

Seoul Water's HRD Plans for Digital Transformation



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- II. Computer Systems in SW**
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I. Introduction to Seoul Water



1. Introduction to Seoul Water

Population

9.64M



Production

3.05M/day



**Monitoring Water
Quality**

527 locations



Length of Water Pipes

13,350km



**Distribution
Rate**

100%



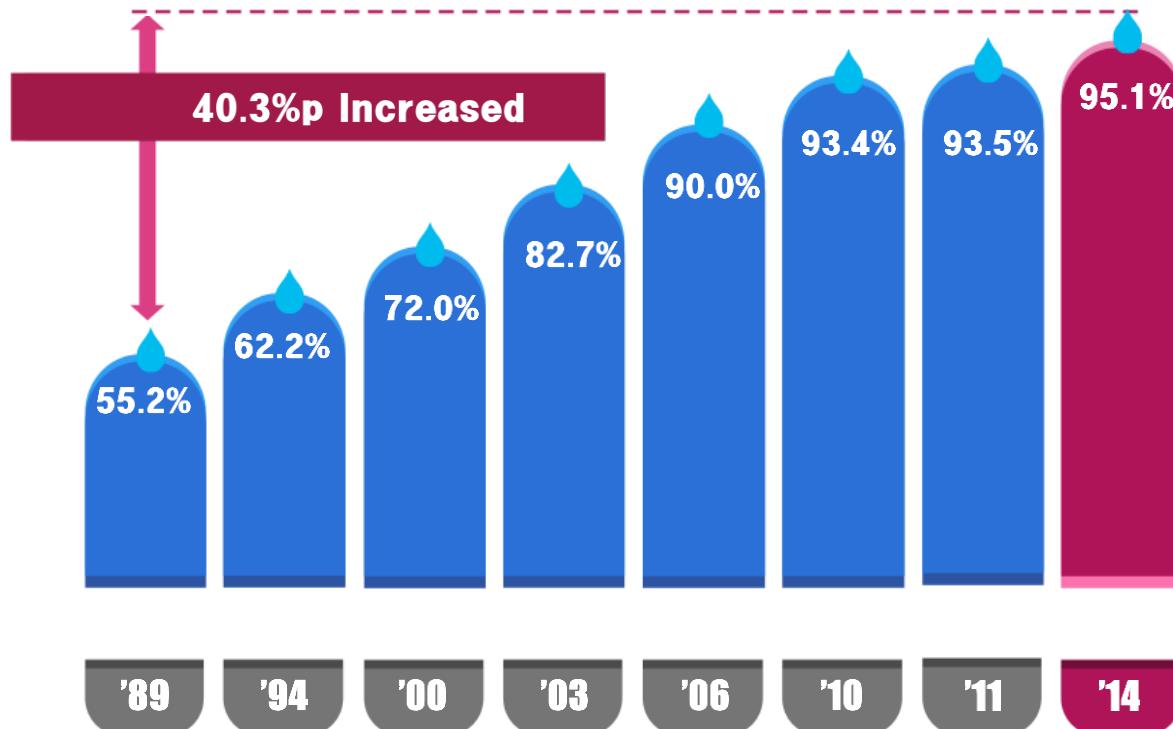
**Revenue
Water Ratio**
95.3%



2. Revenue Water Ratio

- Revenue Water Ratio(RWR)

- Started 55.2% in 1989 and Reached 95.5% in 2017(26 years)
- Until now have Kept NRW staying over 95.0%



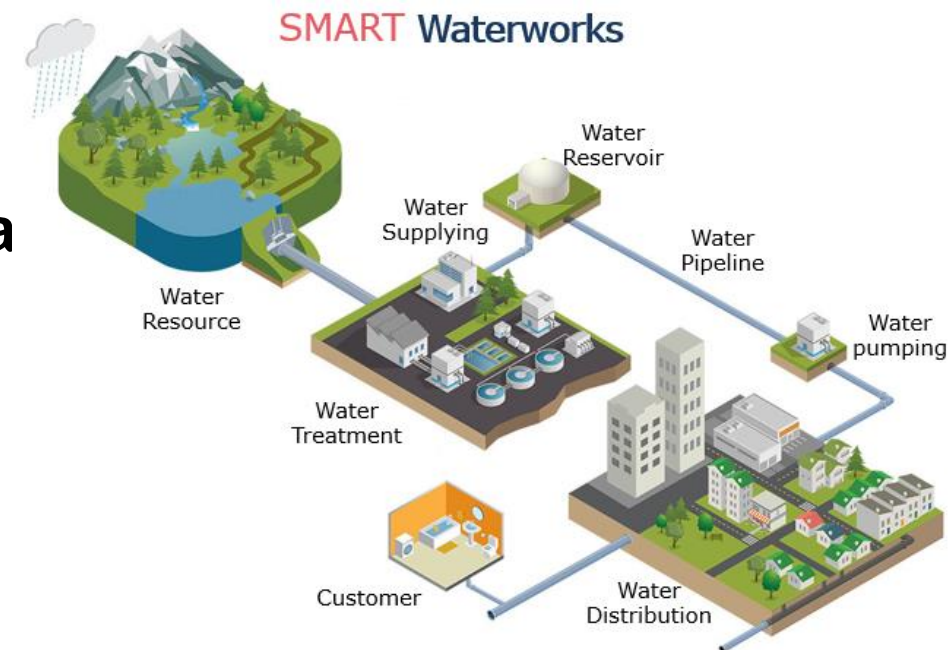
- Annual Water Production Decreased from 1.635B ton in 1989 to 1.112B ton in 2022
=> Decreased about 32%
- Carbon Emissions Reduced by 2.767M tons
- WTPs Decreased from 10 to 6

