

Spatial Accounting™
Using GIS to Power Decision Support Systems in
Asset Management, Facility Maintenance and
Real Estate Operations

Daniel Elroi
President & CEO, NSGIS
delroi@nsgis.com

CGIA Brown Bag Webinar

March 18, 2020

About the Speaker

- Daniel Elroi, President & CEO of NSGIS
- 33+ years' experience in geospatial and related technologies
- Entrepreneur helped start 4 GIS companies in 3 countries
- “Adopted” Californian (UCLA grad, 16+ years here)
- Coined the term Spatial Accounting™
- Frequent speaker and writer on GIS, asset management, property management, security management



Purpose of Presentation

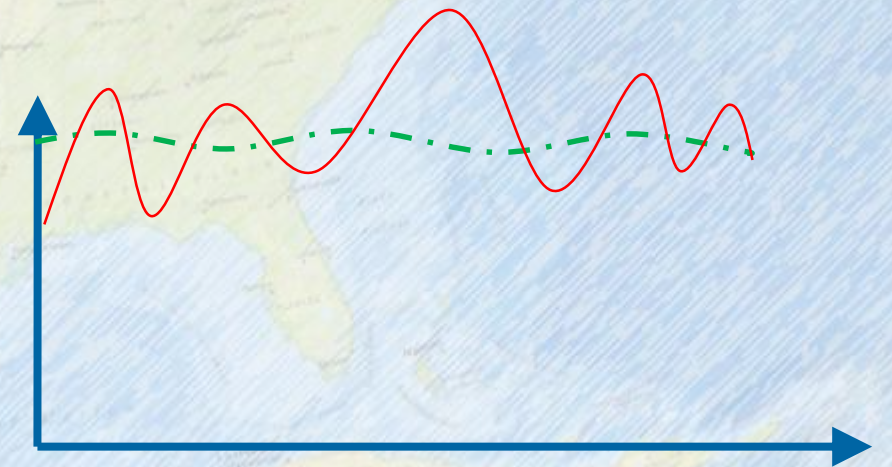
- Touch on SAM (Strategic Asset Management) principles
- How they apply to asset, facility and property management
- How SAM principles can be used in practical decision support terms
- The concept of Spatial Accounting™
- Outlining the steps to get there
- Assessing your organization's readiness
- Recommending next steps

Strategic Asset Management (SAM/SAMP)

- Purpose of Strategic Asset Management:
 - *“Optimize the use and value of assets, assessing risk and cost, all driven by data”*
- Asset:
 - *“An item, thing or entity that has potential or actual value”*
- Examples:
 - A pump
 - The water treatment plant that the pump is located in
 - The land that the water treatment plant is built on
- Everyone makes SAM decisions:
 - Private entities
 - Institutions
 - Government

SAM Principles

- Increase predictability of asset performance
- Balance:
 - Level of Service from an asset
 - Likelihood of the failure of an asset
 - Consequence of the failure of an asset
- Reduce the variability in repairs and replacements
- Furthermore, look at the bigger context of the asset



