K-water's SWM Solution for Water Quantity Management

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K water

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K water

I. SWM Issues

◈ **How can we maintain the smart infra and device?**

◈ **What kinds of smart solutions should be developed?**
  * Physical model analysis, data driven analysis

◈ **What kinds of objectives are appropriate for SWM?**
  * Water loss control program, water quality integrity, the relationship with consumers

II. Smart Solutions

◈ **From data to value in the water supply system**

　　* flow, pressure, vibration, acoustic sound, movement, and etc.

◈ **Importance of smart solution for water utilities**
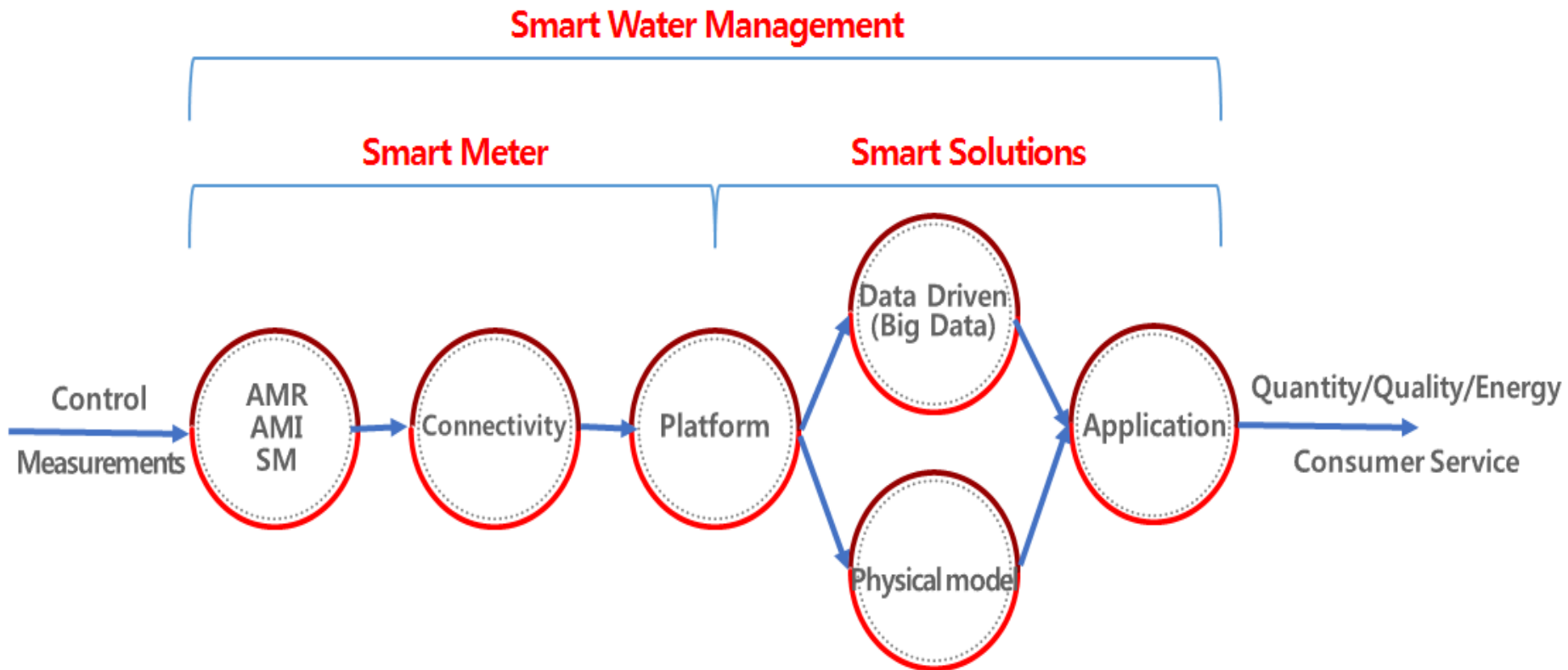
II. Smart Solutions

◈ **Extracting value from data is very complicate and difficult, requires expertise**

