ITU-SUDACAD Regional Forum on Internet of Things for Development of Smart and Sustainable Cities

Khartoum, Sudan 13-14 Dec 2017

Smart Technologies for Smart Water in the Smart Cities: Country Experiences

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ITU expert

Outline:-

Technologies for the Smart Water Supply System are classified into;

- Water Resources Technologies
- Planning a Decentralized Water System
- Water and Wastewater Treatment Technologies
- Water Production Technologies
- Water Distribution Technologies
- Water Operation and Maintenance Technologies
- Smart Water Irrigation, Smart Water Agriculture, and Smart Water Industrial
- Smart Water Recycling Technologies
- Energy Consumption Management Technologies

Technologies for the Stormwater System are classified into;

- Urban Flooding Management Technologies
- Stormwater Management Technologies
- Watershed Analysis Technologies

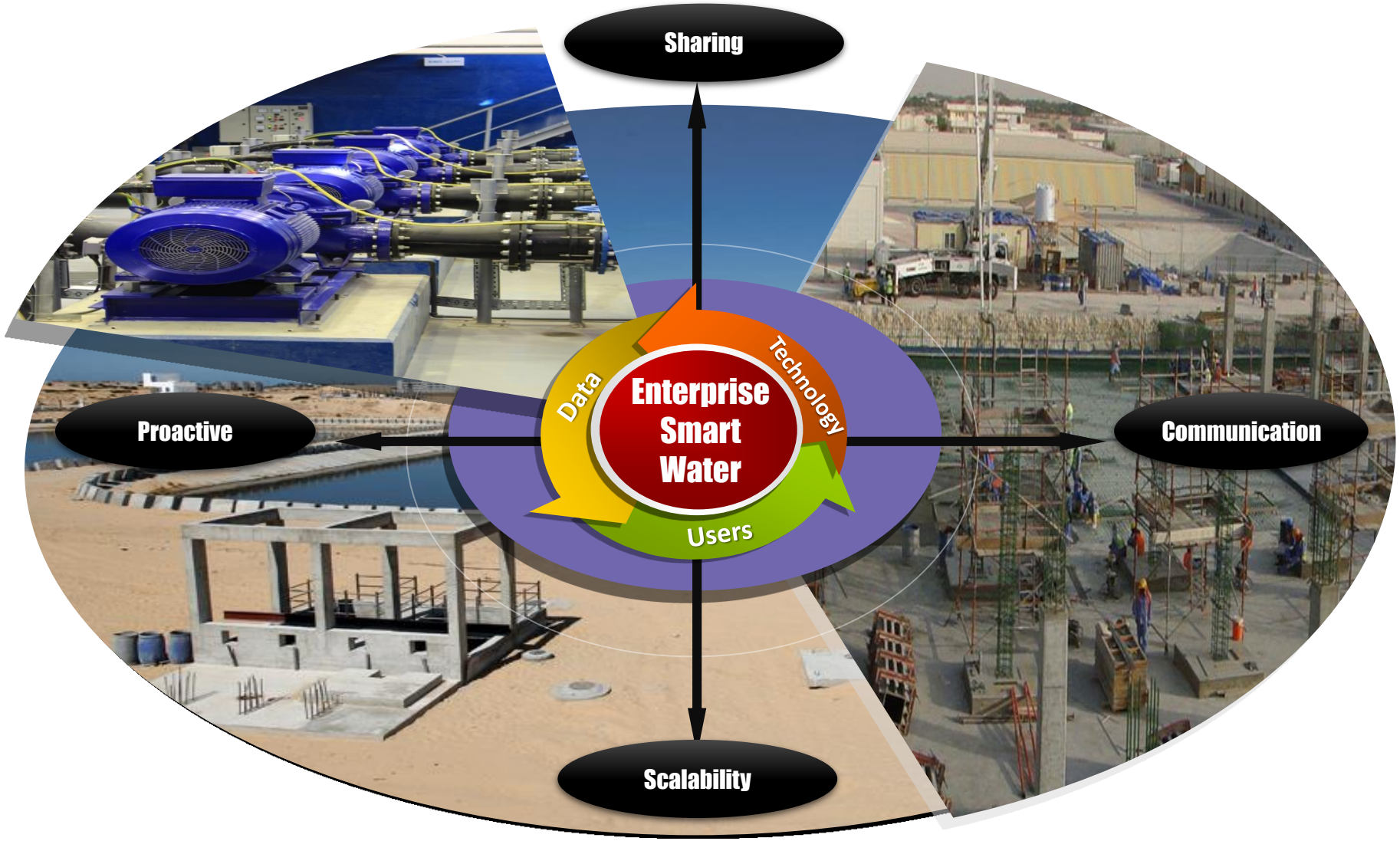
Technologies for Integrated Enterprise Smart Water Management;

- Smart Water Grid (SWG)
- Droughts and Desertification Control Technologies
- Early Warning System (EWS) Technologies
- Disaster Risk Management (DRM) Technologies
- Web Based Smart Decision Support System (DSS) Technologies

Examples of Water Smart Cities

Road Map

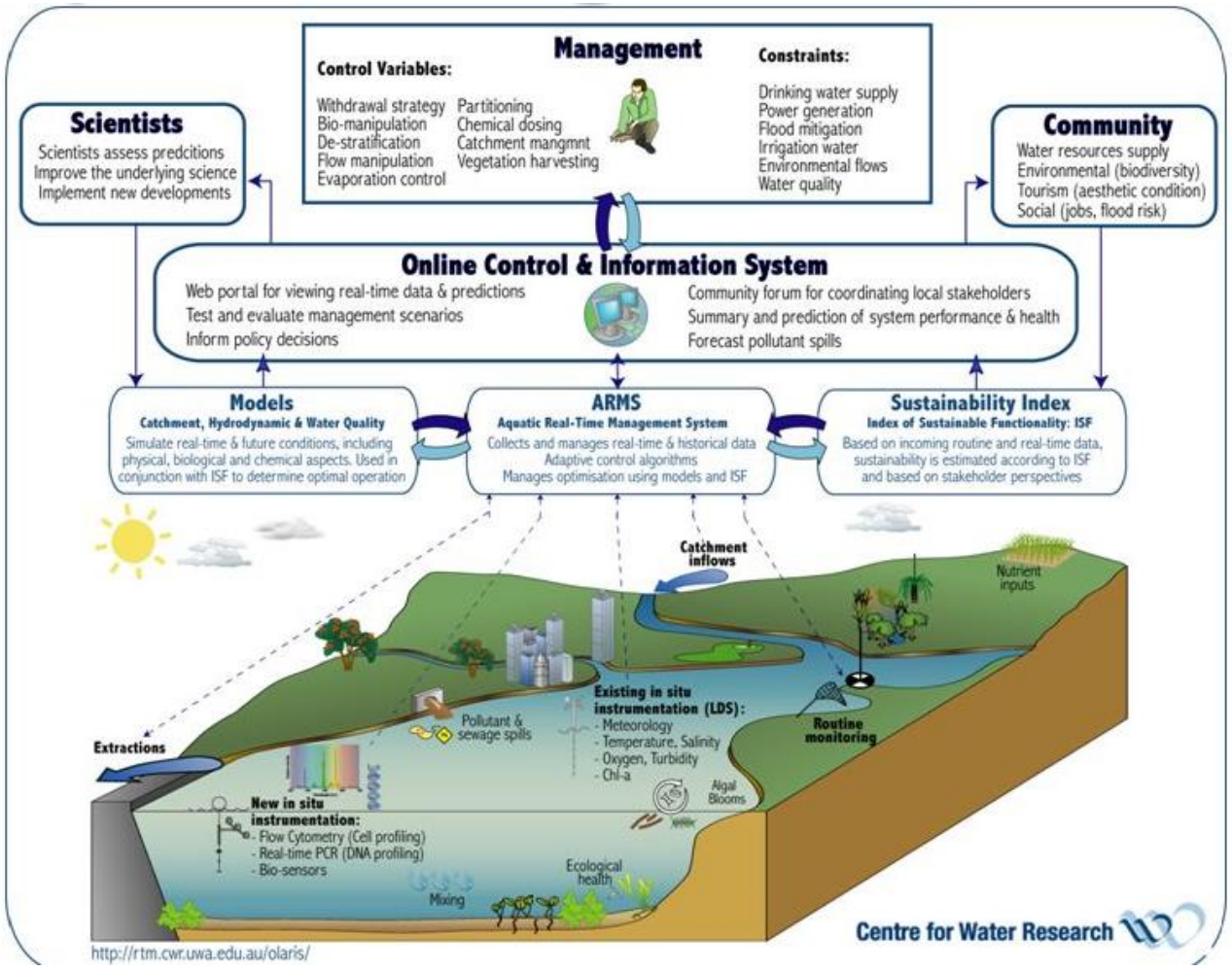
Vision

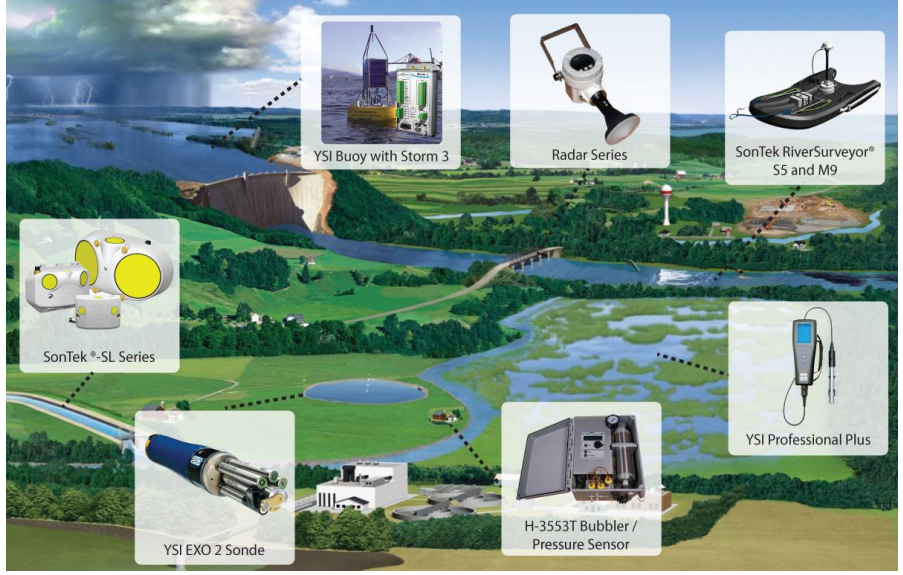

Sharing
Proactive
Communication
Scalability
Enterprise Smart Water
Data
Technology
Users

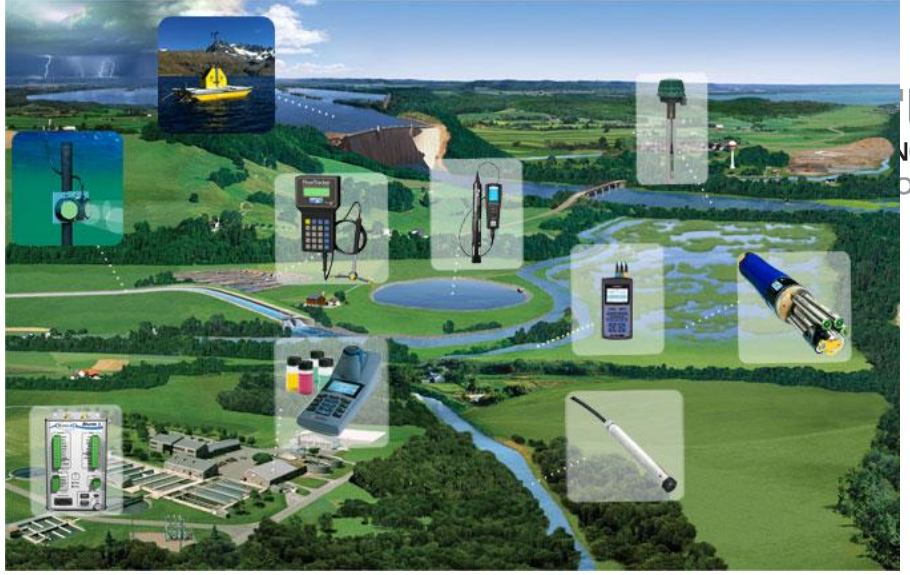
- **Water Resources Technologies**
  - ✓ Surface Water (Fresh & Saline)
  - ✓ Groundwater
  - ✓ Rain Harvesting & Flood Management

- **Water Resources Technologies**
  - ✓ Surface Water (Fresh & Saline)

Technologies for regular and real time monitoring, diagnosis, modeling, automatic controls for surface water resources

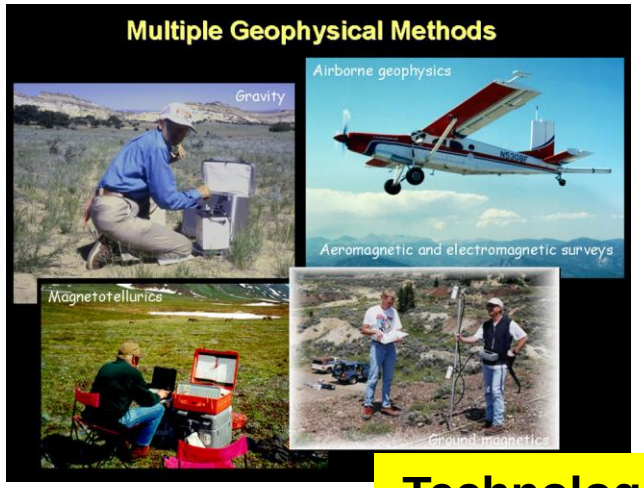


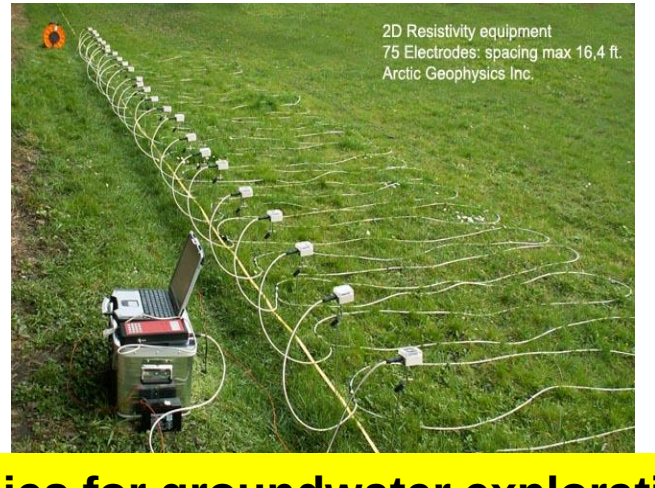




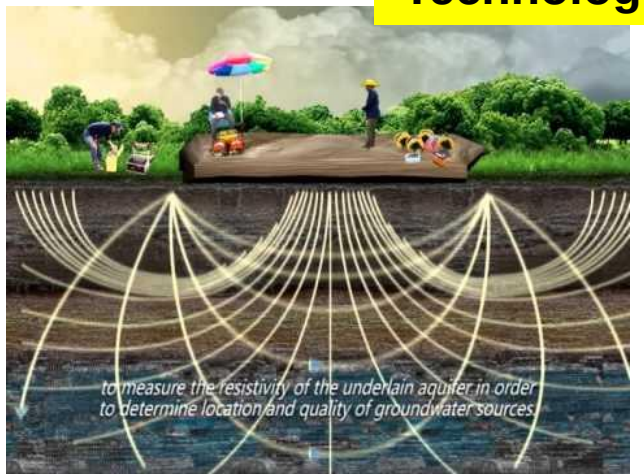
Technologies for real time monitoring and automatic controls for surface water resources

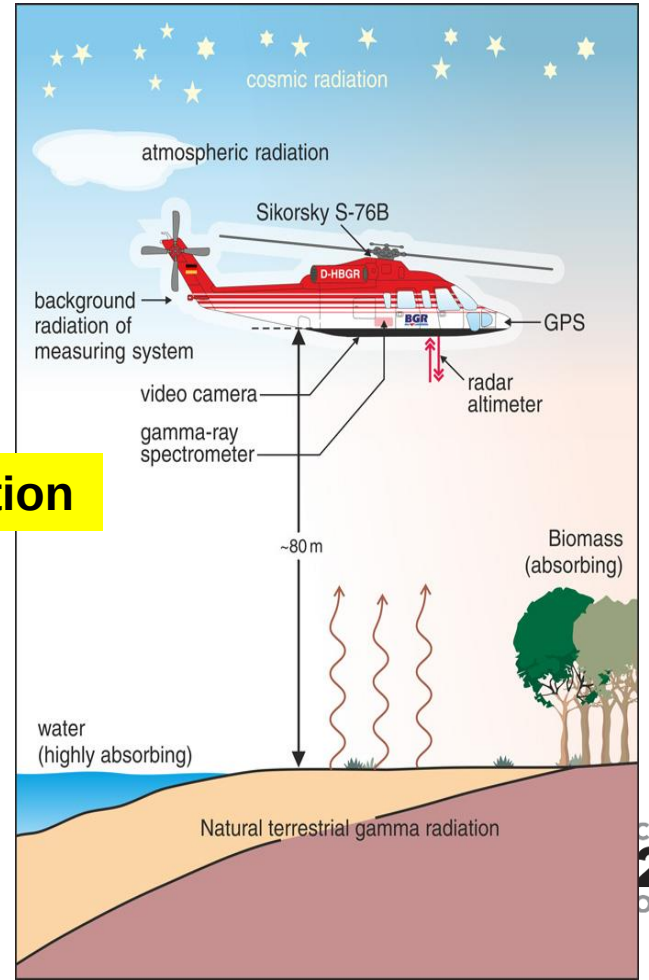
- **Water Resources Technologies**
  - ✓ Groundwater
    - ❑ Technologies for groundwater exploration
    - ❑ Technologies for regular and real time monitoring, diagnosis, modeling for groundwater resources

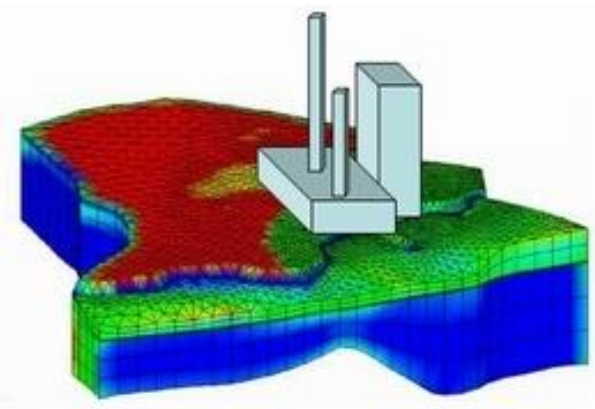




Technologies for groundwater exploration



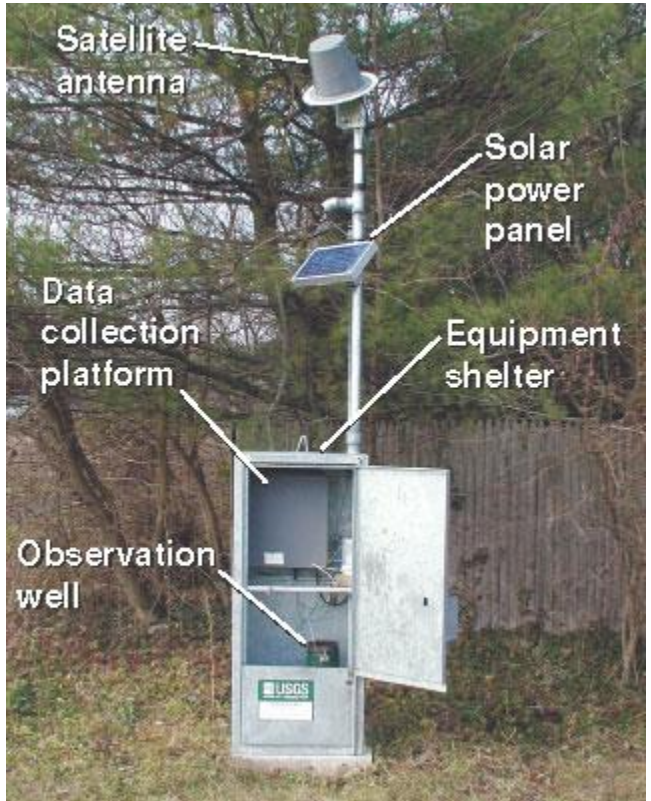


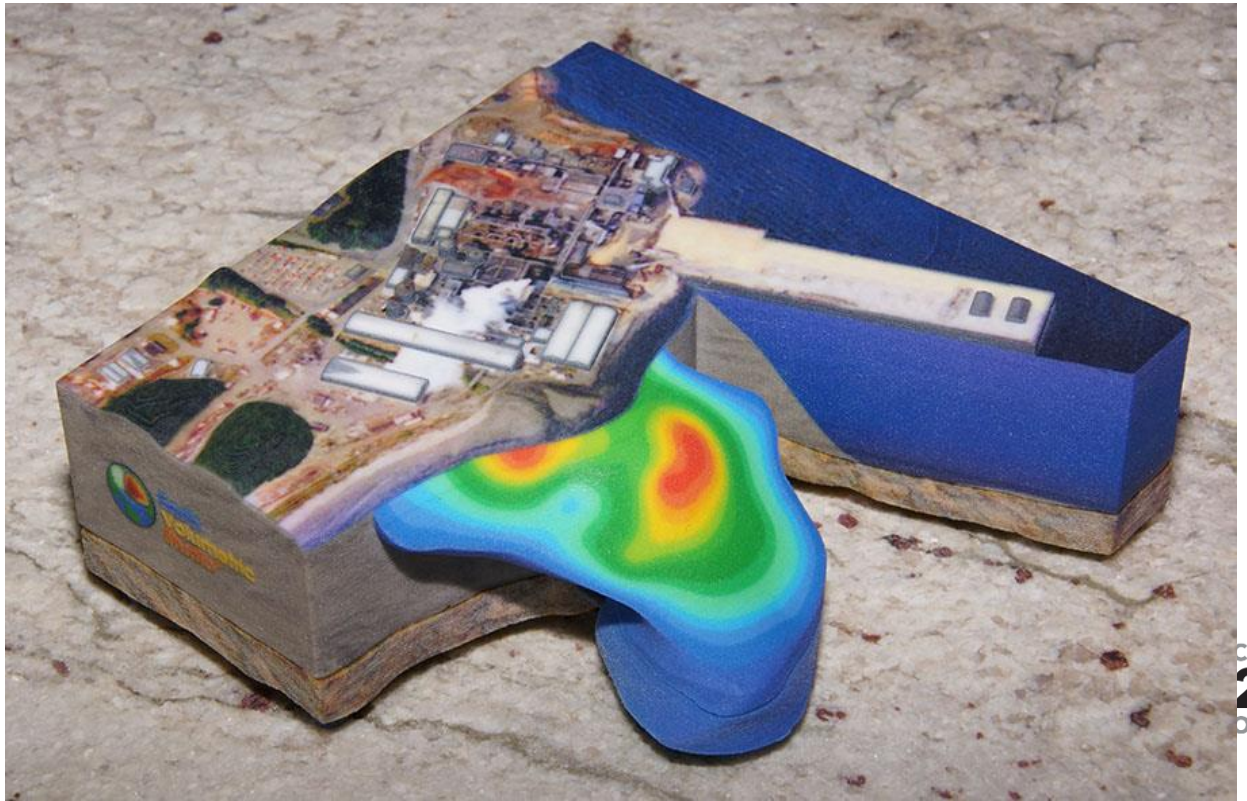


Site 3D model

UWTDC
BUENOS AIRES 2017
October

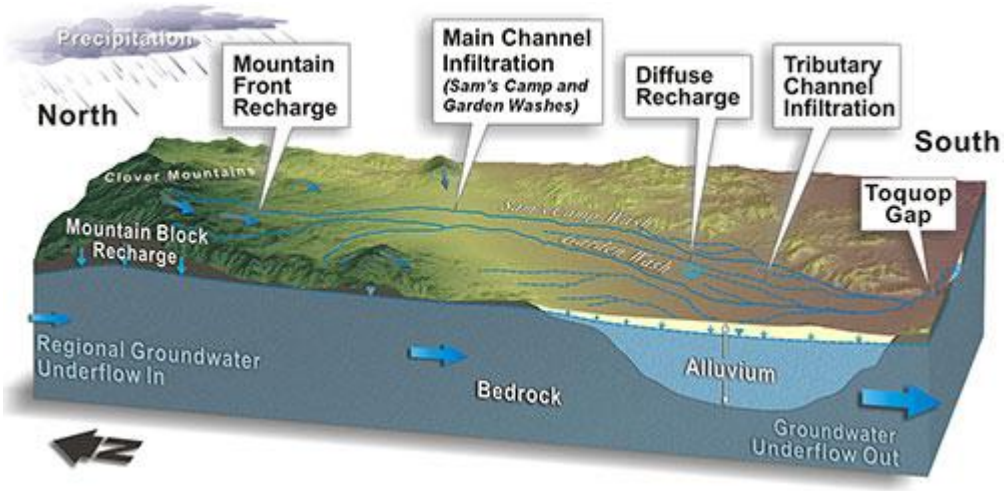
Technologies for regular and real time monitoring, diagnosis, modeling for groundwater resources