II. Computer Systems in SW



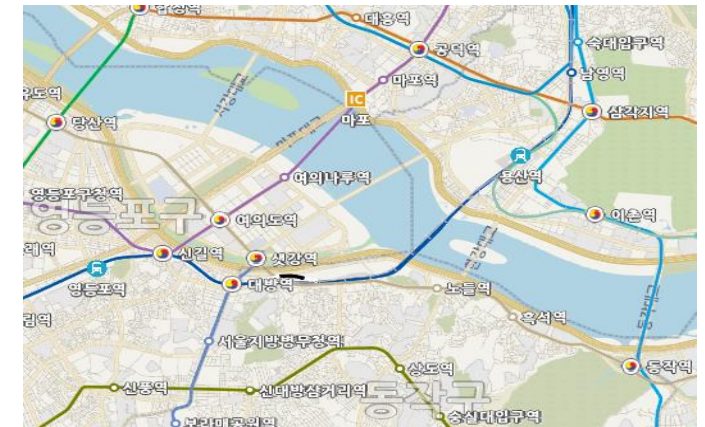
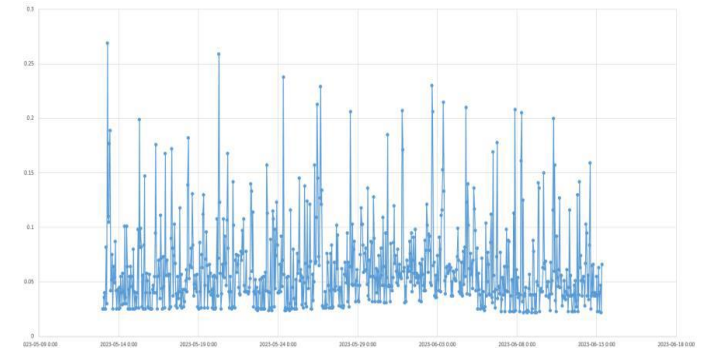
1. Computer Systems in SW

- (Production) Systems for drinking water treatment plants
 - Controlling and Monitoring processes
 - Number of tags are about 100,000.
- (Supply) GIS, Water Management Information Sys, AMI Sys
- (Water Quality) Seoul Water Now
- (Billing) Arisu Info System
 - Total Accounts, Water Consumption Data
- Customer Support System
 - Handling customer complaints (water bill, leak, rusty water, etc)



2. Characteristics of Data

- (Asset) Purchase Date, Price, Manufacturing Company,...
- (M&O) Time Series, Diagnostic Report,
- (Billing) Accounts No., AMI
- (Pipes) GIS, Leak, Flushing, Block System
- (Production) Water Quality, Flow Rate,
Processes Monitoring
- (Water Quality) GIS, Turbidity,



III. Big Data Analytics Examples and Challenges in SW

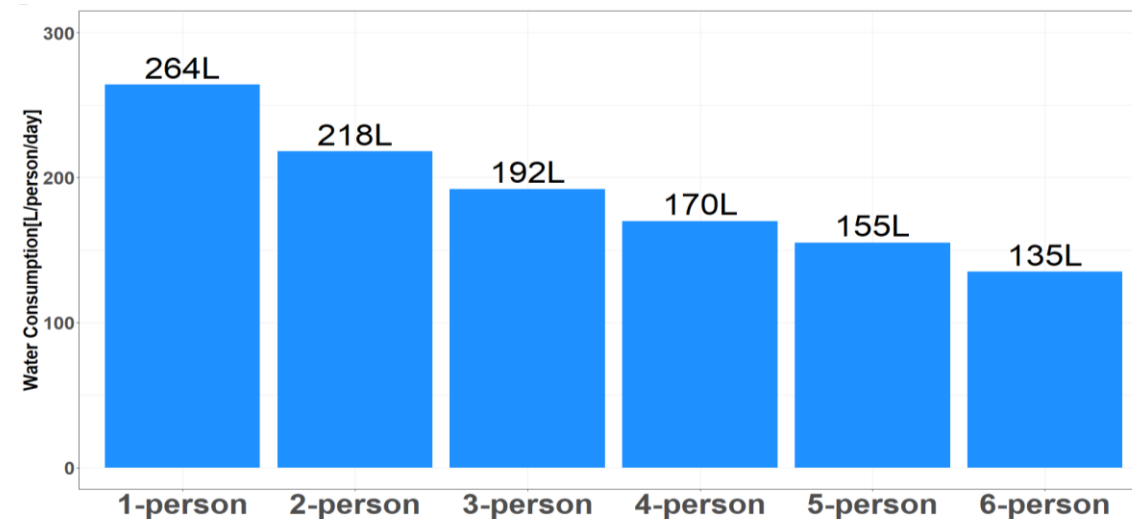
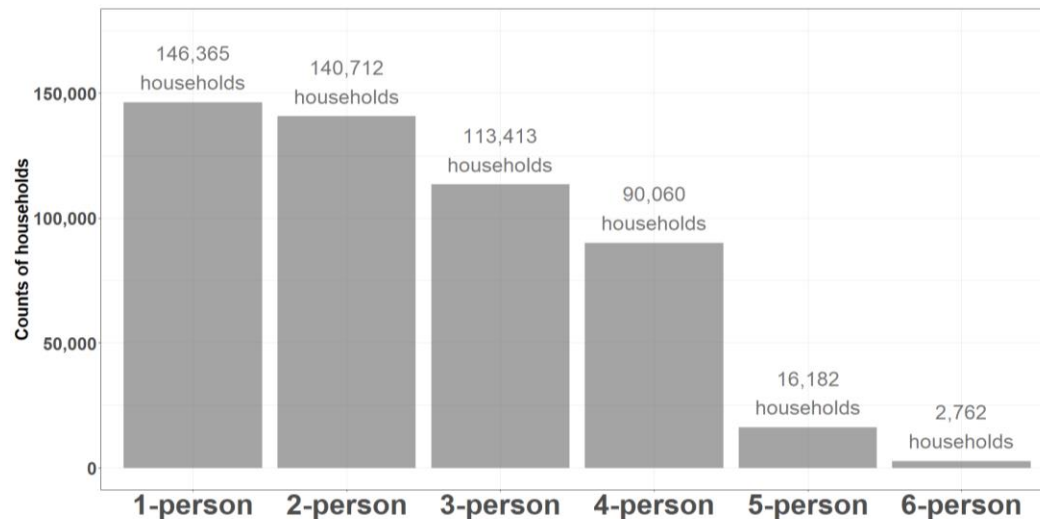


List of Examples

1. Predicting Household Water Consumption
2. Predicting the Conc of Taste and Odor compounds in Hangang River
3. Injecting coagulant in DWTPs by using AI
4. Indoor Leak detection in AML system
5. Data Standardization in WTPs
6. Text Mining