◈ **Long term efforts are necessary to summarize the accumulated know-how**

◈ **Solution is perceived as the most suitable tool to show the technological capacity of a company**

Sensors, Smart Pipes, Smart Meters

Data Storage, Cloud

Data transfer

Data Collection → Data Dissemina-tion → Data Integration with Historical Data → Modelling and Analytics → Visualization → Management and Control → Decision Support

Data Quality Control

Physically-based Models Data Driven Analysis

Decision Making
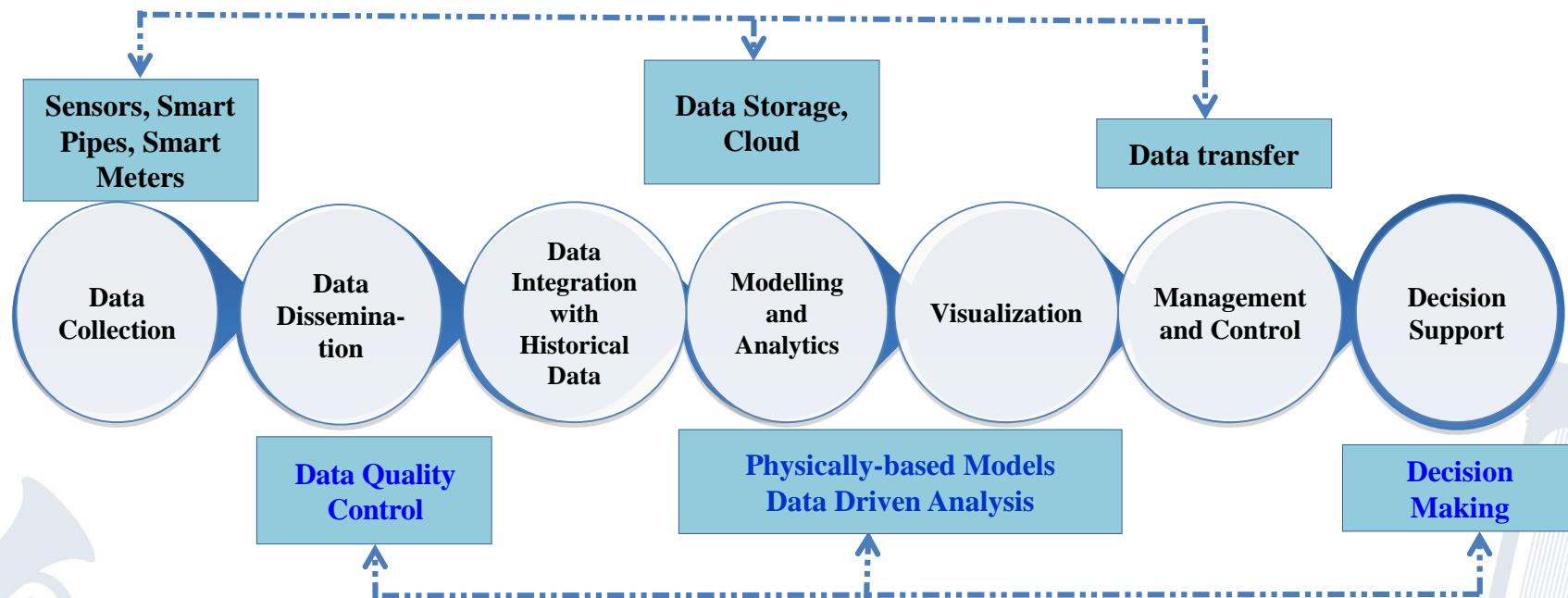
III. O&M Management System

Asset Management System

Finance Management System

Water Network O&M Management System

Design & Construction

- LCC analysis
- Durability
- Vandalism & theft prevention
- Material selection
- Workmanship & construction quality control

- Provide system redundancy
- DMAs construction
- PMZs consideration
- Flow velocity guideline satisfaction
- Water Hammer protection
- Minimize water age

- Storage reservoirs
- Material selection
- Dead-end mains
- Construction procedures
- Sewer pipe placement

Operation

- Proper operational settings
- Operated within capabilities
- Information on state
- Regulation & Bylaws compliance
- Operation strategy compliance
- Records