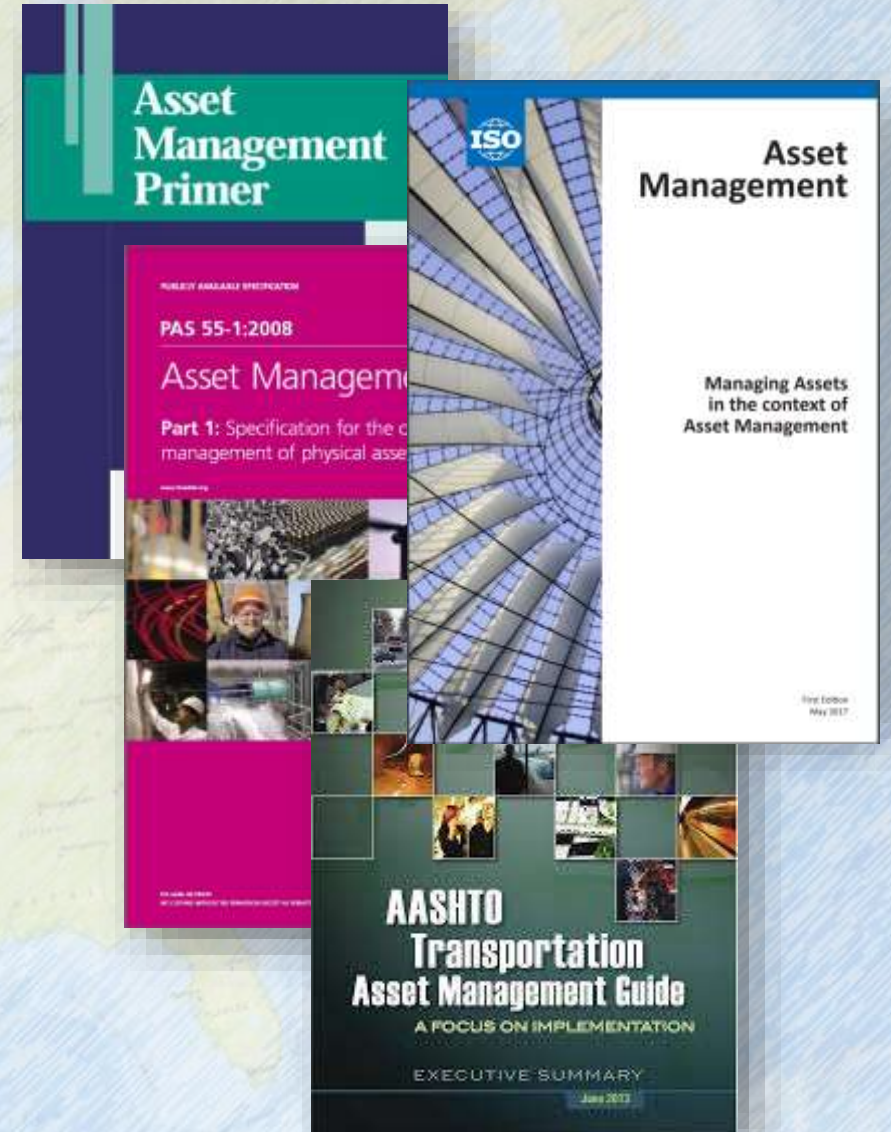
Asset Maintenance vs. Asset Management

- Asset Maintenance = Facilities Management
- CMMS = Computerized Maintenance Management System
- This is not synonymous with Asset Management
- EAM = Enterprise Asset Management software
- Strategic Asset Management (SAM) starts at the top, permeates the entire enterprise

SAM Standards

Standards

- **Are:** Specifications
- **Are not:** Prescriptions
- **Do:** Provide guidelines
- **Do not:** Provide implementation
- **Can:** Help design a SAM program
- **Can not:** Get a program off the ground



Key Info Management Components of SAM

- SAM developed in Australia, New Zealand and Europe – we learn from them
- Foundation Systems
 - ERP – Enterprise Resource Planning, *or*
 - EAM – Enterprise Asset Management
 - GIS – Geographic Information System
 - EDMS – Electronic Document Management System
- Expert Systems
 - Engineering
 - Condition Assessment
 - Materials Testing and Lifecycle Modeling
 - Real Estate
 - Mass Assessment
 - Comparables Analysis
 - Fleet
 - Automotive diagnostics



