What Does The IoT (Internet of Things) & The IIoT (Industrial IoT) mean to Water & Wastewater?

Joe Finn
Wonderware Midwest
Brookfield, WI
IoT defined

- Internet of things
  - the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data:

Examples:
- SmartHome
  - Control a home thermostat from your phone
  - Open a garage door from your phone
  - Self replenishing refrigerators
- Driverless cars
- Wearble IoT
  - Fitbit, Apple Watch, etc.
- Virtual Personal Assistant’s (VPA’s)
  - Amazon Echo (Alexa)
  - Google Home (Hey Google)
  - Apple HomePod (Siri)
Internet of Things in Healthcare
IoT Wearables

* IoT Wearable Photo: Mistral Solutions
The best example of IoT? – Your cell phone

• *MOST Phone App’s are using the Cloud*
  • Weather
  • GPS (your phone is the ‘device’ being tracked)
  • Email
  • Social Media Apps – Facebook, Twitter, LinkedIn, etc
  • Banking

https://www.arcweb.com/blog/what-are-iot-iiot-industry-40

Your smartphone represents a common example in use today that we are familiar with. The phone is an intelligent device that sends data (like GPS location) to applications in the cloud (mapping). The cloud application performs a function, and send results back to your phone (your location and directions to where you want to go).

* ARC Advisory Group
Is there Value in IoT / IIoT

• Tons of money has gone into IoT and there IS payback.
  • The City of Barcelona saved $37 million a year thanks to smart lighting.
  • Barcelona's IoT infrastructure has created 47,000 new jobs

• Cloud is the backbone of IoT: People's comfort level growing as they are already using Cloud with Government, Banks, Healthcare, etc. Kohl's CIO said everything will be in the Cloud by 2021 (for Kohls)

• Analysts project by 2025, data from connected devices (commercial & industrial) will yield insights driving potential economic value as much as $11 Trillion USD *

Barcelona Story link in Appendix

Mind boggling numbers? (hold my beer)

- **Forrester Research** reports workers with Smart Glasses
  - . . . will number 2.6M THIS year!
  - . . . and as many as 14.3M by 2025

- **Gartner**: In 2016 there were 6.4 Billion IoT devices connected
  - *Business Insider* thinks 2020 looks like 23 billion devices connected
  - *Intel* thinks 2020 looks more like 200 billion devices connected

- **More IoT Stats**
  - IoT and IIoT will lead to a 15% increase in productivity
  - 60% of all plants today use IoT Analytics to make decisions
  - By 2020, 70% of Enterprise Software will be on our mobile devices
IoT in our Water & Wastewater plants?

• Little to None – IoT is more Commercial

• Our Water & Wastewater Plants will use IIoT
  • Industrialized version of IoT
IIoT defined

• **Industrial** Internet of things
  • A subset of the broader IoT *
    • To produce physical products (including potable water, clean water, etc)
    • To maintain the physical assets of those plants (tanks, pumps, motors, etc)

• Examples: (Those ‘things’ are your assets)
  • Internet wired Meters, ‘Smart Meters’
  • Machine to Machine (M2M) Devices
  • Tank Level Sensor, Motors, Pumps
  • ANY device with Internet access
  • Everything you use today in the plant, slightly altered

* Source: LNS Research
Questions to Ponder before IoT / IIoT

1) What problem are you trying to solve?
2) Where are you today (technologically speaking)
3) Where do you want to go?
4) Where do you want to start?

• IoT and IIoT are a journey.
  • There is no single part number to order
  • ‘I have $30,000; What Can You Do Around IIoT’
    • What Problem are you trying to solve?
    • Where are you at today. . .
## IoT Segment