- Monitoring & Assessment (audit)
- Hydraulic model building & analysis
- Pressure management for regulation satisfaction, NRW reduction and energy saving
- Water metering

- Risk assessment
- Monitoring (routine, recover, receiving water quality)
- Maintaining disinfectant residuals (Re-chlorination, automatic drain)
- Emergency response (water safety plan)

Maintenance

- Condition monitoring
- Preventative maintenance
- Protection of system environment
- Corrosion control
- Cross connection & Backflow prevention
- Records

- Flushing or cleaning of pipes
- Active leak detection & leakage awareness
- Repair (fast, QC, records)

- Cleaning & flushing pipes
- Disinfection & flushing procedures compliance
- Regular cleaning of strainers

Objectives

Physical Integrity

Hydraulic Integrity

Water Quality Integrity

Mgmt. proc. structure

| Systems | Procedures | Rules | Rules of Thumb |

| Planning | B/C Analysis | Implementation & Feedback | Integration | Accountability |

Assessing Status

| Evaluation | Reporting | PIs | Information collection |

Information System
- Integrated System (customer, bill, etc.)
- SCADA, SWM
- GIS
- Network operating & diagnosis system
- CMMS (Asset)

Operating System
- Quantity mgmt.
- Pressure mgmt. (Energy saving)
- Quality mgmt.
- Risk mgmt.

Facility Management System
- Degradation module
- Risk module
- Financial & economic module
- Decision module

Customer Service System
- Communication with customers
- Billing
- Customer complain management

Training & Technical Support System
- Centralized education center
- Decentralized Technical Support

O&M Framework, Implementation and Good Partnership

Implementation

Framework

- Systems
- Procedures(Guidance materials)
- Rules
- Rules of thumb

- Identification
- Selection
- Design
- Construction
- Monitoring
- Evaluation

Good Partnership

- Effectiveness
- Efficiency
- Accountability
- Transparency
- Fairness
- Participation
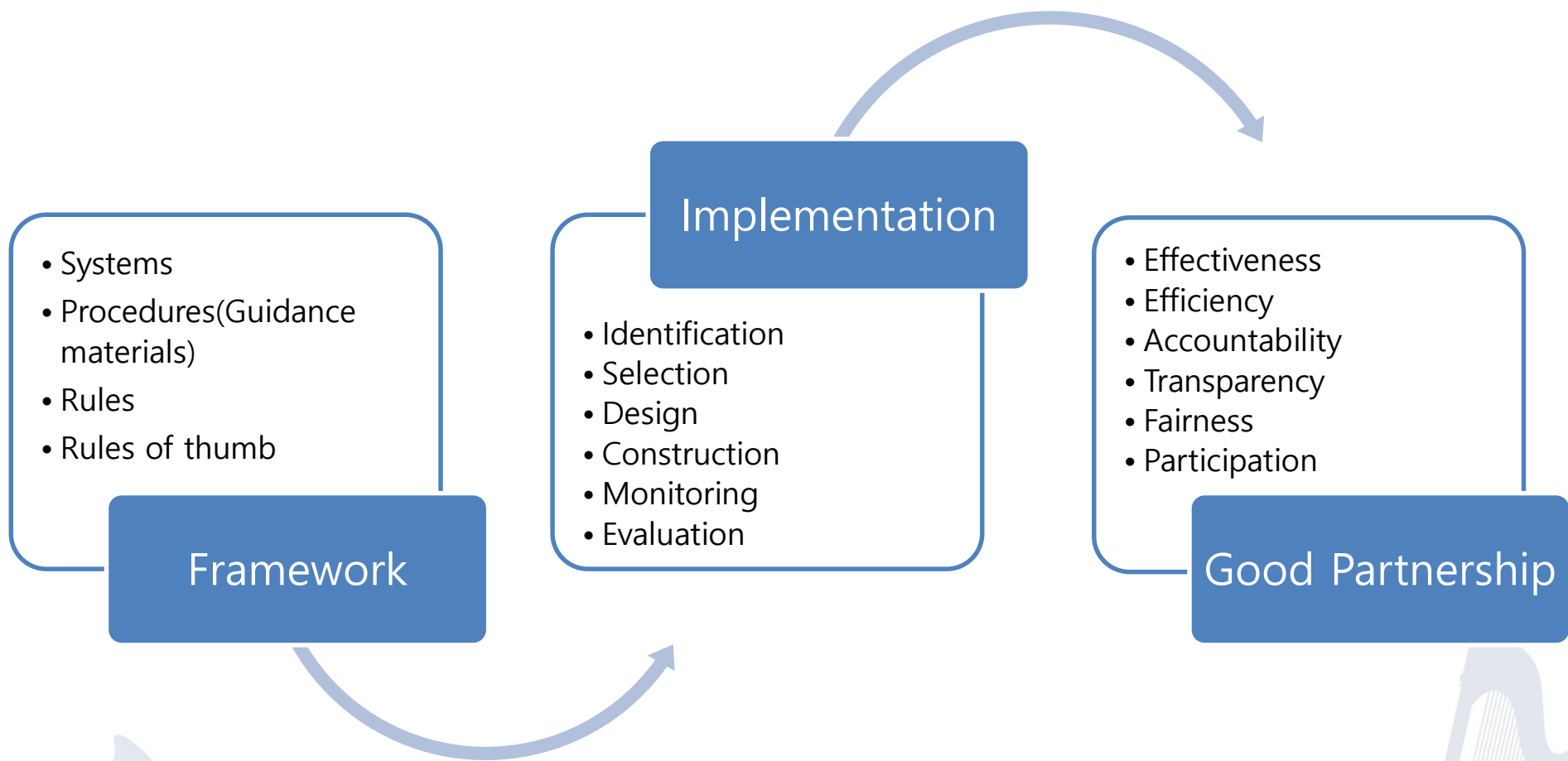
◈ **Water Quantity management(i.e. water loss management) is mainly composed of assessment, detection, and control**

