AI and Water Utility Management

A Technology Overview and Industry Applications

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Marc Pfeiffer, Associate Director, Bloustein Local
Center For Public Policy Research
Bloustein School Of Planning And Public Policy
Rutgers University

Key AI Technologies Explained

Introduction to AI

- **What AI does:**
  - Automates tasks and decisions typically requiring human intelligence (image recognition, analytics, predictions, etc.)
  - Identifies patterns and extracts insights from data at scale
  - Continuously learns and improves over time as it processes more data

- **Importance in Government: automate** routine tasks, gain insights from data, enhance decision-making, and improve citizen services, which theoretically, ultimately leads to more efficient and effective governance.

What is AI? There are a handful of technologies at work…

- **Machine Learning** – learning from user-provided input. Based on human tagging of text and images and algorithms that identify - (license plate, facial imaging/recognition)
- **Natural Language Processing** – understanding spoken and written text and making the meaning useful and can create new text
- **Artificial Neural Networks**: Computing systems inspired by human brain structure that excel at pattern recognition. Trained on and absorbs information fed to it and from the internet itself.

What is AI technology? There are several at work.

- **Generative AI/Large Language Models, aka, Chatbots** – combine ML and NLP with neural networks, absorbing and correlating everything they can suck in off the net. Also drives **Image creation** (still and video) – produces art based on general or detailed prompts.
- **Internet of Things:** Connected devices that generate and respond to data, e.g., sensors, communication infrastructure, control systems
- **Robotics** – devices using AI to make decisions and execute them: think Amazon warehouse robot, but also robotic processes (e.g., business process automation, processing of forms)

What is AI technology? There are several at work.

- **Computer vision** – understanding what it “sees” in video cameras or recordings and acts based on it (Flock license plate readers)
- **Digital Twins** – combines elements of other tools to create a model of a system (e.g., traffic flow) that lets you test changes to the system.
- **Edge Computing** - processing data near its source rather than in centralized data centers. Makes processing faster but requires more data centers

Where do we find AI at work in local government today?

- Operational Efficiency and Automation
- Urban Planning and Infrastructure
- Public Safety and Emergency Response
- Citizen Services and Engagement
- Environmental Sustainability
- Healthcare and Public Health
- Data-Driven Decision-Making

Range of AI Applications in Government

- **Streamline operations** – chatbots for citizen services, process automation, predictive analytics, use of “robotic processes.” Can free up human resources for higher-value activities and reduce operational costs.
- **Citizen services enhancement:** writing personalized interactions, streamlining service delivery, and enabling efficient communication between citizens and government agencies (includes drafting letters, press releases, etc.).
- **Support decision making** - analytics and simulations for resource allocation, policies,
- **Environmental management/IoT**: processing, analysis, and decisions based on Internet of Things sensors
- **Community development** - computer vision for infrastructure monitoring, language services, ”digital twins” to model changes in infrastructure or conditions

What's All the Hubbub About Chatbots?

About Chatbots (e.g., ChatGPT, Claude, Gemini, CoPilot, Perplexity (search), Grok

- **What they do**
  - Provide automated conversational experiences
  - Completes tasks like looking up data and more complex ones like translating languages, including writing computer code, analyzing and summarizing reports and datasets (e.g., Excel worksheets)
  - Responds to user input and queries via “prompts” describing what the user wants to know or tells the bot to do.
- **How it works**
  - Built using rules, decision trees and other AI techniques
  - Processes and analyzes user input (understands natural language)
  - Generates relevant responses based on its programming

About Chatbots (e.g., ChatGPT, Claude, Gemini, CoPilot, Perplexity (search), Grok

- **What it "knows"**
  - Everything that is on the internet, subject to access and date cutoffs.
  - Information, rules, decision logic provided by developers
  - Data and conversation patterns learned from users
  - Only what has been manually programmed or exposed through training
- **On the other hand**
  - It produces words by “predicting what is next” based on training and logic. This also means it can make mistakes, also known as “hallucinate” or “confabulate” content.
  - Humans need to be in the loop to review and proof what it does
  - But it learns from mistakes and instructions.
  - Long-term implications are uncertain and developing as them

Consideration on AI Use: Ethics, Policy, Security

- Use of data – where it comes from, security of storage, how it will be used, potential for public disclosure
- Is impact on recipients equitable (access to all who need it), fair (decisions are made fairly and without illegal or unethical discrimination), accountable (organizational responsibility is clear)
- Financial impact is understood and manageable
- Impact on employment – replacing or augmenting employees or both?
- Understanding the value of the impact of AI issue being addressed
- Is decision-making transparent? Should machine-made decisions be reviewed by humans, and under what circumstances?