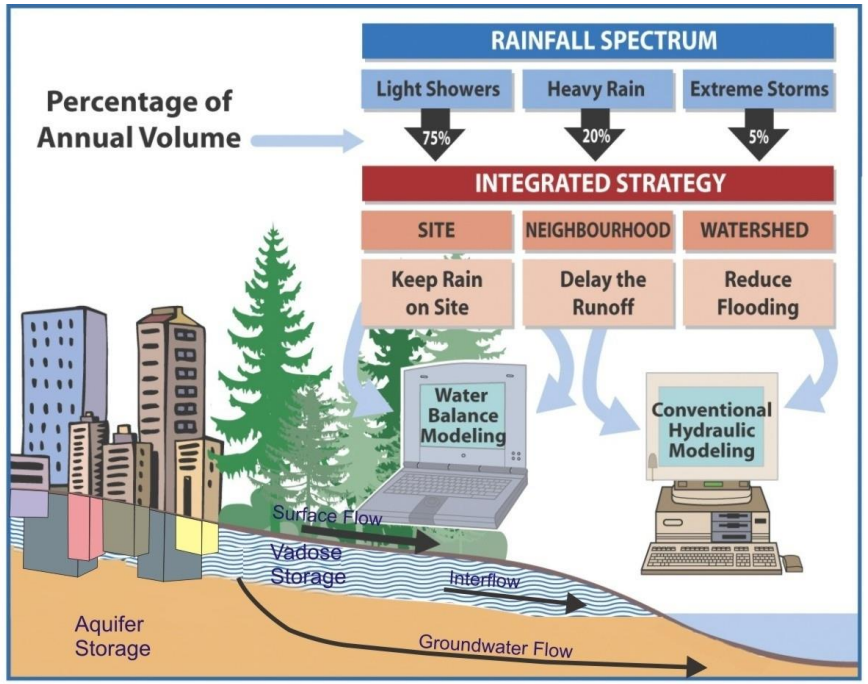


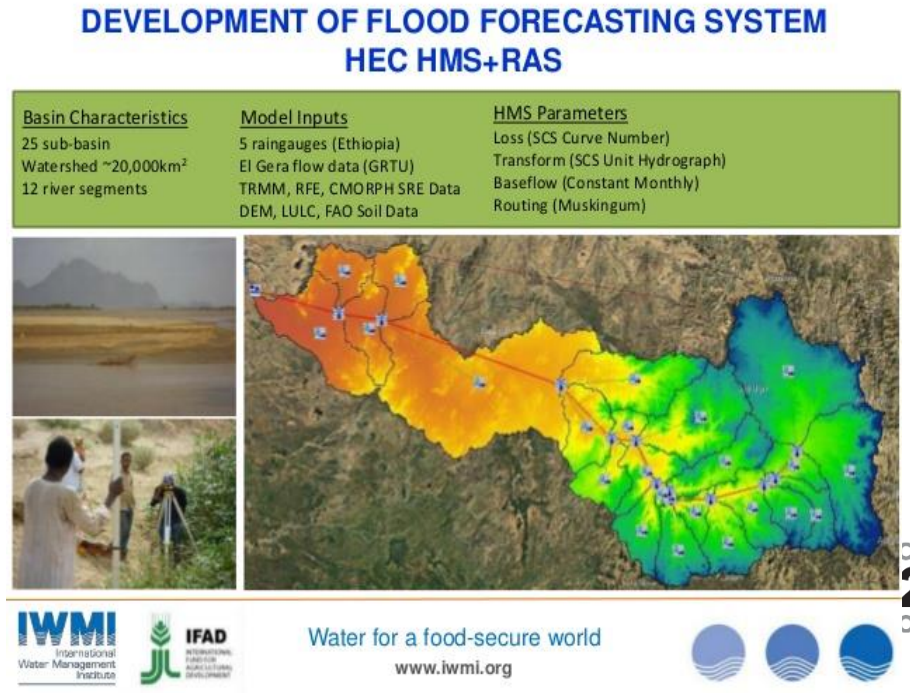


CELEBRATING
25 YEARS
OF ACHIEVEMENTS

- **Water Resources Technologies**
  - ✓ Rain Harvesting & Flood Management

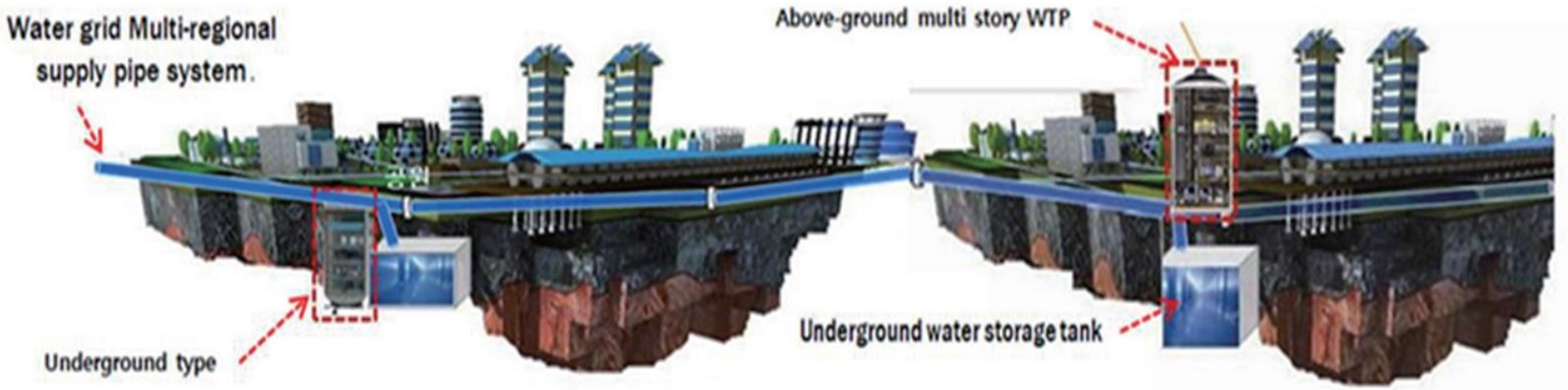




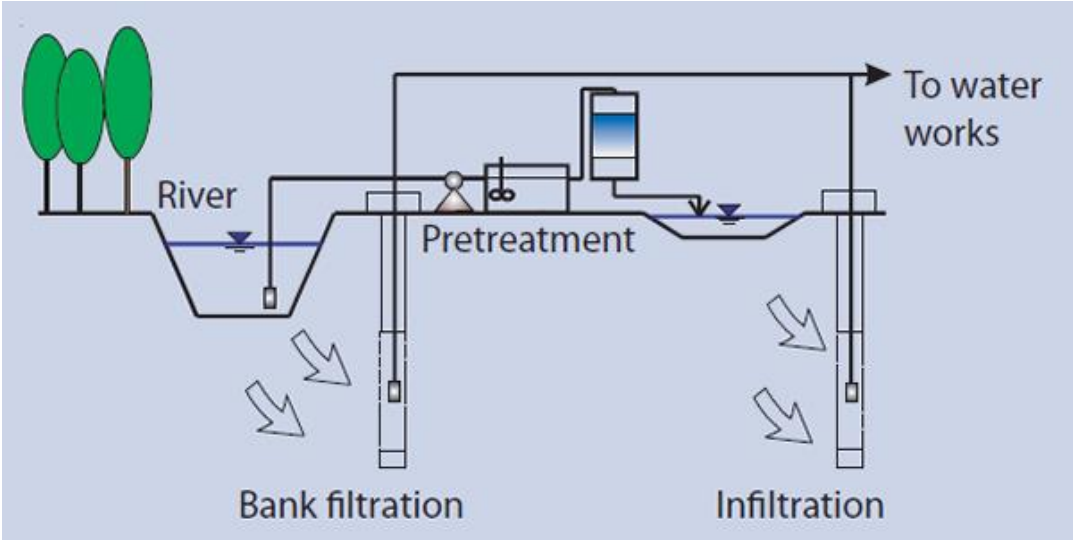


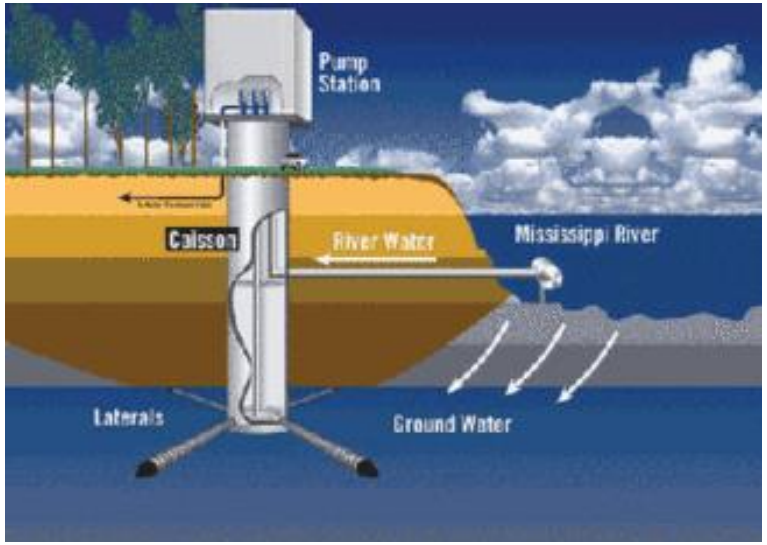
- **Water Resources Technologies**
  - ✓ Planning a Decentralized Water System

A decentralized water supply system used to optimize the production, distribution, operation & maintenance, and mitigated any emergency situation .

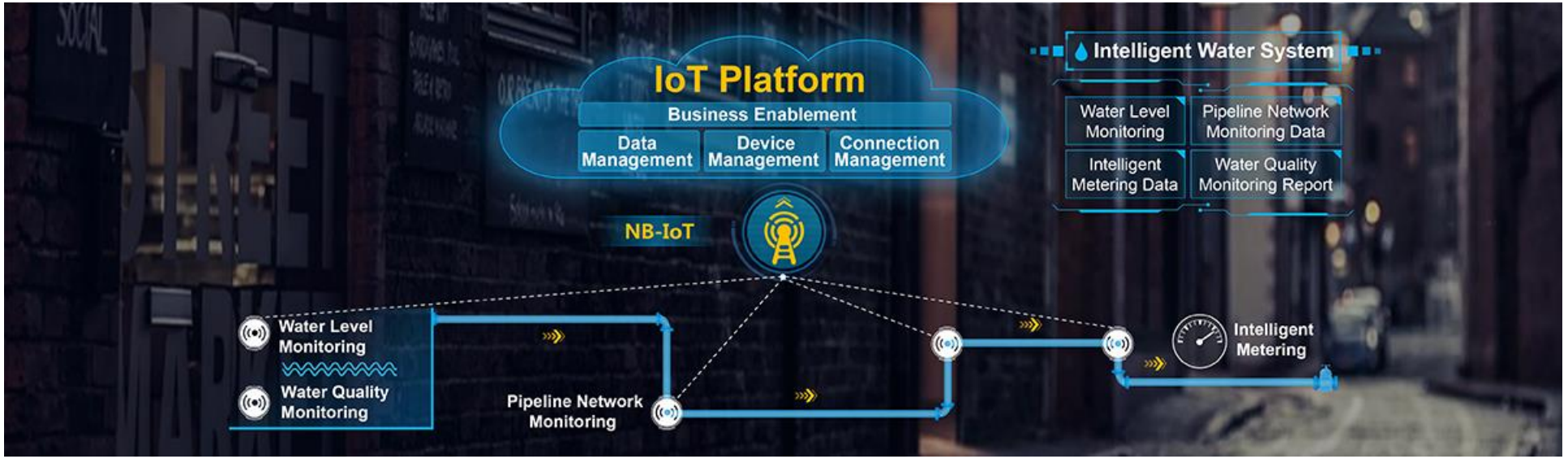


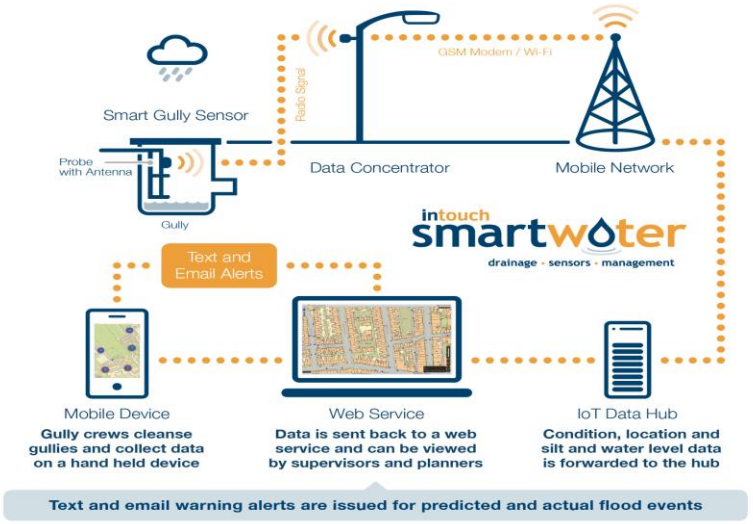
- Smart River Bank Filtering System





- Smart Water Production Technologies





- Water Distribution Technologies are divided into;

✓ Optimized Smart Distribution Technologies

✓ Smart Water Loss Detection & Control Technologies

❖ Water Physical Loss

- Smart leakage detection & control,
- Smart pipe,
- Smart rehabilitation & repair of the deteriorating infrastructure,
- Smart water pressure management and reservoir overflows

❖ Water Commercial Loss

- Smart Meter
- Advanced Metering Infrastructure (AMI)

- Optimized Smart Distribution Technology

Smart Water Networks (SWN)

Real time

Sensor data

(Social) media

System Attributes

Asset data

Customer data

Business Intelligence

- Proactive/Preventive control & measures
- Information provision

Increased process efficiency

Increased customer satisfaction

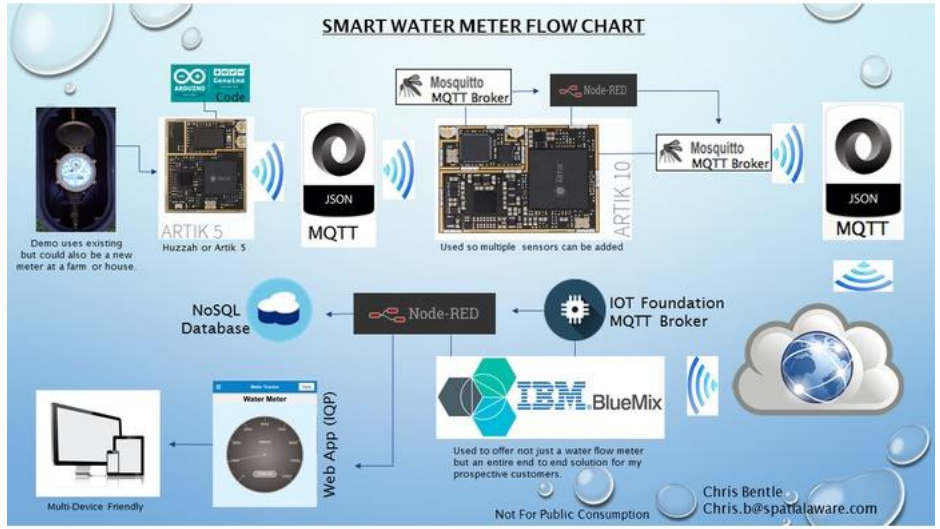
Selected Applications:

Leak detections - Bio-contamination - Energy optimization - Customer interaction

Read More

- **Water Commercial Loss**

  - ✓ Smart Meter
  - ✓ Advanced Metering Infrastructure (AMI)



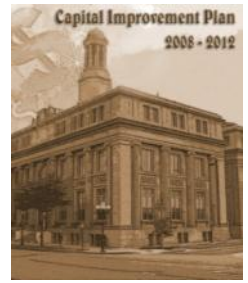
Smart meter provides remote, automatic collection of real-time consumption which allow efficient billing, reduction of peak demand, leak detection, distribution efficiency, nonrevenue water reduction, improved demand forecasting, greater flexibility in tariffs, and optimized capital spending.

Operation and Maintenance Technologies

O&M are interconnected to….

Plant Operation

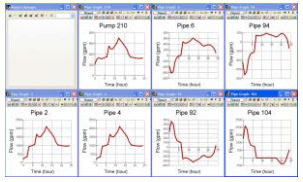
Maintenance



Planning

Water Quality Reporting

Construction



Hydraulic Modeling

Meter Reading

Administration

Customer Service

- Operation and Maintenance Technologies

(a) Real-time monitoring, diagnosis, determination of maintenance priority, and historical data management.

(b) Remote monitoring and control of the whole water supply and distribution process.

(c) Compliance with regulations and policy requirements for water conservation.

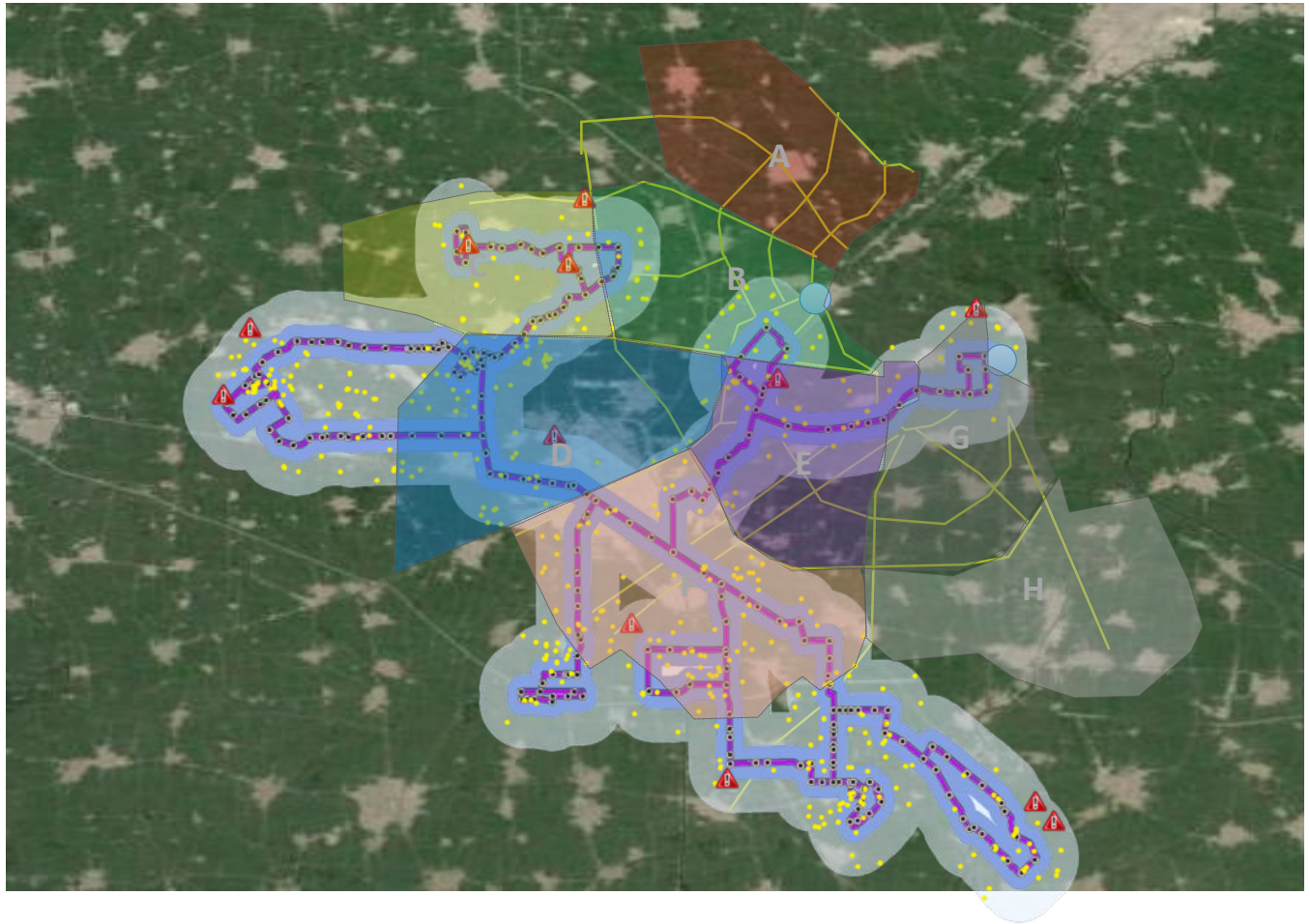
(d) Provision of information to consumers (e.g., water use patterns).

GIS

Location is the Common Element Among Data

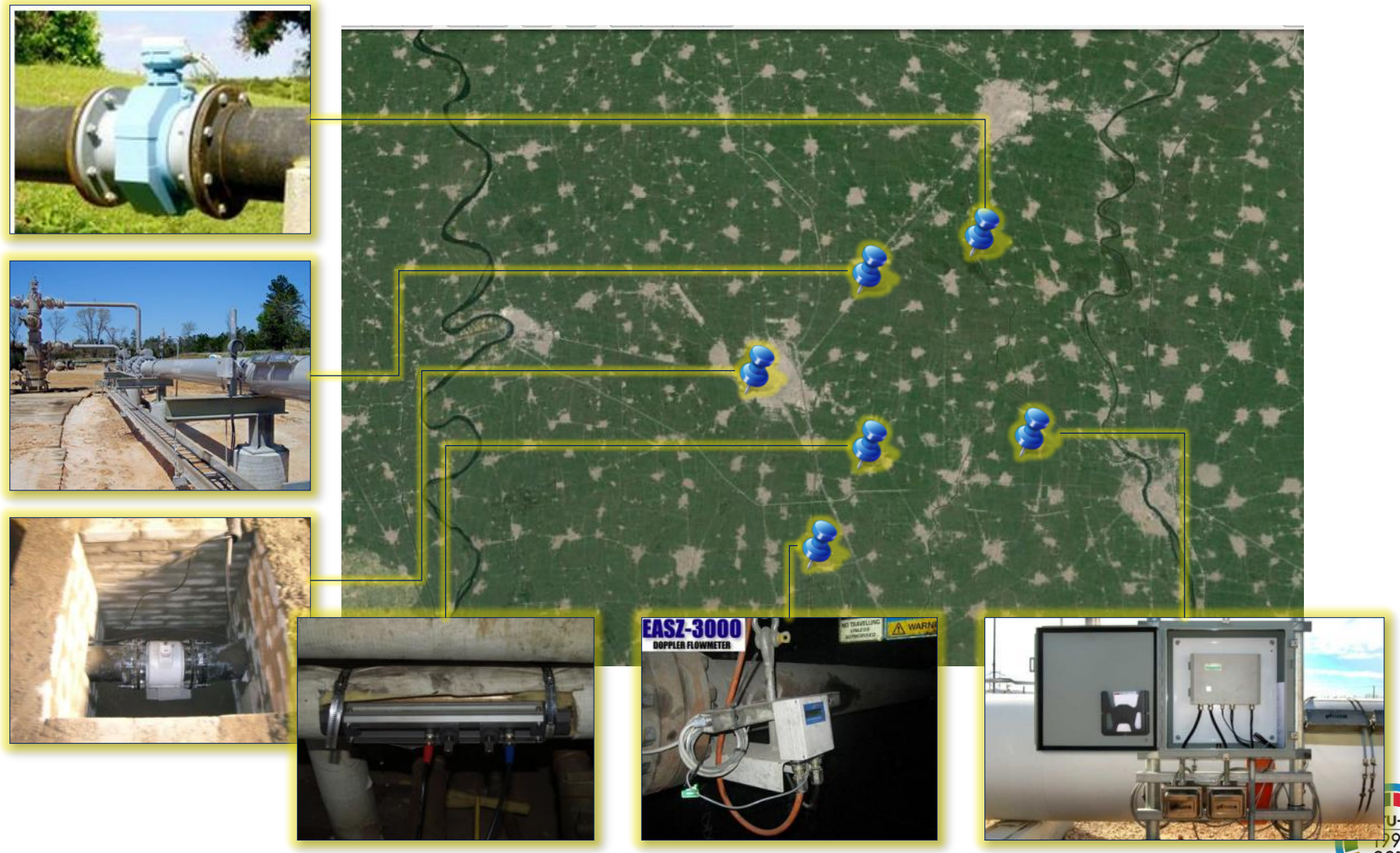
Visualize your:

- World
- Features around you
- Service Areas
- Water Network
- Customers
- Alerts