◈ **With Smart meter, the awareness part is on the rise**

Water Loss Management

Assessment | Detection | Control

Awareness | Magnitude & Localization

Performance Indicator
Top-down Method
Bottom Method

Data Driven Analysis
Hydraulic Model-based

Deterministic
Stochastic

Equipment-based method Direct/Indirect
Time Series Analysis
Pressure Dependent Analysis
Inverse Method/ Inverse Transient Method
Stochastic Method

Passive(reactive)
Active (Pressure/flow control)
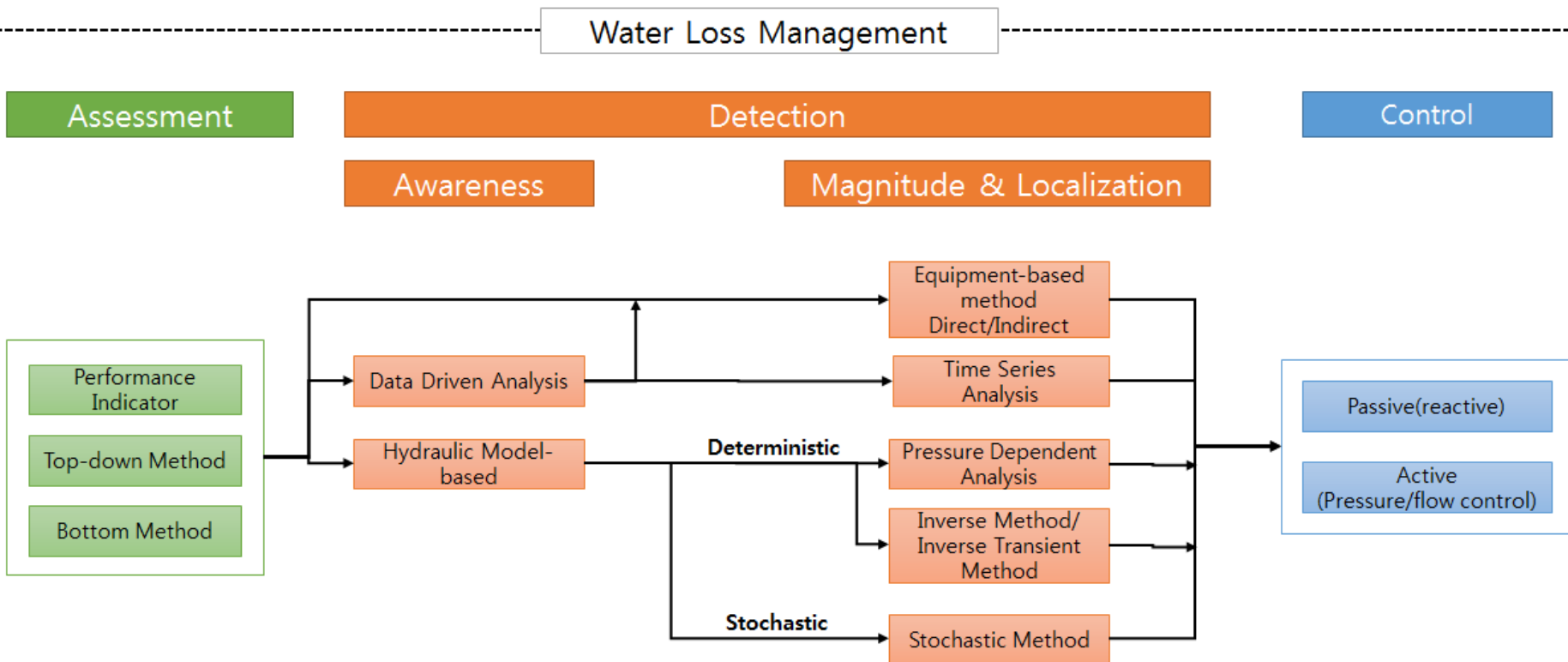
◈ **To detect the event, several data driven method are suggested and implemented using smart meter data**