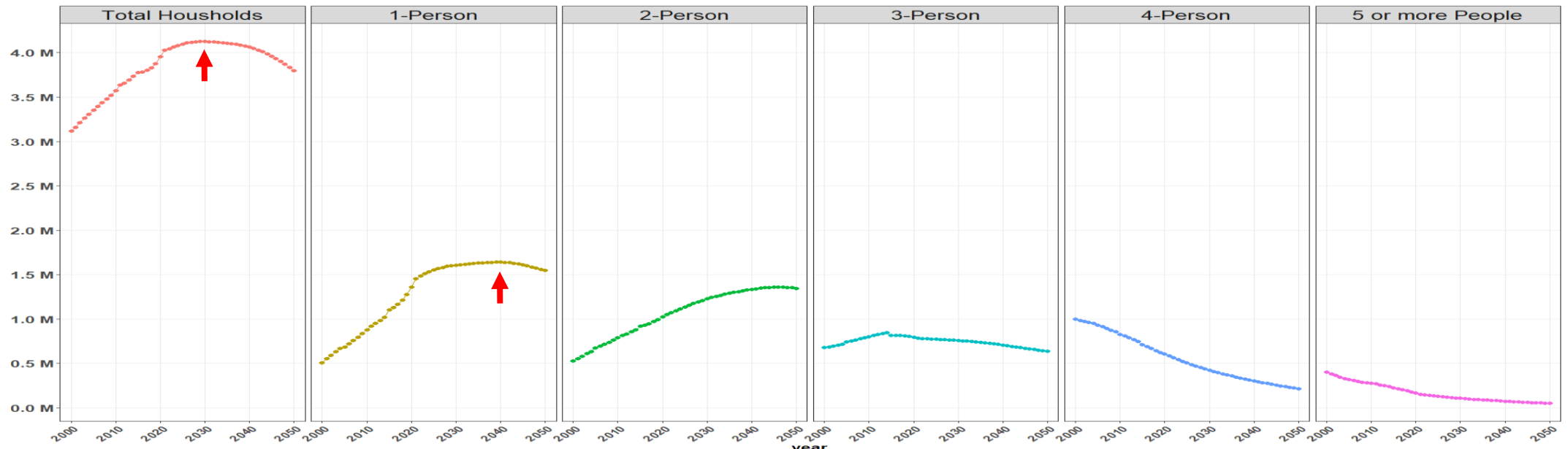
1. Predicting Household Water Consump(1/2)

- Joining 3 DBs to analyze the Household Water Consump in 2021
 - Resident Registration Sys, Building Ledger Sys and Water Billing Sys
 - About 3.2M Seoul citizens' information extracted
 - After data pre-processing, about 510K households extracted



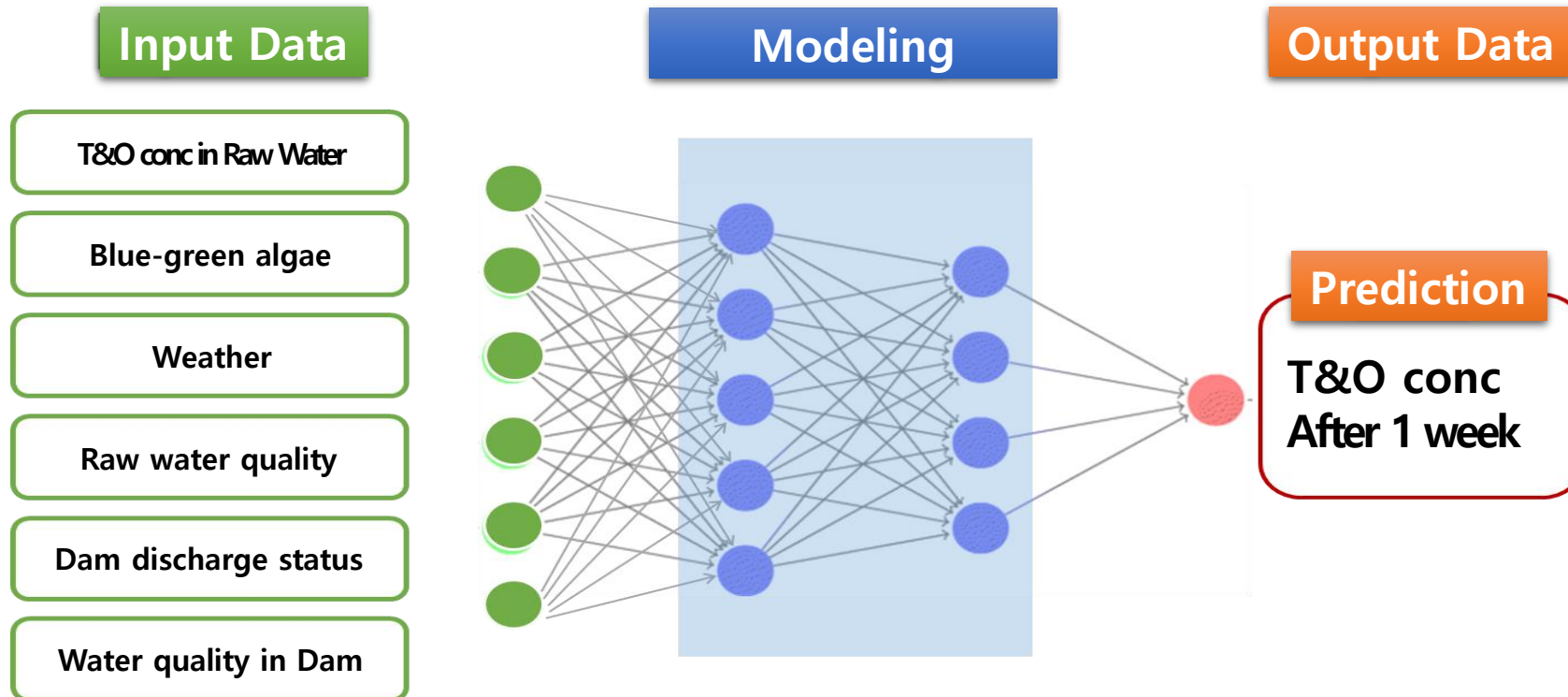
1. Predicting Household Water Consump(2/2)

- Household Water Consumption Prediction in 2050 is ongoing.
 - Combining 2050 Household Estimates in Seoul
 - The Max Number of total Households reached in 2029
 - The Max Number of 1-person households reached in 2040



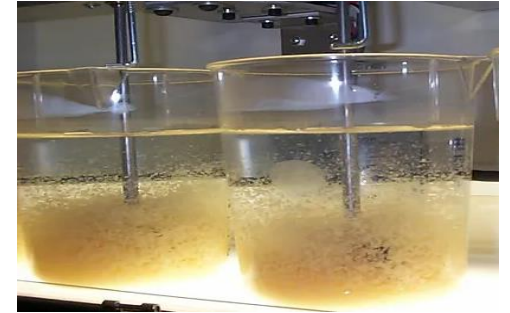
2. Predicting the Conc of T&O

- 2-MIB and Geosmin cause taste and odor in Tap Water
- Predicting two compounds' conc in Hangang River is ongoing.