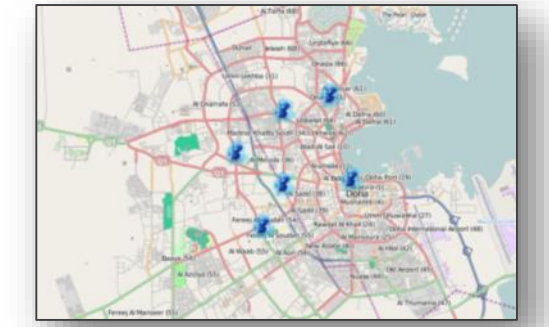


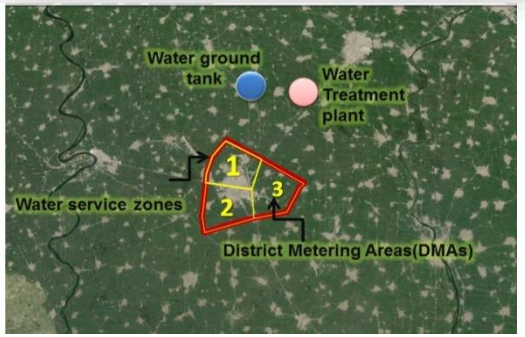
Water Network

Water Network …

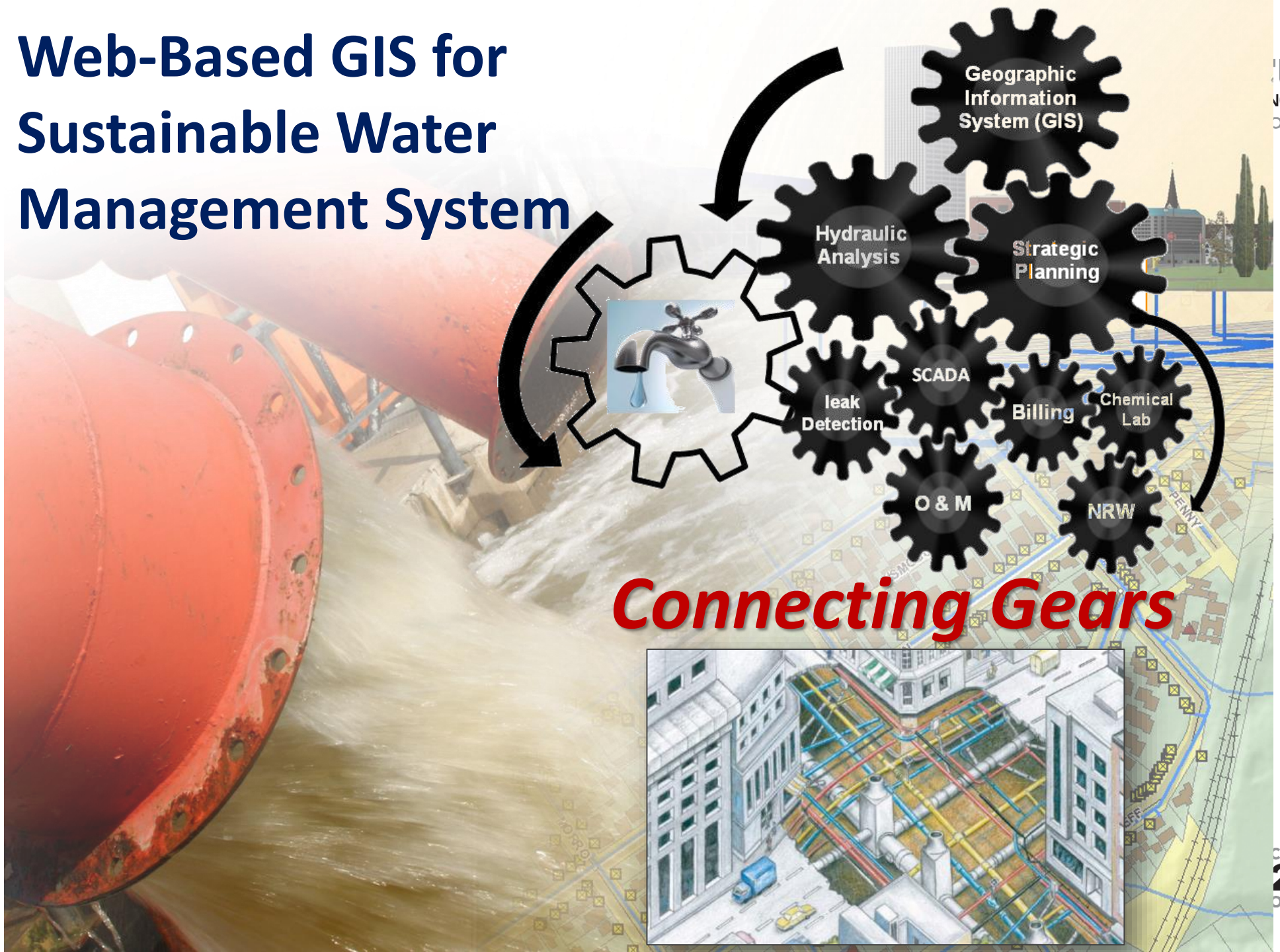


Building Geo-database

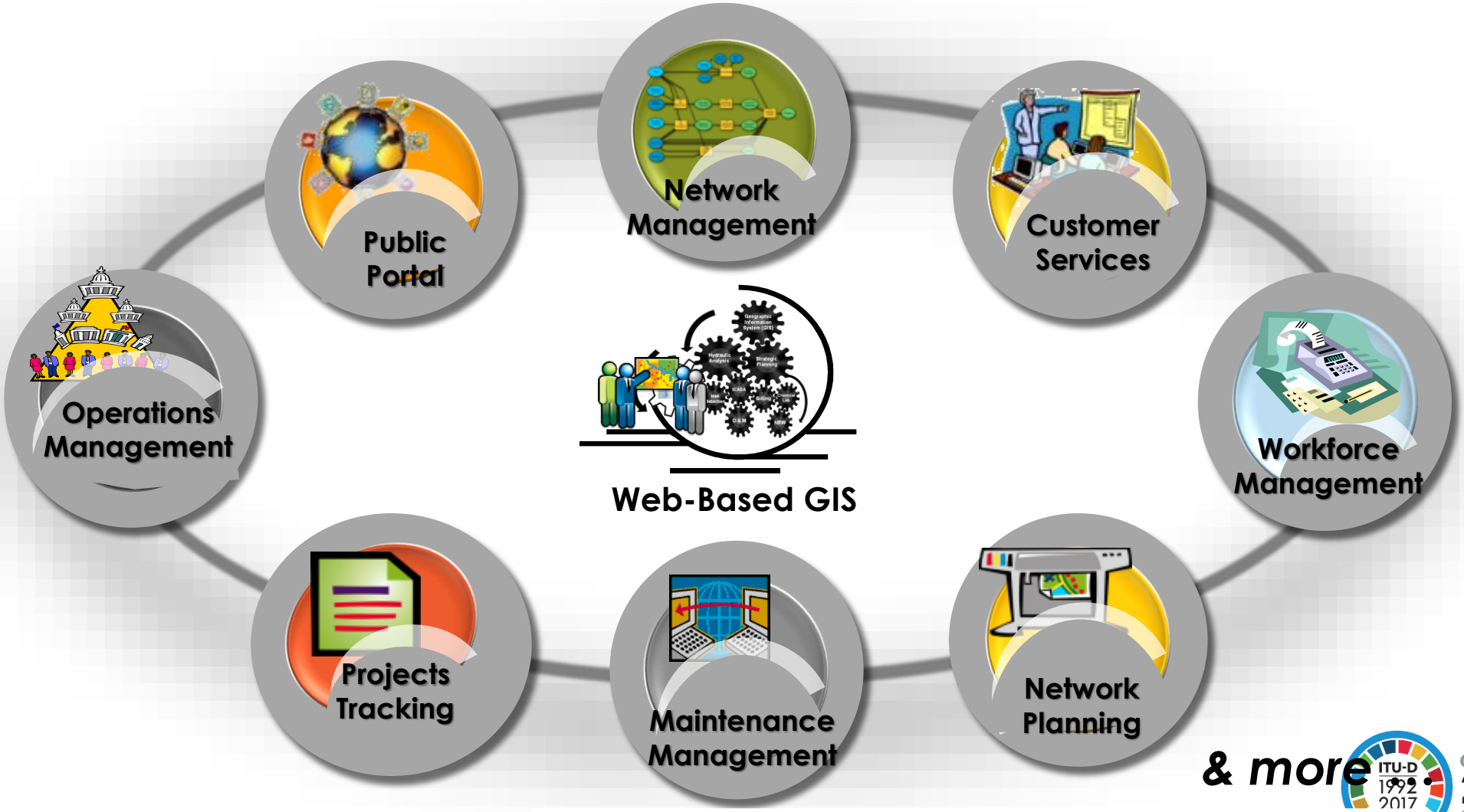




Web-Based GIS for Sustainable Water Management System

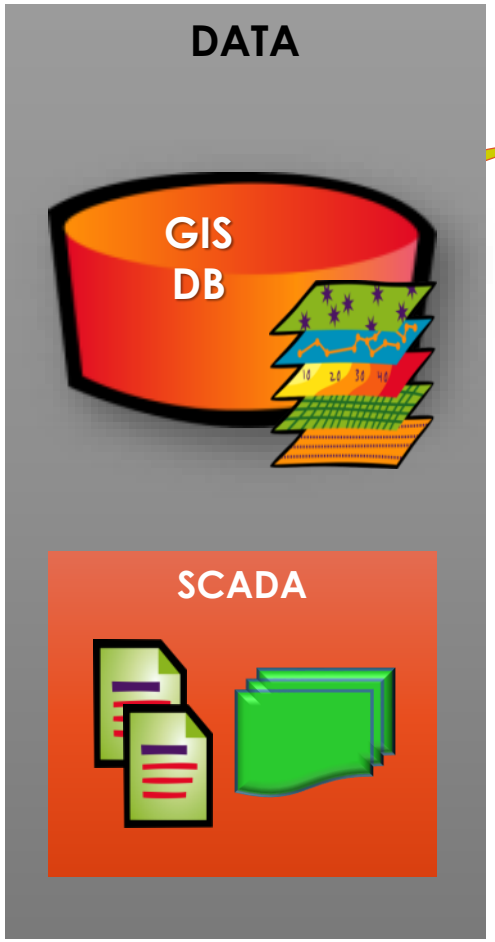


Web-Based GIS for Sustainable Water Management System



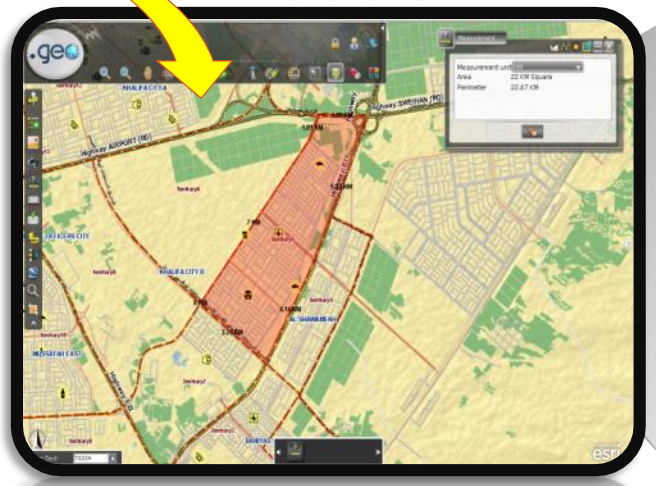
& more

Network Operations



Data

Network Operations Module



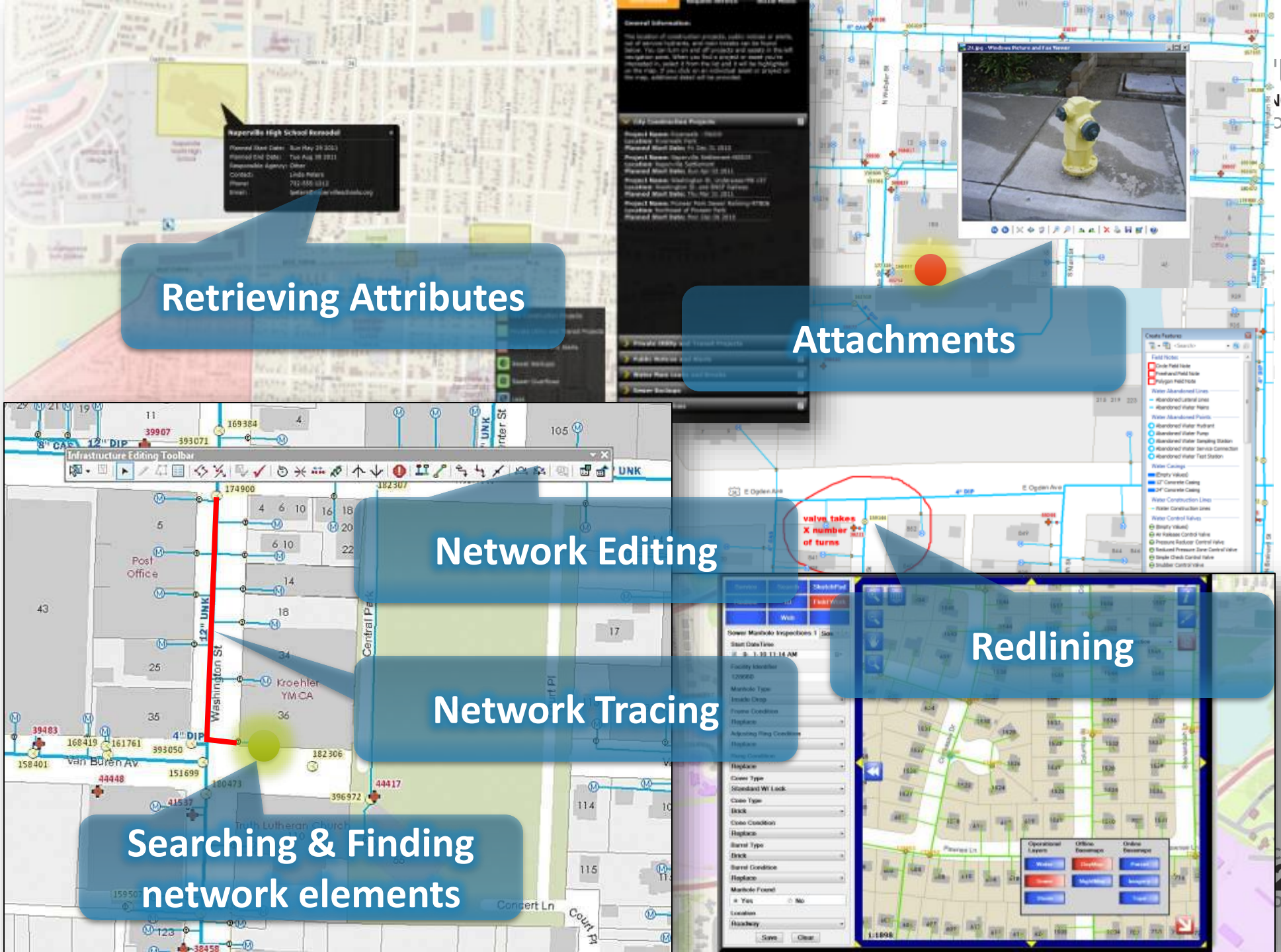
Aim:
Managing for water network components from editing and updating, network tracing, schematic …etc.

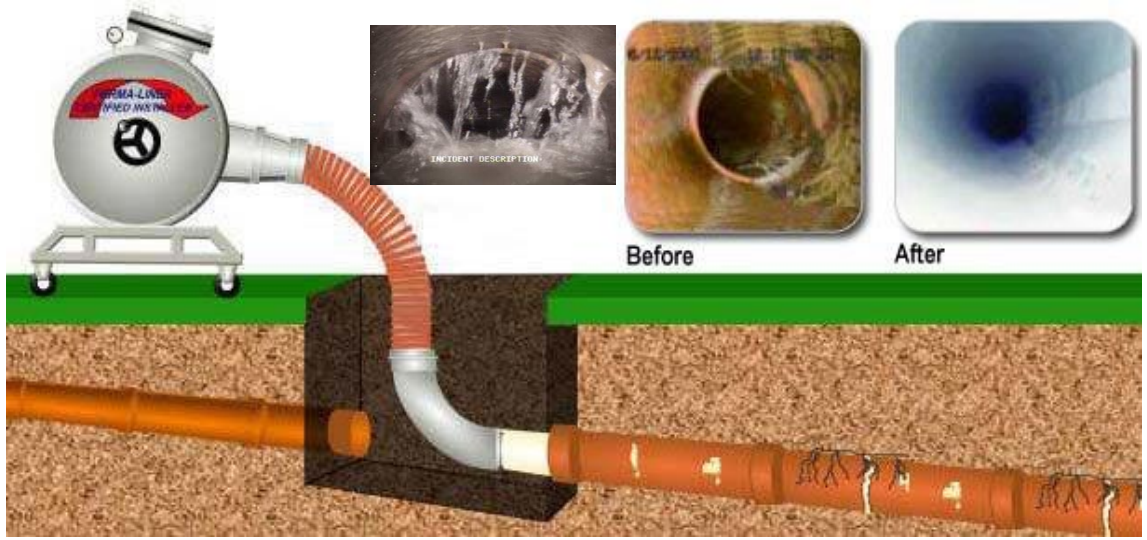
Main Functions

- Map Navigation
- Spatial Search
- Tabular Search
- Measurements
- Base Map
- Bookmarks
- Map Classification
- Rules & Validation
- Editing
- Extracting
- Tracing
- Schematic
- Network Analysis
- Plotting

Can You Access Accurate Information about Your Assets?

…It May Be Due to the Difficulty of Maintaining Your Asset Information


Retrieving Attributes
Attachments
Network Editing
Network Tracing
Redlining
Searching & Finding network elements



Technologies for imaging and repairing for large water pipe

Customer Service

DATA

GIS DB

CRM, Billing …etc

Data

Customer Services Module

Aim:
Managing mobile workforce, request for services, statues, monitor crew and track work orders …etc.

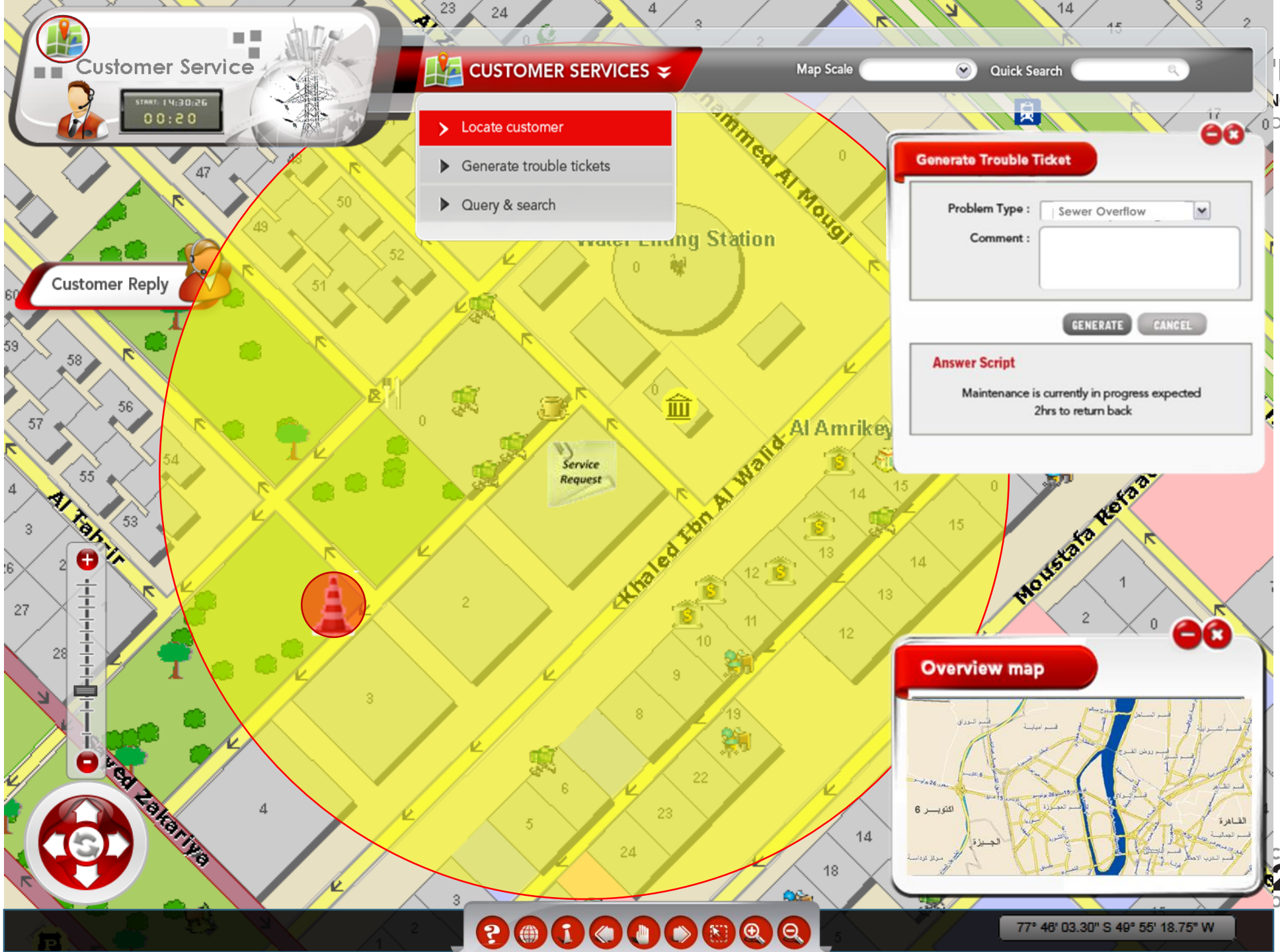
Main Functions

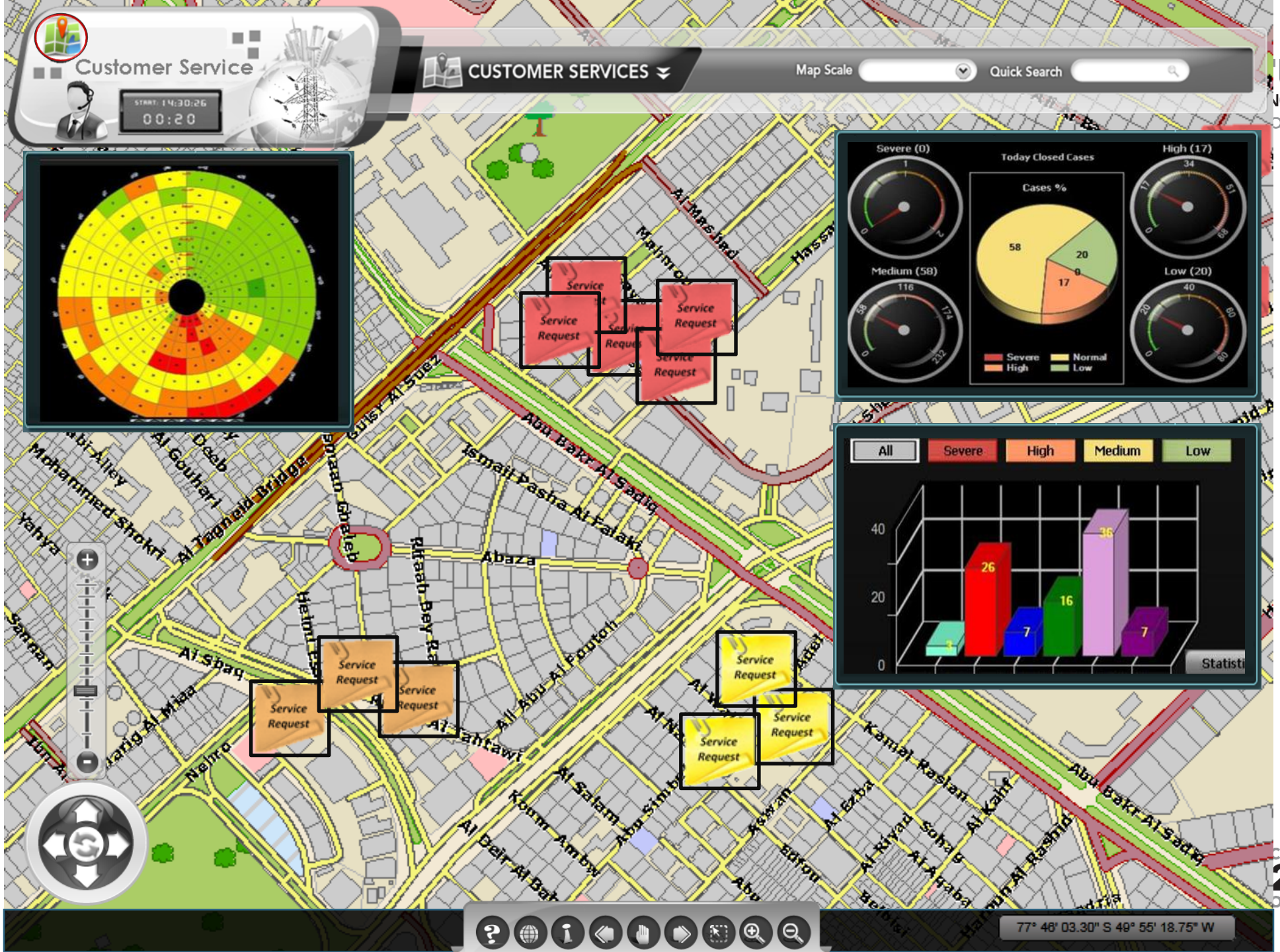
- Map Navigation
- Spatial Search
- Tabular Search
- Measurements
- Base Map
- Bookmarks
- Receive Call
- Locate Customer
- Locate Complaint
- Locate/Show Fault
- Advanced Geo-Analysis
- Close Call
- Reporting