◈ **Statistical process control, traditional time series analysis, and pattern recognition method are evaluated**
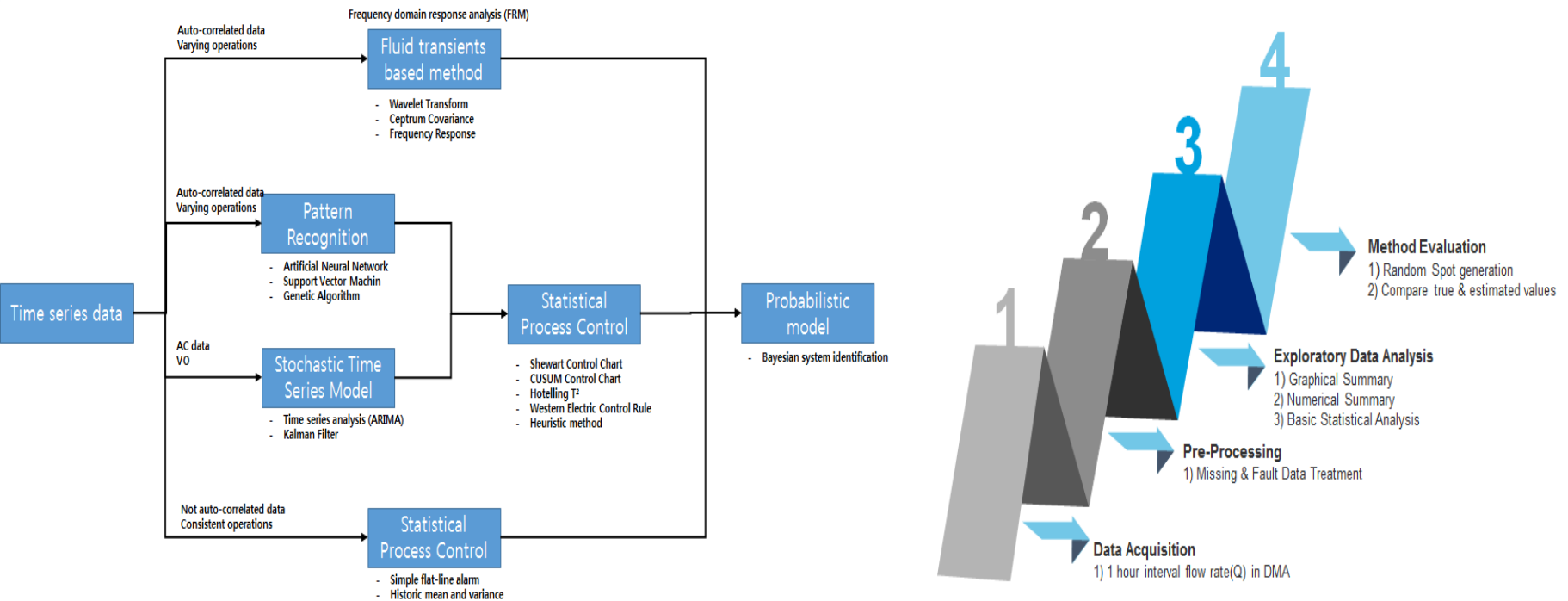