<table>
<thead>
<tr>
<th>Segment</th>
<th>Global share of IoT projects¹</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Smart City</strong></td>
<td>![Smart City Graph]</td>
<td>Americas: 34%</td>
</tr>
<tr>
<td><strong>2. Connected Industry</strong></td>
<td>![Connected Industry Graph]</td>
<td>Americas: 45%</td>
</tr>
<tr>
<td><strong>3. Connected Building</strong></td>
<td>![Connected Building Graph]</td>
<td>Americas: 53%</td>
</tr>
<tr>
<td><strong>4. Connected Car</strong></td>
<td>![Connected Car Graph]</td>
<td>Americas: 54%</td>
</tr>
<tr>
<td><strong>5. Smart Energy</strong></td>
<td>![Smart Energy Graph]</td>
<td>Americas: 42%</td>
</tr>
<tr>
<td><strong>6. Other</strong></td>
<td>![Other Graph]</td>
<td>Americas: 50%</td>
</tr>
<tr>
<td><strong>7. Connected Health</strong></td>
<td>![Connected Health Graph]</td>
<td>Americas: 55%</td>
</tr>
<tr>
<td><strong>8. Smart Supply Chain</strong></td>
<td>![Smart Supply Chain Graph]</td>
<td>Americas: 49%</td>
</tr>
<tr>
<td><strong>9. Smart Agriculture</strong></td>
<td>![Smart Agriculture Graph]</td>
<td>Americas: 39%</td>
</tr>
<tr>
<td><strong>10. Smart Retail</strong></td>
<td>![Smart Retail Graph]</td>
<td>Americas: 53%</td>
</tr>
</tbody>
</table>

1. Based on 1,600 publicly known enterprise IoT projects (Not including consumer IoT projects e.g., Wearables, Smart Home).
2. Trend based on comparison with % of projects in the 2016 IoT Analytics Enterprise IoT Projects List. A downward arrow means the relative share of all projects has declined, not the overall number of projects.
3. Not including Consumer Smart Home Solutions. **Source:** IoT Analytics 2018 Global overview of 1,600 enterprise IoT use cases (Jan 2018)

**Source:** IoT Analytics, Jan 2018
Smart City Solutions Portfolio

Optimizing Operational Systems & Empowering Human Systems

**Smart Energy**
- Adv Dist Management & GIS Solutions
- Smart Metering & Demand Response
- Renewables Integration & Micro Grids
- Real-Time Grid Management
- Gas Distribution Management

**Smart Mobility**
- EV Charging & Management Services
- Advanced Traffic Mgt (moving cars)
- Dynamic Tolling & Congestion Mgt
- Integrated Corridor Mgt (moving people)

**Smart Water**
- Distribution Mgt & Leak Detection
- Power, Control & Security Systems Integration
- Stormwater & Urban Flooding Mgt

**Smart Public Services**
- Public Safety
  - Video Surveillance
  - Emergency Mgt
- Digital City Services
  - e-Government
  - Education
  - Healthcare
  - Tourism
- Safe & Smart Streets

**Smart Buildings & Homes**
- City Energy Mgt
  - High-EE Buildings
  - Energy Mgt & Security
  - Energy Services
- Efficient Homes
  - Home Energy Mgt
- Renewables Integration MicroGrids

**Smart Integration**
- Integrated City Management Platform
- EcoDistrict Planning & Implementation
- Security and Energy Managed Services
- Weather Intelligence
Technical Issues around IIoT in our Plants

• Cyber Security Protection
  • Today’s Devices are not smart and not (Cyber) Secure
  • Over time (remember the journey!) we will drop in new layers OR begin to replace these devices as they age and fail

• Advanced Cyber Security is now designed into each device right from the start
  • Digitally signed firmware
  • Disable USB ports
  • Require passwords
  • Refuse actions and send alarms . . . if the device thinks it is being hacked!
Technical Issues around IIoT in our Plants

• New IoT / IIoT Protocols
  • MQTT – Message Queue Telemetry Transport
  • Odata – Open Data Protocol
  • JSON – JavaScript Object Notation
  • REST – REpresentational State Transfer (RESTful API or RESTful web service)
Technical Issues around IIoT in our Plants

‘We build IIoT on existing Infrastructure OR add a layer of Infrastructure on top of existing Infrastructure to capture and collect data.

