable customer insights, more effective targeting, richer engagement, as well as tailored marketing and cross-selling strategies. Bad debt (or debt collection) is another critical issue for water utilities. Many are adopting AI-based bad debt management solutions to analyze data from internal customer systems and external sources (e.g., demographic, economic, geolocation, credit bureau, mortgage companies) to build a view of an individual customer's creditworthiness, payment habits, and propensity to pay. This helps utilities identify risks and predict who is likely to default on a bill and also enables the utility to tailor recovery strategies to individual circumstances. In some instances, these systems have achieved 50% improvement in debt collection. (Source: WNS)

Digital use case across the water utility value chain



Source: Arthur D. Little analysis

Deep dive: Digital solution to address the challenge of non-revenue water

No one-size-fits-all solution can address the issue of water leakages. Rather, utilities should consider a portfolio of digital solutions fit to purpose. For a pipeline network spread across a large area, especially with transmission networks, satellite-based pipeline leak-detection technology is an apt solution. It employs radar- or imagery-based satellites that can scan a few meters into the earth to identify areas where large leakages exist, allowing for timely mobilization of a field force. Using this solution, utilities have been successful in identifying two to three leaks per mile of pipeline inspected.

For distribution networks, clamp-on flow meters within district metering areas/district metering zones enable an accurate water-balancing exercise to identify areas of water leakages. Crews can be mobilized to zero-in on the leakage's precise location using technologies such as intra-pipe advanced acoustic sensors. These sensors also can identify minor leakages before larger, more severe failures occur and can achieve up to 25% reduction in leakages. Using this technology, acoustic sensors in a form of a ball or probe go inside pipelines and scan to identify the precise location of small leakages.

For aging networks, AI-based leak detection can lead to a reduction of breakages of over 20% on large pipes. This method collects data from the network and the overall operational environment and employs AI algorithms for predicting likelihood of failure (LOF), consequence of failure (COF), and business risk exposure (LOF x COF = BRE), thus initiating repair before the leakage occurs. Additionally, utilities are increasingly deploying other means of leak detection (e.g., drones, smart meters with built-in acoustic sensors, and helium/nitrogen gas injections).

Utilities are also leveraging advanced metering infrastructure data and employing AI-based fraud-detection algorithms to detect consumption anomalies and reduce fraud or nontechnical losses in the network. Finally, digital tools can help improve efficiency of the customer service function through employment of AI-based chatbot/virtual assistants and predictive ticketing.

Corporate support. Corporate support functions (e.g., HR, finance, and procurement) play an important role in enabling day-to-day operations in water utilities. These functions face numerous challenges, which digital technologies can address. Inefficiencies in the HR hiring process, for example, can be addressed through AI-based HR analytics, which employs AI and pattern recognition to create customizable talent metrics based on benchmarks. These metrics are then used to forecast trends across workforce skills and composition, performance, talent acquisition, diversity, total employee rewards, and so on. The solution also visualizes workforce mobility across business units, locations, and job families to understand how these movements affect cost models, career-path initiatives, and succession plans. Such solutions enable higher performance, engagement, and retention.

In finance, the time departments take to process supplier purchase orders (POs) can be reduced by employing a robotic process automation (RPA) solution for PO automation. By using a bot that scans the supplier quote, extracts the relevant information via optical character recognition, and creates the PO in the ERP system, utilities can achieve up to 70% improvement in productivity and up to 50% of cost savings, according to UiPath.

In procurement, an AI solution can better manage spare parts inventory and dynamically determine the optimal quantities and location for picking the material by leveraging predictive maintenance information. As reported by c3.AI, this results in 20%-50% reduction in inventory levels and subsequent holding costs.

Good governance and implementation practices are key to unlocking the potential of digital solutions

Developing a digital transformation strategy and identifying high-impact digital solutions (*the what*) is only part of the problem and can bring concrete benefit to utilities only if implemented successfully (*the how*). Typically, utilities face the following challenges in the implementation phase, which prevents them from unlocking the full potential of digital solutions:

- **Lack of accountability** – on who should be the owner of the initiative and its implementation.
- **Lack of transparency and adequate communication** – on initiative selection, execution, and post-implementation.
- **Lack of required technical capabilities** – to successfully select and execute the appropriate use cases seamlessly in a cost-efficient manner.
- **Lack of value-realization tracking** – to ensure investment yields the benefits outlined in planning stage.

Instituting robust governance and implementation practices is paramount to a successful digital strategy implementation in order to reap all benefits of digitalization.

Based on our work with global water utilities and input from experts in the field, here are several key takeaways for defining an effective digital transformation governance system and implementation practices:

- **Break the silos.** Convergence between IT and operation technology is driving utilities to rethink organizational boundaries to enhance coordination and collaboration. Project execution of new-age digital projects is often carried out by cross-functional teams.
- **Steer from the top down.** Utilities typically have an overarching steering committee (typically led by the CEO) that sets the digital strategic direction, monitors implementation, and ensures accountability.
- **Include technical architects/gurus within IT/digital function.** Modern utilities appoint technical experts that constantly scan the market for new digital technologies, differentiate between hyped-up technologies versus the difference makers, lead the development of digital transformation roadmaps, support ongoing projects, and often are a part of the technical architecture committee.
- **Utilize open innovation.** Several utilities are institutionalizing the concept of open innovation to leverage the ecosystem of partner capabilities and stay abreast of the latest technology trends.
- **Engage business partners.** Many utilities have institutionalized business partners positions within the digital function or within the end-user function to enhance communication and coordination between functions.
- **Employ value realization monitoring/KPIs.** Value realization post-implementation vis-à-vis the business feasibility developed at the planning stage is key to ensuring benefits are realized and proper accountability is in place to maximize the digital ROI.

Insights for decision makers

The digital transformation of a water utility is not a one-time effort but rather a continuous process with a holistic approach that requires support and commitment from senior management. To succeed and fast-track digital transformation, a water utility should first focus on exigent business challenges, such as an aging infrastructure, construction delays, high network losses, and increasing customer expectations.

As outlined in this Viewpoint, high-impact use cases addressing these challenges include: demand forecasting analytics; advanced workforce management systems, which can lower O&M costs by over 30%; intra-pipe sensor leak detection, which can reduce leakages by 25%; predictive maintenance. which typically lowers equipment downtime by over 20%; and AI-based bad debt management solutions, which can generate up to 50% improvement in debt collection. In addition, the utility's management should ensure institutionalization of digital transformation by establishing good governance processes, implementing mechanisms to track progress and results, and acquiring or building strong technical capabilities to drive the aspired change.

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