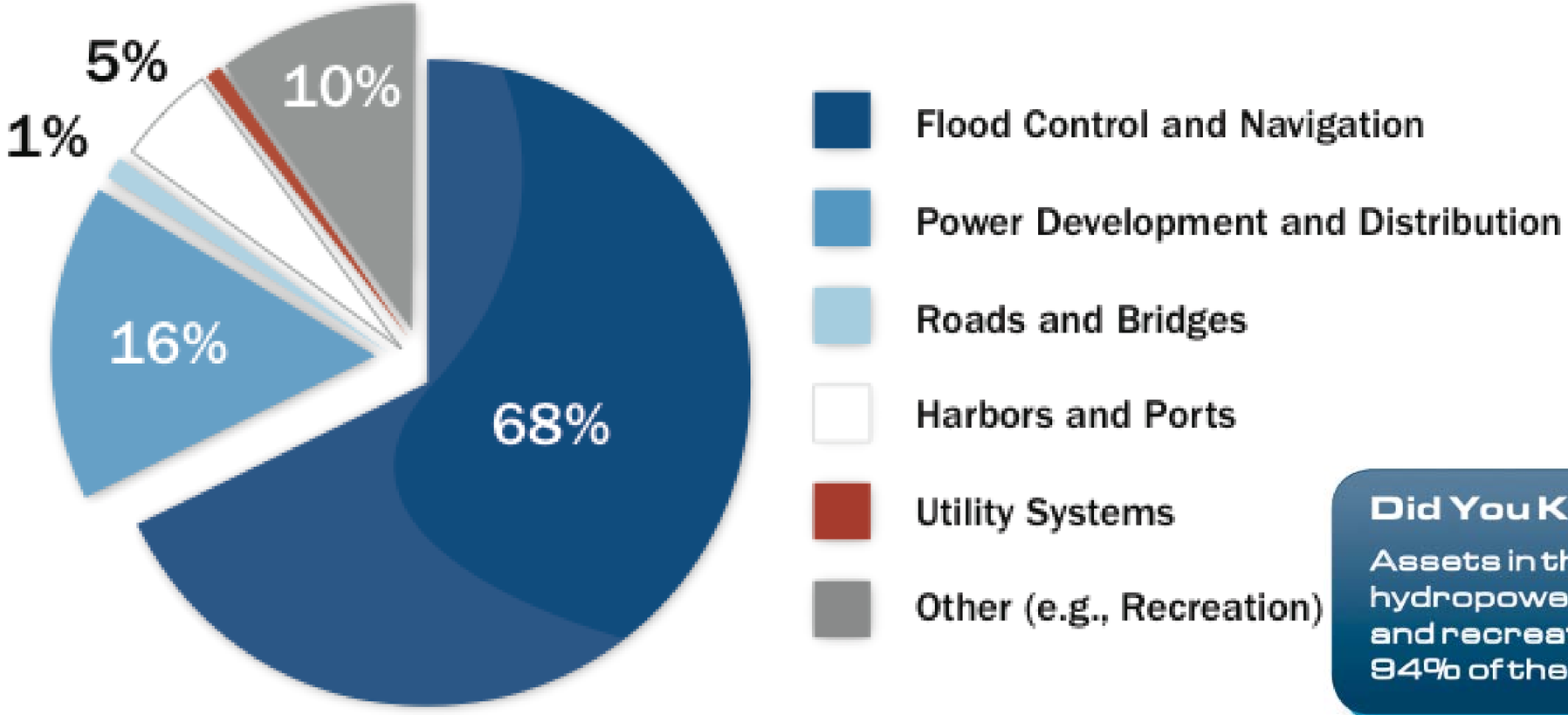
Mobile Information Collection Application (MICA) for Asset Management

James Stinson and Eric Roth
U.S. Army Corps of Engineers -
Information Technology Laboratory

Corps Maintains Infrastructure

USACE operates, maintains, and manages more than $232B worth of the Nation's water resource infrastructure assets.



Did You Know?

Assets in the four business lines of hydropower, navigation, flood control, and recreation constitute more than 94% of the total value of USACE assets.

Challenge: How do we decide what to fix?

- Many projects are over 50 years old!!!!
- When was the last time things were inspected?
  If so:
  - Where did the inspection data go?
  - Was the inspection process consistent across the country?
  - Was the information gathered and put into a standard decision process applied for projects across the nation?
    - No!