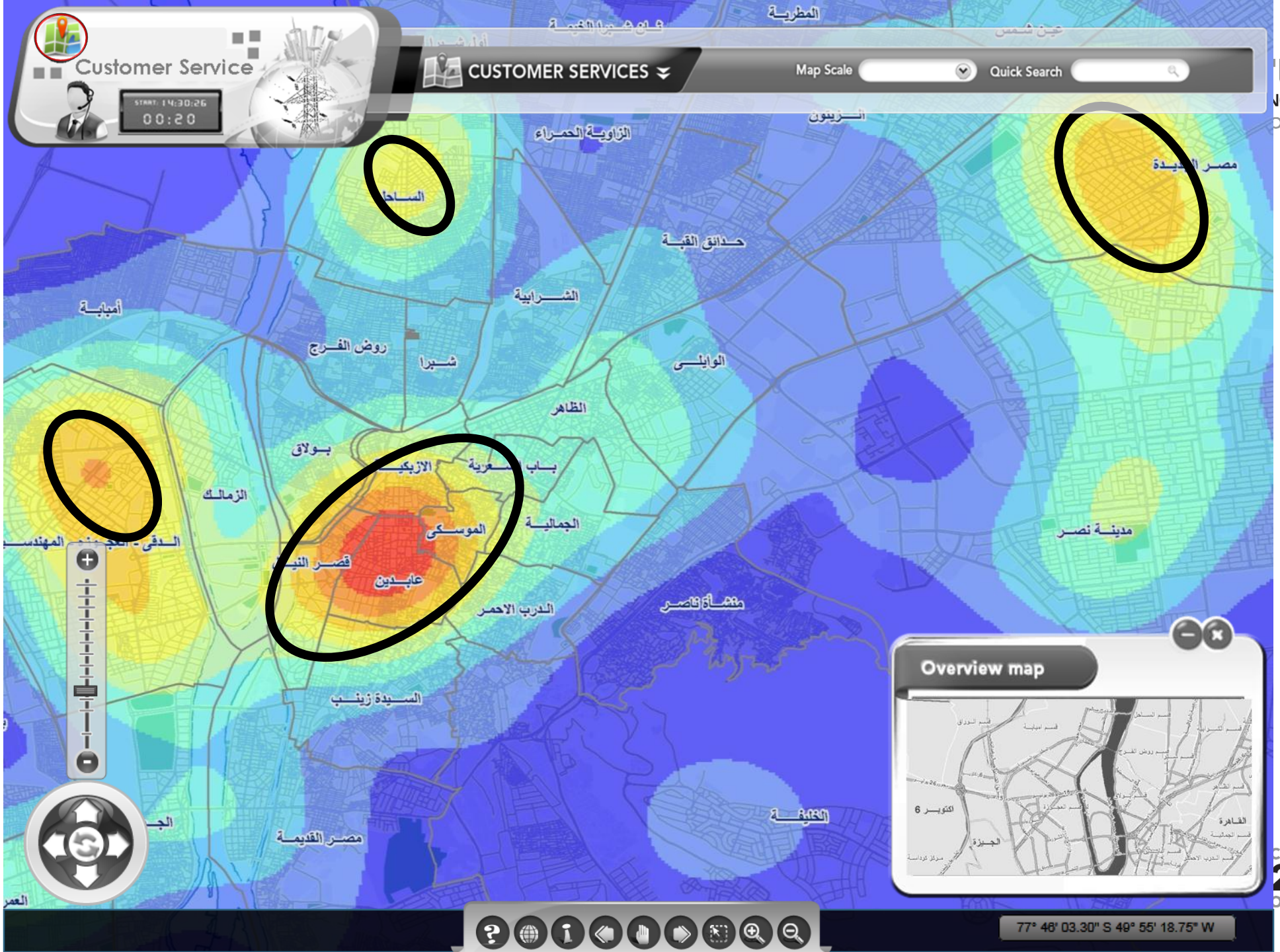

Customer Service
START: 14:30:26
00:20
CUSTOMER SERVICES
Map Scale
Quick Search
Locate customer
Generate trouble tickets
Query & search
Locate Customer
Fixed no. :
0235731127
Customer Name :
Mohsen Amin
Address :
454 El Ahram El Giza
LOCATE
CANCEL
Overview map
77° 46' 03.30" S 49° 55' 18.75" W


Customer Service
START: 14:30:26
00:20
CUSTOMER SERVICES
Map Scale
Quick Search
Locate customer
Generate trouble tickets
Query & search
Customer Reply
Customer Information
Phone number
0384783666
Owner's full name
Mohamed Ahmed
Contact information
Contact information
Contact phone number
0387436739
Mobile number
0103762368809
Address
454 Al ahram Al Giza
Connection Details
Service Information
Overview map
Water Filling Station
Khaled Ibn Al Walid
Al Tahrir
77° 46' 03.30" S 49° 55' 18.75" W

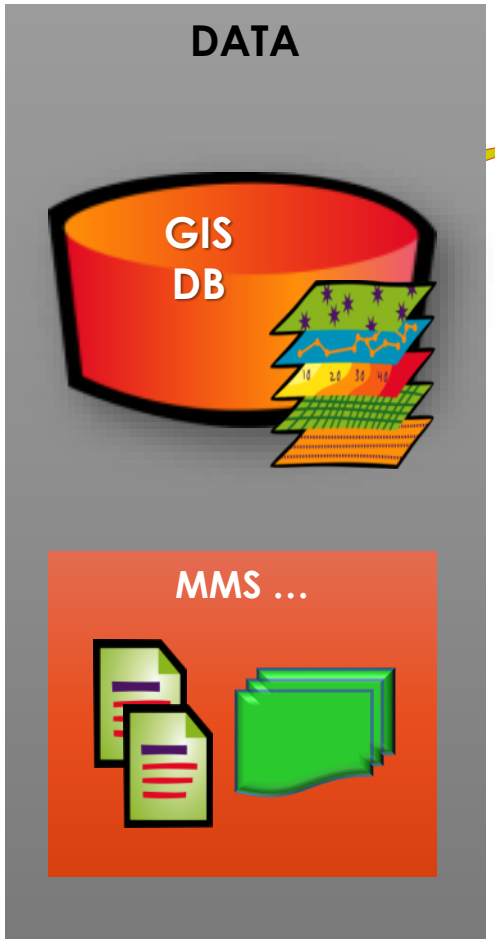

Customer Service
CUSTOMER SERVICES
Map Scale
Quick Search
Locate customer
Generate trouble tickets
Query & search
Customer Reply
Customer Information
Phone number 0384783666
Owner's full name Mohamed Ahmed
Contact information Contact information
Contact phone number 0387436739
Mobile number 0103762368809
Address 454 Al ahram Al Giza
Connection Details
Service Information
Generate Trouble Ticket
Problem Type : Pipe leakage
Comment : Pipe Leakage
GENERATE
CANCEL
Overview map
77° 46' 03.30" S 49° 55' 18.75" W


Customer Service
START: 14:30:26
00:20
CUSTOMER SERVICES
Map Scale
Quick Search
Locate customer
Generate trouble tickets
Query & search
Customer Reply
Generate Trouble Ticket
Problem Type :
Sewer Overflow
Comment :
GENERATE
CANCEL
Answer Script
Maintenance is currently in progress expected
2hrs to return back
Overview map
Service Request
Khaled Ibn Al Walid
Al Amrikey
Moustafa Kefaa
Al Tahrir
77° 46' 03.30" S 49° 55' 18.75" W



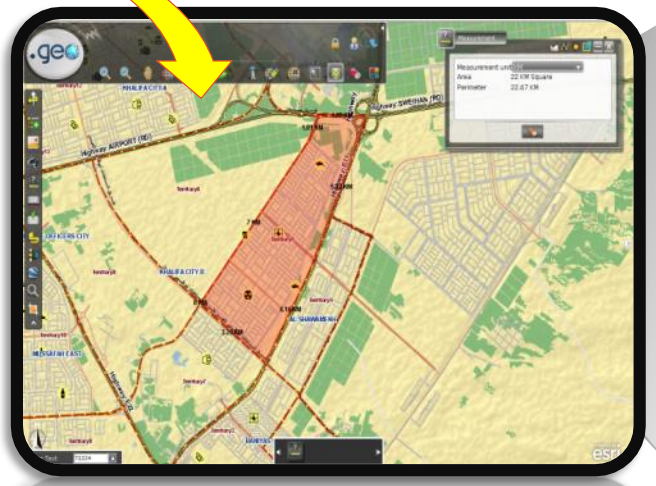


Maintenance Management



Data

Maintenance Management Module

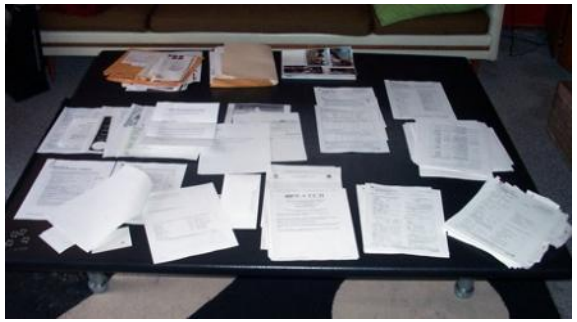


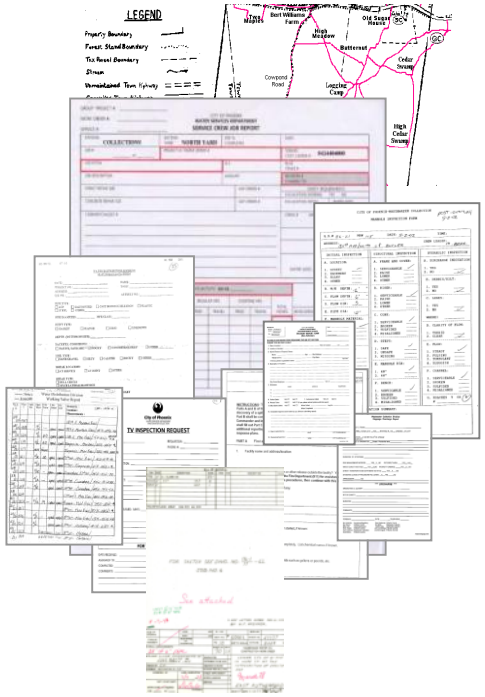
Aim:
Managing maintenance process for water assets and provide workforce with maintenance map…etc.

Main Functions

- Map Navigation
- Spatial Search
- Tabular Search
- Measurements
- Base Map
- Bookmarks
- Map Classification
- Show Assets
- Editing
- Maintenance Status Map
- Tracing
- Schedule Maintenance Plan
- Assign to workforce
- Plotting

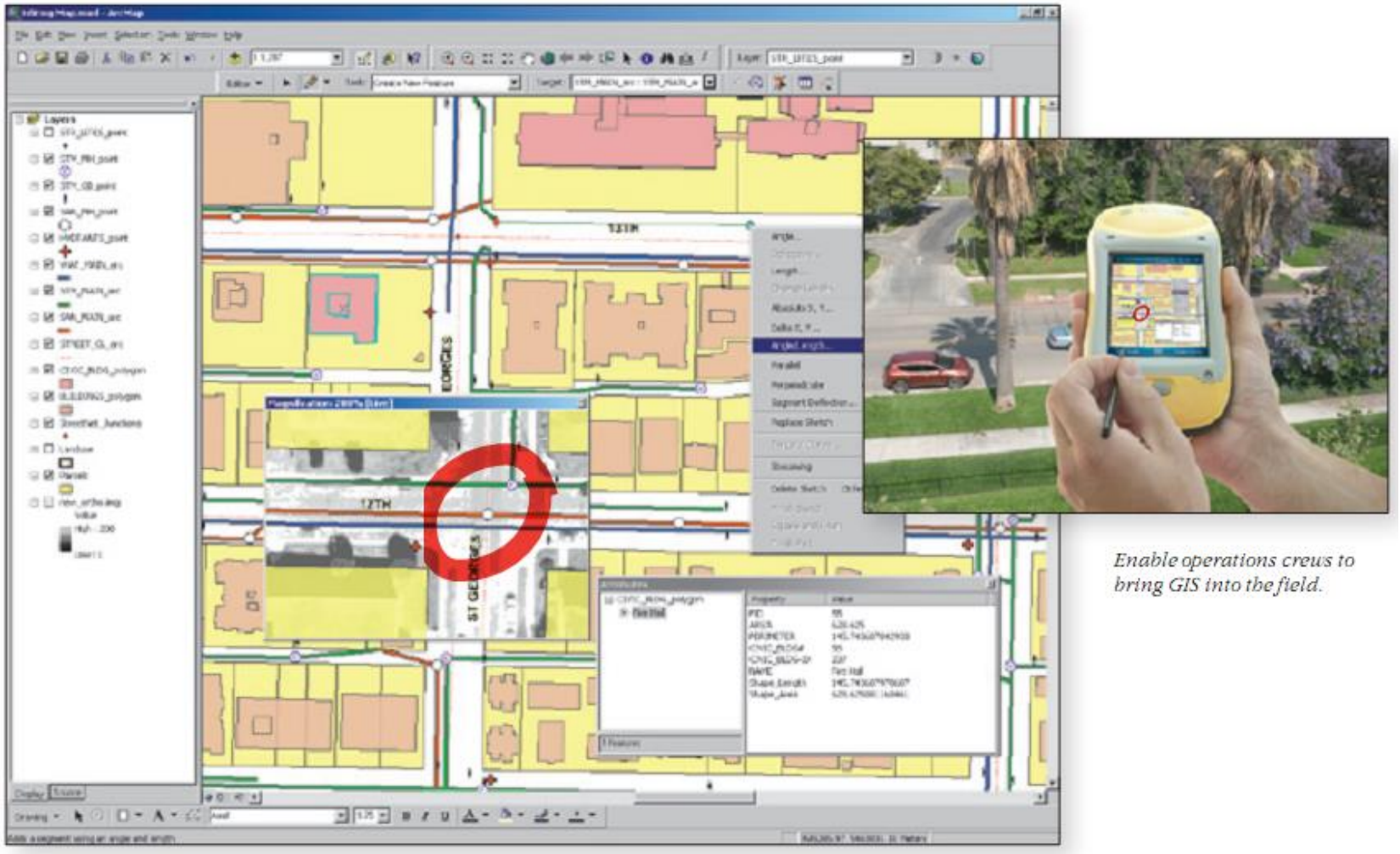
How Long does it Take to get Information Into and Out of the Field?





It is Difficult to Effectively Communicate with Field Operations

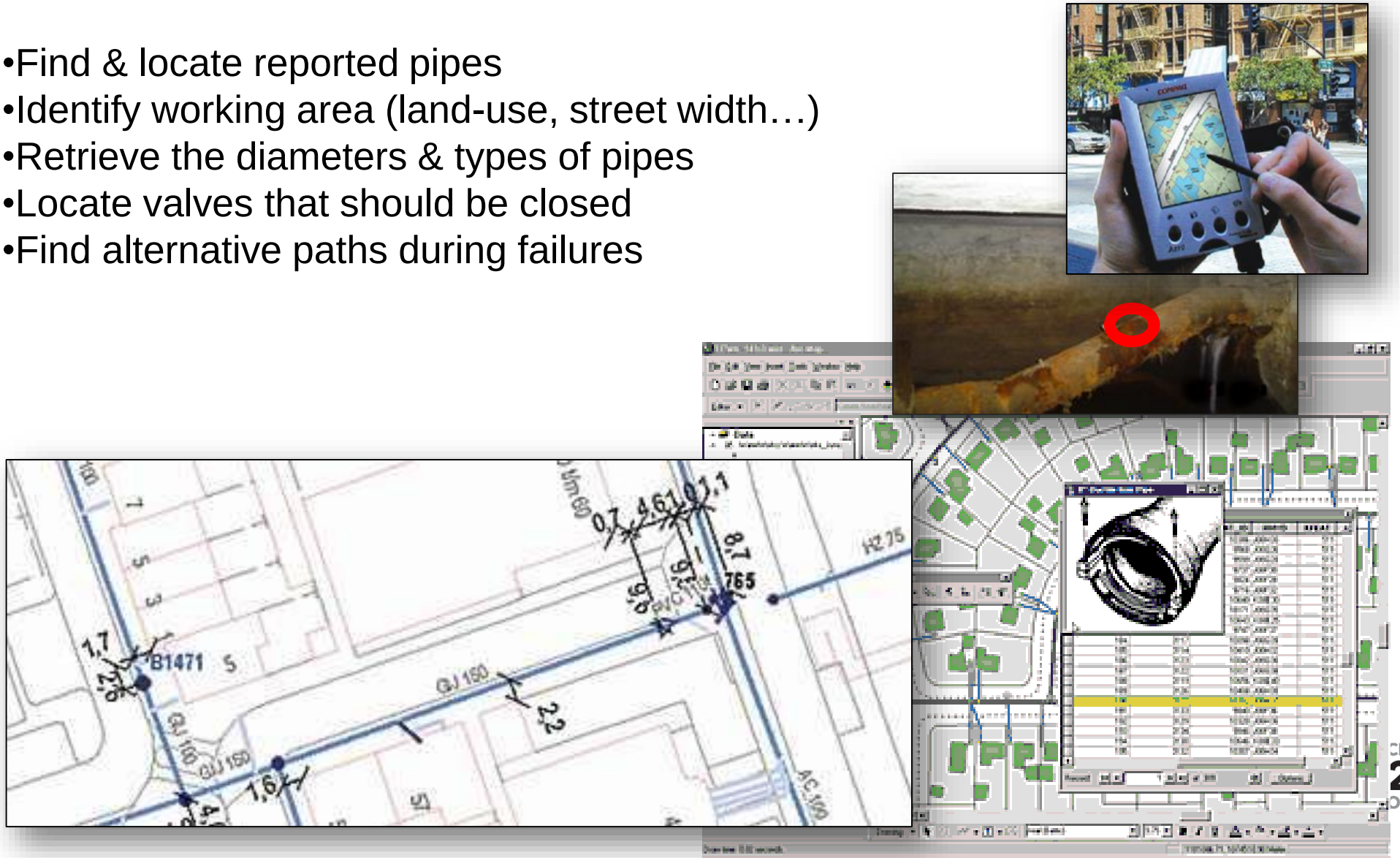
Supporting Field Crew



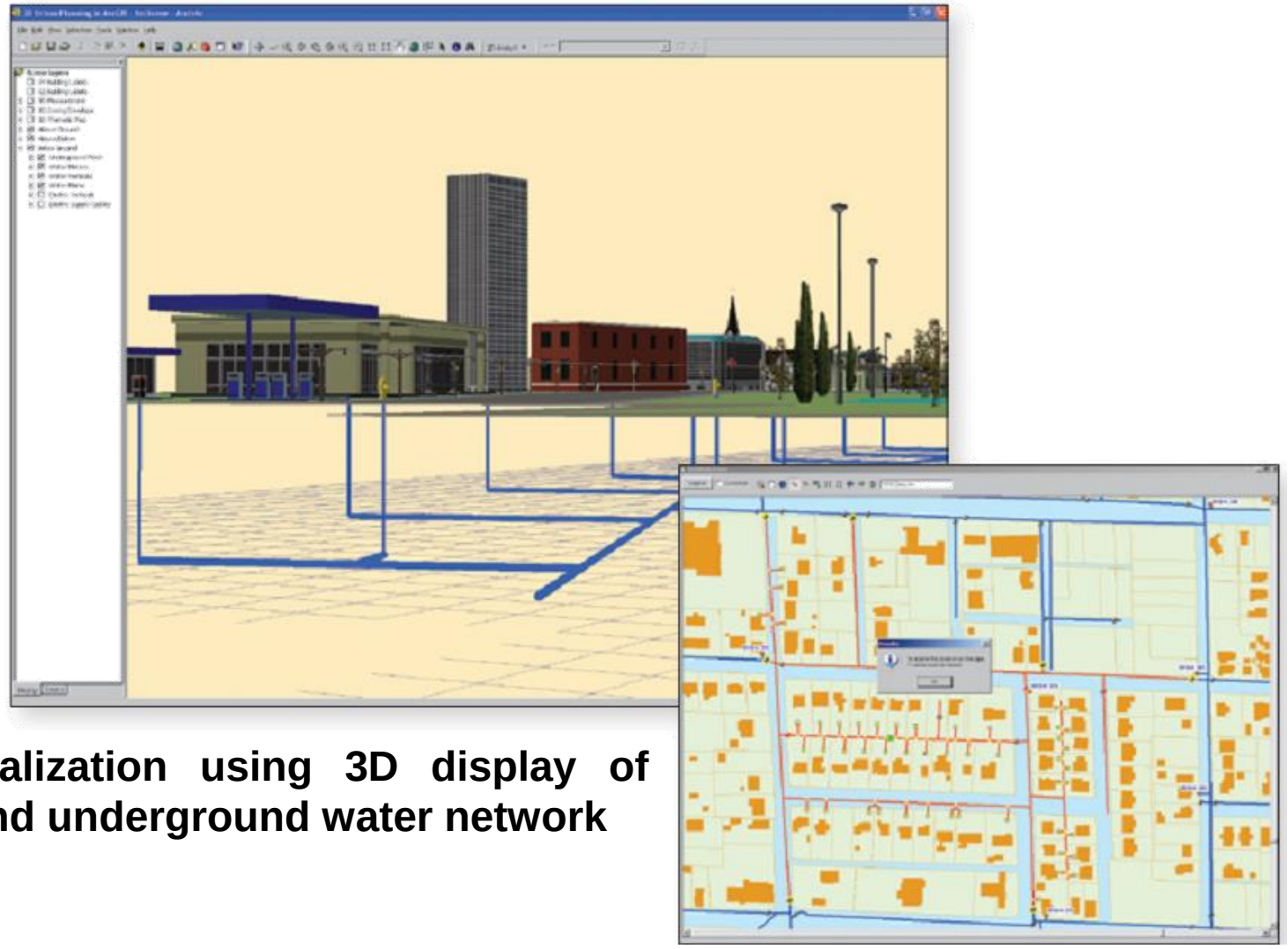
Enable operations crews to bring GIS into the field.

Easy Access to Information, Anywhere

- Find & locate reported pipes
- Identify working area (land-use, street width…)
- Retrieve the diameters & types of pipes
- Locate valves that should be closed
- Find alternative paths during failures