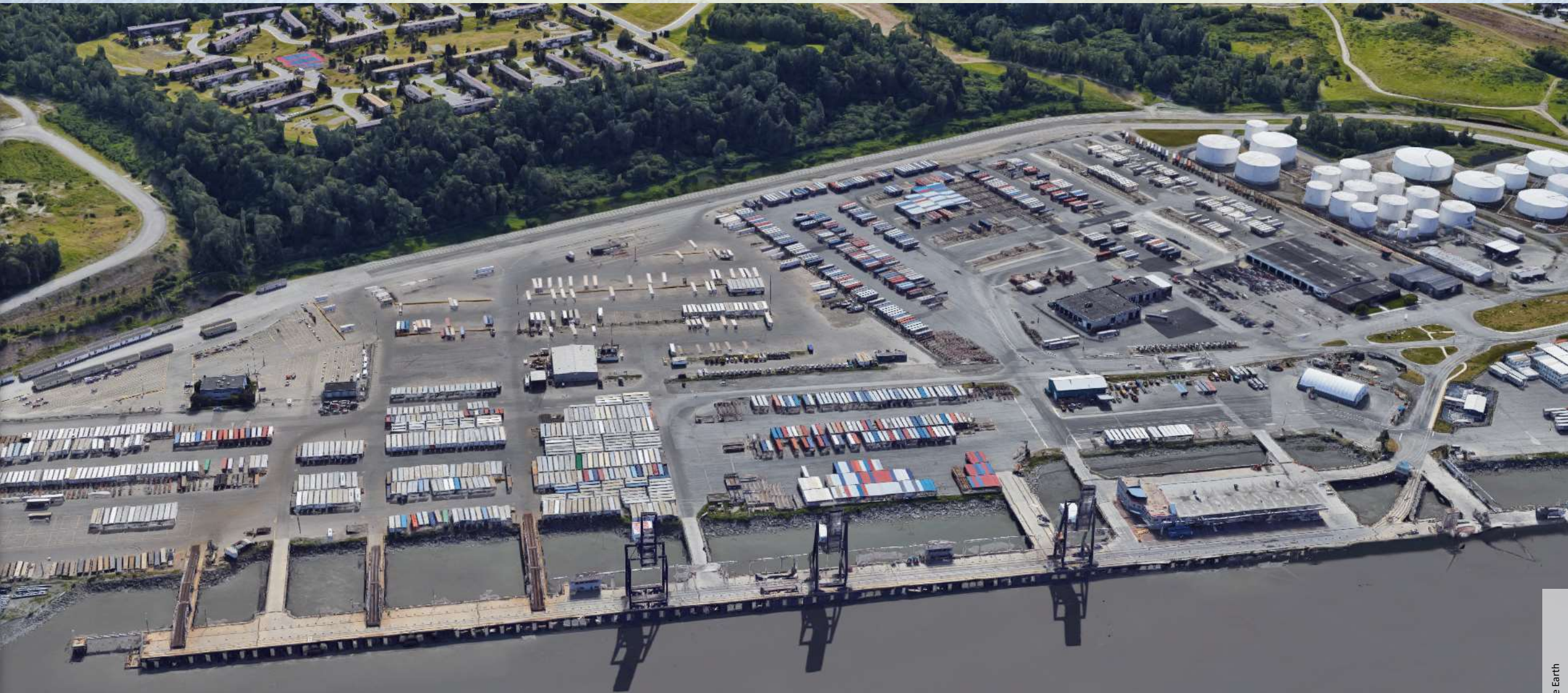
Decision Support System

- What is your organization's current "decision support system"?
 - Your staff's brain, memory, knowing where to find information
 - Your institutional knowledge, your "old timers"
 - Your staff and management's gut feel, intuition
- What does it lack?
 - Accountability
 - Transparency
 - Repeatability
 - Scalability
 - Resiliency
- What is the new Decision Support System?
 - Let's take a look



Strategic Asset
Management
Decision Support System

Decision Support System



Decision Support System



Source: WJE

Source: WJE

Source: Port of Alaska

Source: Google Earth

Decision Support System

- “It’s broken, it needs to be fixed, now!”
- “We’ll have to stop operations if we don’t fix”
- “We’ll have to stop operations in order to fix”
- “Somebody is going to get hurt”
- “We’re not meeting the lease terms”
- “It’s not in the budget”
- “We should have inspected sooner”

- But...
- “It’s broken, it needs to be fixed, now!”



Decision Support System

View Inspection | Quick Tools

Inspection Location: [Close]

Inspection Attributes:

- Created Date: 05/07/2018 14:57
- Created By: Administrator
- Last Edited Date:
- Last Edited By:
- Property:
 - Berth 0
 - Asset ID: 12534
- Inspection Date(s): 15-10-2017
- Inspection Type: Baseline
- Scope of Inspection: Berth 0 Superstructure and substructure inspections
- Inspection Firm: ABC
- Responsible Engineer: Fiona Meury
- Inspection ID: D45678
- Asset Condition Rating (ACR): 4
- Superstructure Rating: 3
- Substructure Rating: 3
- Bulkhead Rating: 4
- Fender System Rating: 1

Inspection | **Containers**

Inspection	Containers
Berth 0	2x22x11M-c95c-4805-9c2d-7016a3e4b054
Berth 0	2x22x11M-c95c-4805-9c2d-7016a3e4b054
Berth 0	2x22x11M-c95c-4805-9c2d-7016a3e4b054

The Port | Maritime Asset | Cargo Terminal - Wharf 001 | July 25, 2018 | Page 4 of 14

Follow-up Actions

Property: Cargo Terminal | Asset ID: Wharf 001

Inspection Type: Baseline Routine Special | Inspection Date: May 9 & 10, 2018

Scope of Inspection: Above Water

Inspection Firm(s): Prime Wils, James Elder Associates, Inc. (PWE)