Problem With Reality

To make decisions we need information and data, however…

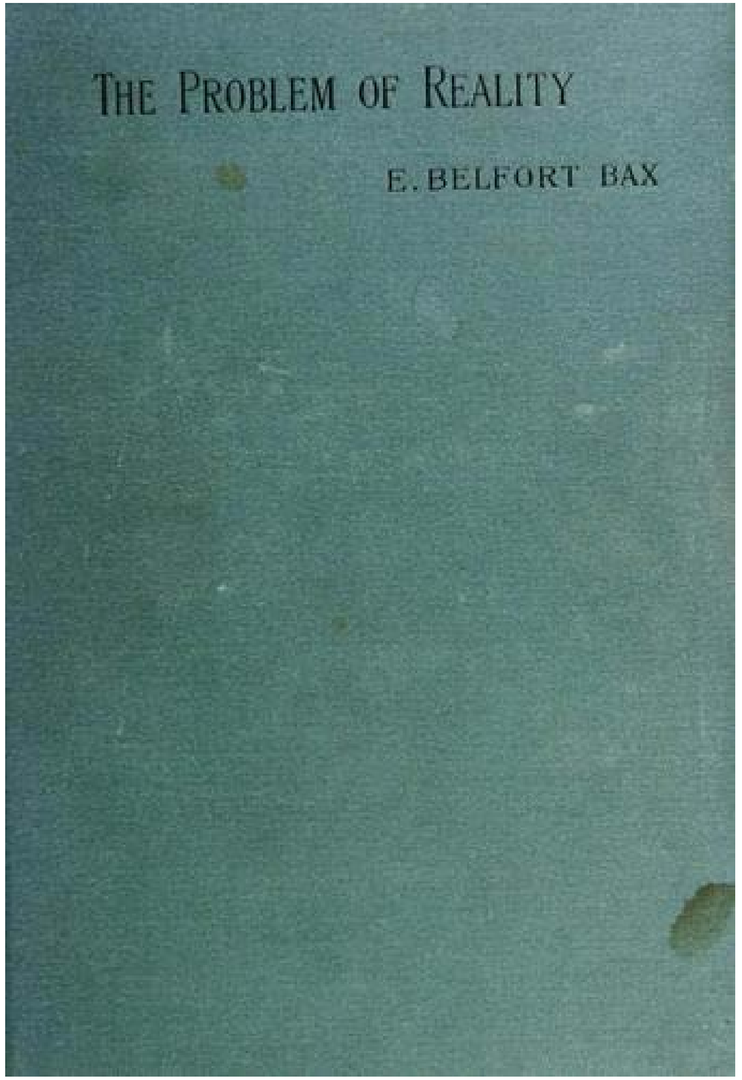
Most asset management and inspection data is

- Scattered across various databases

  OMBIL, OCA Inland, OCA Coastal, RecBest, HydroAmp, etc.

- Has different levels of fidelity
- Is inconsistent
- Is usually on paper in reports
- Varying accessibility
- Different levels of upkeep and maintenance

- WE NEED TO DELIVER FIELD DATA CONSISTENTLY AND EASILIY!!!!!



Solution: Use ever evolving technology to help us

Create an enterprise level Data Delivery Framework for field inspection data collection

1. **Gather from the field in a consistent, repeatable, efficient, error resistant, process oriented manner**
2. **Organized into a logical structure conducive to analysis**
3. **Readily available for decision making**

Framework's Goals - All AM Activities

- All inspections/assessments on projects related to
  - Flood Risk Managements (Dams, Reservoirs)
  - Inland Navigation (Locks and Dams)
  - Coastal Structures (Jetties, Breakwaters, etc.)

Will use mobile technology to deliver information about physical and functional condition of projects, in a consistent, repeatable guideline driven manner, for use in budget driven decision making.

Framework's Process (For All BL)

- Step 1: Model or define the structure/project
  - Define what your are going to inspect
- Step 2: Field Inspect or Assess the structure (Mobile Tools)
  - Gather current physical/functional condition
  - Vet, Reconcile, QA/QC

- Step 3: Run through the risk analysis/consequence tools
  - Pair with economics, life safety, other weighted factors to decide best "bang for buck"
  - Rank based on condition, risk, consequence (Coastal structures: Dr. Ned Mitchell's CSMART/CPT database)

Why? Pads and Phones Can Almost Do It All!

- Phone, Camera, Camcorder, Voice Recorder, GPS, Map, Computer and more!
- Advantages
  - Now Cheap, ubiquitous, network connected
  - Easily customizable (There’s an app for that.)
  - Sync with enterprise systems
  - Great for disaster response coordination and situational awareness

Upward Reporting to HQ

Powerful!

No more paper!

No more data entry!

Automated and efficient!

Close to Real-Time!

Saves Time and Money!

AM Analytics Database

ID	Feature Type	System	Segment	Site	Asset	Site ID	Division	District	P2 ID	Condition	...
01	02	Arkansas	003	David Terry Lock	Main Lock	347	02	03	G6VB09	B	...
02	03	East Gulf Coast	Florida Panhandle	White Beach Jetty	West side Jetty	1112	03	09	F6BVVH	B	...
03	06	Ohio	Wolf Creek	Wolf Creek Dam	Spill Way	53	01	07	L33HRK	F	...
04	09	MS River	Mile Marker 72	Channel 72	Disposal Site	72	02	04	Y8LM3	C	...