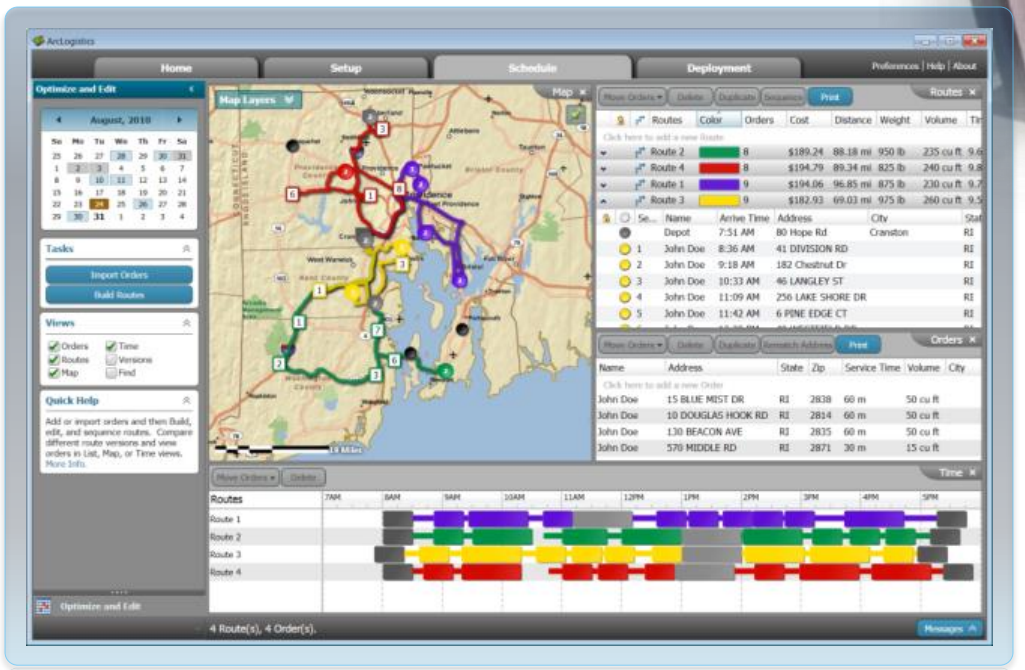


Powerful Visualization

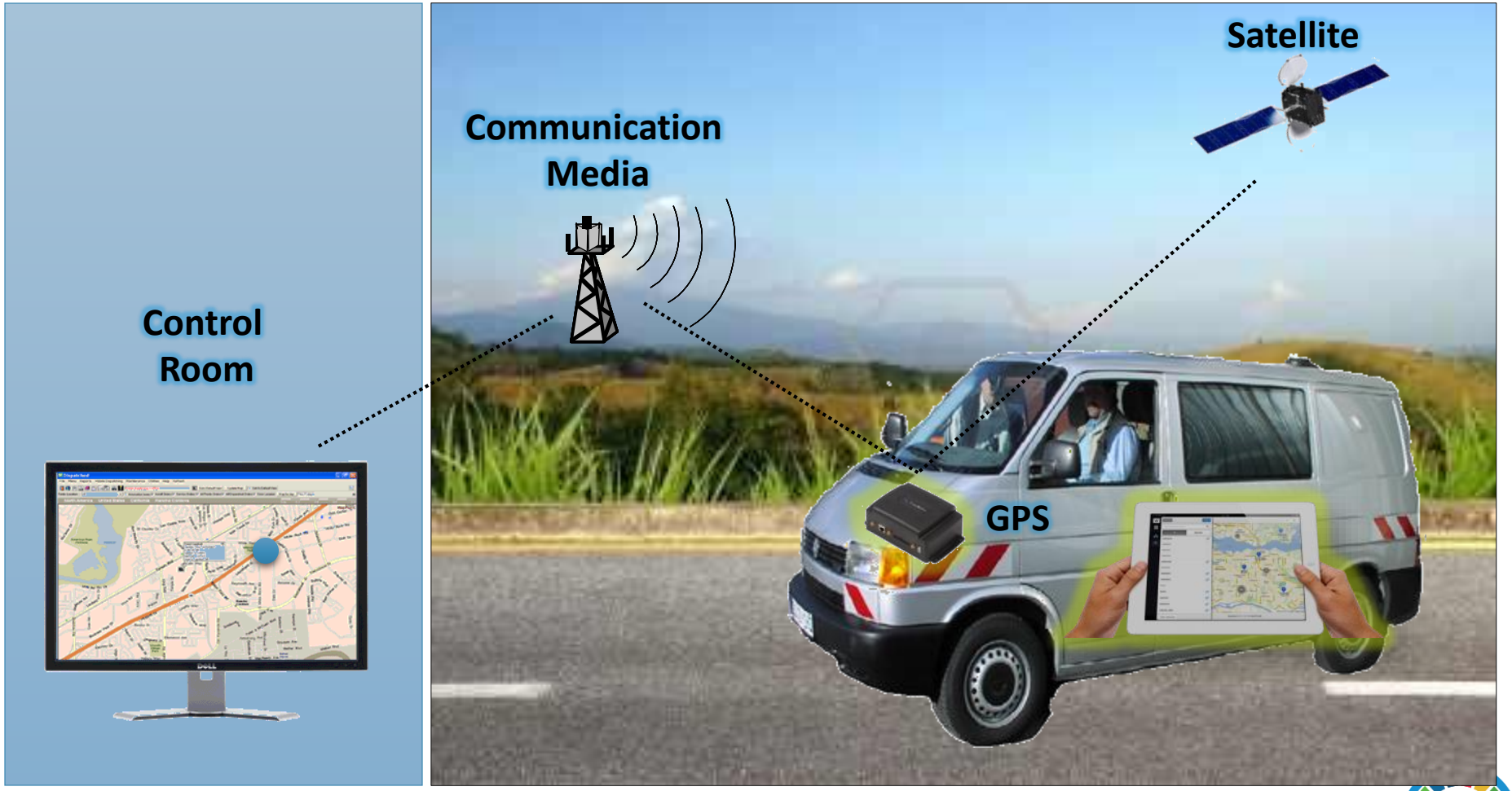


Better Visualization using 3D display of Buildings and underground water network

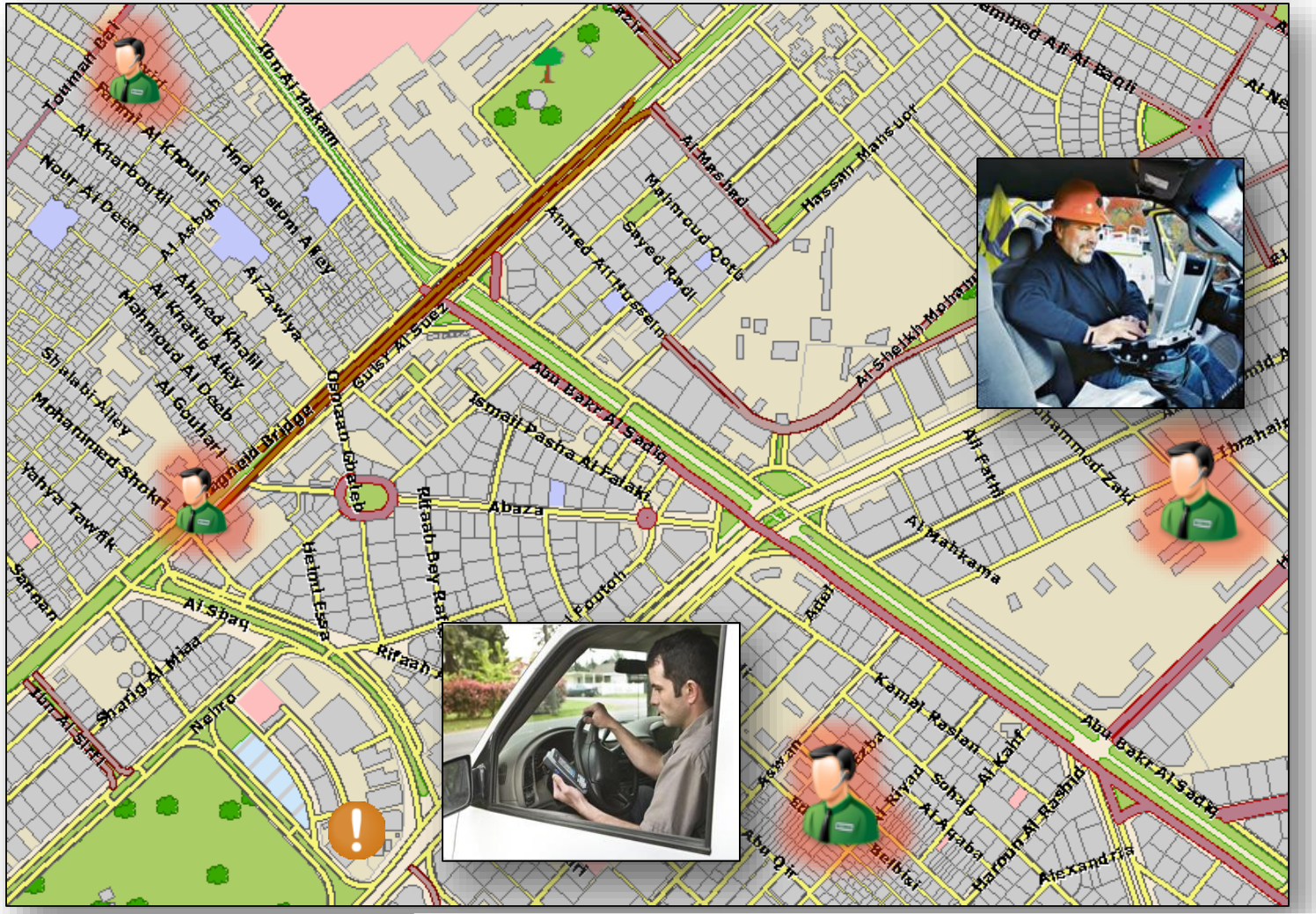
Workforce Optimization



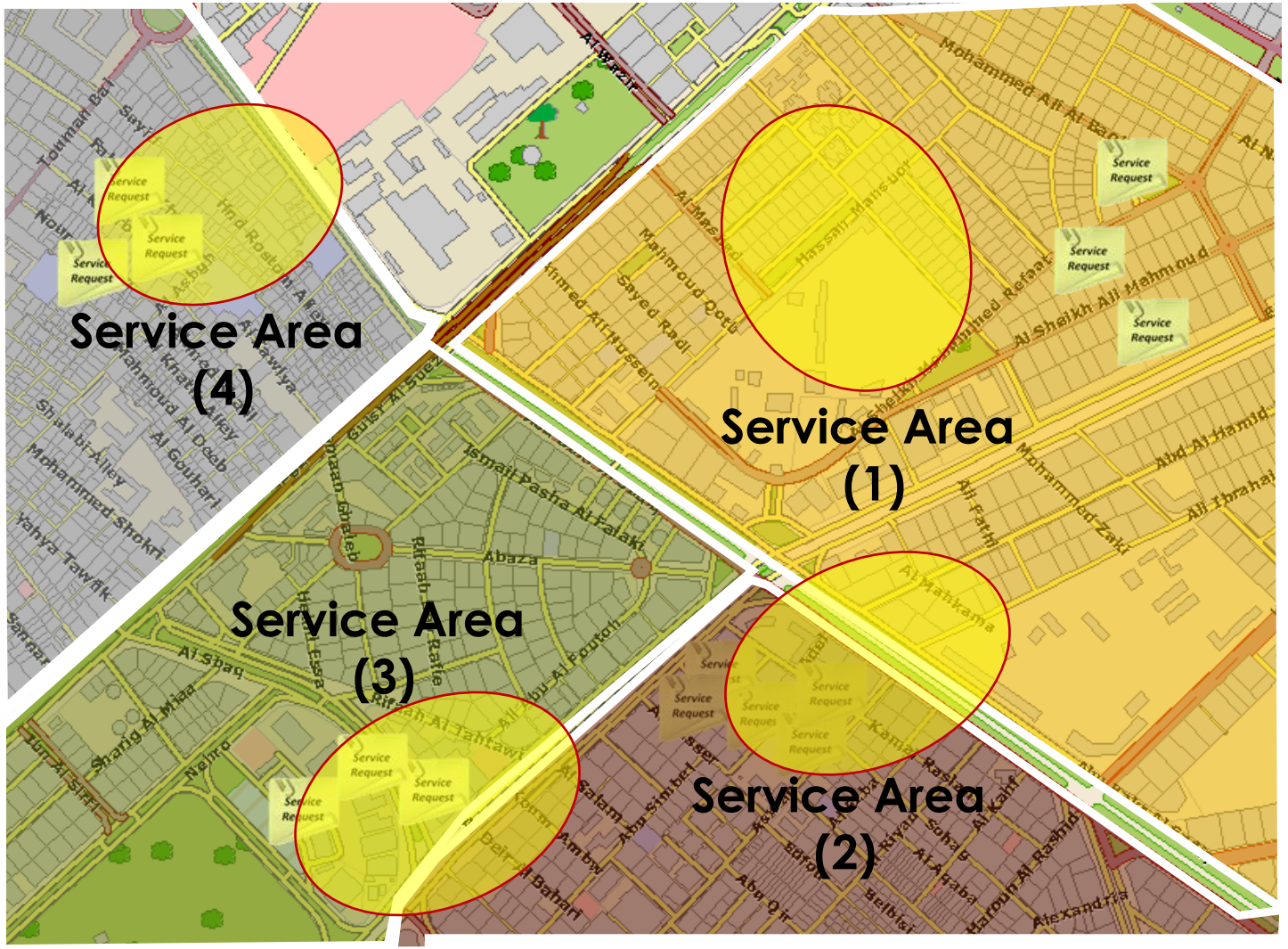
Tracking in-Field Teams



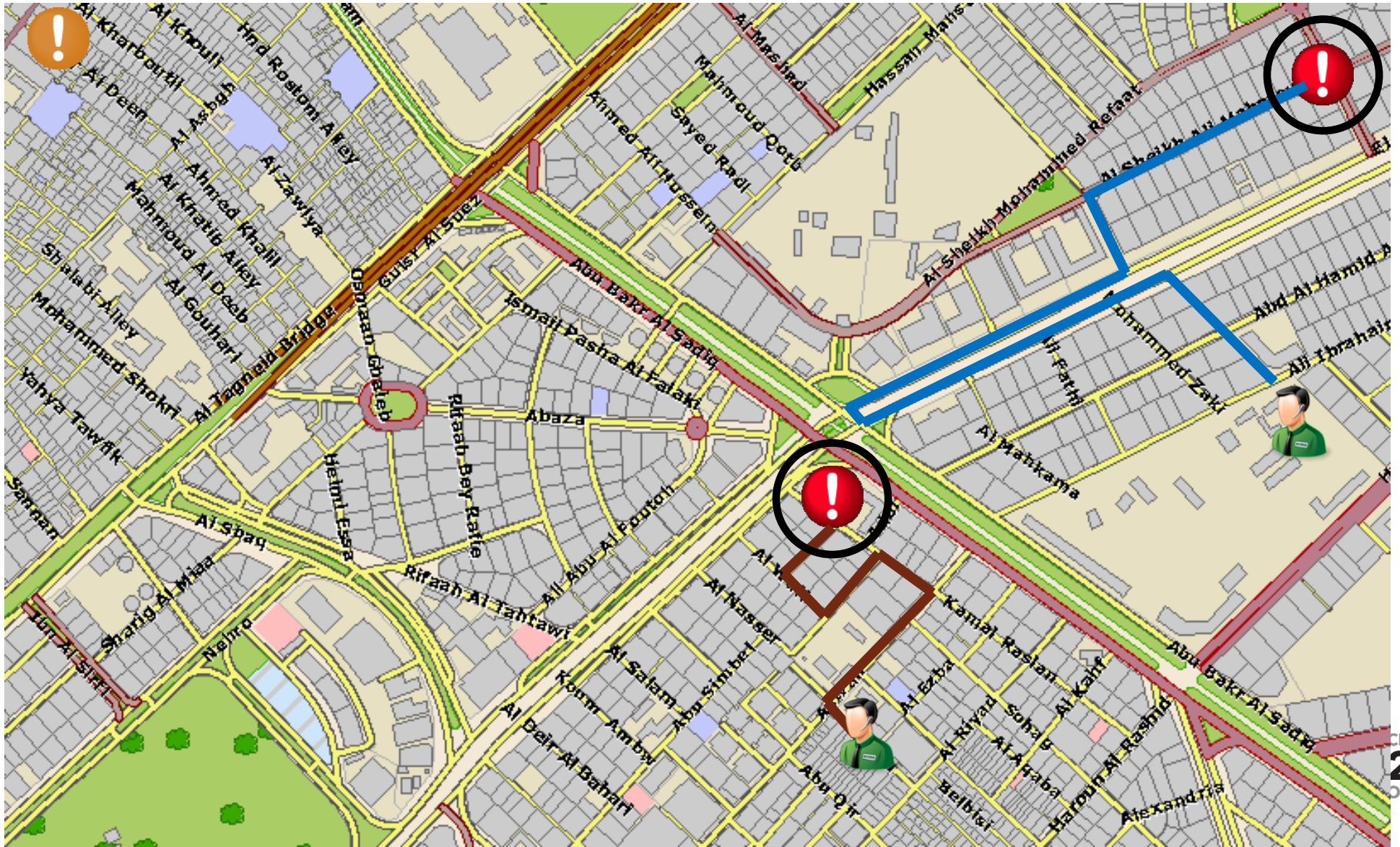
Tracking in-Field Teams



Locations of Service Requests

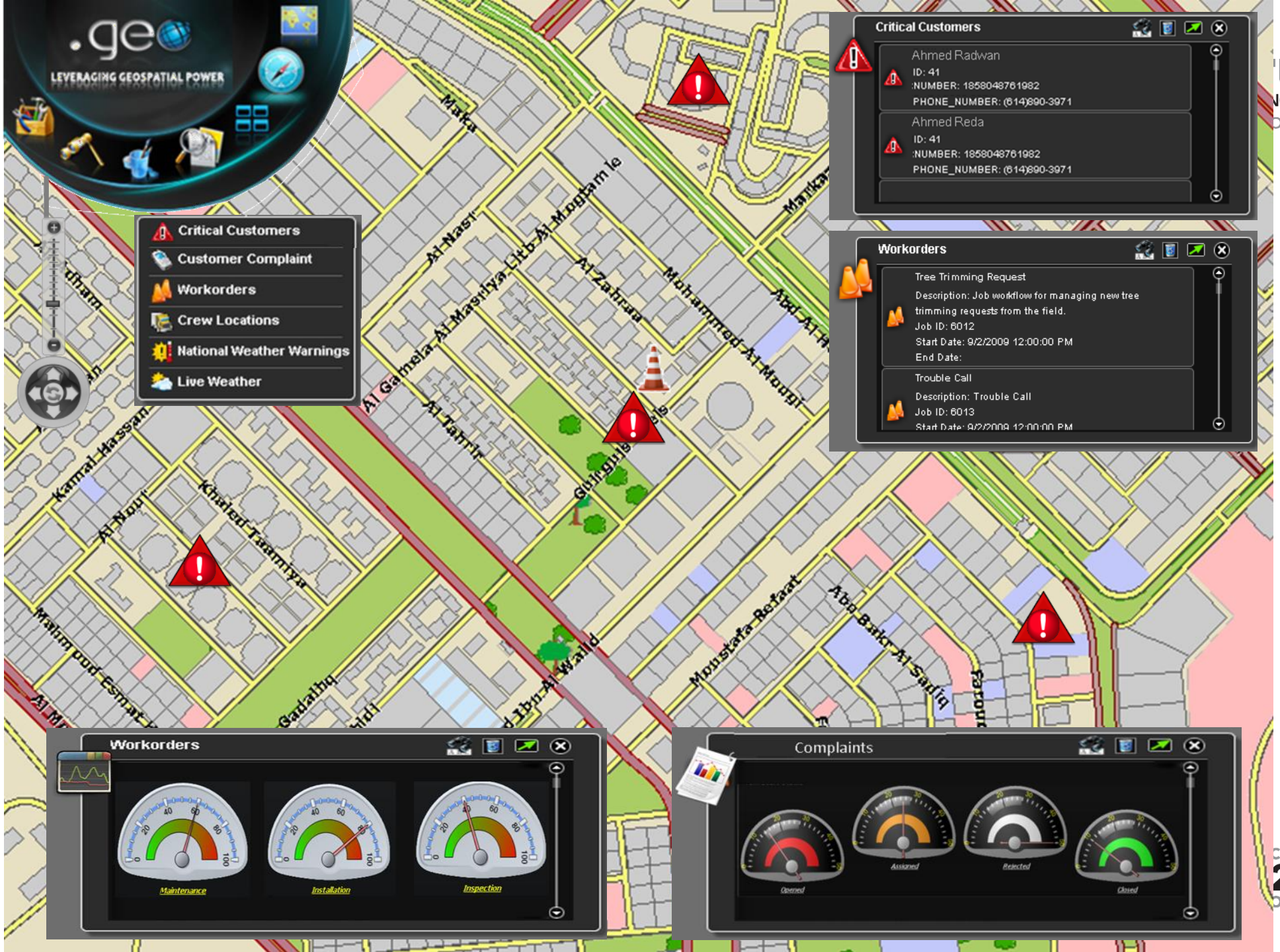


Assign Service Requests

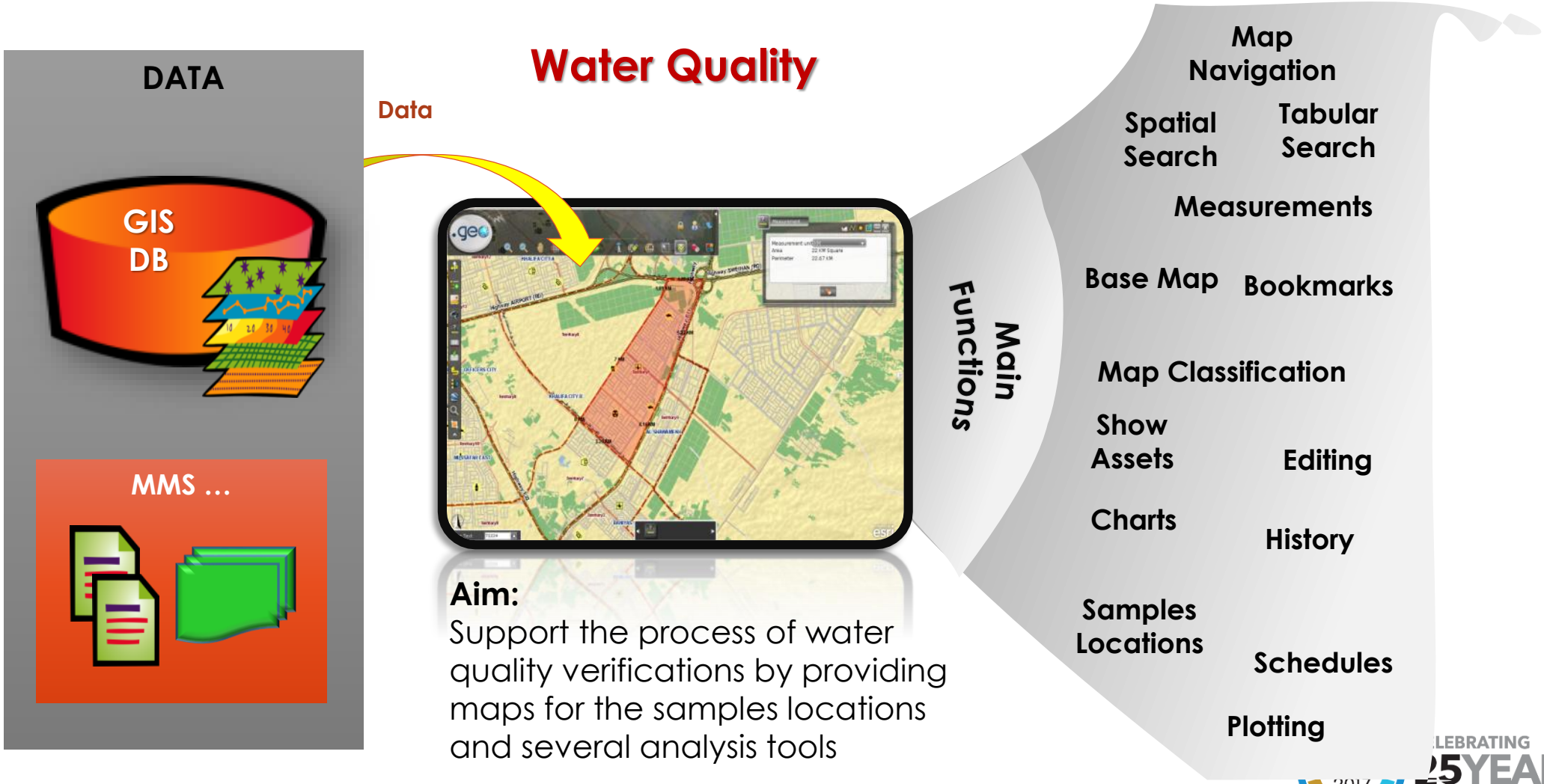



Crew 1
Kamal Ras
Al-Ezba
Al-Riyad


Crew 2
Hassan Mans
Al-Sheikh Mohammed Refaat
Ahmed Zaki


.geo
LEVERAGING GEOSPATIAL POWER
Critical Customers
Customer Complaint
Workorders
Crew Locations
National Weather Warnings
Live Weather
Critical Customers
Ahmed Radwan
ID: 41
:NUMBER: 1858048761982
PHONE_NUMBER: (614)890-3971
Ahmed Reda
ID: 41
:NUMBER: 1858048761982
PHONE_NUMBER: (614)890-3971
Workorders
Tree Trimming Request
Description: Job workflow for managing new tree trimming requests from the field.
Job ID: 6012
Start Date: 9/2/2009 12:00:00 PM
End Date:
Trouble Call
Description: Trouble Call
Job ID: 6013
Start Date: 9/2/2009 12:00:00 PM
Workorders
Maintenance
Installation
Inspection
Complaints
Opened
Assigned
Rejected
Closed
Al-Nasr
Al Gamela Al Masriya Lltb Al Mogtam le
Al Zahraa
Mohammed Al Mougi
Al Tahrir
Kamal Hassan
Al Nour
Khaled Taamiya
Gadalhq
Ibn Al Walid
Moustafa Refaat
Abo Bakr Al Sadiq

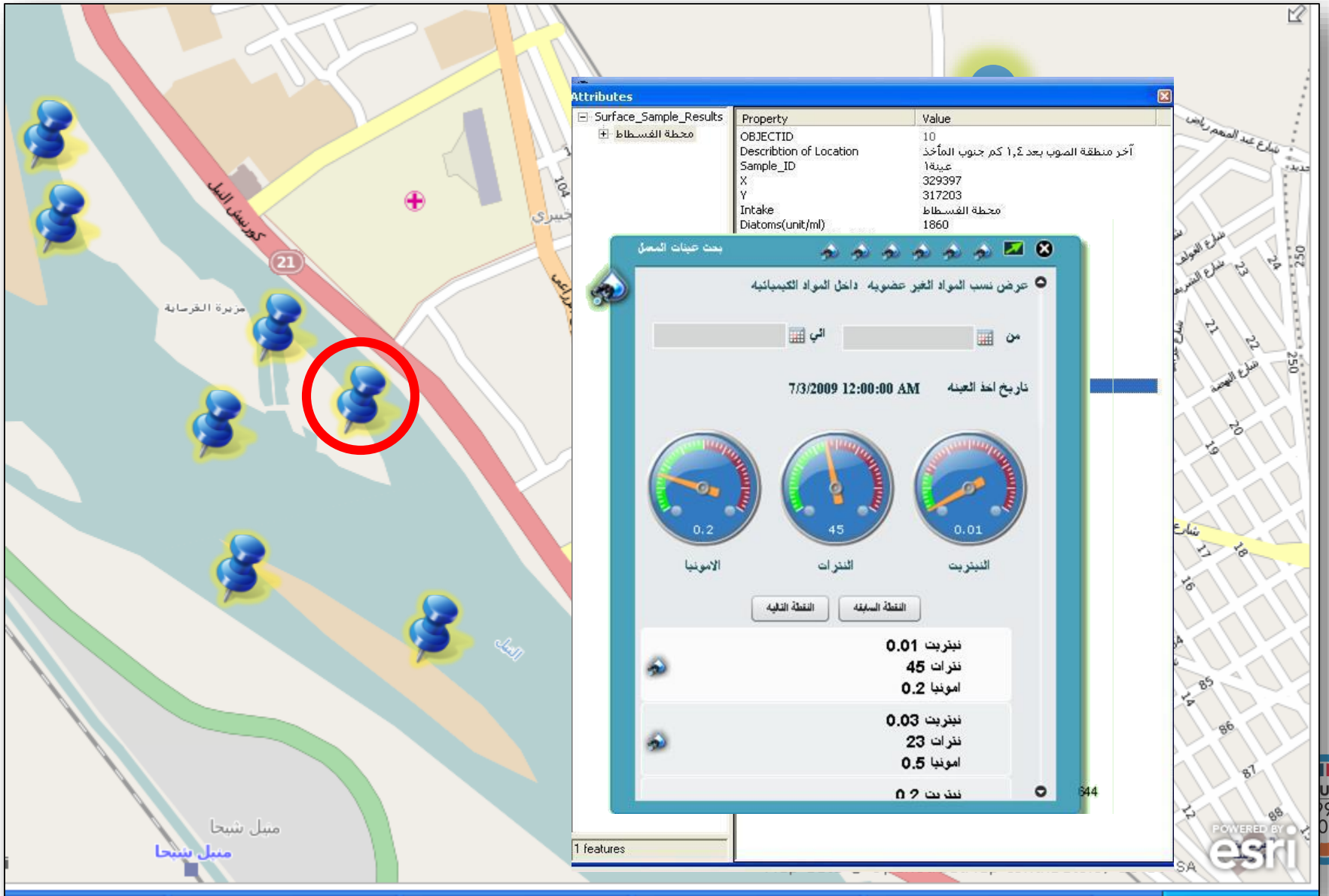
Water Quality



GIS for Water Quality

- Using coordinates from GPS, samples can be re-collected from same locations
- Follow current & historical results of samples
- Analyses & Reports