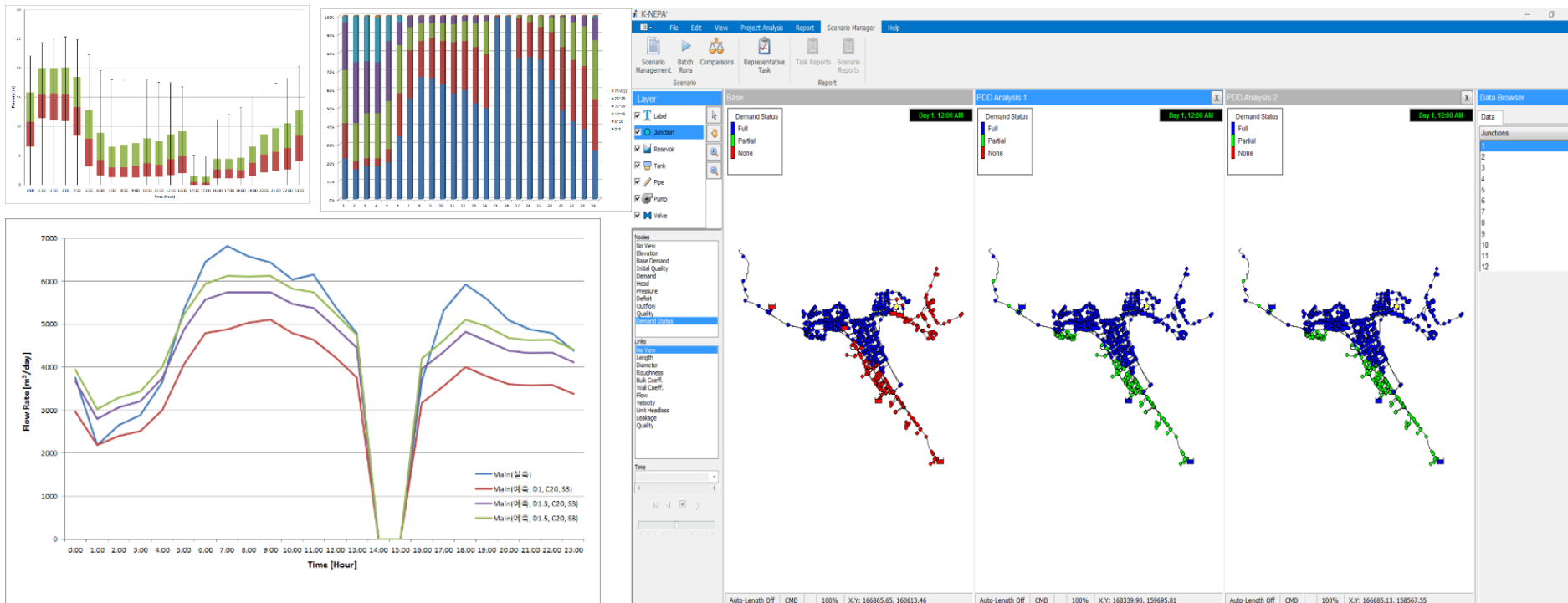
�æ **Solution using pressure driven analysis has been developed to estimate leakage amount**