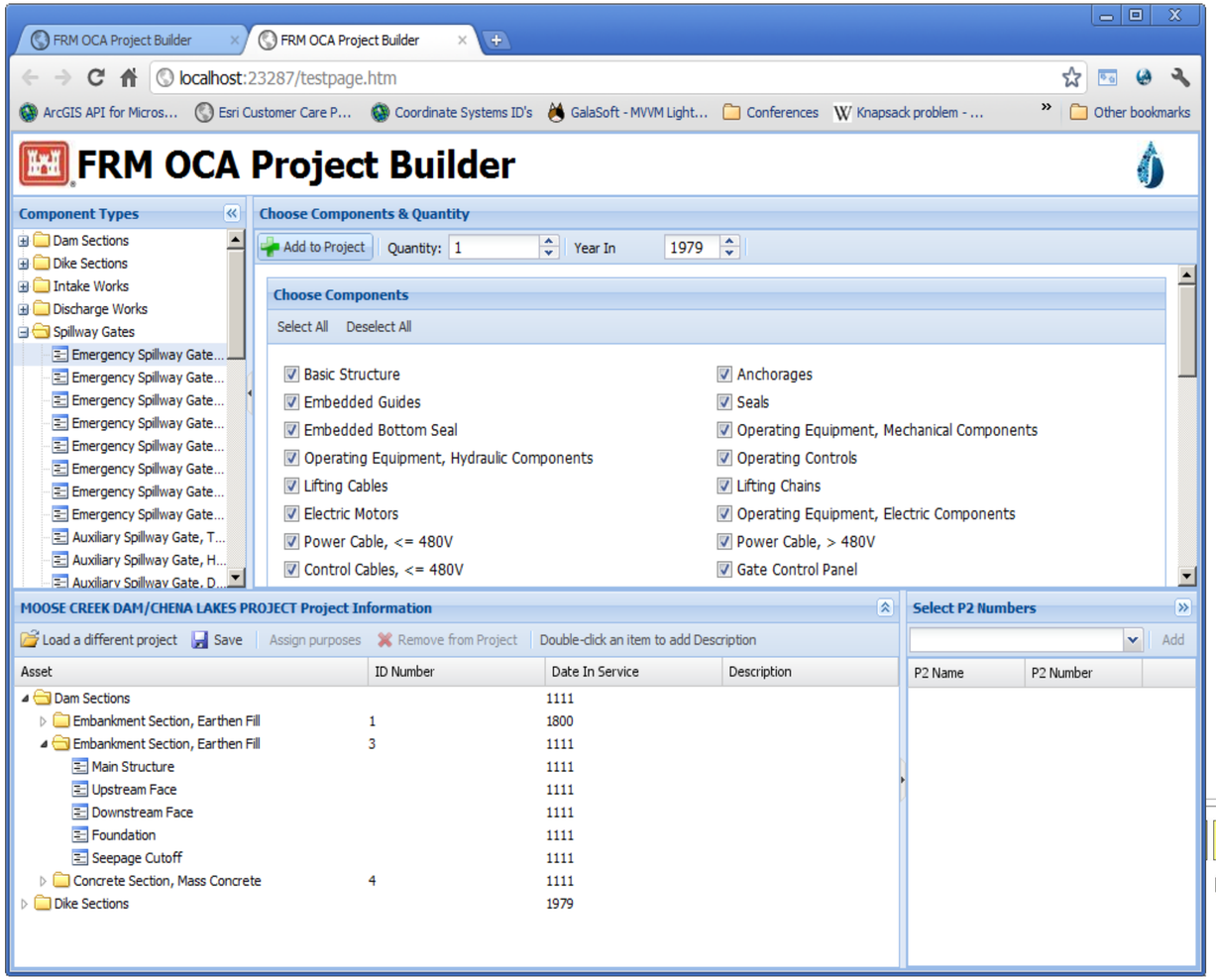
Data Delivery Framework Process In-Depth