Underwater: N/A

Reported By: Patrick Morris, MSc | Report Date: July 25, 2018

Follow-up Actions:

Item No.	Priority	Category	Structure
1	High	Structural	Superstructure

Element Type: MC Deck Beams (Element 000) | DR #1, DR #3, DR #4, DR #5, DR #6, DR #7, DR #8, DR #9, DR #10, DR #11, DR #12, DR #13, DR #14, DR #15, DR #16, DR #17, DR #18, DR #19, DR #20, DR #21, DR #22, DR #23, DR #24, DR #25

Condition Identified: Displaced deck beams at ends of frontal beams, possibly indicative of shear distress.

Reason for action: Condition may reflect past overloading or underlying deficiency in structure.

Recommended Action: Follow-up investigation (in-depth inspection) to include structural calculations.

Figure 1. Typical appearance of displaced crack on joint beam, resulted in loss of visibility. Note that the crack shown does not appear to originate at the supporting element.

SAMPLE

0 Files | Download | 0 Faves

Comments:

- [Image]
- [Image]
- [Image]



Let's Start with Condition Assessments



Put All Assessments in a Database

Inspection ID: 875643

Property: Berth 2
Asset ID: 25464
Date of Inspection: 5-2-2017
Type of Inspection: Baseline
Scope of Inspection: Berth 2 superstructure and substructure inspections
Inspection Created by (User): administrator
Inspection Created by (Firm): WJE
Asset Condition Rating: 74
Superstructure Rating: 4
Substructure Rating: 4

[View Additional Details](#) [Edit Feature](#)



Look at the Overall Rating to Identify Trouble



Access Current and Past Assessments

View Inspection Close

Inspection Location
Click here to view the inspection location.

Inspection Attributes

Created Date
06/07/2018 18:57

Created By
administrator

Last Edited Date

Last Edited By

Property
Berth 9

Asset ID
13524

Inspection Date(s)
10-10-2017

Inspection Type
Baseline

Scope of Inspection
Berth 9 superstructure and substructure inspections

Inspection Firm
ABC

Responsible Engineer
Elena Murray

Inspection ID
045683

Asset Condition Rating (ACR)
4

Superstructure Rating
3

Substructure Rating
3

Bulkhead Rating
4

Fender System Rating
1

Quick Tools

View Documents

Total Document Count: 5

	Inspection	Container ID	Document ID	Created Date	Created By	Last Edited Date	Last Edited By	Document Name	Document Date	Description	URL
	Berth 9	2e23e1ff-c95c-4865-9ca9-0b1ce3e64094	262ccb2d-6591-4040-ad7b-9edeafad5f04		administrator		administrator	Plannotea Project	7/2/2018, 5:00:00 PM		FY0E3FF7-2F8E-4F03-B936-C8833F796530
	Berth 9	2e23e1ff-c95c-4865-9ca9-0b1ce3e64094	932973a0-6c11-469b-9b4e-528b2634ce951		administrator		administrator	Plannotea Elemental Inspection	6/3/2018, 5:00:00 PM		31324887-F157-494E-9776-CE1682228146
	Berth 9	2e23e1ff-c95c-4865-9ca9-0b1ce3e64094	f0270ba7-0218-4402-ae72-011c4d9b0343		administrator		administrator	Berth 9: Follow Up Action	5/2/2018, 5:00:00 PM		Demo2_Follow-upAction_Baseline_2018-05.pdf

Retrieve Inspection Records



▼ Photos

5/10/2018 10:14:31 AM

Rotate Download Rotate

Tags:

Comment:

The Port Maritime Asset Follow-up Actions Cargo Terminal - Wharf 101 July 25, 2018 Page 1 of 28

Property: Cargo Terminal Asset ID: Wharf 101

Inspection Type: Baseline Routine Special Inspection Date: May 9 & 10, 2018

Scope of Inspection: Above Water

Inspection Firm(s): Prime: Wiss, Janney, Elstner Associates, Inc. (WJE) Underwater: N/A

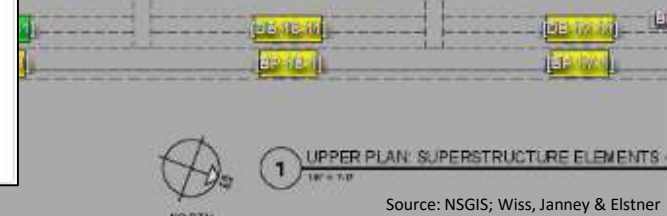
Reported By: Patrick Marra, WJE Report Date: July 25, 2018

