This material is shared as a learning resource to promote awareness and good practice in the provision, use and management of water resources for sustainable social and economic development and maintenance of African ecosystems.

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Practical Insights to SWM Deployment in Utilities

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Ⅰ. Water Supply History of Korea
Ⅱ. Recent Issues & SWM
Ⅲ. Experiences of SWM
I. Water Supply History of Korea
Water Supply History

- **Late Period of Chosun (1900~1910)**
  - Construction of Dduk-do WTP (1908)
  - Capacity: 12,500 CMD

- **Period of Japanese Occupation (1910~1945)**
  - Spread of WS systems (83 cities with 2 mil. in 1945)
  - Capacity: 272,000 CMD

- **Economic Development (1950~1990)**
  - Coverage: 18% (1962) → 77.3% (1990)
  - Spread of WS systems (83 cities with 2 mil. in 1945)
  - Capacity: 272,000 CMD (1945)

- **Recent Years (1990~2017)**
  - Coverage: 98.8% (2017)
  - Capacity: 32,591,000 m$^3$/d
  - Restoration & Enlargement of WSS
  - Multi-regional & Industrial WSS

- **Recent Years: Restoration & Enlargement of WSS**
  - Multi-regional & Industrial WSS
  - Coverage: 98.8% (2017)
  - Capacity: 32,591,000 m$^3$/d
Historic Development of Waterworks

1900~1910

The first Waterworks in Seoul

1910~1945

MyeongJang WTP (1942, Pusan)
Historic Development of Waterworks

1950~1990

Multi Regional Water supply (1970)

Water Treatment Plant (2000)

1990~2014
1. K-water overview

Concept of Korean Water Supply Systems

- "Treated water"
  - App. 50% of total supply
  - 161 local governments

Local Systems
- 161 local governments
- App. 50% of total supply

Regional Systems
- K-water
- App. 50% of total supply
Components of Water Consumption

Basic statistics of water use components

<table>
<thead>
<tr>
<th>component</th>
<th>Data(n)</th>
<th>Mean</th>
<th>Std.</th>
<th>1-quartile</th>
<th>3-quartile</th>
<th>C V</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washbowl</td>
<td>98,330</td>
<td>15.43</td>
<td>17.07</td>
<td>4.50</td>
<td>20.68</td>
<td>1.11</td>
<td>0.00</td>
<td>272.07</td>
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<tr>
<td>Bathing</td>
<td>94,153</td>
<td>24.73</td>
<td>25.13</td>
<td>6.25</td>
<td>35.33</td>
<td>1.02</td>
<td>0.00</td>
<td>331.63</td>
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<tr>
<td>Kitchen</td>
<td>87,911</td>
<td>28.37</td>
<td>23.94</td>
<td>12.42</td>
<td>38.00</td>
<td>0.84</td>
<td>0.00</td>
<td>276.50</td>
</tr>
<tr>
<td>Laundry</td>
<td>96,436</td>
<td>30.76</td>
<td>47.93</td>
<td>0.00</td>
<td>51.47</td>
<td>1.56</td>
<td>0.00</td>
<td>300.45</td>
</tr>
<tr>
<td>Toilet</td>
<td>109,149</td>
<td>38.46</td>
<td>27.29</td>
<td>21.27</td>
<td>48.88</td>
<td>0.71</td>
<td>0.00</td>
<td>379.90</td>
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<tr>
<td>misc.</td>
<td>25,955</td>
<td>13.50</td>
<td>58.48</td>
<td>0.00</td>
<td>9.88</td>
<td>4.33</td>
<td>0.00</td>
<td>4,752.48</td>
</tr>
<tr>
<td>Total</td>
<td>49,971</td>
<td><strong>151.3</strong></td>
<td>113.98</td>
<td>91.17</td>
<td>217.35</td>
<td>0.69</td>
<td>0.00</td>
<td>1,478.15</td>
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</table>

% of water use components

<table>
<thead>
<tr>
<th>End-use</th>
<th>Toilet</th>
<th>Laundry</th>
<th>Kitchen</th>
<th>Bathing</th>
<th>Washbowl</th>
<th>misc.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water uses</td>
<td>38.5</td>
<td>30.8</td>
<td>28.4</td>
<td>24.7</td>
<td>15.4</td>
<td>13.5</td>
<td>151.3</td>
</tr>
<tr>
<td>Ratio (%)</td>
<td>25.4</td>
<td>20.4</td>
<td>18.8</td>
<td>16.3</td>
<td>10.2</td>
<td>8.9</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Ⅱ. Recent Issues & SWM
Tap Water Drinking Issues

Past Water Issues

- State of Development
  - ✔ Water infra expansion
  - ✔ Improving water quality

Current Water Issues

- Increased risk of WQ in water resource
  - ✔ Climate changing and Urbanization (Increase of pollution)
- Aged-infra & inadequate O&M
  - ✔ Water quality deterioration due to aged pipe, etc.