- Next slide

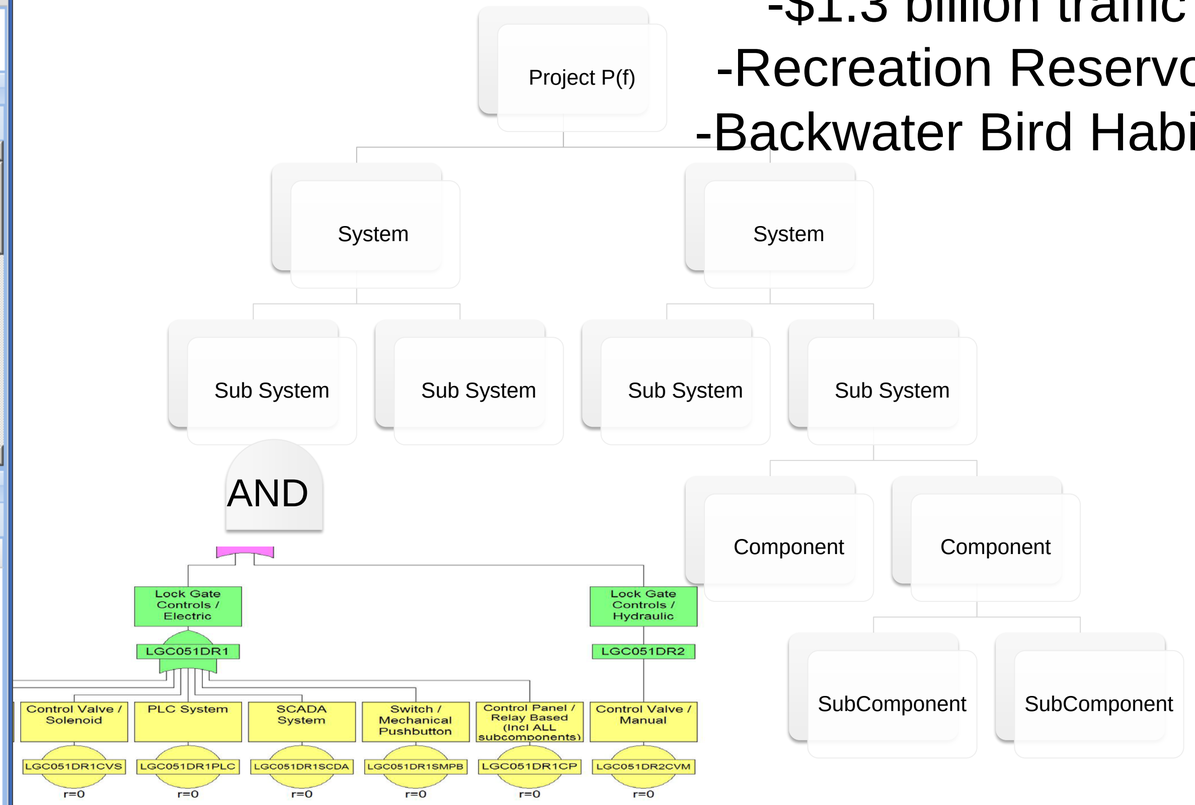
Step 1: Model the infrastructure

- Define the structure’s current
  - Physical Characteristics
    - What are the components/relations to be rated
  - Functional Characteristics
  - Understand its history
  - Understand its purpose
  - Model information is stored in a database
- This definition is used in the mobile tools by inspectors during assessments