    * burst, unreported real loss, reported real loss

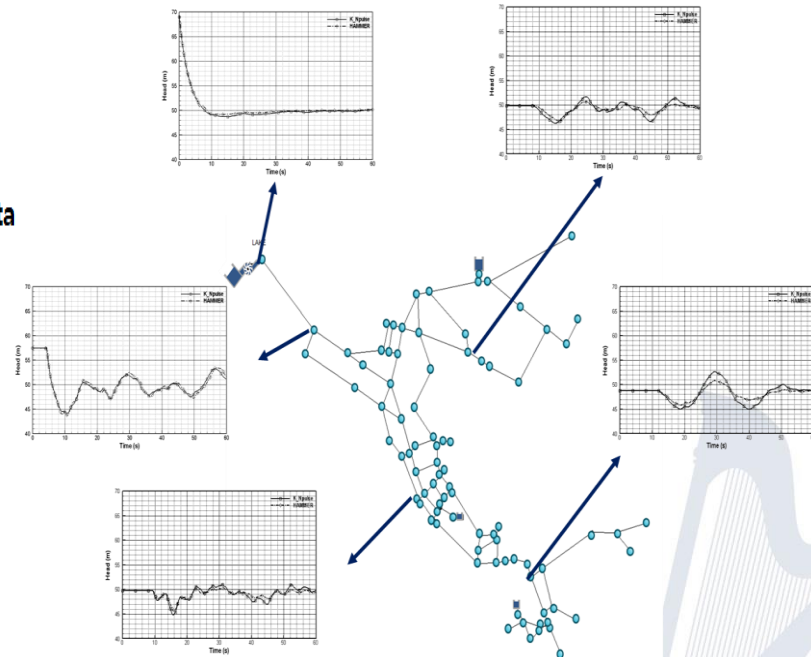◆ **This solution can be used to respond to risk**

◆ **In event case, pressure is change rapidly because of high wave speed**

◆ **By using high frequency smart pressure meter and Inverse transient analysis solution, water utility can pinpoint the event location and magnitude**

Forward Transient Analysis (FTA)

① Leak location & size
② Pipe roughness
③ Friction coefficient
④ Creep coefficient
⑤ Air cavity volume

INPUT → Transient Flow System → OUTPUT → Transient data

Inverse Transient Analysis (ITA)