Locations of Water Samples



Details of the sample

Network Planning

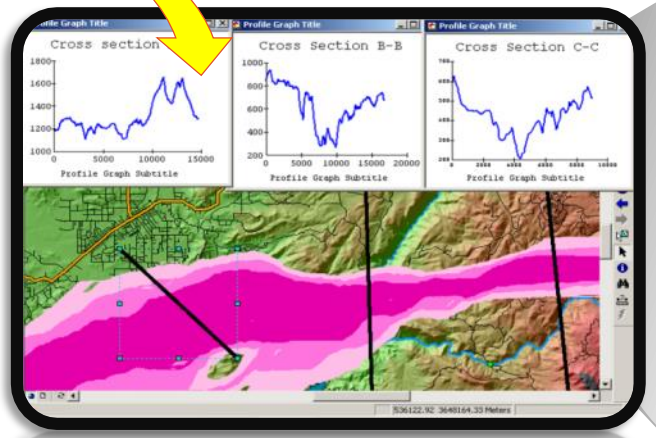
DATA

GIS DB

Other Data

Data

Network Planning Module

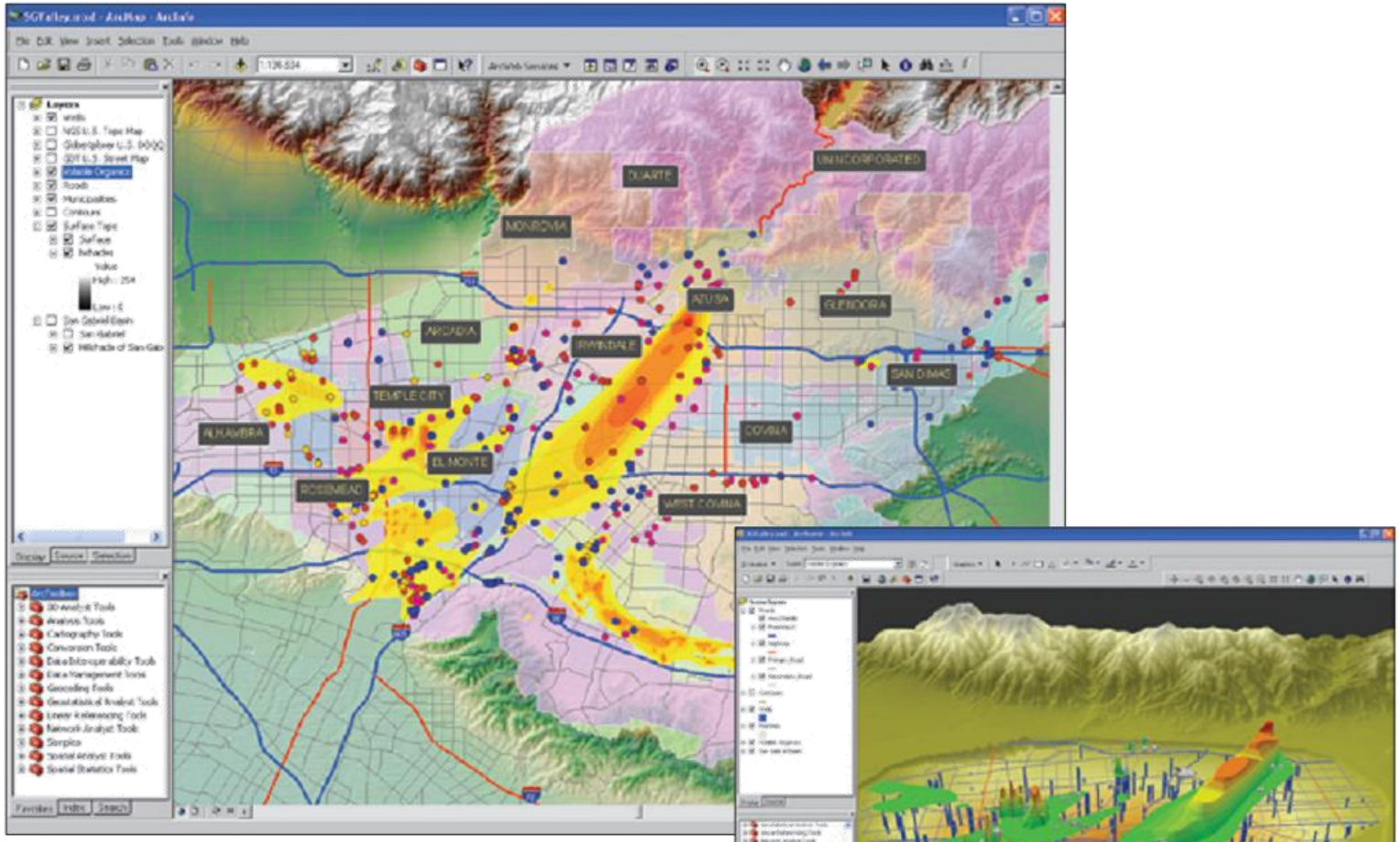


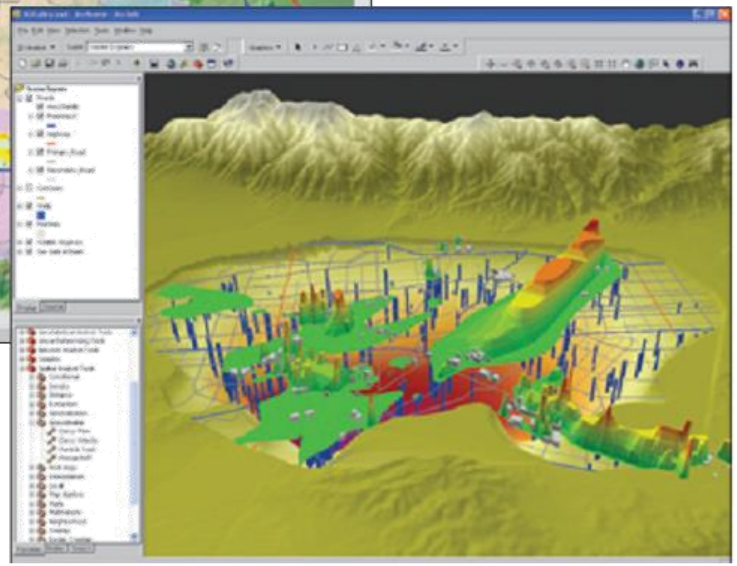
Aim:
allows planners with multiple tools to assess and weigh scenarios that balance levels of investment against asset life span.

Main Functions

- Map Navigation
- Spatial Search
- Tabular Search
- Measurements
- Base Map
- Bookmarks
- Map Classification
- Least Cost Path
- Obstacles along route
- Regulations
- Topography
- Land-use

Analyze & Plan





- Model your network data
- Analyze populations, customers, Consumption and Demand

W-GIS (Projects Tracking)

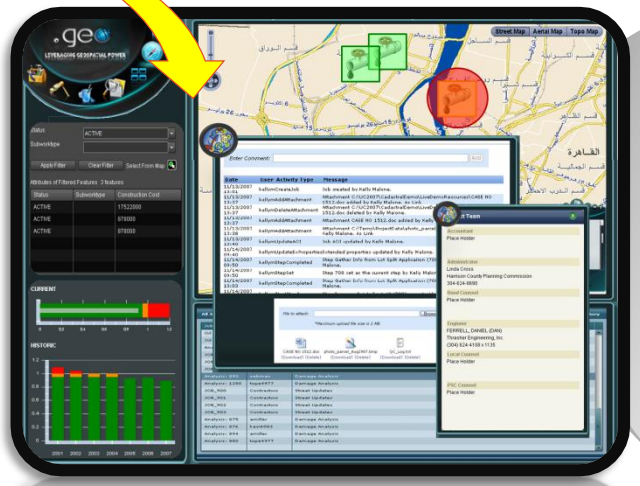
DATA

W-GIS DB

Project Server

Data

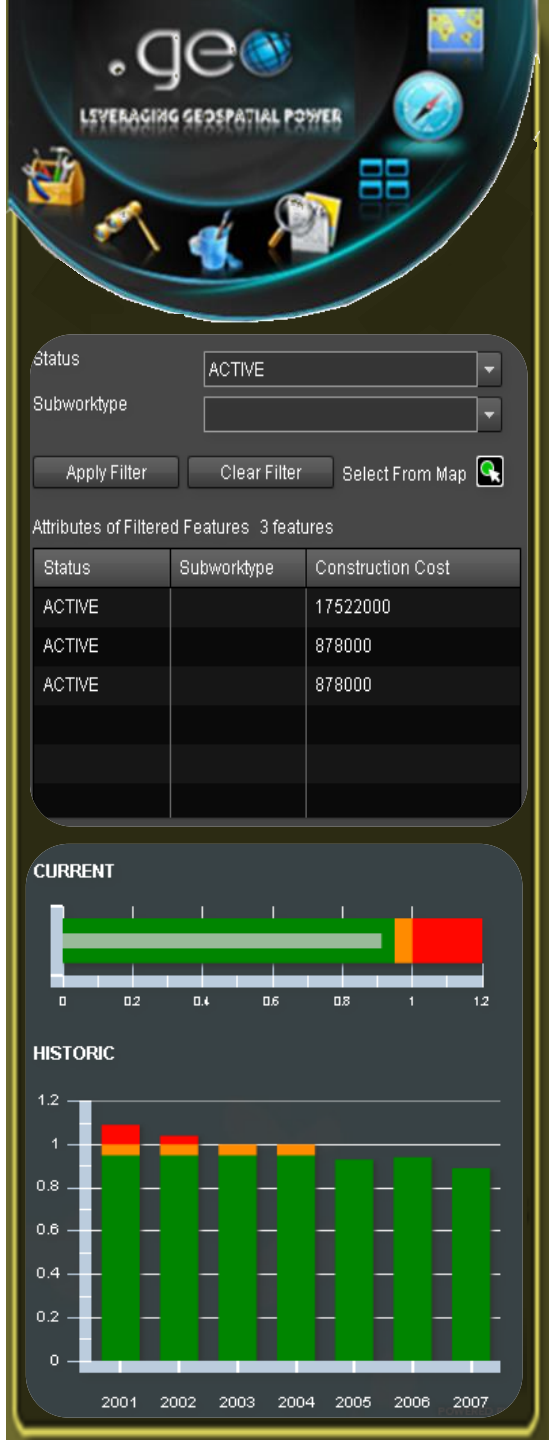
WGIS Projects Tracking Module

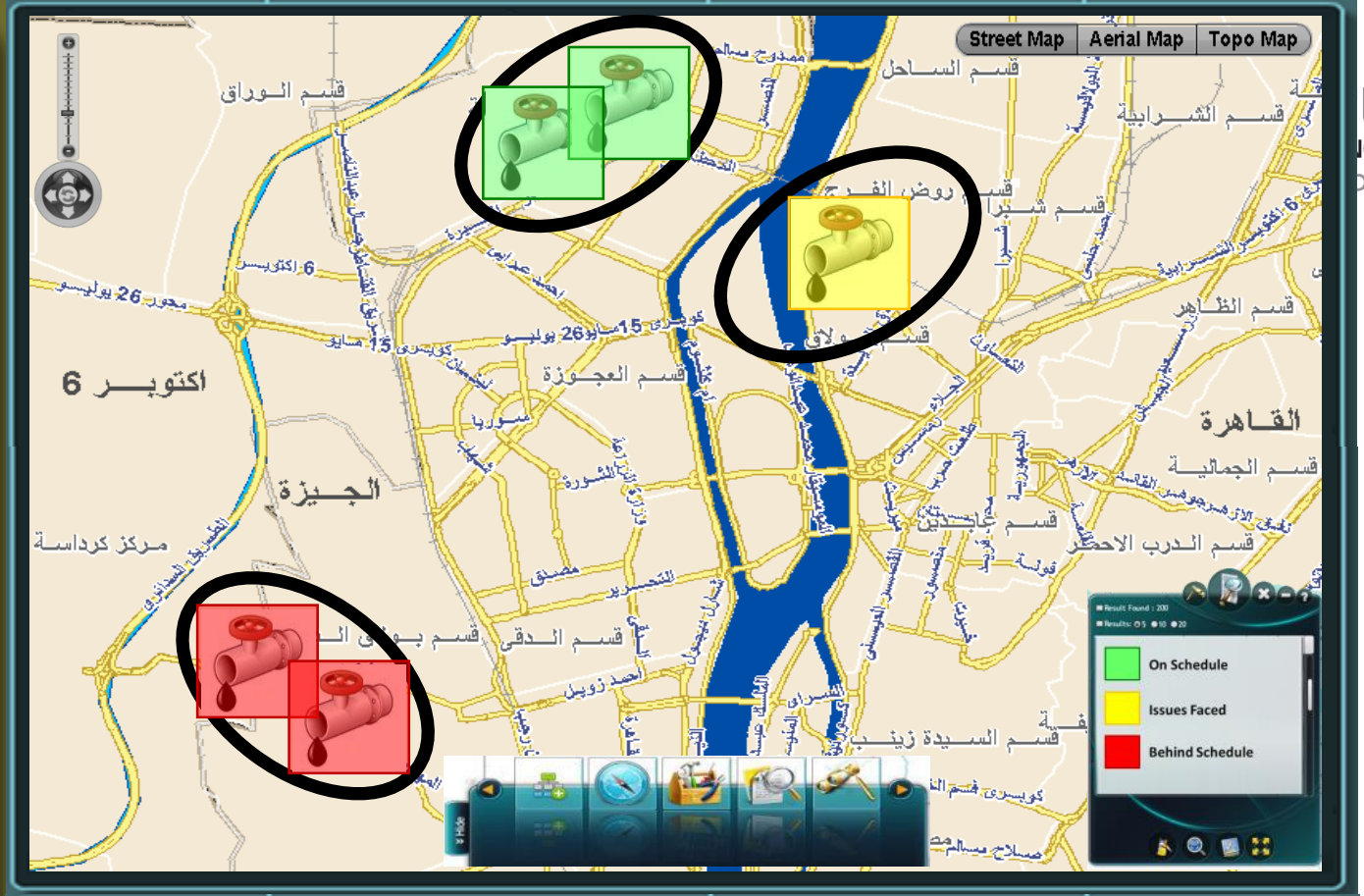


Aim:
provides access to Water projects information and provides tools to support project planning, management, and data acccess…etc.

Main Functions

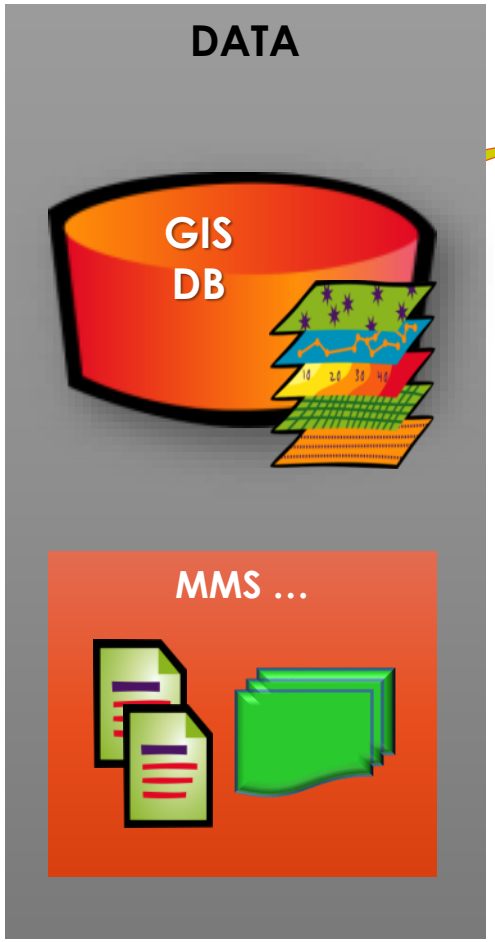
- Map Navigation
- Spatial Search
- Tabular Search
- Measurements
- Base Map
- Bookmarks
- Map Classification
- Project Browser
- Project Analyzer
- Project Finder
- Project Tracking
- Reporting
- Redlining
- Plotting


.geo
LEVERAGING GEOSPATIAL POWER
Status
ACTIVE
Subworktype
Apply Filter
Clear Filter
Select From Map
Attributes of Filtered Features 3 features
Status
Subworktype
Construction Cost
ACTIVE
17522000
ACTIVE
878000
ACTIVE
878000
CURRENT
0
0.2
0.4
0.6
0.8
1
1.2
HISTORIC
1.2
1
0.8
0.6
0.4
0.2
0
2001
2002
2003
2004
2005
2006
2007


Street Map
Aerial Map
Topo Map
اكتوبر 6
الجيزة
القاهرة
On Schedule
Issues Faced
Behind Schedule


All Jobs
Properties
Workflow
AOI
Attachments
Notes
History
Job Name
Assigned To
Job Type
Oil Spill Analysis
gones
Damage Analysis
Oil Spill Analysis
gones
Damage Analysis
Analysis: 860
Damage Analysis
JOB_862
tope4977
Street Updates
JOB_881
Street Updates
JOB_882
Landbase Updates
Analysis: 893
webman
Damage Analysis
Analysis: 1280
tope4977
Damage Analysis
JOB_900
Contractors
Street Updates
JOB_901
Contractors
Street Updates
JOB_902
Contractors
Street Updates
JOB_903
Contractors
Street Updates
Analysis: 875
amiller
Damage Analysis
Analysis: 876
kevi6083
Damage Analysis
Analysis: 894
amiller
Damage Analysis
Analysis: 880
tope4977
Damage Analysis

Executive Dashboard



Data

Dashboard

Main Functions

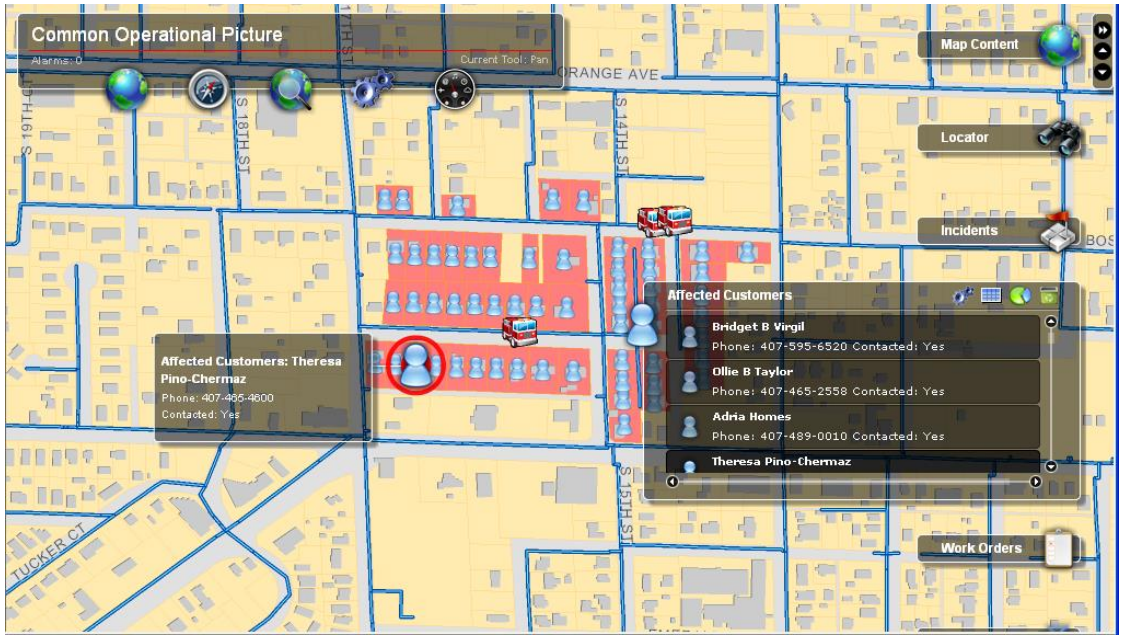
- Map Navigation
- Spatial Search
- Tabular Search
- Measurements
- Base Map
- Bookmarks
- Map Classification
- Show Assets
- Editing
- Charts
- History
- Performance Indicators
- Track Projects

Aim:
Support the process of water quality verifications by providing maps for the samples locations and several analysis tools

GIS Provides Complete Operational Awareness

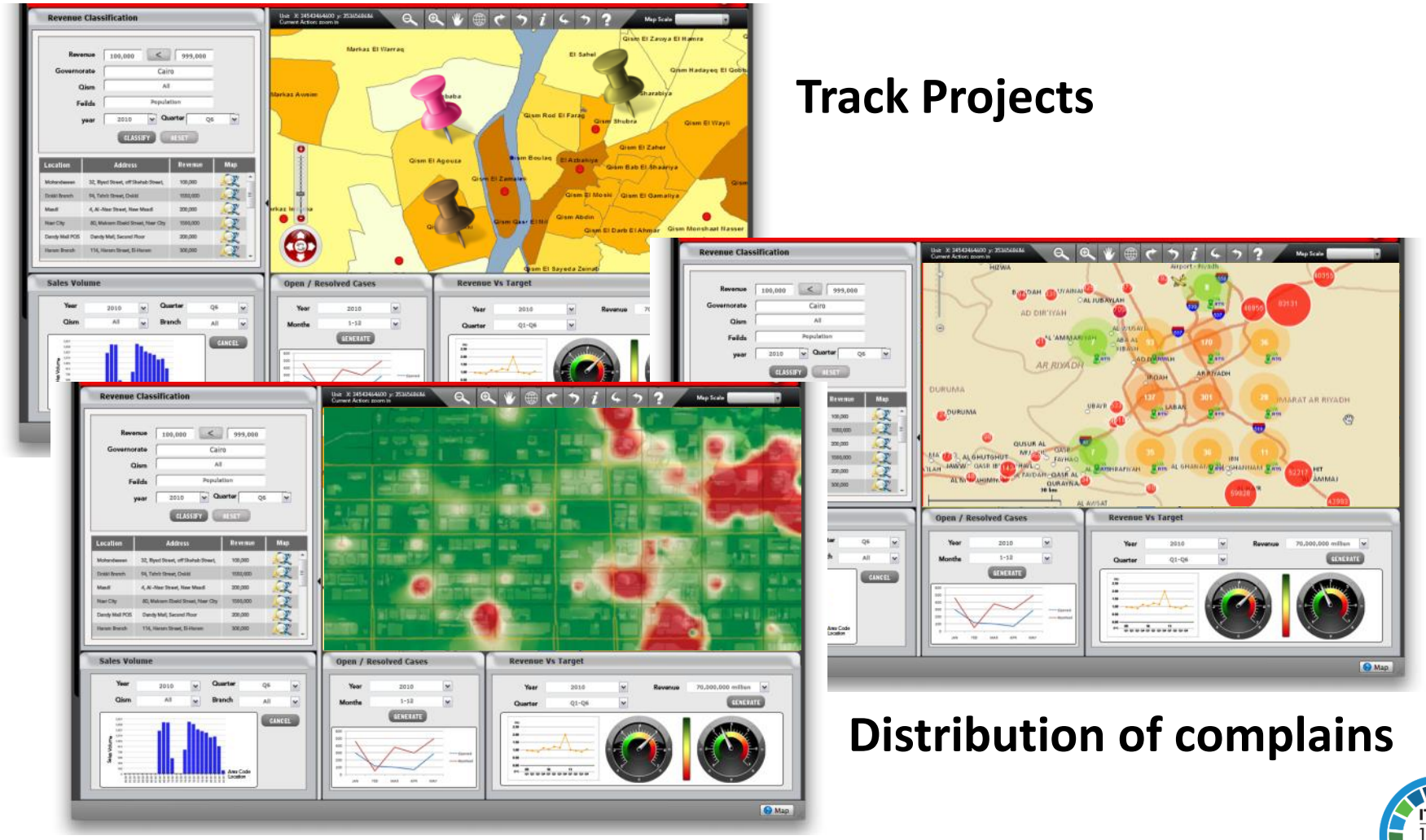
A Common Platform for Sharing Information