* Source: LNS Research
The IoT Technology Stack

The IoT Technology Stack

- Device Hardware
- Device Software
- Communications
- Cloud Platform
- Cloud Applications

Managed by you

Managed by provider

Controlled by you

Secure Device Layer
- TPM – Trusted Platform Module
- Secure boot/ Trusted boot
- Secure code update
- Key protection
- Tamper resistance
- Device Management

Secure Communications Layer
- Encryption for Data in Motion (TLS v1.2)
- Unidirectional
- IDS/ IPS / AV / Anti-Malware
- Firewalls
- Data Loss Prevention
- Cloud Access Security Broker (CASB)

Secure Applications & Cloud Layer
- Encryption for Data at Rest
- Authentication
- Authorization
- Identity Management
- CIA Triad

Architecture

Insight powered by Wonderware Online

Process Analytics | Asset Efficiency

Single, outbound, unidirectional encrypted data stream on Port 443 from publisher to cloud.
Architecture

Insight powered by Wonderware Online
Process Analytics | Asset Efficiency

Single, outbound, unidirectional encrypted data stream on Port 443 from publisher to cloud.

Logos:
- sigfox
- Node-RED
- libelium
- MOXA
- Schneider Electric
- Raspberry Pi
- ADVANTECH
Cloud-to-Cloud

Leverage any number of publicly available cloud integration services and data feeds to compliment your industrial data for added context.
What is driving the adoption of IoT & IIoT?

• ‘**Data** is the driving force of the Digital Transformation (IIoT) Adoption’ *

• Devices are important – but only to capture **data**

• IIoT is really all about the **Data. Data** transformed into **Plant Intelligence** – to better run and manage your plant assets.

• ‘**We**’ must ACT on that **data**.
  • ‘**We**’ must ACT on that **data**.
  • ‘**We**’ must ACT on that **data**.

* Source: LNS Research
The IIoT opportunity

Get more people, better actionable information (InSight), faster and easier than ever before ...

... so that they can make better data driven decisions faster, with less skills yet with more impact, all at an attractive price point.
Leading to concrete use cases

• Real-time asset monitoring
  • Reduce time to awareness, action and corrective measures for water and energy efficiency.

• Remote service, diagnostics and troubleshooting
  • Save time by doing more with less. Stretch resources, reduce travel time, eliminate dark spots and operational lag.
  • Let the Asset – and its condition – come to you
  • Doing Rounds? Walk up, blue tooth connect, move to next device. Show up, Connect, Collect!
Leading to concrete use cases

• Collaborative, Self-Serve reporting and dashboards
  • No more bottlenecks and information gaps. Get everyone on the same page, including partners.
  • The data is easy to get at... by ANYone
    • Ask the question: How do I . . . . . ?

• Proactive, Predictive and Prescriptive system generated InSight for assets and process.
  • Reduce skill set needed for higher levels of efficiency, optimization and maintenance on a more consistent basis.
Leading to concrete use cases

• Alexa leaves the house & gets a Job!*

* Source: Gartner THINKCAST Podcast Series
**APM 2.0 Maturity Model with IIoT**

APM = Asset Performance Management

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
<th>Asset Attributes</th>
<th>Car Analogy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescriptive</td>
<td>Model and knowledgebase* identifies an issue and what to do for repair.</td>
<td>Complex assets requiring advanced skills</td>
<td>Dealership-level diagnostic equipment</td>
</tr>
<tr>
<td>Predictive (PdM)</td>
<td>Equipment specific algorithms* or machine learning*. Multivariable.</td>
<td>Critical assets where unplanned downtime has business impact</td>
<td>Battery Management System in electric cars</td>
</tr>
<tr>
<td>Condition Based (CBM)</td>
<td>Alerts for bad trends or other rules-based logic using a single data value.</td>
<td>Assets with a random or unpredictable failure pattern</td>
<td>Oil pressure, coolant temp. indicators</td>
</tr>
<tr>
<td>Preventive</td>
<td>Service in a fixed time or cycle interval</td>
<td>Probability of failure increases with asset use or time</td>
<td>Replace engine oil every 5,000 miles</td>
</tr>
<tr>
<td>Reactive</td>
<td>Run to failure, and then repair</td>
<td>Failure is unlikely, easily fixed/replaced, or non-critical</td>
<td>Radio</td>
</tr>
</tbody>
</table>

Notes:
- Knowledgebase = the underlying set of facts, assumptions, and rules that a computer system has available to solve a problem
- Algorithm = a formula, process or set of rules to be followed in calculations or other problem-solving operations
- Machine learning = software that provides computers with the ability to learn without being explicitly programmed

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* ARC Advisory Group
IIoT Having Impact?