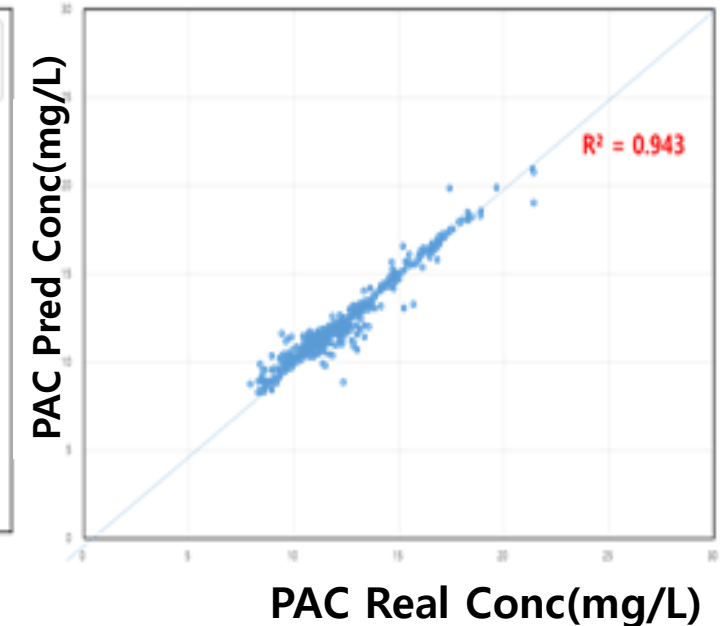
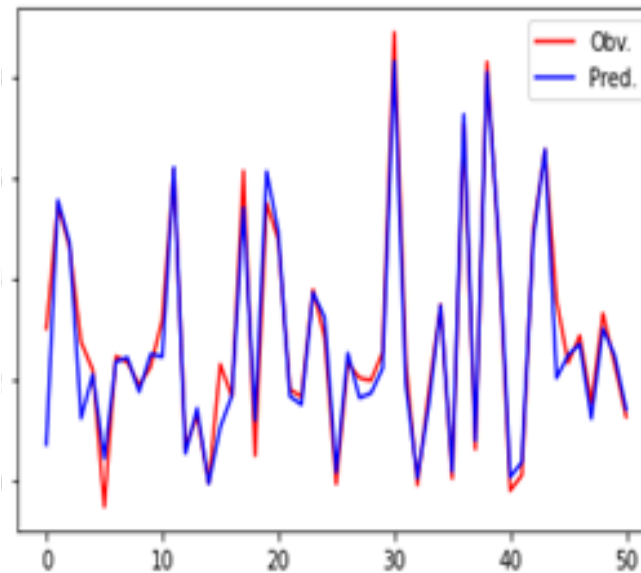


3. Injecting coagulant in WTPs

- Injecting coagulant in DWTPs by using AI
 - Inputs : Turbidity, pH, Temp, Alkalinity
 - Models' test R^2 over 0.91

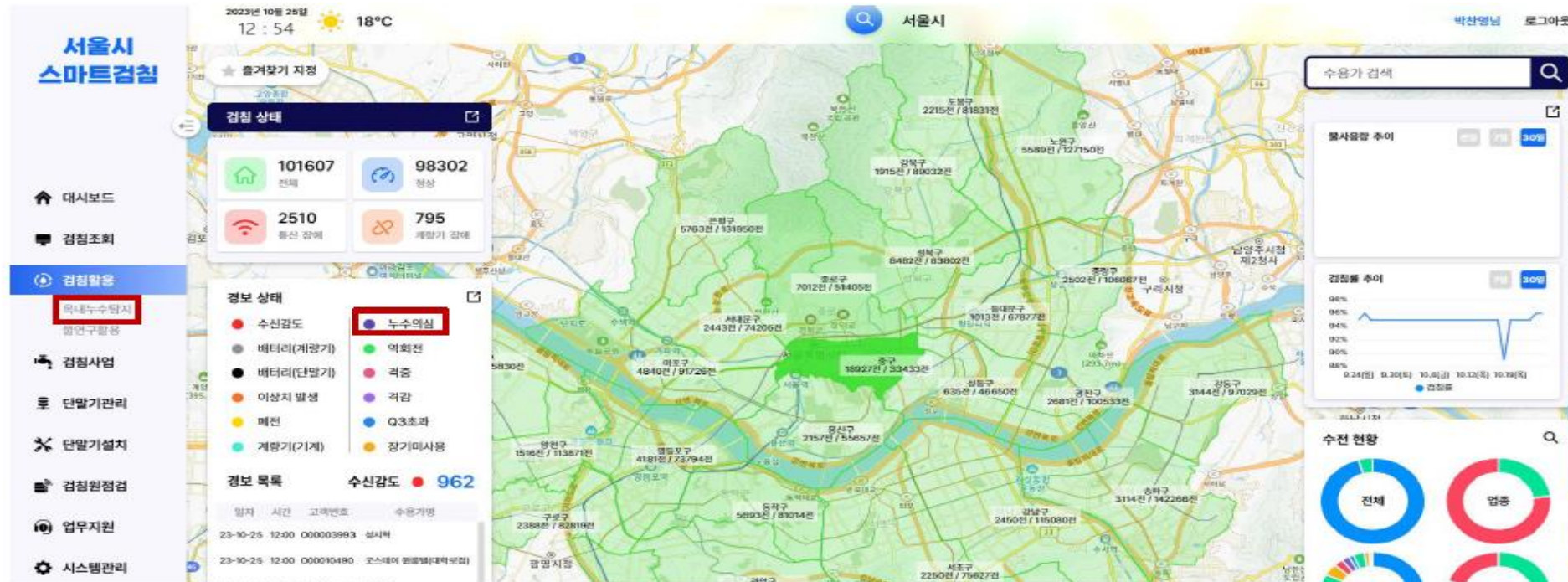


Model	PAC	$R^2(\text{test})$	$R^2(\text{train})$	MAE	RMSE
Ensemble -voting	XGBR-KNN	0.942	0.989	0.306	0.522
	XGBR-KNN- Linear regression	0.925	0.961	0.408	0.600
	XGBR-KNN- Random Forest	0.942	0.990	0.310	0.515
Ensemble -stacking	XGBR-KNN	0.910	0.975	0.450	0.655
	XGBR-KNN- Linear regression	0.943	0.995	0.310	0.519
	XGBR-KNN- Random Forest	0.930	0.984	0.360	0.573