Modeling Tools

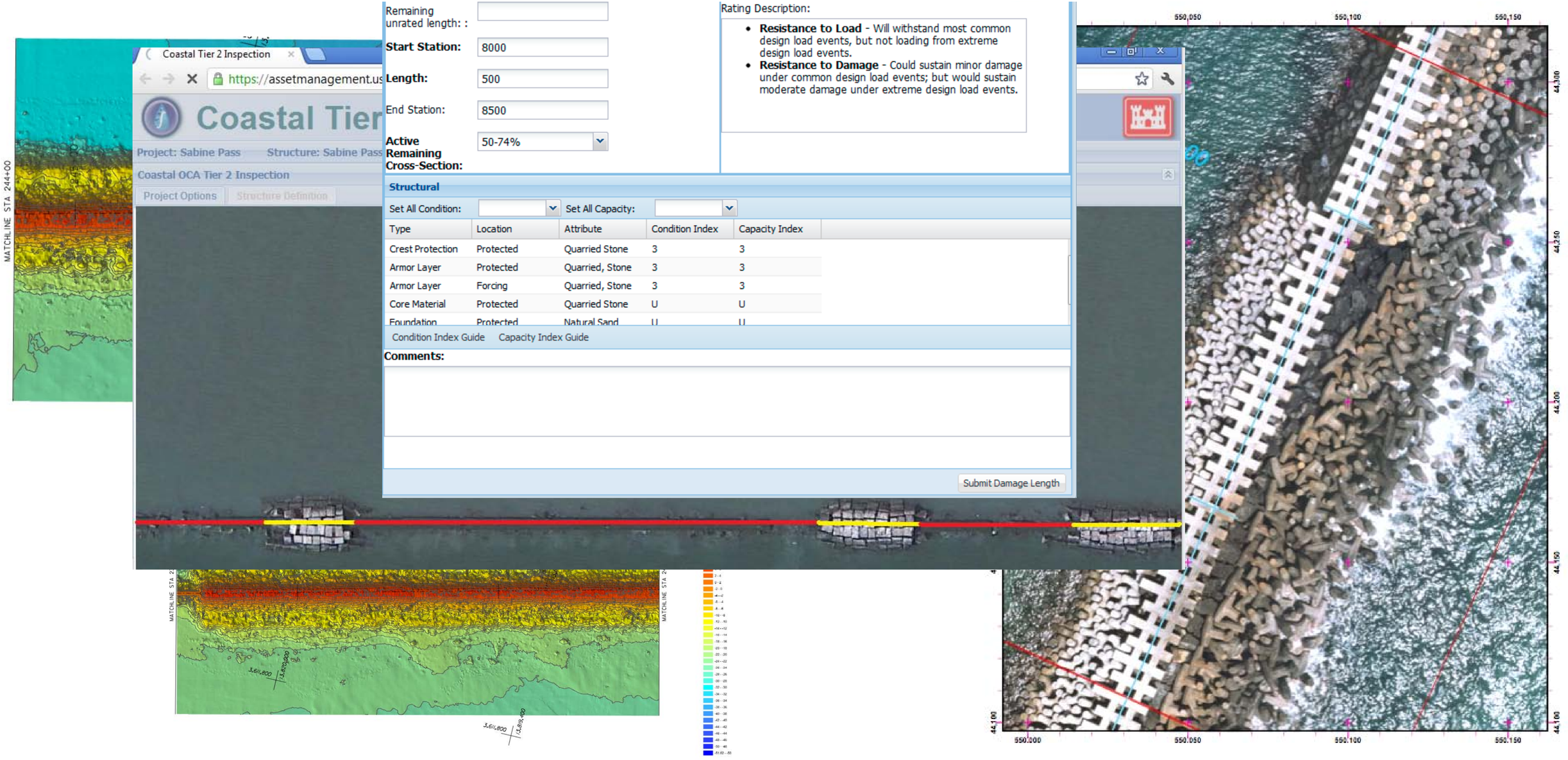


Project has a VTN
-$1.3 billion traffic
-Recreation Reservoir
-Backwater Bird Habitat



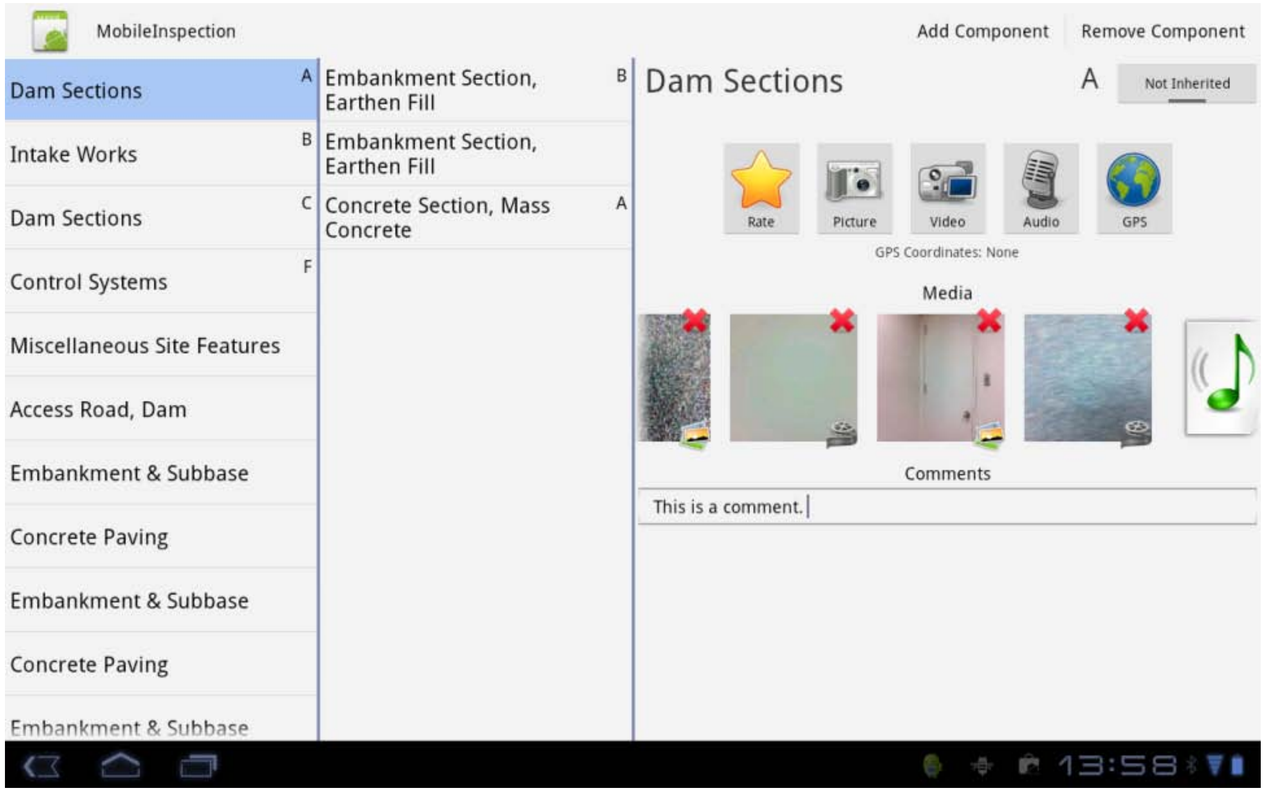
Sub Component Condition, in conjunction with boolean logic, rollups up to P(f)

Modeling Tool



Step 2: Mobile Tools – Field Data Collection

- Go to the field project site (Dam, Lock, Breakwater, Jetty, etc.) and give the items defined in the model a rating
  - Ratings are A-F
- Examples
  - Dam Gate Operating Machinery
  - Lock Gate Gear Equipment
  - Length of Damaged Section for Breakwater Armor Stones, TriBars, etc .