① FTA
② Optimization model
  - Simple sum of least square
  - Weight sum of least square
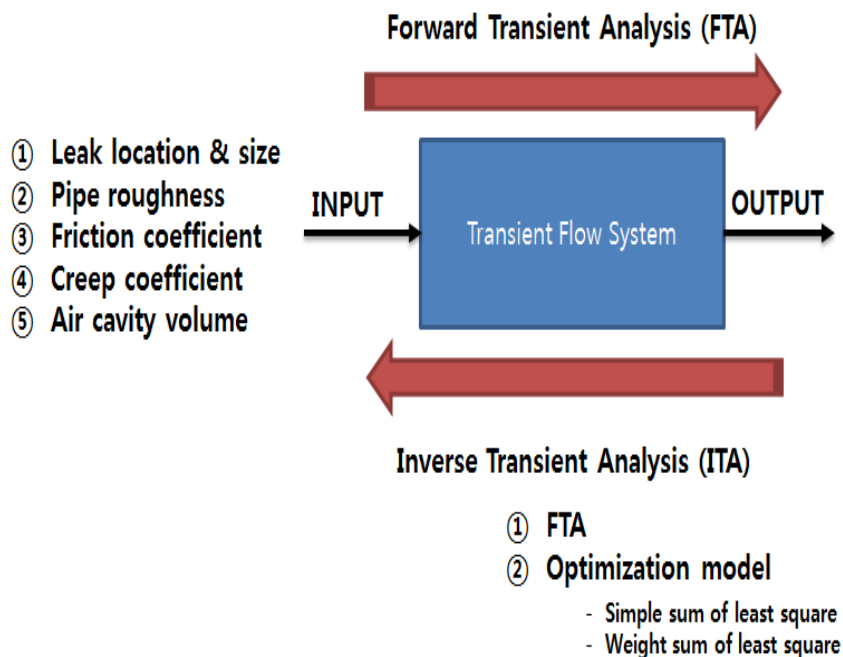
Partnership Establishment
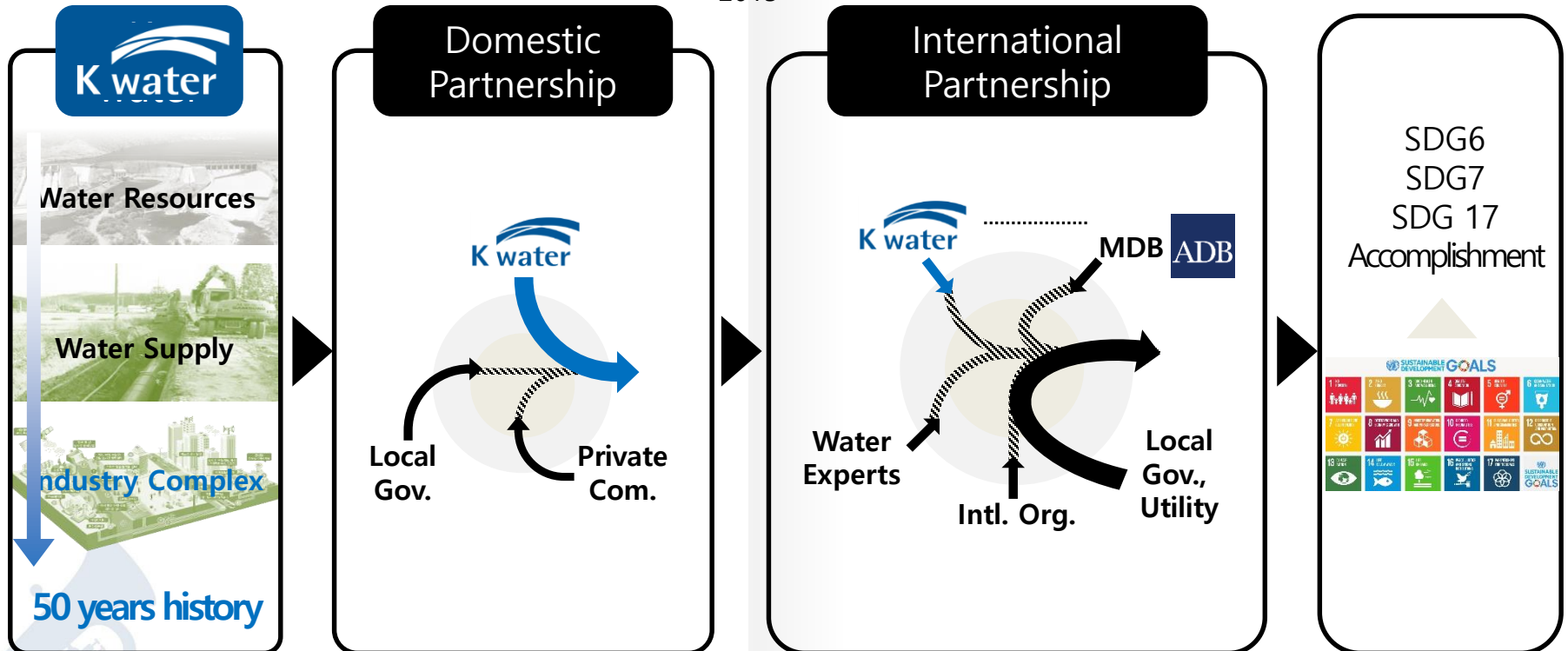
Partnership is very effect tool for improving O&M efficiency

"K-water" – "local gov." – "local util." – "private company"

Conclusions

◈ There are various issues such as SM maintenance, smart solution, SWM implementation

◈ With SWM, water utilities can operate the system more efficiently, but it don't guarantee for water utilities to operate the system more easily

◈ The objectives and designs of SWM should be suggested with considering current system state

◈ Following the implemented SWM, appropriate smart solution should be developed for successful SWM