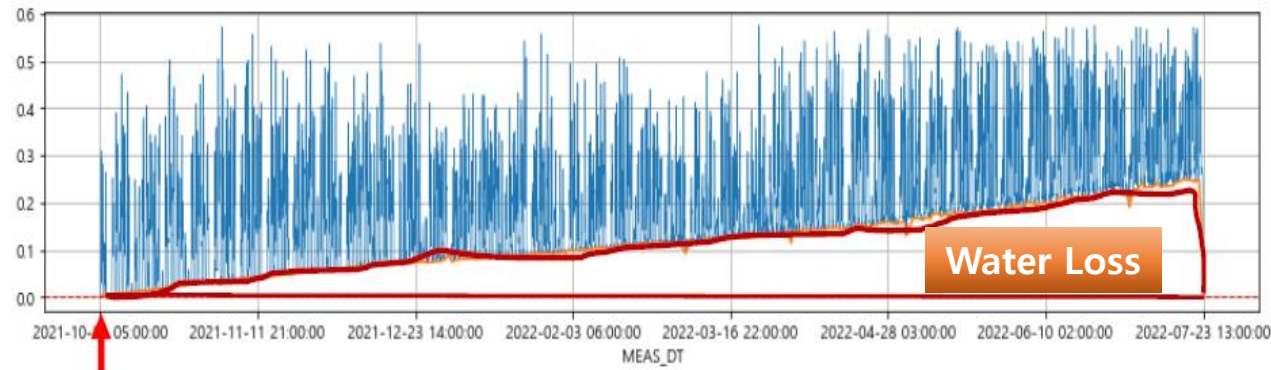
4. Indoor Leak Detection Tool(1/2)

1. Monitoring and Analyzing Water Consumption Patterns by using AMI's Data
 - Targeting Household 15mm, Finding Outliers

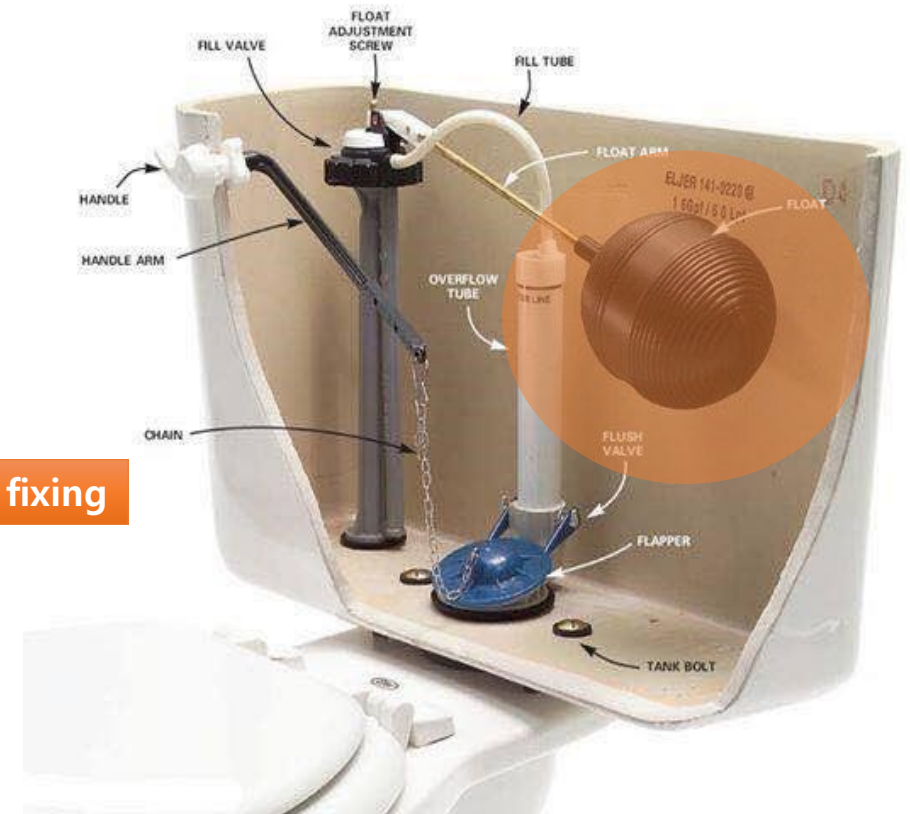
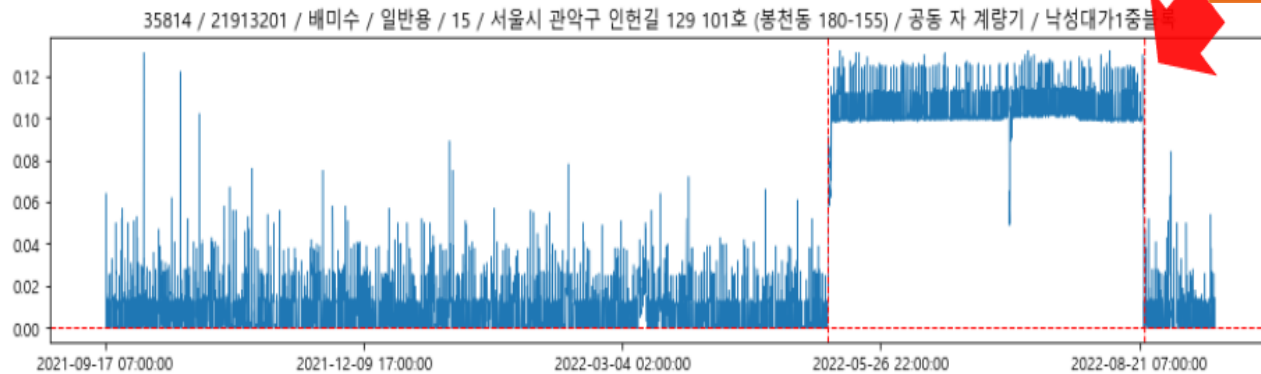