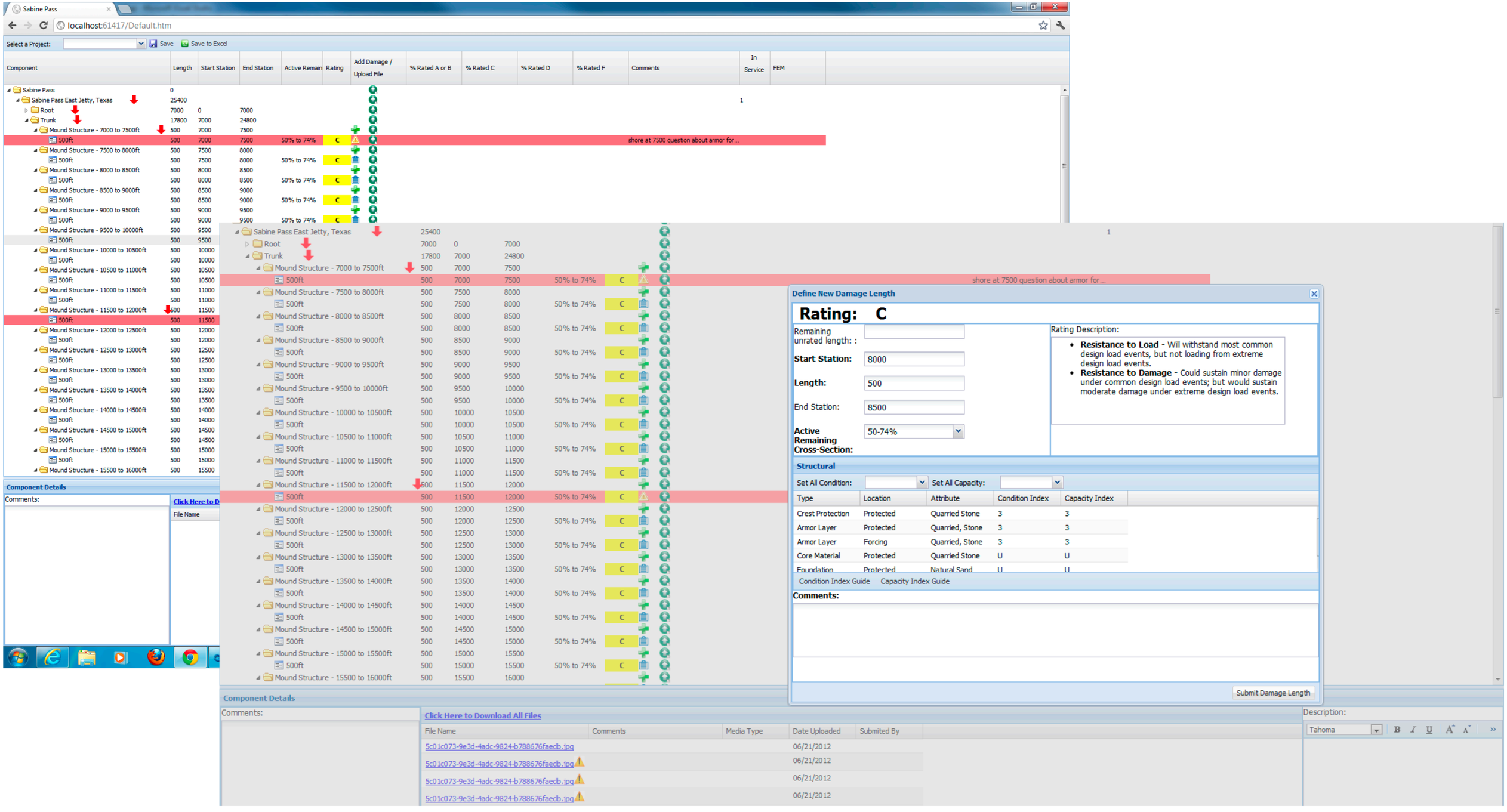


Step 2: Mobile Tools – Field Data Collection

Demo Shortly

Step 2: Mobile Tools – Reconciliation and Quality Control

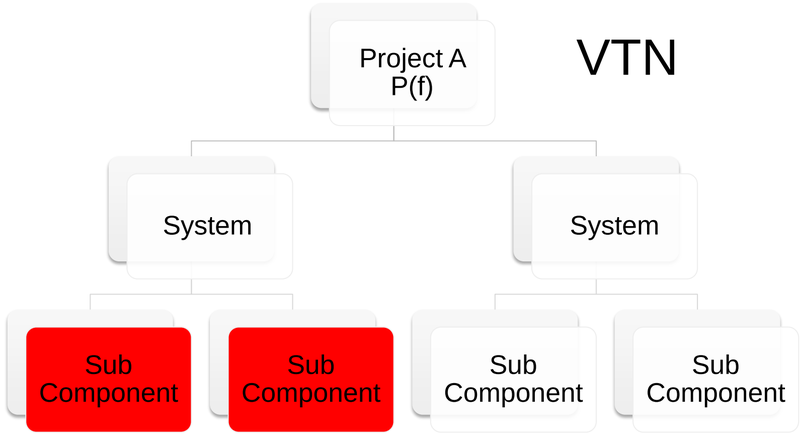
- Inspection team vets collected data
- Data collected from mobiles are editable on website
  - Round table discussion
  - Verify discrepancies
  - Follow guidelines
  - Come to consensus
  - Sign off on inspection verifying QA/QC

