# PANEL SESSION, Tuesday, December 7th 3:15 pm – 5:15 pm (ET)

**Moderator: Ken Thompson, Jacobs**

**PANEL SESSION: STRATEGIC PLAN FOR INTELLIGENT WATER MANAGEMENT AT RIVER-BASIN SCALE**

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| Guest Speaker: Metro Vancouver, Canada – John McMahon | 3:20 – 3:35 pm |
| Guest Speaker: SUEZ Water, USA - Travis Wagner | 3:35 – 3:50 pm |

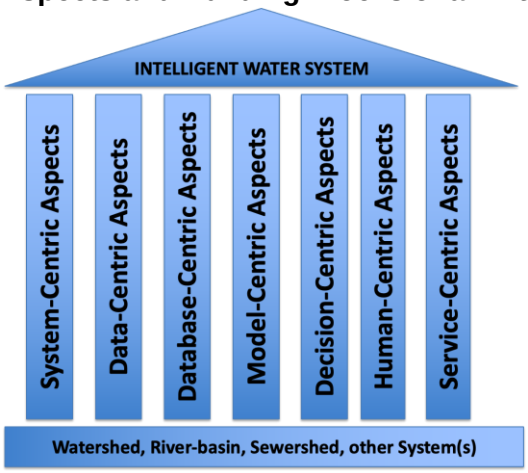
## STRUCTURED PANEL DISCUSSION 3:50 – 4:50 PM

### Theme 1- Intelligent Water System (IWS) Definition & Building Blocks (30-minute discussion):

- **Many Definitions have been suggested in the literature. Our Proposed Definition:**

> "An Intelligent Water System is a digital approach to integrate and derive information from cyber-space, physical-space and social-space based on improved system of systems understanding, implementing data collection, database management, modeling techniques, decision support paradigms, and intelligent workforce skills, all to support data driven decision making and optimize lifecycle management of water systems (Natural, Built, & Socio-Economic) that are affordable, reliable, sustainable, resilient, and provide operational efficiencies."

- **Discuss Fundamental Aspects and Building Blocks of an Intelligent Water System:**




***Question:*** What are your thoughts on the pros and cons of the definitions and building blocks?

### Theme 2- Strategic Plan for Intelligent Water Management (30-minute discussion):

- **Strategy for Intelligent Water System Implementation should be the integration of:**
  - **Technology, Workforce, and Governance**
- **Establish Governance structure for levels of an Intelligent Water System Implementation:**
  - **Federal Level: Department of Water (EPA is a regulatory agency)**
  - **River-basin Level: 18 major river basins in the 48 states of the contiguous US**
  - **Local Level: Local water stakeholders will work in a collaborative environment**

***Question:*** What are the critical features for each level to be successful?

# PANEL SESSION, Wednesday, December 8th 1:15 pm – 3:00 pm (ET)

**Moderator: Lindsay Birt, Ph.D., Xylem**

**PANEL SESSION: DATA COLLECTION & DATA ANALYTICS FOR INTELLIGENT WATER**

Guest Speaker: New York DEP, New York, USA – Brian O'Malley 1:20 – 1:35 pm

Guest Speaker: Houston Water, Texas, USA - Pratistha Pradhan 1:35 – 1:50 pm

**STRUCTURED PANEL DISCUSSION 1:50 – 2:50 PM**

**Theme 1- Steps for Data Management Planning & Preparing (30-minute discussion):**

***DEFINING PROJECT OBJECTIVES AND GOALS FOR IWS APPLICATIONS***

- Framework for defining problem, objectives, and goals for Intelligent Water Applications

***CHALLENGES IN DATA MANAGEMENT FOR WATER UTILITIES***

- Identifying historic problems with data collection and management-siloed departments, no data governance, lack of workforce capacity, etc.

***ORGANIZATIONAL GOVERNANCE AND OPERATIONS FOR IWS APPLICATIONS***

- Framework for developing organizational governance and operations for Applications

***DATA GOVERNANCE-DRIVEN ASPECTS FOR IWS APPLICATIONS***

- Understanding best practices for data stewardship, data access, data storage, protocols for improving data governance, and emerging standards for analytics and data quality.

***DATA SCIENCE PARADIGM-DRIVEN ASPECTS FOR IWS APPLICATIONS***

- Understanding Data Science Paradigms (hypothesis-driven vs. data-driven) approaches.

***TYPES OF DATA-CENTRIC ASPECTS FOR IWS APPLICATIONS***

- Understanding Data Types, Sources, Formats, Quality, Quantity, Preprocessing, etc.

***DATA CLEANING-CENTRIC ASPECTS FOR IWS APPLICATIONS***

- Framework for preparing raw data to clean data, including Data Compatibility, etc.

***Questions:*** Are we missing something or are there other steps for planning and data governance for IWS Implementation? How do you ensure data in absolution truth-avoiding duplicates? How do we make sure that the data is cleaned and ready for training an AI model? What factors do you consider for determining a business intelligence platform? How do we educate and/or train the future water sector workforce to implement?