- Fully Aware
- More Accountable
- Better Managed



Giving You Visibility into Your Operations

Dashboard



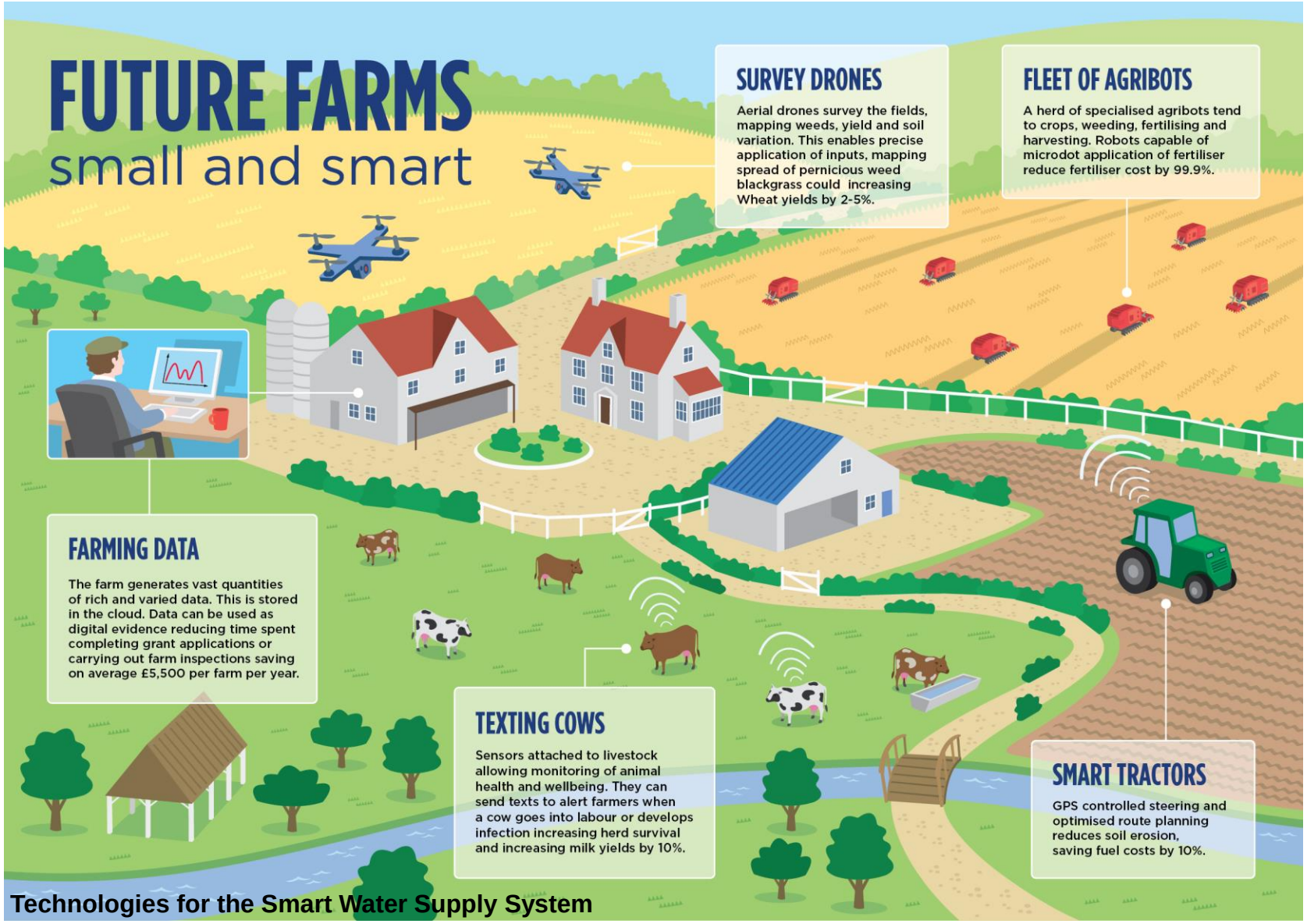
Track Projects

Distribution of complains

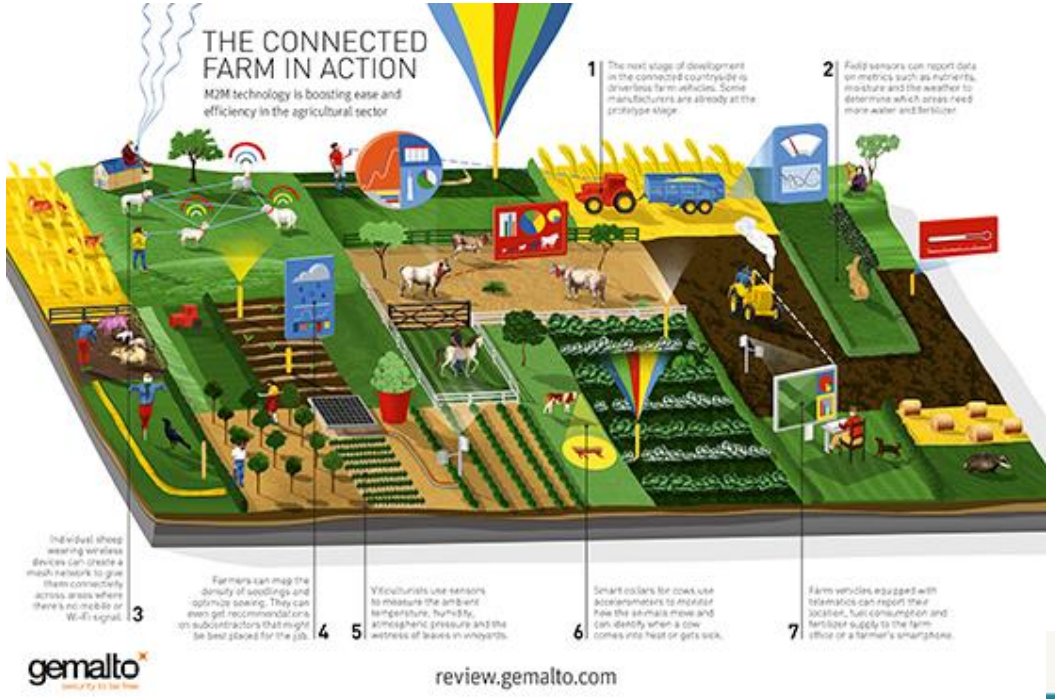
& more KPIs

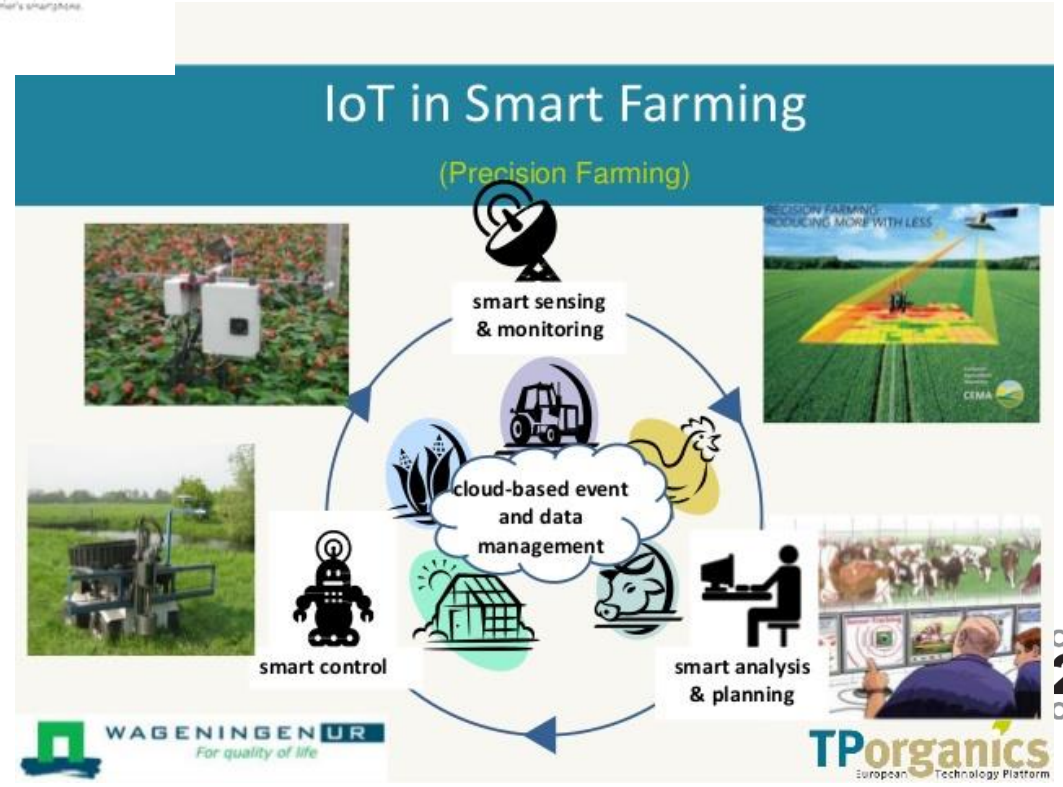
- **Smart/Efficient Water Irrigation, Water Agriculture, and Water Industrial**

Smart sensors optimize water irrigation by measuring humidity, rainfall, wind speed/direction, soil temperature/moisture, atmospheric pressure, and solar radiation.



Technologies for the Smart Water Supply System

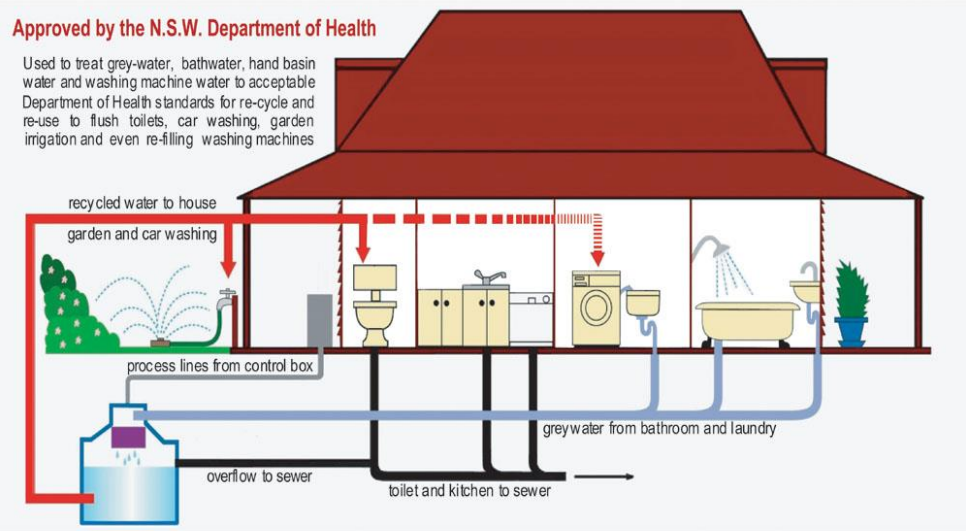


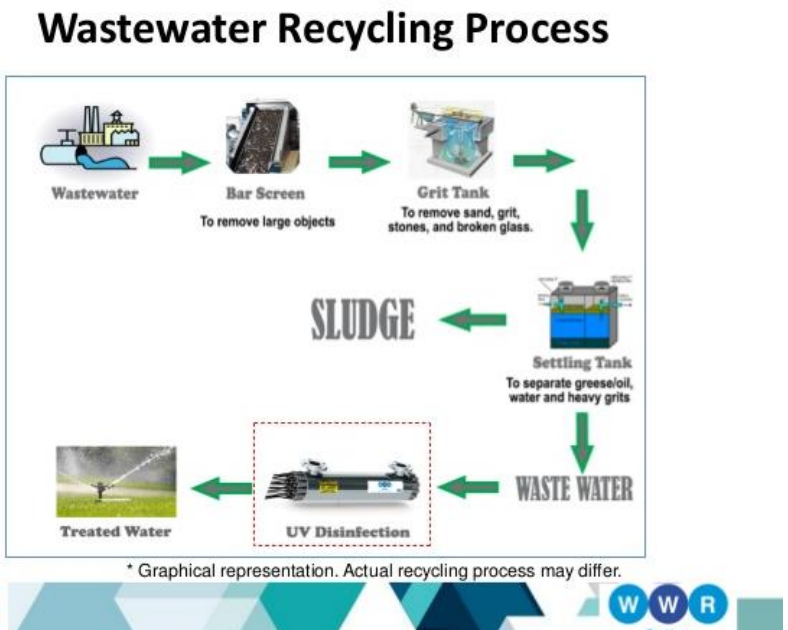


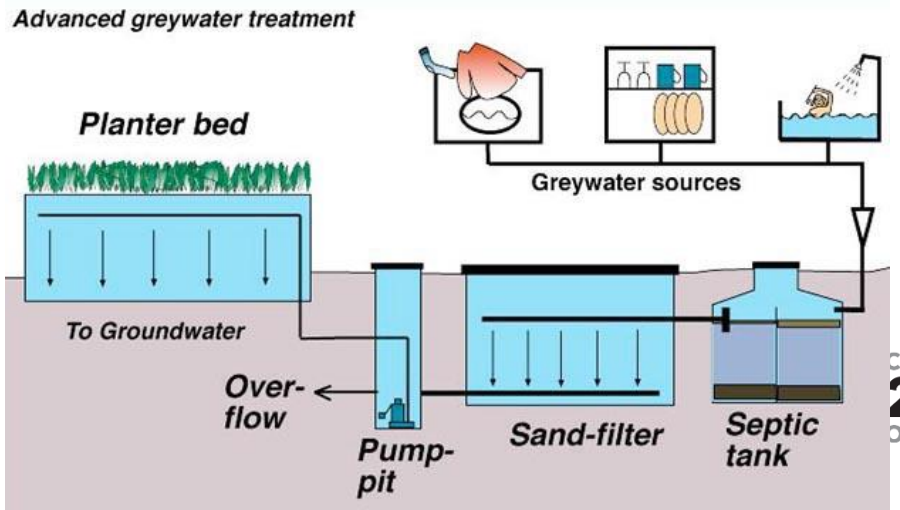
Technologies for the Smart Water Supply System

Water Resources Technologies

✓ Water Recycling

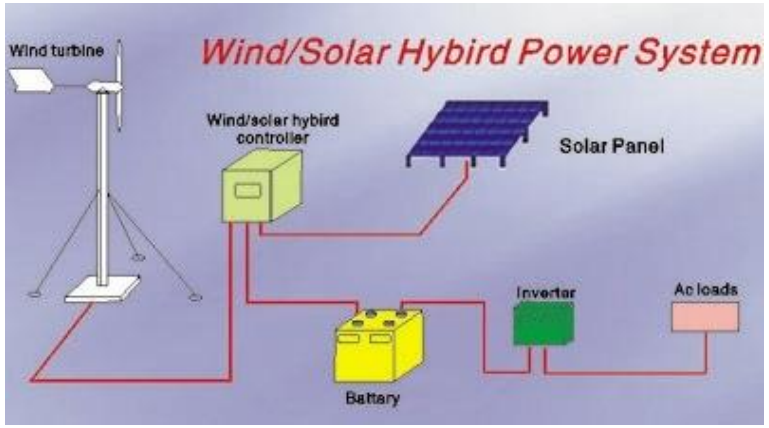


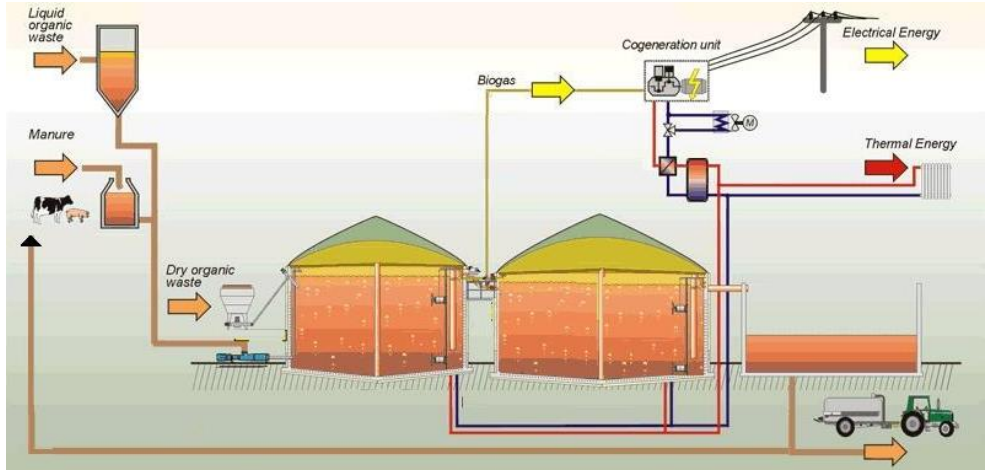


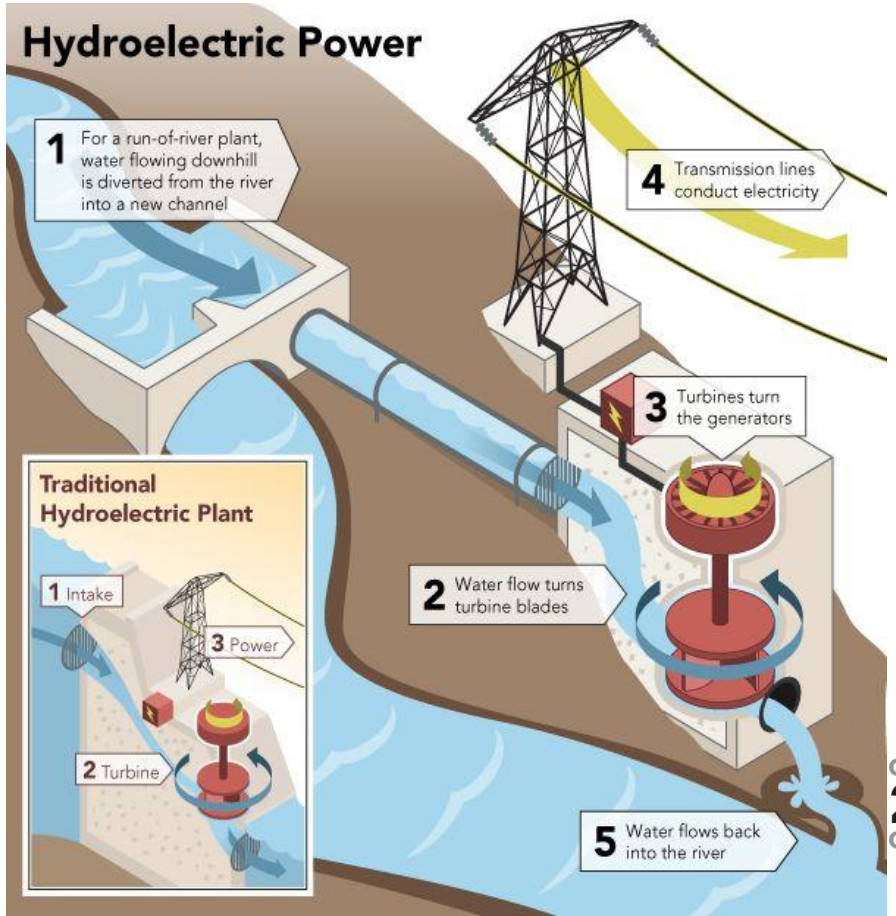


• Energy efficiency in smart water and wastewater systems

- Integrate renewable source of energy such as solar cells, wind turbines, and small or run-of-river hydropower.
- Burn biogas from anaerobic digesters to generate some or all of their own electricity.

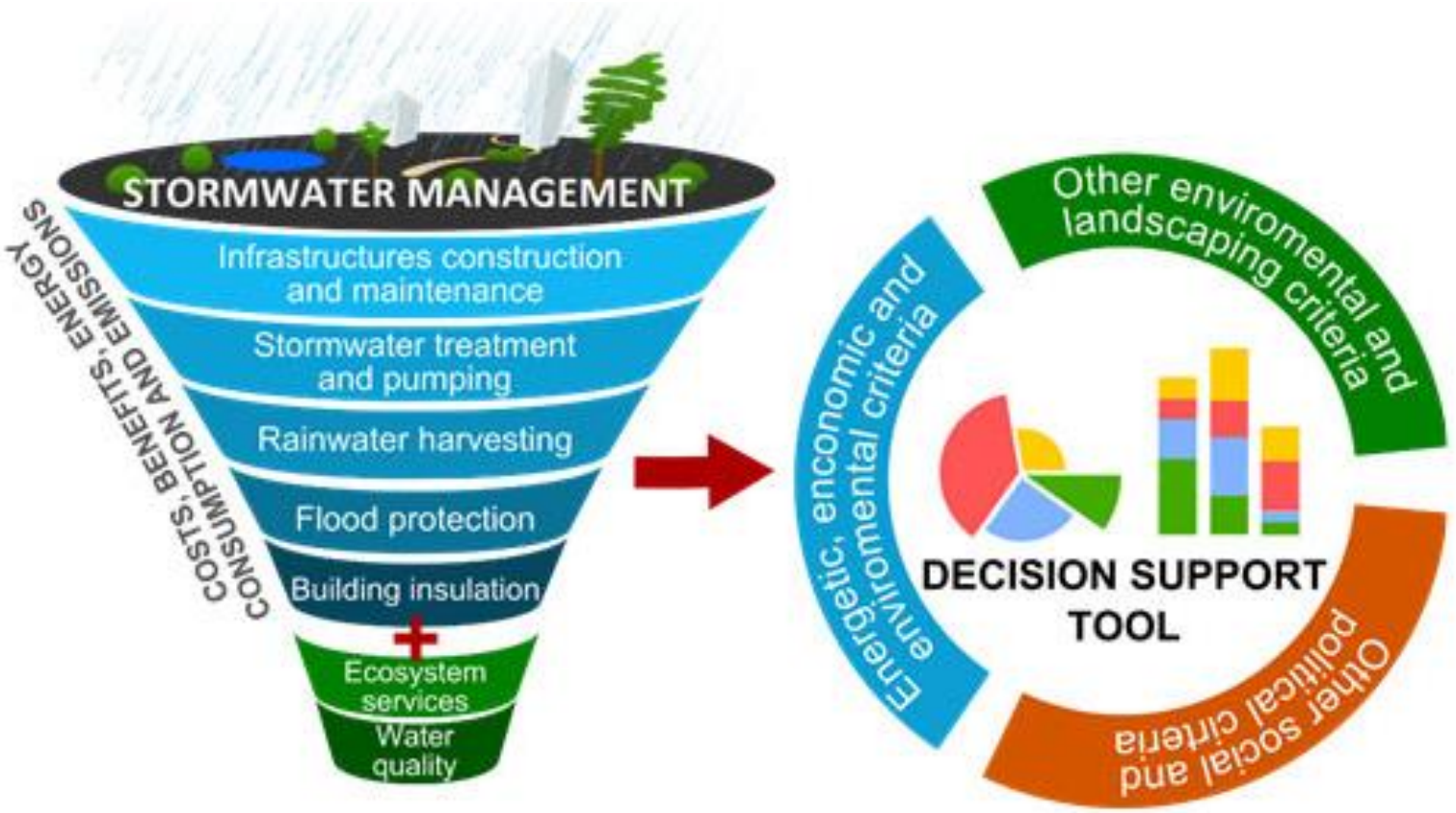


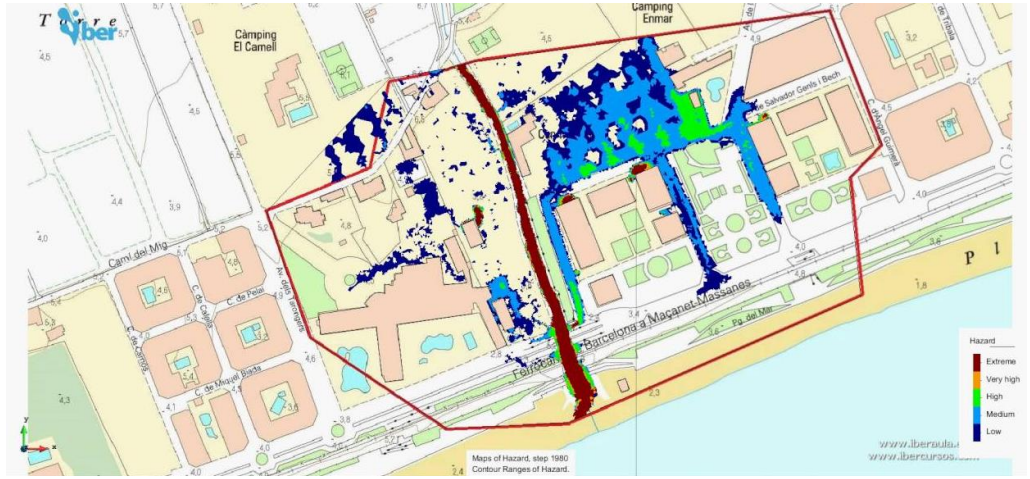


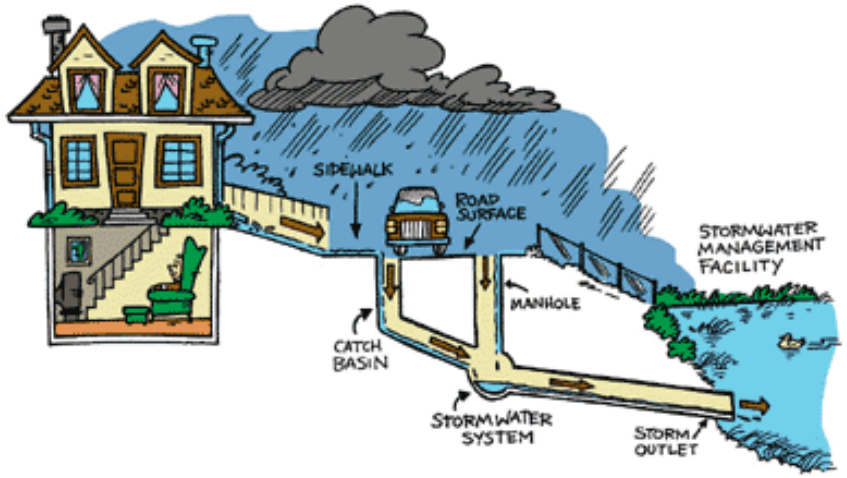


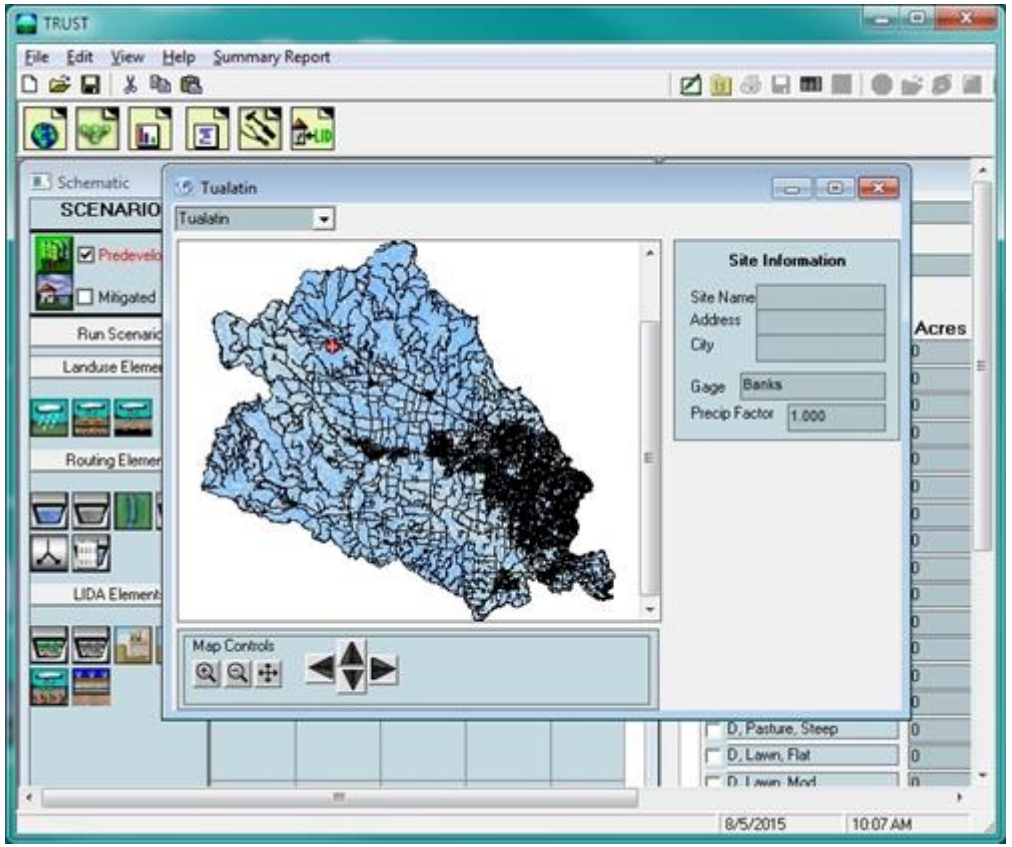
Technologies for the Stormwater System are classified into;