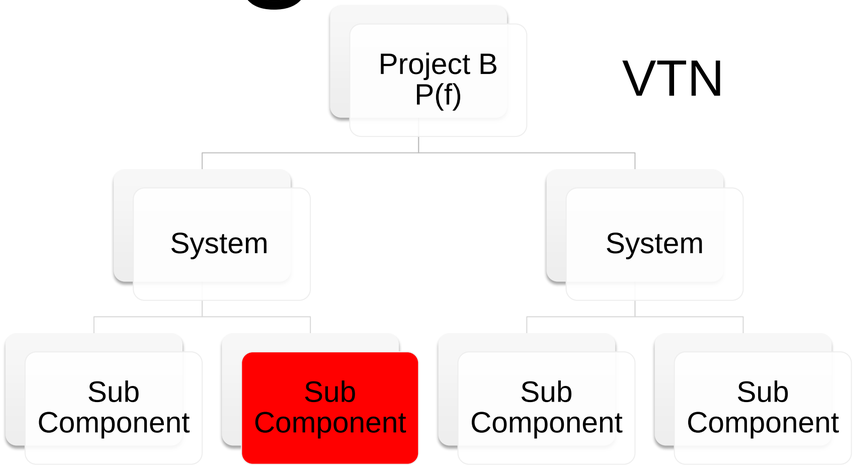

Sabine Pass
localhost:61417/Default.htm
Select a Project:
Save
Save to Excel
Component
Length
Start Station
End Station
Active Remain
Rating
Add Damage / Upload File
% Rated A or B
% Rated C
% Rated D
% Rated F
Comments
In Service
FEM
Sabine Pass
Sabine Pass East Jetty, Texas
Root
Trunk
Mound Structure - 7000 to 7500ft
500ft
shore at 7500 question about armor for...
Component Details
Comments:
Click Here to D
File Name
Define New Damage Length
Rating: C
Remaining unrated length: :
Start Station: 8000
Length: 500
End Station: 8500
Active Remaining Cross-Section: 50-74%
Rating Description:
Resistance to Load - Will withstand most common design load events, but not loading from extreme design load events.
Resistance to Damage - Could sustain minor damage under common design load events; but would sustain moderate damage under extreme design load events.
Structural
Set All Condition:
Set All Capacity:
Type
Location
Attribute
Condition Index
Capacity Index
Crest Protection
Protected
Quarried Stone
Armor Layer
Quarried, Stone
Forcing
Core Material
Foundation
Natural Sand
Condition Index Guide
Capacity Index Guide
Comments:
Submit Damage Length
Click Here to Download All Files
File Name
Comments
Media Type
Date Uploaded
Submited By
5c01c073-9e3d-4adc-9824-b788676faedb.jpg
06/21/2012
Description:
Tahoma

Step 3: Run through the risk analysis/consequence tools

- Couple mobile inspection data with
  - Economics
  - Life safety
  - Risk models - P(failure)/Consequences
  - Different factors weighted to decide best “bang for buck” investment
- Difficulty: Each project has a different value to the nation, difficult to quantify for analysis
- What are the metrics?!?!?!? $$$ for Infrastructure Assets are hard to justify!

Getting Closer: Analysis - Apples 2 Oranges





1. Look at the drivers (components, damage areas, etc.) that are causing increases in failure probabilities for each projects
2. Understand the cost to fix the component (Do Nothing, Sustain, Repair, Modernize, Dispose) and understand what that cost means to the change of the condition state, which in turn effects risk buy down
3. Explore the problem space across projects to see where the biggest bang for the buck can be found with respect to VTN, Risk Reduction, and Investment cost

Questions

- Contact Info – Mobile Software Questions
- James.T.Stinson@usace.army.mil
- Eric.S.Roth@usace.army.mil

Demo of Mobile Tools

Need a Framework for Analytics

- A common high-level repository is needed to compile relevant pieces of information in order to provide timely analytical functions.

- In order to efficiently and effectively perform analysis, data must be

  Organized into a logical structure conducive to analysis

  Readily available, pulled into a high-level repository

Logical Structure

- April 4-5 of 2011, IWR, ITL and AM representatives defined a logical data model for storing and cross-referencing asset management data from varying asset management information systems.

- It was agreed that IWR would focus on data definition, draft vocabulary, dissemination and GIS display and analysis. ITL was tasked with providing a system that performs data analytics and decision support activities that leverage IWR’s GIS capabilities.

