Web-based Dam management system using GIS

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Presentation Outline

- Introduction to KOWACO
- Water resources in Korea
- System history & Configuration
- Weather
- Flood Control
- Water Quality
- Water Sales
- Dam security
- Conclusion & Future Works
Introduction to KOrea WAter resources COorporation (KOWACO)
Scope of Services

Water resources management
- Dams
- Hydroelectric Power
- Flood Control Measures
- Flood forecasting & Warning
- River Basin Management
- Surface water and Groundwater Hydrology

Water Supply & Sanitation
- Water Source Development
- Water Treatment
- Water Storage & Distribution Systems
- Sewerage
- Wastewater

Urban Development
- Industrial Site Development
- New Town Development

Environmental Sciences
- Environmental Impact Analysis
- Environmental Audits
- Environmental Management

Water Business Management
- Environmental Impact Analysis
- Environmental Audits
- Environmental Management

KOWACO, one of Korean government-owned company which manage mainly Dams and Water utilities in Korea, Is trying hard to Be the one of the Global Top Three Water Company
Water resources in Korea - Precipitation

Annual Precipitation: 1,283 mm (1.3 of Global)

Per-capita 2705 m³/yr (12% of Global)

Two-thirds of annual precipitation falls during the rainy season from June to Sept.
Water resources in Korea – Geographic features

- High-east, Low-west topological features
- 65% of S.Korea land is mountainous
- Steep Channel Slopes
- Short Travel Time & Huge Peak flow
Water resources in Korea – Status of Water Resources

Total Water Resources: 127.6 (100%)

- Runoff to river: 73.1 (57%)
  - Flood season: 43.9 (39%)
  - Non-flood season: 23.8 (18%)
- Loss: 54.5 (43%)
  - Loss to ocean: 40.0 (31%)
  - River: 16.1 (13%)
  - Dam: 13.3 (10%)
  - Ground: 3.7 (3%)

Total Usage: 33.1 (26%)
Web-based Dam management system using GIS

System History

Web-based Dam management system is pre-developed system handling six dam associated business areas before GIS functions added
System History – Why GIS needed?

The most of hydrologic data ex-system collected can be used as attribute or meta data of spatial GIS data.

- Collecting and Storing spatial GIS data from other agencies or users
- Combine GIS data and its attribute data
- Analyzing GIS data for better management of water resources

Spatial water resources management
### Software Configuration

Server software is developed mainly in Microsoft .Net platform.

<table>
<thead>
<tr>
<th>Client</th>
<th>User Interface</th>
<th>System management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OS: Windows 98 or more</td>
<td>OS: Windows 98 or more</td>
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<tr>
<td></td>
<td>S/W: Internet Explorer</td>
<td>S/W: Internet Explorer</td>
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<table>
<thead>
<tr>
<th>Server</th>
<th>Internet Server</th>
<th>Map Data Server</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Web Server: IIS 6.0</td>
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<tr>
<td></td>
<td>Internet Map Server: ArcIMS 9.0</td>
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<tr>
<td></td>
<td>Servlet Engine: Tomcat</td>
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<tr>
<td></td>
<td>GIS Engine: ArcSDE 9.0</td>
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<tr>
<td></td>
<td>DBMS: Oracle 9i</td>
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</tbody>
</table>
GIS technology on the web (I)

Changing symbols and labels on the web

- Implemented using multipage control of HTML components and MSXML DOM
- Coding examples

```xml
<OBJECT id=dlgHelper height=0px width=0px classid=clsid:3050f819-98b5-11cf-bb82-00aa00bdce0b VIEWASTEXT> </OBJECT>

axlSymbol.loadXML("<SIMPLERENDERER/>\</SIMPLERENDERER>");
```

Cascaded popup
GIS technology on the web (2)

Drawing map capability on the Web

- Implemented using “asynchronous JAVA script” to process feature data from SDE java API
The Display deployment

- User Menu
- Map management & Retrieving condition
- GIS selection Tab
- Map display area
- Map control

Korea Water Resources Corporations
Weather – Typhoon (tropical storm) tracking

Typhoon trace is dynamically drawn from TM coordinate X and Y stored in database

- Each typhoon trace has x and y coordinate of forecasting from meteorological agencies from three different countries
- Typhoon can be retrieved and colored with different months
- Forecast accuracy can be compared by Comparing real typhoon trace with forecast of three different meteorological agency on each temporal forecasting spot

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Weather – observation station

Retrieving Observation station with many retrieving conditions

Basin
Station name
Recent observed rainfall and time

Move to attribute windows button

Korea Water Resources Corporations
Weather – metrological features by regional grouping

Classifying Regional weather feature in colors during given period by user

Users can choose rainfall or temperature

Users can choose “from date” and “to date” but long term may result in very long time to retrieve

Index is based on comparing average value and given period so we can tell regions are drought or flooded
Weather – Drawing isomorphic rainfall contour

By drawing isomorphic rainfall contour, overall weather status on specific area can be known.
Flood control – Finding observation station

Users can retrieve rainfall or water level stations with retrieving Options

Users can choose basins where stations located

Real time values are retrieved with comparing values

Index is based on comparing average value and current value

Korea Water Resources Corporations
Flood control – Frequently flood areas (FFA)

Users managing Dams scattered all over the Korea input and modify frequently flooded areas

- Each area has water level station attribute so when emergency situation comes, Dam manager can find which areas are in danger

- We implemented Drawing capability with just arcIMS, arcSDE and some web technology without any GIS drawing tools

Users can input attribute data in associated with FFA

Users can draw FFA with Just minimal drawing button
Flood control – Creation of Thiessen Network

Thiessen Network and Thiessen values are dynamically created with the creation, Moving and removal of rainfall stations

- This function supports reading from the different organization’s database sources of rainfall stations

- Many organizations of Korea such as KMA, FCO, Local government and KOWACO have their own rainfall stations so combining the stations can improve accuracy of predicting in-flow and managing dams
Water quality — Creating dynamic river water quality network

River water quality network is classified and colored by stations it contains

Users can choose date, time, and quality items such as BOD, COD, etc.

Indexes
Water Sales – Locations of water sales customers

Customers locations where pumping stations located are very important in analyzing and predicting consumption.

Customers are inclined to clustered so exponential consumption can cause sudden water deficiency.
Dam security – Pointing seismic zone

Dam managers can be ready for dam security by storing and analyzing Earthquake position data.
Conclusion & Future Works

- Dam management can be more efficient and accurate with spatial Data
- Modeling Hydrology using GIS may result in quite different from what it will be. So to show what it is in GIS is more important in dam management and operating

- Typhoon tracking will be more accurate with more appropriate interpolation algorithm
- combining radar raster data and weather GIS data will be useful to Dam manager
- Need GIS data engine to support both spatial and temporal attribute