- Urban Flooding Management Technologies
- Stormwater Management Technologies
- Watershed Analysis Technologies







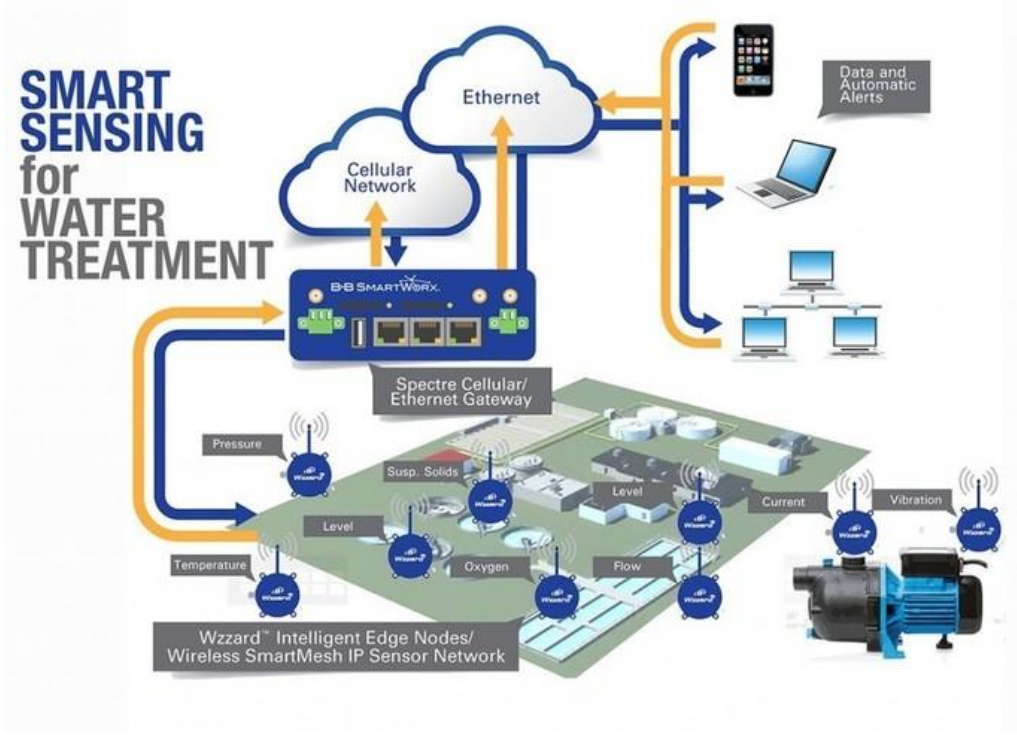


CELEBRATING 25 YEARS OF ACHIEVEMENTS

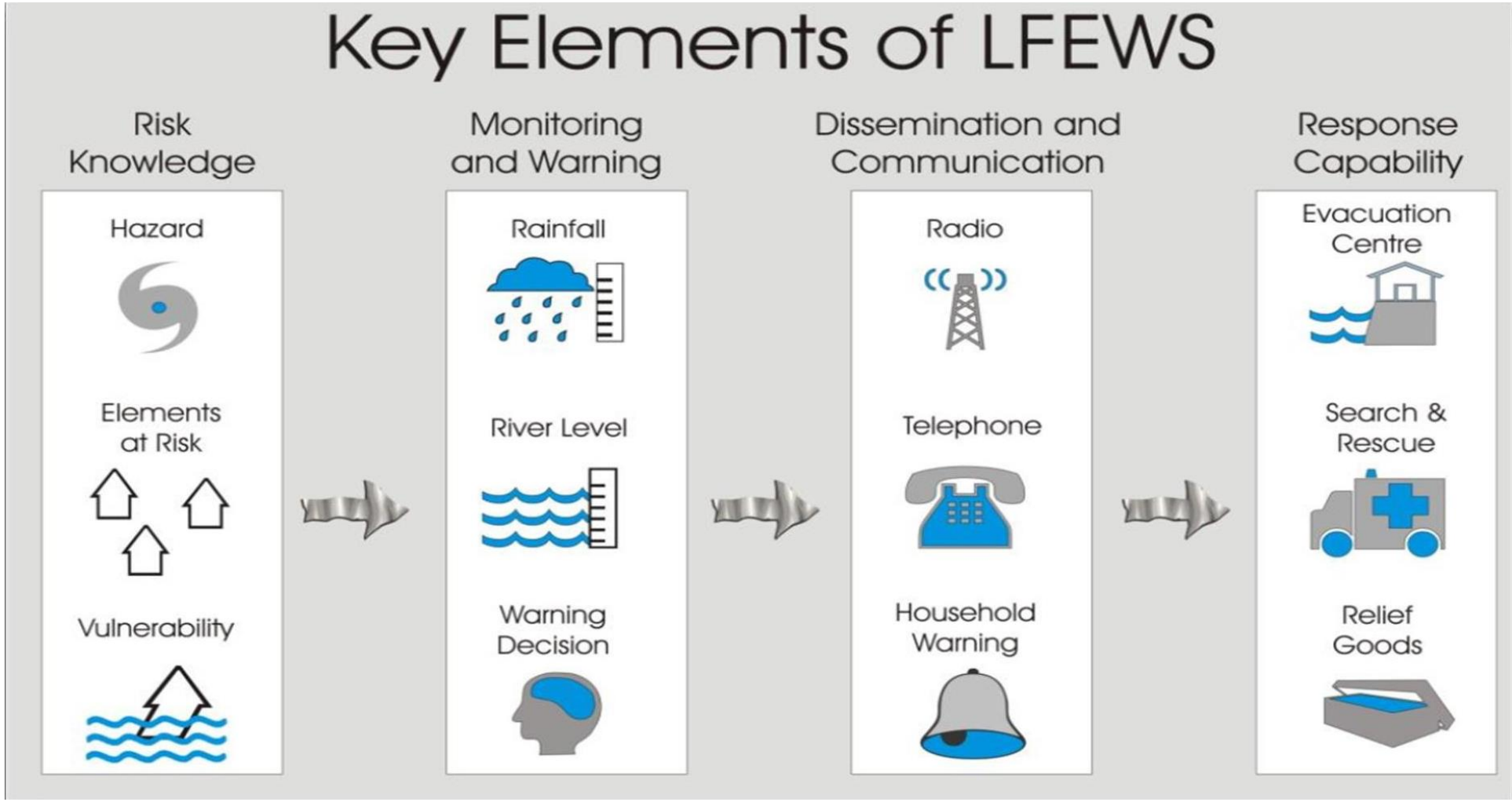
- Technologies in Integrated Enterprise Smart Water Management;
  - Smart Water Grid (SWG)
  - Droughts and Desertification Control Technologies
  - Early Warning System (EWS) Technologies
  - Disaster Risk Management (DRM) Technologies
  - Web Based Smart Decision Support System (DSS) Technologies

- **Smart Water Grid (SWG)**

SWG enables quick and accurate responses and can predict and optimize for future. It's about technology, integration, and modelling. The key feature is how people, systems, and objects interconnection with each other.

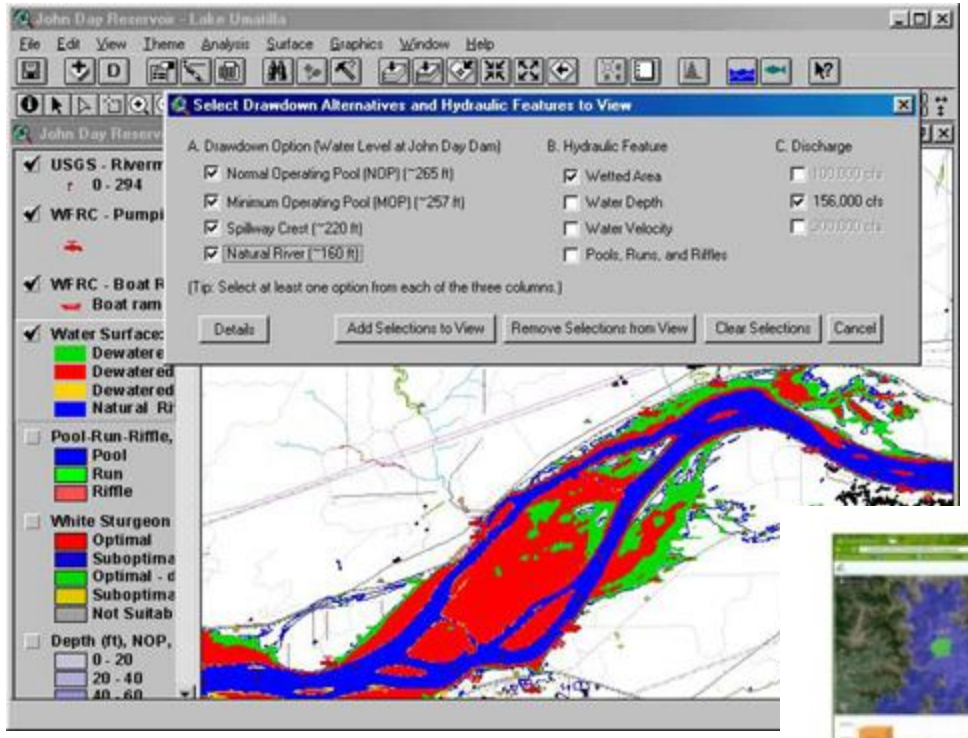


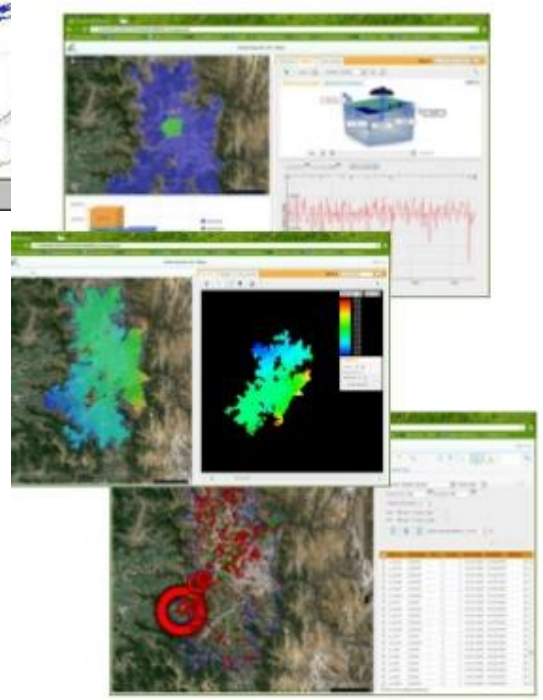
- Early Warning System (EWS) Technologies



Key Element of Flood Early Warning System

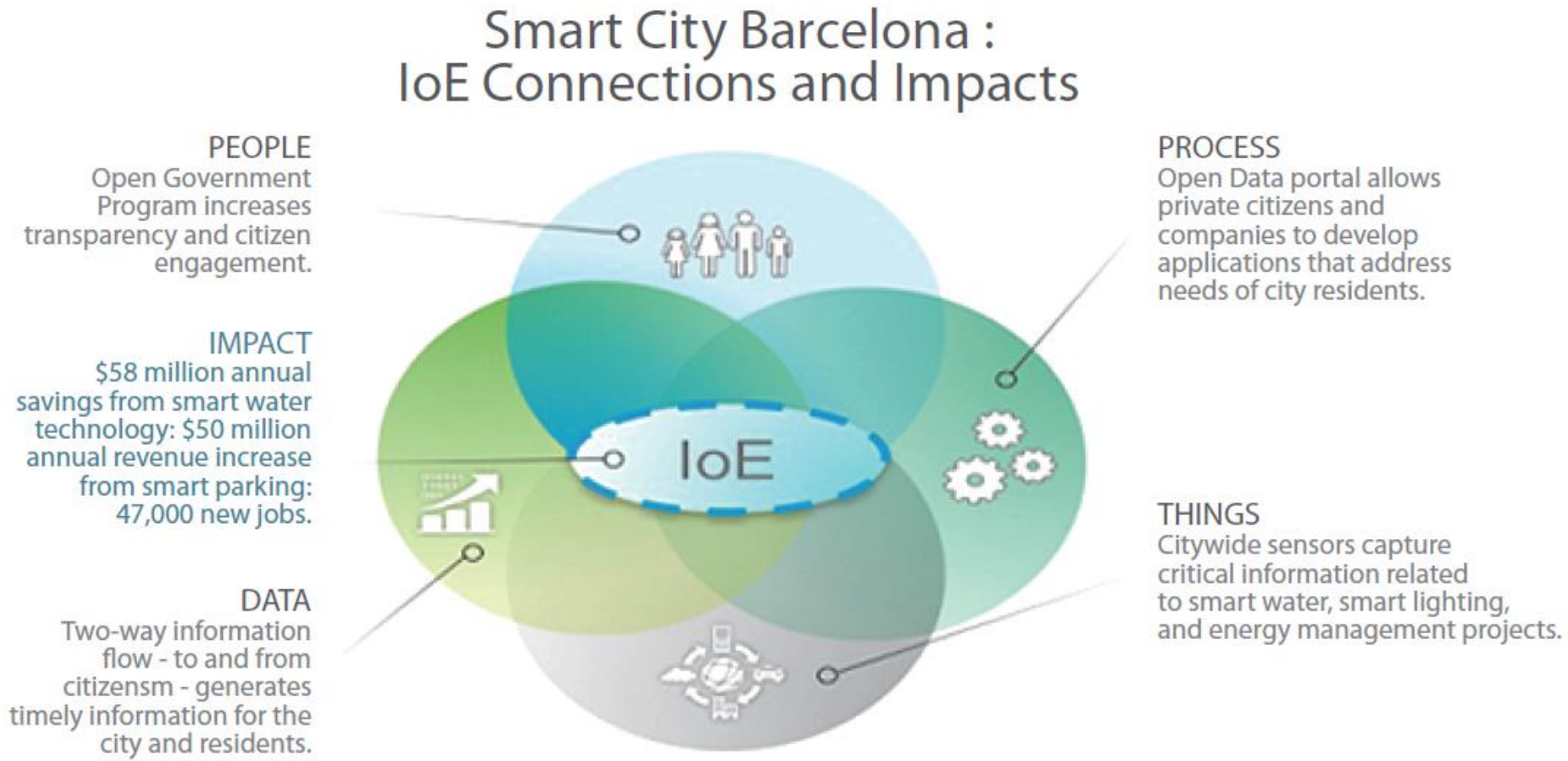
- Early Warning System (EWS) Technologies





- **Cloud** based platform
- **Real time** decision support system
- **Common platform** for groundwater resources
  - ✓ Planners
  - ✓ Managers
  - ✓ Users
- Provides **predictability** and **visibility** over groundwater resources **quantity** and **quality**
- **Easy to** use web based interface to **run complex "what-if" scenarios**

- Examples of Water Smart Cities



Smart city Barcelona (source: Cisco Consulting Services, 2014)

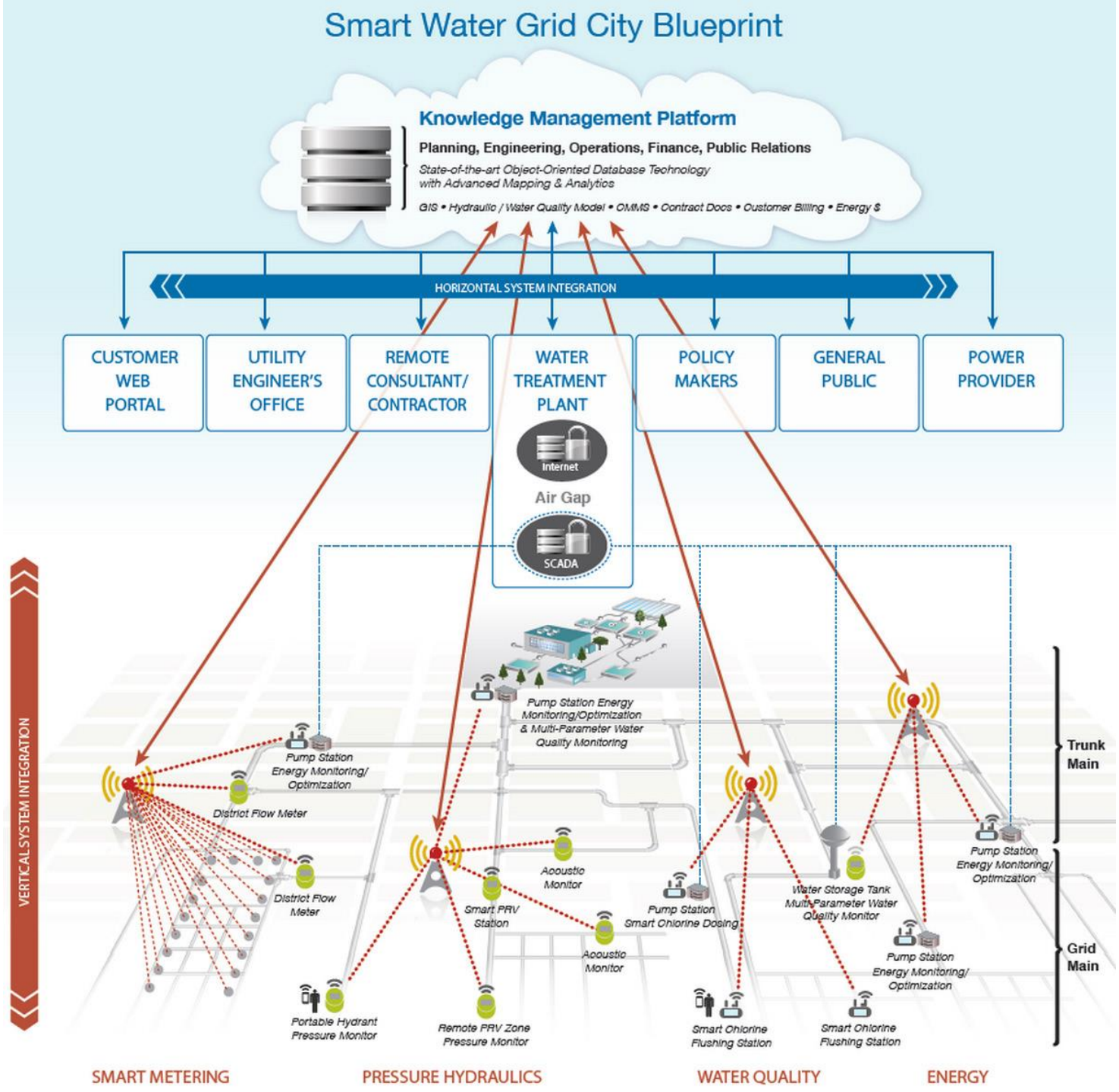

Smart Water Grid City Blueprint
Knowledge Management Platform
Planning, Engineering, Operations, Finance, Public Relations
State-of-the-art Object-Oriented Database Technology
with Advanced Mapping & Analytics
GIS • Hydraulic / Water Quality Model • OMMS • Contract Docs • Customer Billing • Energy $
HORIZONTAL SYSTEM INTEGRATION
CUSTOMER WEB PORTAL
UTILITY ENGINEER'S OFFICE
REMOTE CONSULTANT/ CONTRACTOR
WATER TREATMENT PLANT
POLICY MAKERS
GENERAL PUBLIC
POWER PROVIDER
Internet
Air Gap
SCADA
VERTICAL SYSTEM INTEGRATION
Pump Station Energy Monitoring/Optimization & Multi-Parameter Water Quality Monitoring
Pump Station Energy Monitoring/ Optimization
District Flow Meter
District Flow Meter
Acoustic Monitor
Smart PRV Station
Acoustic Monitor
Pump Station Smart Chlorine Dosing
Water Storage Tank Multi-Parameter Water Quality Monitor
Pump Station Energy Monitoring/ Optimization
Pump Station Energy Monitoring/ Optimization
Trunk Main
Grid Main
Portable Hydrant Pressure Monitor
Remote PRV Zone Pressure Monitor
Smart Chlorine Flushing Station
Smart Chlorine Flushing Station
SMART METERING
PRESSURE HYDRAULICS
WATER QUALITY
ENERGY

Table 4.6 Overview of SWG R&D in major regions

Country	SWG research and development	Notes
USA	• Started Smart Water Grid Initiative • Implemented water supply management system focusing on AMI • Optimized energy consumption or water management facilities using smart electricity grid (Pecan Street Project, Texas) • Used sensor network for water resource and quality management • Implemented efficient water resource management system at national level (Proposed National Smart Water Grid: transferring excess water from the US central region to West Coast)	Billing and leakage detection using AMI
Australia	• Started SEQ Water Grid Project • Set long-term plan to secure water resources (US$9 billion budget / 2008) • Formed five supply chains • Integrated water source management for source and processed water • Integrated management of large-scale water transfer • Implement infrastructure for greater distribution efficiency • Improved sales via integrated management of water reservoirs	First introduction of water grid concept Relatively fewer cases of AMI applications or integration with Smart Grid
European Union	• Aim to introduce smart meter to all households by 2020 • IBM expanding SWG business throughout Europe • Siemens Germany announces Smart Water Grid roadmap • Other water-related R&D activities in progress • Carried out by FP7(Framework Program, 2007–13) • Established Environmental Technology Action Plan (ETAP) • SWITCH (Sustainable Water Management Improve Tomorrow's Cities' Health)	Introduced AMI later than USA
Israel	• TaKaDu leads SWG business • Developed SWG technology using data on climate, existing sessions, GIS, sound, others	Cooperate with IBM and Thames Water, UK
Other cases of water resource vancement	• Singapore provides industrial water with recycled sewage and waste water • UK runs facility management for uncertainty in future via "Resilient Infrastructure" project • California has integrated water management from Water Plan Update 2009 to resolve water issue • Korea is developing four SWG technologies listed below via convergence of IT technology: • Technology for spatiotemporal stability of water resource acquisition and supply • Water demand and supply evaluation and management technology based on the supply and demand evaluation and automation among grids in consideration of climate change • Interactive and real-time operation technology by utilizing ICT infrastructure and technologies • Integrated water management technology	

Thank You