Follow-up Actions

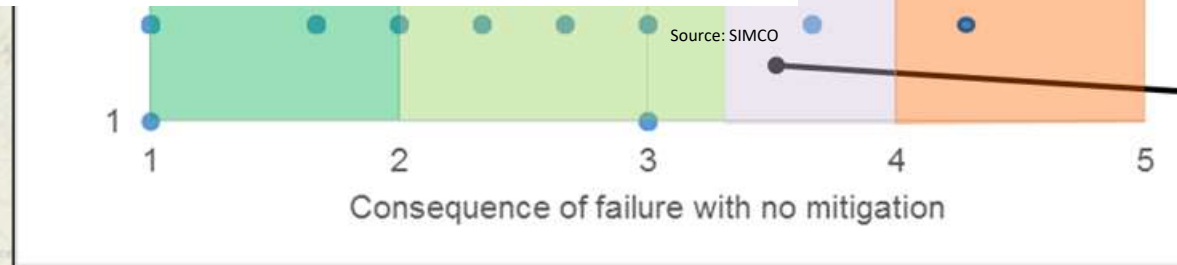
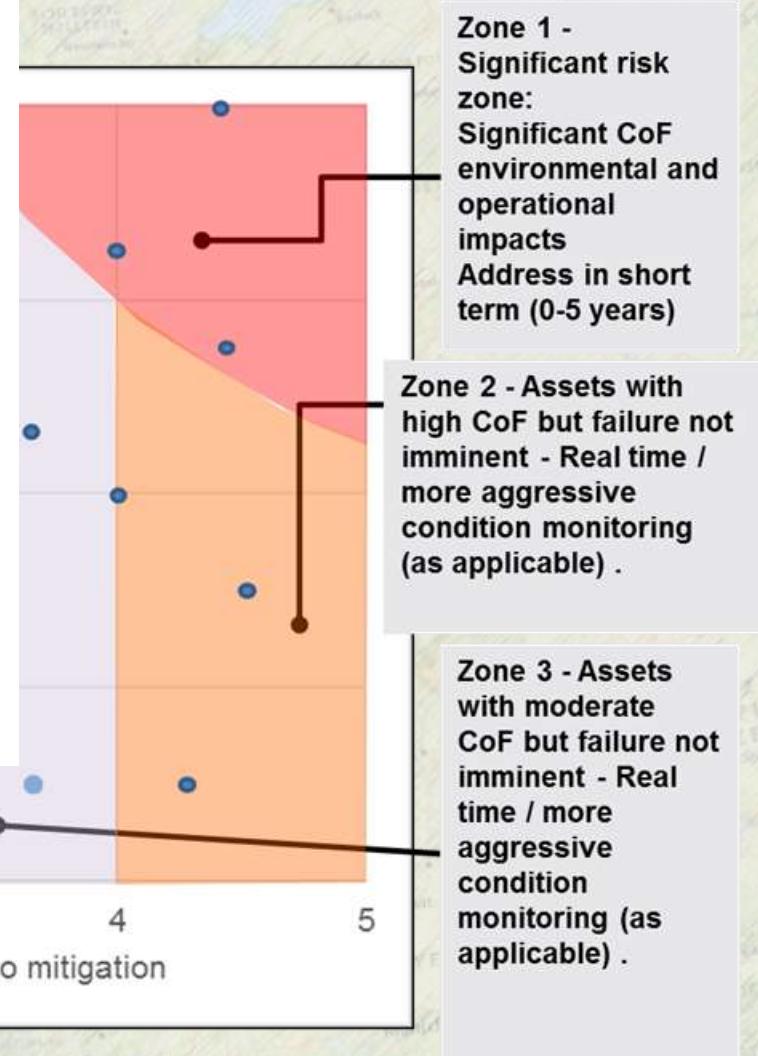
Item No.:	1	Priority:	<input type="checkbox"/> Priority <input checked="" type="checkbox"/> Routine
Component:	Superstructure		
Element Type:	RC Deck Beams	Element ID(s):	DB 4-1, DB 5-1, DB 6-1, DB 7-1, DB 8-1, DB 9-1, DB 10-1, DB 11-1, DB 15-1, DB 16-1, DB 18-1, DB22-1, DB 23-1.
Condition Identified:	Diagonal crack present at ends of frontal beams, possibly indicative of shear distress.		
Reason for action:	Condition may reflect past overloading or underlying deficiency in structure.		
Recommended Action:	Follow-up investigation (In-Depth Inspection) to include structural calculations.		