Logical Structure

- Before compilation into a high level repository, a generic mapping of fields needs to be considered
- System (A waterway or coastline)
- Segment (A particular reach or boundary)
- Site (A Corps managed project)
- Asset (A structure or asset at the project)
- Component (A specific feature of the asset)

Logical Structure

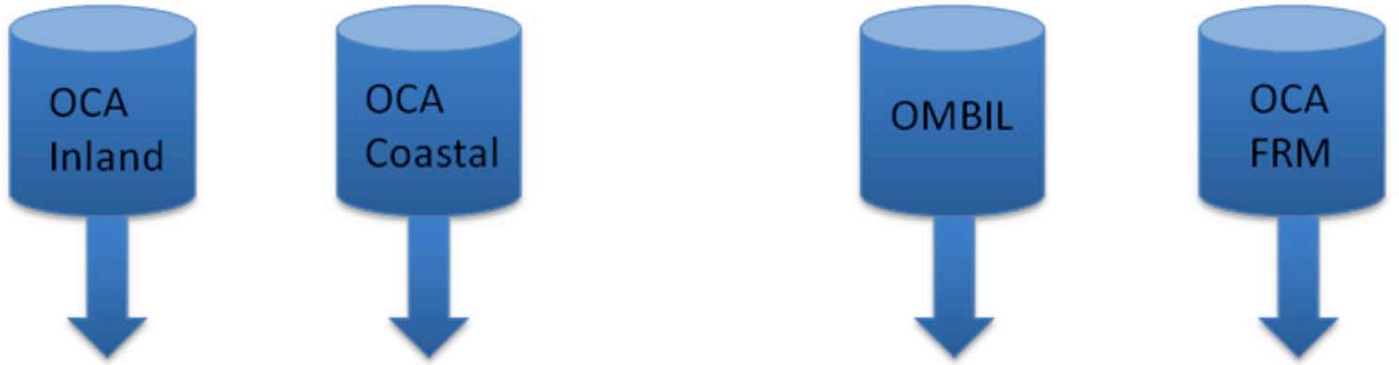
- Many Corps managed assets can be mapped into this structure.
- Example would be a lock and dam.
  - A lock is on a waterway or system, at a particular segment or reach. The lock and dam project site contains assets, which are comprised of components.
    - This model provides a generic way for grouping disparate business line data into a meaningful format for analysis.

Data Must Be Readily Available

- Create a high-level AM analytics database
  - Encompasses the logical structure for integration of asset information from other databases down to the asset level.

Provides a querying mechanism that pulls information from existing AM databases into the AM Analytics databases.

Analytics Database Mapping



AM Analytics Database

ID	Feature Type	System	Segment	Site	Asset	Site ID	Division	District	P2 ID	Condition	...
01	02	Arkansas	003	David Terry Lock	Main Lock	347	02	03	G6VB09	B	...
02	03	East Gulf Coast	Florida Panhandle	White Beach Jetty	West side Jetty	1112	03	09	F6BVVH	B	...
03	06	Ohio	Wolf Creek	Wolf Creek Dam	Spill Way	53	01	07	L33HRK	F	...
04	09	MS River	Mile Marker 72	Channel 72	Disposal Site	72	02	04	Y8LM3	C	...

Analytics for Decision Making

- Simple Analytics

  Involves selection based on the desired high-level attribute information

- Complex Analytics

  More rigorous and scientifically involved

- Real-Time Analytics

  Situational Awareness usually associated with disaster relief (MS River Flood 2011, Hurricane Katrina, etc.)

Simple Analytics

- Analytics Database contains many attributes for high level simple querying and reporting
- Some examples include but are not limited to:
  - **What assets are in a region?**
  - **Who is responsible for maintaining these assets?**
  - **What are their condition?**
  - **When were they last rated?**
  - **What is the average rating per district?**

Simple Analytics Demo

Complex Analytics

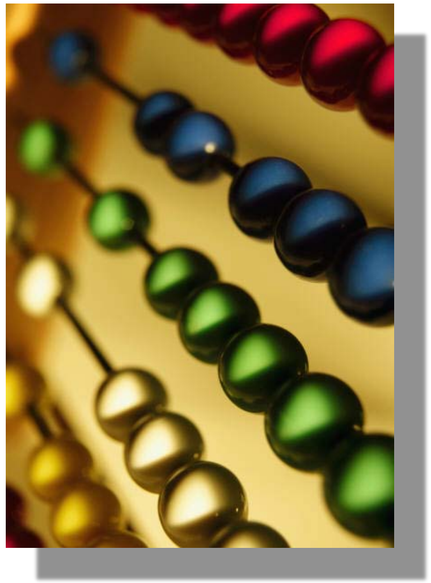
Focuses on Risk, Consequences and Relationships between project sites.

- More rigorous and scientifically involved

  Main analysis focuses on economic impacts of loss of service or asset failure

  May involve numerical modeling and geospatial analysis

  Mines historical data for predictive analysis



Complex Analytics

- Examples can include but are not limited to:
- Riverine:
  Loss of pool - effects to reservoir upstream water levels
  Effects of failure within a segment vs. within a network of segments, downstream?
- Coastal:
  Traffic analysis (How does jetties condition affect channel navigation?)
  Relationships between tonnage, dollars, structures and channel deposition rates and wave heights
- Environmental:
  How does breakwater deterioration affect beach nourishment projects?

Complex Analytics Demo

Real Time Analytics

- Data is captured from the field in real time
- Uses mobile devices synced with enterprise systems
- Provides upward reporting and statistics to decision makers
- Great for disaster response coordination and situational awareness

Real Time Analytics Demo