Until 1990’s

- State of Development
- Unexpected issue
  - ✔ Phenol spillage on Nakdong River

1991

- State of Development
- Unexpected issue
  - ✔ Phenol spillage on Nakdong River

Up to now

- State of Development
- Unexpected issue
  - ✔ Distrust tap-water quality
  - ✔ Increasing of water purifier

How to use of drink water

- Directly drinking Tap-water: 5.4%
- Bottle water: 15.1%
- Etc. (boiled water): 33.0%
- Usage of water purifier: 46.5%

Reasons why don’t drink Tap-water

- Concerns about water resource: 28.1%
- Distrust of water tank & pipe: 24.0%
- Particle & Smell: 30.8%
- Negative media release: 10.4%
- The others: 6.7%
Needs for Higher Standards

**Highest Level of Coverage, Lowest Tap Water Drinking Ratio**

- **Almost 100% of Water Supply Coverage**
  - Change of Coverage: 77.3% in 1990 → 87.1% in 2000 → 98.8% in 2017

- **Need for High Quality Water** (Tap Water Drinking Ratio: 5%, 2013)

**Water Supply Coverage of OECD Countries (2015)**

- AU: 99.7%
- DE: 99.5%
- KR: 98.1%
- JP: 97.5%
- DK: 97.2%

*Note: In this case, those who respond 6 or over on a 10-point scale of satisfaction are considered to be "satisfied".*
4th Industrial Revolution in Korea

Water industry and 4th industrial revolution

**Automation**
- Water treatment plant
- Environmental monitoring
- Pollution prevent facility
- ...

**Informatization**
- Waterworks quality monitoring DB
- Water environment monitoring DB
- Watershed characteristics
- ...

**Intelligence**
- Water treatment plant operation
- Water environment monitoring
- Water supply source monitoring
- ...

Integrated water management with big data, deep learning, ICT, IoT, cloud computing ...
Motivation

**Why should we introduce Smart Water Management?**

- **Regional deviation of production cost**
  - 4,839 KRW (4.4 USD)/m³
  - 461 KRW (0.5 USD)/m³

- **Imbalance of raw water sources**
  - Only 18% of local cities have their own sources

- **Increase of customer complaints**
  - Customer needs & expectation
  - O&M cost

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**What is Smart Water Management?**

*A future-oriented water management strategy by ICT-based technologies, for securing the stability, safety and efficiency of water systems*

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**Why Smart Water Management?**

*Needs for more efficient & sustainable method for water security through the improvement of facilities and O&M efficiency*
Definition & Components of SWM

Contributions

- Water quantity & quality Mgmt. from source to tap using SICT
- Confidence increase by providing of WQ information to consumers

Components

Smart devices

Smart solutions

Smart services

Total care Service (water quality test, Inspection of pipe)
Ⅲ. Experiences of SWM
SWC pilot project

- A city which is implemented with a smart water management system
- Pursuing scientific management adopting ICT to manage water from the source to the tap

- Located in the center of the Korean Peninsula (adjacent to the DMZ)
- Population of target area: 37,000
- Coverage: 95%
- Daily average supply: 14,000 m³
- NRW: 14%
- Comparable to various population density and urbanization levels
1. **K-water overview**

**Smart Water City**

- Establishing Water-Net system to control the whole process of water supply
- Setting up the measuring instruments to monitor water quantity and quality
- Installing re-chlorination equipment to improve the taste and odor
- Cleaning the inner pipeline and draining automatically in vulnerable zone

**Water Quality Control of the Supply Chain**

- Real-time monitoring
- Diagnosing the inside of pipelines
- Pipeline cleaning
- Automatic drain
- Normalization of Chlorination
1. **K-water overview**

**Smart Water City**

- Providing real-time pH, turbidity, and chlorination data for tap water
- Electronic display boards were installed in the village & APT. complexes
- A specialized smartphone application was developed
- Improve tap water reliable and encourage people to directly drink

**Providing Water Quality Information**

- Display panel for WQ information
- To inform hourly & daily water usage, fare
- To show water quality at main point in water supply
- To manage bidirectional notice & complaint board
Smart Water City

Customer Satisfaction Activities

- Diagnosing and cleaning the pipes inside of houses
- Providing on-site water quality analysis services
- Installing public water fountains to encourage people to drink the tap water
- Promoting tap water drinking activities with NGOs and SNS supporters
Smart Water City

Achieved Outcomes

- Enhancing the direct tap water drinking rate from 1% to 36%
- Improving the customer satisfaction rate from 55% to 92%
- Reducing customer claims from 4.5 to 1.3 cases a month
- Equalization of residual chlorination along the whole supply chain
Smart Metering

Installation & Operation of 1,620 smart meters in Seosan city

Installation & Operation of 32 smart meters in Goryeong province

Remote Reading Unit

Digital Flow Meter
Application of Smart Metering Data

Leakage detection in pipe network

24 hr ahead prediction

Emergency allocation 25/1/01
Application of Smart Metering Data

Abnormality and indoor leakage detection

Water use variation in residential & commercial area

Indoor leakage detection
Prevention of pipe burst and leakage detection

**Songsan Green City by Smart Pipes**

**Hardware**
- Maintenance Books
- Software System Update
- Repair Products
- Labor Maintenance

**Software**
- Songsan Green City by Smart Pipes

**Maintenance**
- Repair Products
- Labor
- System Update
<table>
<thead>
<tr>
<th>Summaries</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximization of Limited Water Resources</strong></td>
<td>SWM provides the optimal utilization system by combining every water resource available. Water can be provided and reused wherever necessary without construction of large scale infrastructures</td>
</tr>
<tr>
<td><strong>Reducing Leakage and Incidents through Comprehensive Monitoring</strong></td>
<td>SWM is capable of identifying leakage incidents through information collected from smart devices. Improved response time to incident and pressure management is reducing the risk of incidents</td>
</tr>
<tr>
<td><strong>Facilitation of Water &amp; Energy Savings</strong></td>
<td>SWM is capable of accurately predicting the needs and appropriate coordination of production and supply through the ICT-based analysis. As such, water and energy savings can be promoted.</td>
</tr>
</tbody>
</table>
Thank you for attention!!