4. Indoor Leak Detection Tool(2/2)

1. Detecting the Indoor Leak

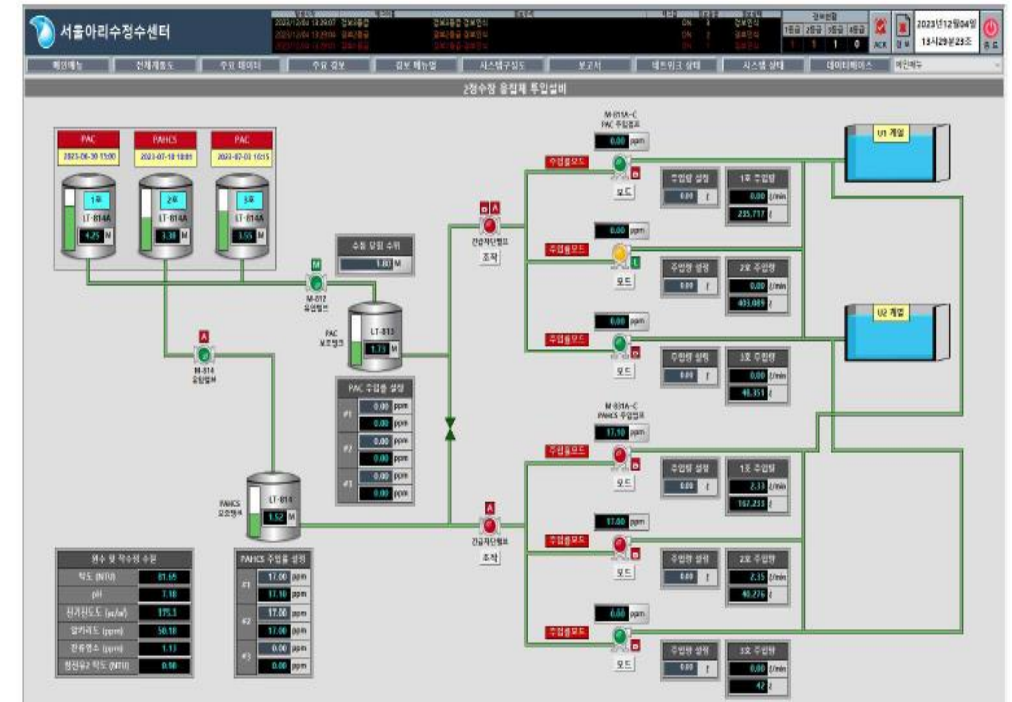
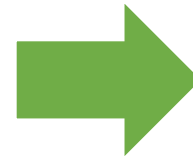
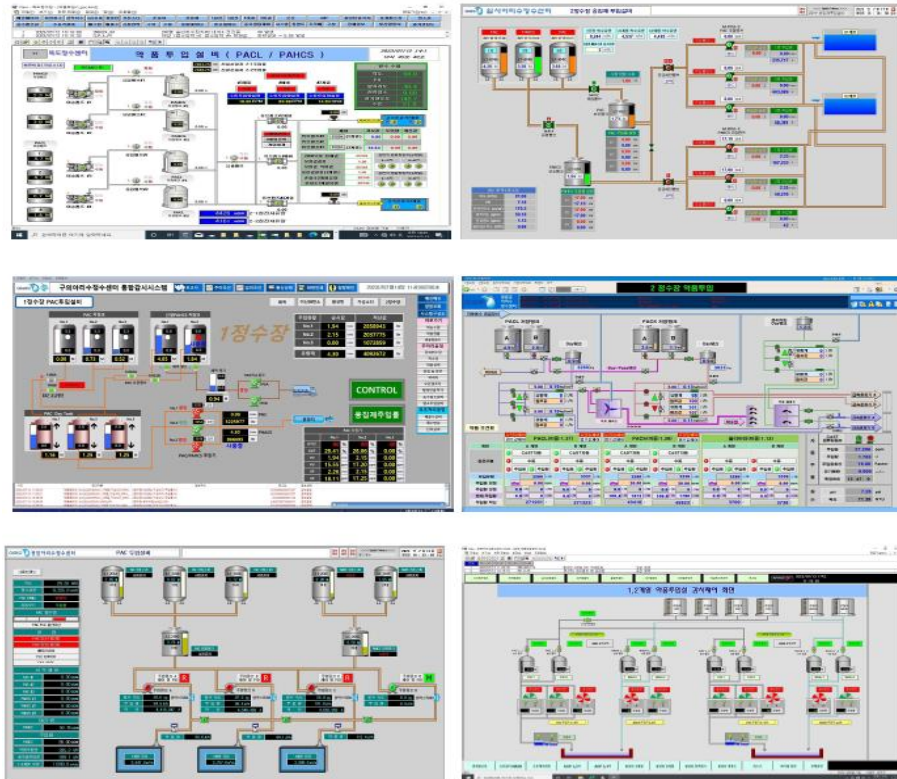


2. Repairing the leak



5. Data Standardization in WTPs(1/2)

- Standardizing HMI(Human Machine Interface)



- Six WTPs are using different HMI.

- Shortened the time to adapt to the system after moving in

5. Data Standardization in WTPs(2/2)

- Standardizing Tag names, words, domains and so on
 - Six WTPs are using different Tag names.
 - Easy to extract data from WTPs by using the same Tag names

6개 정수센터별 전체 태그현황

독도 정수센터	
포인트이름	설명
2BW_3P12A_MVO	여과지2계열 역세펌프 주파수설정
M1004_LIT2_HH	농축조 슬러지저류조 2지 수위HH 설정
CA_FIT_10_SET4	활성탄흡착지 10지 수세 유량 20도 이하
YG212_RPM	응집기#2 1열 2호기 rpm
AO_2BW1_TB	2계열 1지 탁도계
:	:

구의 정수센터	
태그명	태그설명
GU2SW00ON4_M_509C_OP	M_509C 역세척펌프 흡입밸브_OPEN
GU2SW00ON4_M_848A_ON	M_848A 용마 제수변실 바닥배수펌프_ON
GU1CS00FL3_1M6B_F	PAC 탱크 유입밸브 NO.2 FAULT
GU2FT00VA2_1지_여과수위_SV	1지 자동 반자동 여과 수위 설정값
GU2CD00VA1_WQP_2_502_PV	2정수장 여과수 탁도
:	:

강북 정수센터	
포인트이름	설명
LIT01A_HH	[LIT-01]
DIT09A_LL	[DIT-09]
ZC-302A	분배조
AOP3_AO3	3지 AO
TUBI0528	2계열
:	:

정수 센터	현장 태그	태그 설명	설명
독도	AO_2BW1_TB	2계열 1지 탁도계	1공)변절실 HV-46 VCB ON
강북	TUBI0528	2계열 여과지 여과수탁도 8	#1위수 이상화탄소투입설비#1_FAULT
영등포	RCS2_BASIN_F_TBIT_301_PV_R	여과지F(6) 탁도계 현재값(PV)	활성탄흡착지2계열22지유출밸브 CLOSING
구의	GU2CD00VA1_WQP_2_502_PV	2정수장 여과수 탁도	1여과지 3,4계열 PLC CPU #B B-LINE 통신상태
암사	TUBI_225A	12계열 혼화수 유입 탁도	12계열 혼화수 유입 탁도
광암	F19_TB	FCC19 탁도	:

영등포 정수센터	
포인트이름	설명
C_243_CLL_60250	후염소 #1 실투입량
FLOW_RCS2_FIT_305_ADD	2정수 여과유출유량 적산
RCS2_BASIN_B_IN_PC_301_SUM	여과지 2계열 유입 입자계수 합
M301A_STOP	가압식막여과 1계열(M301A) 여과수 순환펌프 STOP
RCS2_BASIN_F_TBIT_301_PV_R	여과지F(6) 탁도계 현재값(PV)
:	:

영등포 정수센터	
포인트이름	설명
M902A_FLT	슬러지 저류조 교반기 A호기 FAULT DI
TL_EHV12_ARM	주변압기 온도감시 A ALARM
F22_M403_AUTO	역세수 유입밸브(역세변)A AUTO
F22_M402B_OPEN	사여과지 22지 여과지 유입밸브 B OPEN
F19_TB	FCC19 탁도
:	:

6. Text Mining to surveying Consumers' Drinking Water Perception

- Consumer Perception Inspection on Drinking Water is ongoing.
 - Targets : Tap water, Water Purifier, Bottled Water
 - Methods : Crawling News and comments, YouTube, etc
 - Analyzing Keywords and Sentiment

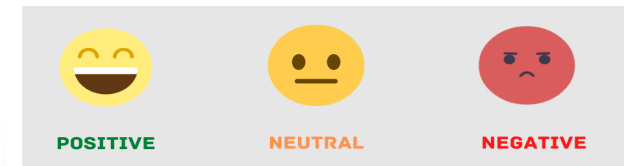
Tap Water



Water Purifier



Bottled Water

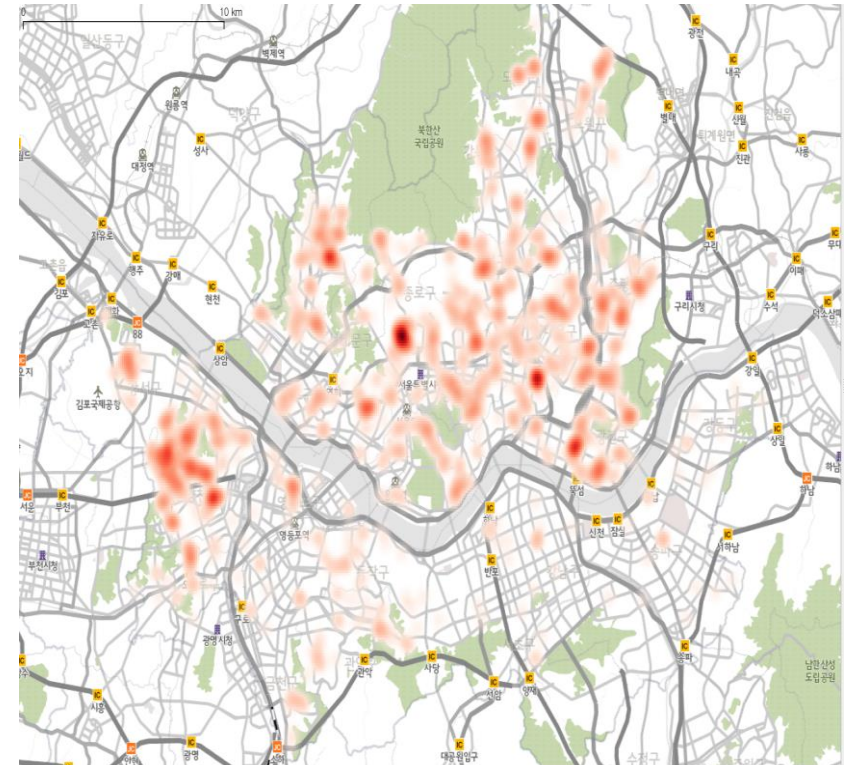
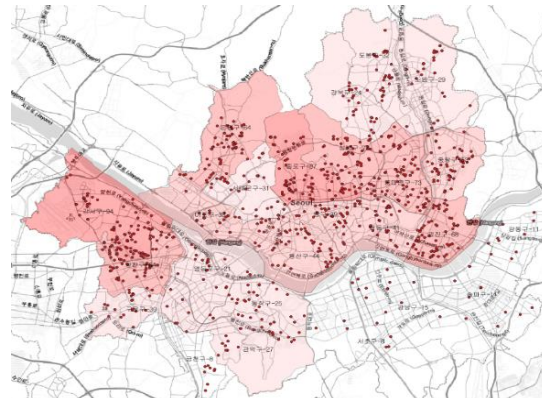


List of Challenges

1. Predicting Reddish Tap Water Areas
2. Water Pipe Lifespan

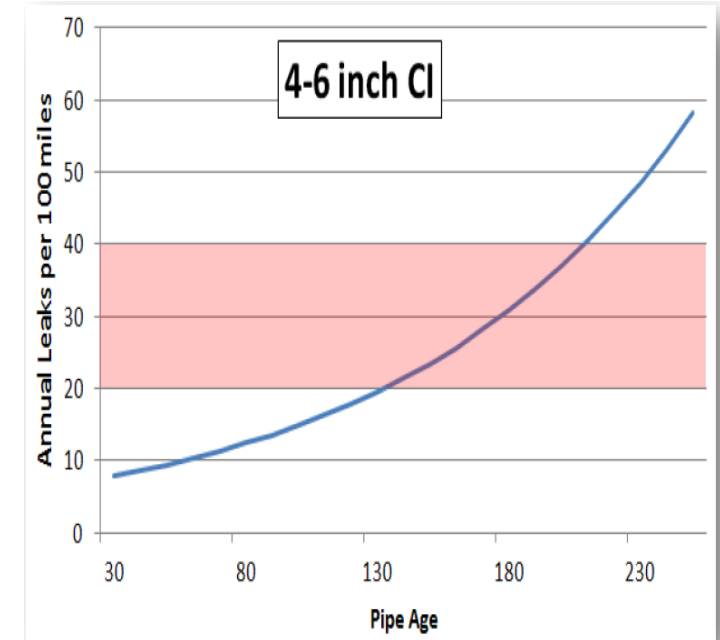
1. Predicting Reddish Tap Water Areas

- Water Quality Complaints
- Flushing
- Maintenance
- Water Pressure
- etc



2. Water Pipe Lifespan

- Leak and Break Data
- Soil Condition
- Traffic Data
- Weather Data
- Water Pressure
- Risk Evaluation
- etc