**Theme 2- Steps for Data Management, Processing, and Integration (30-minute discussion):**

***DATA CAPTURING-CENTRIC ASPECTS FOR IWS APPLICATIONS***

- Featuring new technologies to collect data in real-time (sensors, data frequency, etc.)

***DATA INTEGRATION-CENTRIC ASPECTS FOR IWS APPLICATIONS***

- Feature case studies of the application of data integration for various data streams

***FEATURE ENGINEERING-CENTRIC ASPECTS FOR AI/ML APPLICATIONS***

- Feature Engineering, Continuous Data, Discrete Data, etc.

***STATISTICAL ANALYSIS & DISTRIBUTIONS- ASPECTS FOR IWS APPLICATIONS***

- Understanding statistical analysis, Sampling Distributions, Statistical Distributions, etc.

***DATA MANAGEMENT FRAMEWORKS- ASPECTS FOR IWS APPLICATIONS***

- Understanding platforms best fit your dataset, objectives, and data governance

***EVALUATION OF DATA FRAMEWORK FOR IWS APPLICATIONS***

- Best practices for evaluating errors, Training Data, Validation of Data, Testing Data, etc.

***Questions:*** What are your thoughts on the development of best practices for data management for intelligence water systems technology applications? How are others handling data integration-could you please help us identify case studies to provide broader insight into the real-world applications? How do data management efforts get funded? Any thoughts on how to incorporate data science/data management practices and methodologies into a centralized platform?

# PANEL SESSION, Wednesday, December 8th 3:15 pm – 5:15 pm (ET)

**Moderator: Edgar Westerhof, Arcadis**

**PANEL SESSION: GOVERNANCE AND IMPLEMENTATION OF INTELLIGENT WATER SYSTEM**

Guest Speaker: Miami-Dade Water & Sewer, USA – Hardeep Anand 3:20 – 3:35 pm
Guest Speaker: Waternet, Netherlands - Kees van der Lugt 3:35 – 3:50 pm

## STRUCTURED PANEL DISCUSSION 3:50 – 4:50 PM

### Theme 1- Implementation of the One Water - Intelligent Water System (30-minute discussion):

Envision the implementation of the intelligent water approach and technologies at a national scale, as an enabler for One Water.

- Some potential ways implementation could occur:
  - Congress enacts a law or policy
  - Value propositions are used to motivate states, counties, municipalities to identify opportunities and resources for implementing local or regional networks or hubs of users and providers.
  - Stress drivers (e.g., natural hazards, climate change, population increase) could be used to identify unique value propositions for communities.

***Questions:*** What are your thoughts on the pros and cons of these governance and implementation strategies? How does this work in the Netherlands, is EU and national legislation a stimulant to organizational improvements or is it slowing down change? Are we missing something and/or are there other strategies, i.e. do we have a solid understanding of the benefits and also costs to transition to One Water? What are the key enablers and key obstacles in your opinion? What is your organization doing to stimulate the enablers and to mitigate the obstacles – can you share lessons learned (Waternet) and/or strategies that are in the works (WASD).

### Theme 2- Measurement of Success for moving to One Water through Intelligent Water (30-minute discussion):

Measurement of success in the governance and implementation of an intelligent water system.

- Some ways to measure success could be:
  - Return on investment
  - Customer satisfaction
  - Public health impacts
  - Environmental impacts
  - Recovery and resilience of aging water infrastructure and stressed water resources.
  - Benchmarking – utilizing utility peer assessments

***Question:*** What are your thoughts on the pros and cons of these for measuring success? Are we missing something and/or are there other strategies and/or indicators for measuring success?

## PANEL SESSION, Thursday, December 9th 1:15 pm – 3:00 pm (ET)

**Moderator: Sunil Sinha, Virginia Tech**

**PANEL SESSION: ARTIFICIAL INTELLIGENCE APPLICATION FOR INTELLIGENT WATER**

Guest Speaker: Clean Water Services, Oregon, USA – Ting Lu 1:20 – 1:35 pm
Guest Speaker: Anglian Water, United Kingdom - Lauren Knight 1:35 – 1:50 pm

**STRUCTURED PANEL DISCUSSION 1:50 – 2:50 PM**

**Theme 1- Steps for Artificial Intelligence Technology Implementation (30-minute discussion):**

***SYSTEM-CENTRIC ASPECTS FOR AI/ML APPLICATIONS***

- System of Water Systems (Natural, Build, and Socio-Economic Systems)

***DATA-CENTRIC ASPECTS FOR AI/ML APPLICATIONS***

- Understanding the Types of Data, Data Quality, Data Quantity, Data Preprocessing, etc.

***KNOWLEDGE-CENTRIC ASPECTS FOR AI/ML APPLICATIONS***

- Knowledge-guided Data Science Theory, Models, and Applications.