Does AI affect or alter the underlying value of the services

- Surveillance implications on criminal justice or quality of life
- Impact of traffic signaling controls on congestion vs. speed?
- Value of public safety priority signaling/red-light camera ticketing practices
- Use of environmental sensors to support development decisions

How will it be implemented

- Mostly integrated into vendor-supplied solutions
- Chatbots: Incrementally through user-introduced use cases; shared peer experiences
- Agencies with internal staff with sophistication to develop their own applications

AI Applications in Water Management: Overview

Predictive Analytics & Forecasting

- Demand Forecasting: ML models predict water consumption patterns based on historical data, weather conditions, and population growth
- Flood Prediction: Neural networks analyze weather data and watershed conditions to forecast flooding events
- Drought Monitoring: AI systems track multiple variables to predict drought conditions and severity

Infrastructure Management

- Leak Detection: AI algorithms analyze pressure, flow, and acoustic data to identify leaks before they become major issues
- Asset Management: Predictive maintenance systems determine optimal maintenance schedules for pumps, pipes, and treatment equipment
- Digital Twins: Virtual replicas of water systems simulate performance under different conditions and optimize operations

Water Quality Monitoring

- Real-time Analysis: ML systems process sensor data to detect contaminants, algal blooms, and other water quality issues
- Computer Vision: Image recognition identifies visual indicators of water quality problems in reservoirs and treatment facilities
- Anomaly Detection: AI identifies unusual patterns in water quality parameters that may indicate contamination events

Treatment Process Optimization

- Chemical Dosing Optimization: ML models determine optimal chemical dosages for water treatment based on incoming water quality
- Energy Efficiency: AI optimizes energy usage in treatment processes by adjusting operations based on demand and grid conditions
- Process Control: Advanced control systems use AI to maintain optimal treatment conditions despite varying inputs

Customer Engagement & Conservation

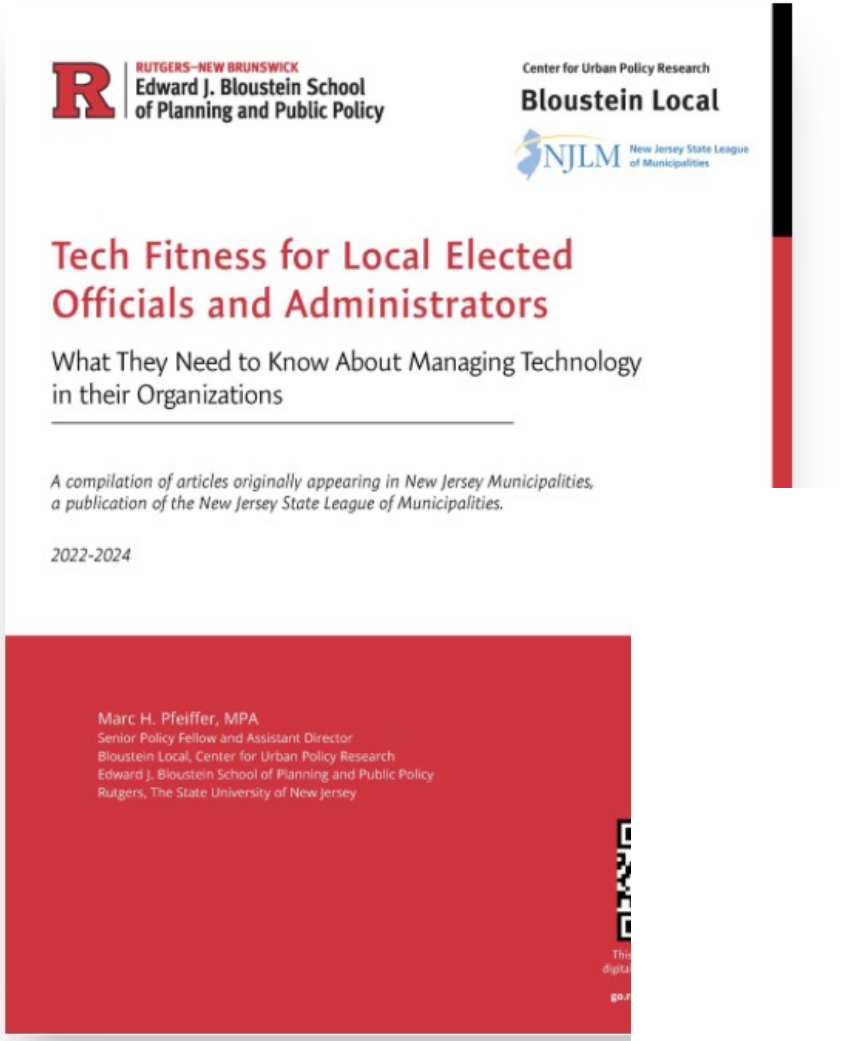
- Smart Metering: AI-powered analytics detect unusual consumption patterns and provide insights to customers
- Personalized Conservation: Chatbots and recommendation systems provide tailored water conservation advice
- Behavioral Analytics: ML systems identify patterns in water usage to design effective conservation programs

Resource Management & Planning

- **Watershed Management**: AI models simulate watershed behavior to optimize reservoir operations and groundwater management
- **Climate Adaptation Planning**: Deep learning models assess climate change impacts on water systems and evaluate adaptation strategies
- **Infrastructure Planning**: AI systems identify optimal locations and specifications for new infrastructure investments

Let’s talk

- Questions
- Answers
- Speculation
- Demo?



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