- State of the Water Industry

**TABLE 2** Top 20 issues facing the water industry as ranked by all respondents

<table>
<thead>
<tr>
<th>Rank</th>
<th>Category</th>
<th>Score</th>
<th>Critical %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R&amp;R of aging water and wastewater infrastructure</td>
<td>4.53</td>
<td>63</td>
</tr>
<tr>
<td>2</td>
<td>Financing for capital improvements</td>
<td>4.42</td>
<td>59</td>
</tr>
<tr>
<td>3</td>
<td>Long-term water supply availability</td>
<td>4.39</td>
<td>57</td>
</tr>
<tr>
<td>4</td>
<td>Public understanding of the value of water systems and services</td>
<td>4.34</td>
<td>54</td>
</tr>
<tr>
<td>5</td>
<td>Public understanding of the value of water resources</td>
<td>4.22</td>
<td>45</td>
</tr>
<tr>
<td>6</td>
<td>Watershed/source water protection</td>
<td>4.18</td>
<td>46</td>
</tr>
<tr>
<td>7</td>
<td>Emergency preparedness</td>
<td>4.10</td>
<td>37</td>
</tr>
<tr>
<td>8</td>
<td>Cost recovery (pricing water to accurately reflect its true cost)</td>
<td>4.04</td>
<td>35</td>
</tr>
<tr>
<td>9</td>
<td>Public acceptance of future water and wastewater rate increases</td>
<td>4.01</td>
<td>34</td>
</tr>
<tr>
<td>10</td>
<td>Water conservation/efficiency</td>
<td>4.00</td>
<td>36</td>
</tr>
<tr>
<td>11</td>
<td>Groundwater management and overseen</td>
<td>3.98</td>
<td>35</td>
</tr>
<tr>
<td>12</td>
<td>Aging workforce/anticipated retirements</td>
<td>3.98</td>
<td>40</td>
</tr>
<tr>
<td>13</td>
<td>Asset management</td>
<td>3.91</td>
<td>26</td>
</tr>
<tr>
<td>14</td>
<td>Talent attraction and retention</td>
<td>3.91</td>
<td>30</td>
</tr>
<tr>
<td>15</td>
<td>Improving customer, constituent, and community relationships</td>
<td>3.91</td>
<td>29</td>
</tr>
<tr>
<td>16</td>
<td>Data management</td>
<td>3.91</td>
<td>29</td>
</tr>
<tr>
<td>17</td>
<td>Governing board acceptance of future water and wastewater rate increases</td>
<td>3.91</td>
<td>32</td>
</tr>
<tr>
<td>18</td>
<td>Drought or periodic water shortages</td>
<td>3.90</td>
<td>33</td>
</tr>
<tr>
<td>19</td>
<td>Water loss control</td>
<td>3.90</td>
<td>26</td>
</tr>
<tr>
<td>20</td>
<td>Compliance with current regulations</td>
<td>3.87</td>
<td>26</td>
</tr>
</tbody>
</table>

R&R—renewal and replacement

\( n = 1,647 \)

\(^4\) Average rating of issue importance where 1 = unimportant, 2 = slightly important, 3 = important, 4 = very important, and 5 = critically important
Having significant impact

• On Energy
  • U.S. drinking water and wastewater systems spend about $4 billion/yr on energy to pump, treat, deliver, collect and clean water – at ratepayer and municipal expense.