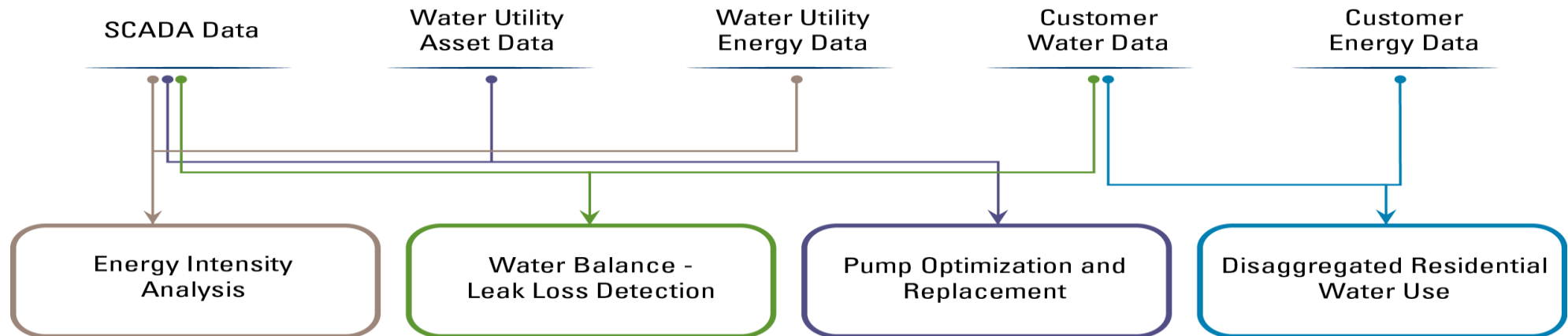
IV. Why does SW strengthen Digital Education?



1. SW's Data(1/2)

- **(Internal) Large Volume, Data interconnected**

- Asset(price, date, manufacturer,...)
- GIS(latitude and longitude)
- Time, Flow Rate, Pressure, Energy(KWh),...
- Water Quality(Turbidity, pH, Temp,...)



1. SW's Data(2/2)

- (External) Unpublished SW's Data

- National security facilities

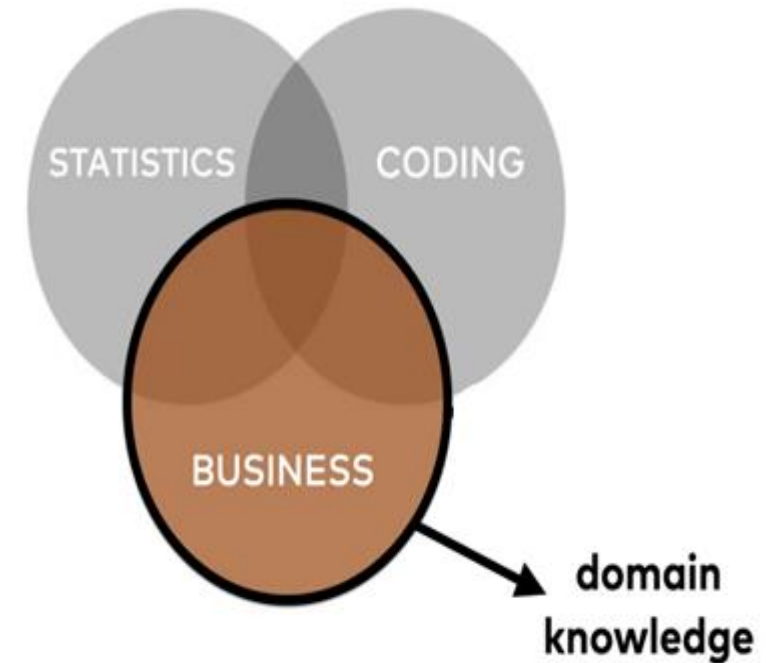
- Only local Govt or K-water run water utilities exclusively

(It means, their staffs having the Domain Knowledge
in water utilities)

CONFIDENTIAL

2. SW's Human Resource

- Employees having High Domain Knowledge
 - SW training them periodically
 - However, lacking Big Data Analysis Skills
- => SW opening various training programs

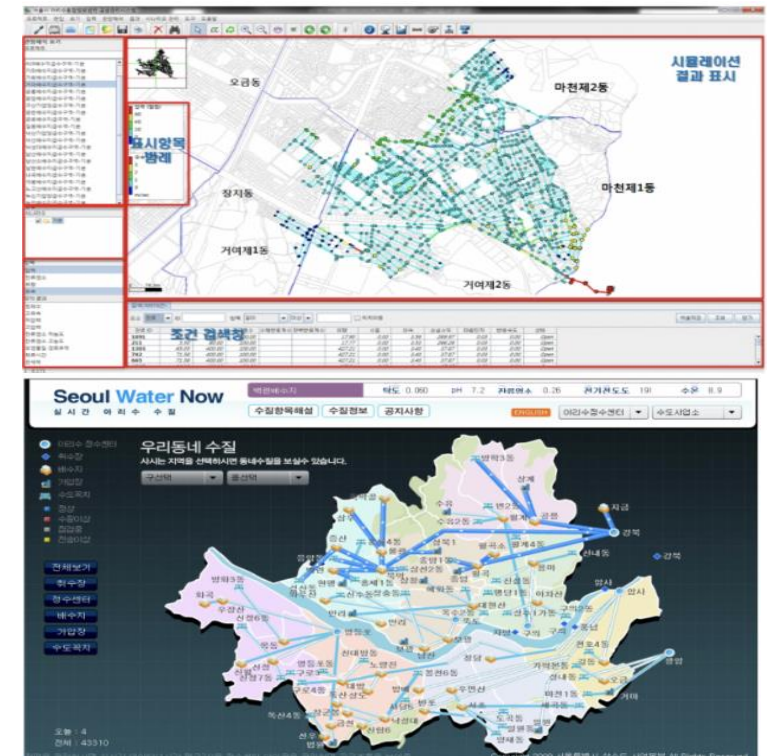




V. SW's HRD Plans for DT

1. SW's HRD Programs(Short Term)

- Purpose Helping Understand and Familiarize SW's Systems
- Making and Announcing an Annual Training Plan
- SW's Curriculum
 - How to use GIS
 - Water Quality Monitoring System
 - SCADA system used in DWTPs
 - AMI
 - Big Data in Waterworks
 - Water Supply Network Analysis
 - Arisu Integrated Information System



2. SW's HRD Programs(Long Term)

- **Beneficiaries of Domestic University and Graduate School Tuition Assistance Program ('20 ~ '24)**

No. in total	No. of Graduate School Applicants	No. of University Applicants	No. of Short Course Applicants	No. of Digital Related Major Applicants
84	29	51	4	8

- **Examples of Digital-Related Majors**

: Computer Science / Big Data AI Business Information /
Mechatronics Engineering / Mechanical Convergence Engineering /
Mechanical Engineering / Smart Electrical and Electronic Engineering

3. SMG's HRD training programs

- Focusing on How to use Big Data Analysis Tools
- Making and Announcing an Annual Training Plan
- SMG's Curriculum
 - R, Python Programming
 - How to Use ChatGPT
 - SQL Practice
 - GIS Program
 - How to Analyze Big Data



ChatGPT



Thanks