***MODEL-CENTRIC ASPECTS FOR AI /ML APPLICATIONS***

- Framework for Classification, Bayesian Networks, Artificial Neural Networks, etc.

***PLATFORM-CENTRIC ASPECTS FOR AI/ML APPLICATIONS***

- Cyberinfrastructure Platform Architecture, and Cybersecurity.

***DECISION-CENTRIC ASPECTS FOR AI/ML APPLICATIONS***

- Visualization, Diagnostic/Prescriptive/Predictive Decision Support System, etc.

***HUMAN-CENTRIC ASPECTS FOR AI/ML APPLICATIONS***

- The new breed of engineers/students, digital training for the professional workforce, etc.

***Questions:*** Are we missing something or are there other steps for AI/ML Technology Implementation? How do you ensure that AI applications are not biased? How do we make sure that the data is ready for training an AI model? What factors do you consider to select the best AI model? Do you have a robust database structure and decision support platform? How do we educate and/or train the future water sector workforce to implement AI/ML digital technologies?

**Theme 2- Applying Artificial Intelligence Technology in Water Sector (30-minute discussion):**

The research approach for applying Artificial Intelligence (AI) and Machine Learning (ML) will be to engage and capture expert opinion to produce an informative summary on how AI/ML technologies can be easily adapted to improve services. The selection of case study will be based on achieving the following research objectives:

- ***Identify best practices of AI/ML applications for the water sector.***
- ***Identify what is working and not working and why is related to AI/ML applications.***
- ***Identify gaps and challenges in the current practice of AI/ML applications.***
- ***Identify emerging technologies to support AI/ML applications for the water sector.***
- ***Compare state-of-the-art literature review with the current water industry practice.***
- ***Provide recommendations to enhance AI/ML applications for the water sector.***
- ***Develop a national strategy for AI/ML applications in the water sector.***

***Questions:*** What are your thoughts on the development of best practices for artificial intelligence technology applications? Could you please help us identify case studies to provide broader insight into the real-world applications of Artificial Intelligence practices and methodologies in the water sector?

# PANEL SESSION, Thursday, December 9th 3:15 pm – 5:15 pm (ET)

**Moderator: James Horne, U.S. EPA**

**PANEL SESSION: WATER SECTOR WORKFORCE DEVELOPMENT FOR INTELLIGENT WATER SYSTEMS**

Guest Speaker: Baywork and San Francisco PUC – Catherine Curtis 3:20 – 3:35 pm
Guest Speaker: City of Fort Worth Water Department - Shane Zondor 3:35 – 3:50 pm

*"As the water system operating environment evolves to incorporate technology advancements, there is a growing need to train and employ water protection specialists with a high degree of technological competence to make data-driven decisions and to track all aspects of utility operations based on up-to-date and accurate information. In addition to water operators, the growing role of technology in day-to-day operations will continue to expand the role of engineers, information technology (IT), and security specialists, helping the water sector attract more technologically competent workers. At the same time, this shift will require training and retraining for existing workers in partnership with educational organizations to ensure their skill sets allow them to operate within an increasingly complex work environment. To leverage technology innovation and create a more resilient water sector future, the water sector should make significant investments in technology education through training, operator certification, apprentice programs, and other means. This education should focus on the use of digital tools that will enable workers to employ activities like digital sampling based on current conditions, asset management, gap assessments, and others to help utility managers improve worker competence. Investing in these workforce skills of the future will build a more resilient and adaptable workforce ready to meet the challenges and opportunities of the 21st-century water economy."* EPA's Water Workforce Initiative.

**STRUCTURED PANEL DISCUSSION 3:50 – 4:50 PM**

**Theme 1- Intelligent Water System (IWS) Workforce Development (30-minute discussion):**
**Objective: Understand the key factors to help utilities successfully integrate intelligent technology into a utility's workforce.**

**Theme 2- Intelligent Water System (IWS) Workforce Deployment (30-minute discussion):**
**Objective: Understand and learn from the experiences and challenges of one utility's journey to successfully deploy new and intelligent technology.**

**Questions:**

- What are the biggest challenges utilities face in moving toward greater use of intelligent technologies, even if they aren't in a position to develop a truly "intelligent water system" at this time?
- What role should organizations like the SWIM Center and others play in "demystifying" the term intelligent water system and helping to train utility workers and managers on how and why they should embrace greater use of new and innovative technology?
- Does there need to be some sort of "curriculum" for training providers, academic institutions like community colleges, and others, to help guide their efforts to help workers develop the skills they need to adopt new technology, and if appropriate, move toward an intelligent water system?
- What role should organizations like the SWIM Center and others play in "demystifying" the term intelligent water system and helping to train utility workers and managers on how and why they should embrace greater use of new and innovative technology?
- What are the practical workforce approaches to selecting and implementing digital tools?
- What are 3 critical pieces of advice we could give utilities to help their workforce in the journey toward an intelligent water system?