  • Nationwide, drinking water and wastewater systems use 75 billion kilowatt hours/yr – as much as the pulp and paper, and petroleum industries combined (enough electricity to power 6.75 million homes/yr).
So... why not use ‘Apps’ at work?
data anomaly newsfeed
high resolution process trends
easy to: share, embed, export, mobilize, collaborate.
plot up to six (6) tags

toggle tags on/off
Notify me when Turbidity is greater or equal to 0.5

is greater than

is equal to

is not equal to
Configurable push notifications

single location to view all active alerts across reports
Quickly assess running process ‘in-spec’ or ‘out-of-spec’ by enabled ‘zones’
Key takeaways

• **Connect** all the things (but start small)
  • to see better and understand faster

• **Empower** your people in the plant & in the field
  • to become more productive, in *their* context

• **Leverage** technology & culture for an edge
  • to achieve better results, faster and cheaper
  • to acquire new capabilities to become stronger
  • to attract young(er) talent
Getting Started with IIoT

• Start with a problem
  • ‘Start with function, not technology’ *
  • ‘IIoT must add value – not just replacing old technology’ *
  • “Without Value tied to it, it is just a science project” **

• Get educated
  • YouTube boasts 12,000+ videos with a simple “IIoT” search.

• Have a plan. . . . Any plan . . And start small
  • Innovate in small, incremental steps

• Mine the data you already have
  • Stop ‘Drowning in your own data.’ Mine it!
  • Get ‘Predictive’ on your Assets

• If you partner with someone, how well do they know IIoT??
  • Can they spell IIoT? What is their experience to date?

• IIoT is a journey, not a single project.

* Peter Martin – Schneider Electric
** Steven Meyer – Intel – National Mfg Tech Show, May 2017
‘This year we crossed the point where more than 50% of ‘things’ connected to the internet were NOT tablets or phones.’ *
The future is now.

How are you staying competitive | relevant | differentiated
Let’s continue the discussion.

Joe Finn

d 262-432-1081
c 414-303-1529
joe.finn@wonderwaremidwest.com

* Copy of Slide Deck available with additional IIoT articles and resource links
Additional Resources

- IIoT World with Lucian Fogoros

- An Executive’s Guide to the Internet of Things
  - [http://tinyurl.com/yc32jalc](http://tinyurl.com/yc32jalc)

- Improved Asset Management with IIoT (Ralph Rio, ARC Research)
  - [https://www.youtube.com/watch?v=C5oawvflJdI](https://www.youtube.com/watch?v=C5oawvflJdI)

- Controlling the IIoT – How the Industrial Internet of Things is changing the role of the Control Engineer. (John Boville, Schneider Electric)

- Integrating the IIoT – How the Industrial Internet of Things will help System Integrators deliver on the promise of a connected enterprise

- How Smart City Barcelona brought the Internet of Things to life
Connecting vast amounts of data, providing context and analysis to prescribe the appropriate actions.

- Improve asset performance
- Increase reliability and reduce unscheduled downtime
- Increase asset utilization and extend equipment life
- Reduce operations and maintenance costs

Maximize Economic Return on Assets
Closed Loop Asset Performance Management
The Digital Asset Journey
Improving Equipment Health & Process Efficiency

**Real-Time Analytics**
- **What’s Happening**
  - Processing of real-time operational data
  - Rule based inference for causal analysis
- **Real-Time Domain**

**Historical Analytics**
- **What Happened**
  - Assessment and exploration of historical operational data
  - Trends, KPIs, Dashboards to present abstracted views
- **Historical Domain**

**Predictive Analytics**
- **What If**
  - Comprehensive model based assessment of operational data ranges to determine potential outcomes.
  - Deterministic or non-deterministic models
  - Open-loop simulations
- **Science Domain**

**Prescriptive Analytics**
- **What’s Needed**
  - Systems that synthesize, predict and provide scenario-based guidance
  - Deterministic or non-deterministic models or learning elements
  - Closed-loop algorithms
- **Artificial Intelligence Domain**

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The Digital Asset Journey:
Improving Equipment Health & Process Efficiency

**Complexity**
- Real-Time Analytics
- Historical Analytics
- Predictive Analytics
- Prescriptive Analytics

**Value**
- Life Is On
- Schneider Electric