Figure 1. Typical appearance of diagonal crack on front beam, marked in red for visibility. Note that the crack shown does not appear to originate at the supporting element.

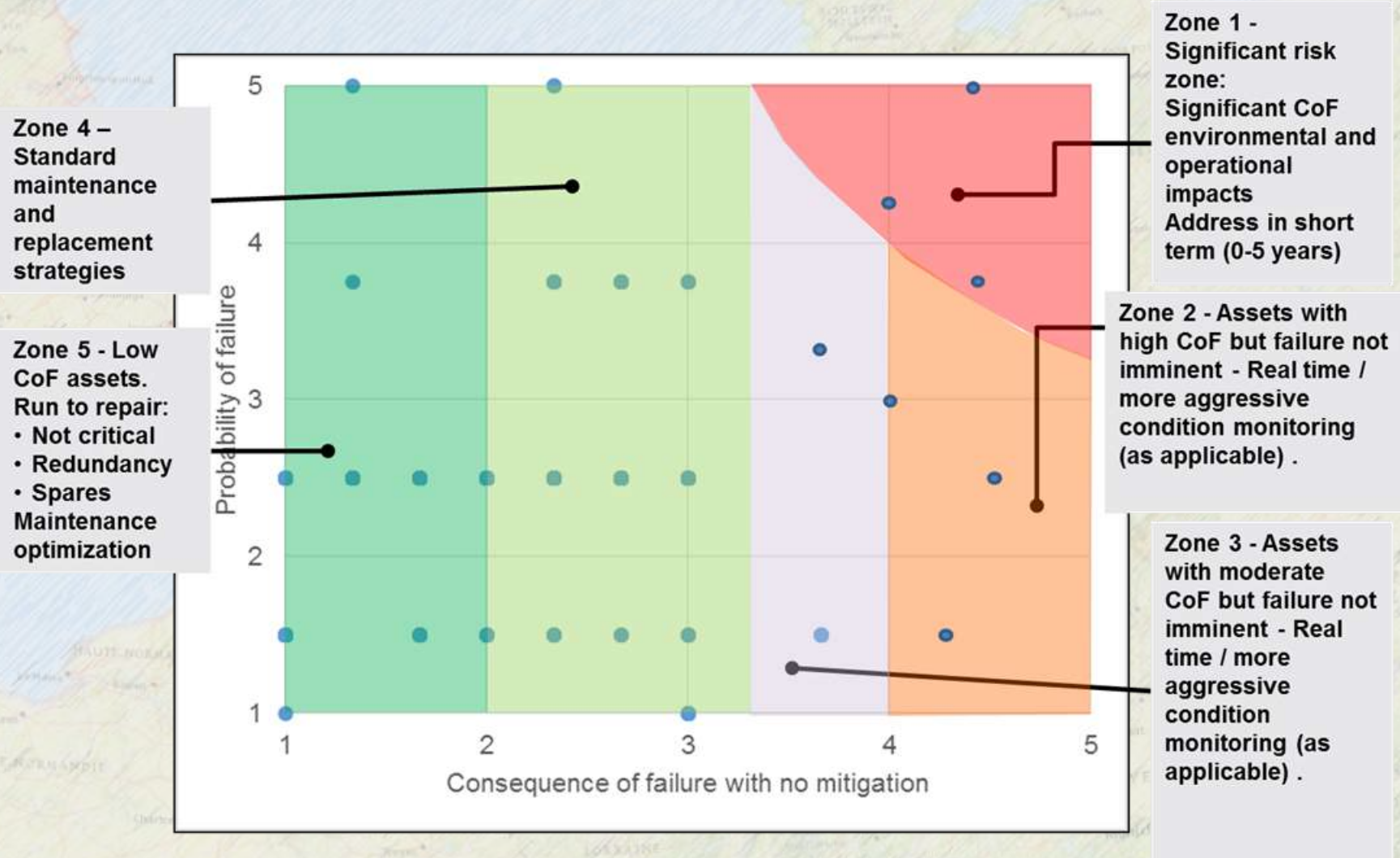
SAMPLE



Model Deterioration and Life Cycle



Let's Not Stop There!



Use Spatial Accounting™!

- A visual dashboard into your data, maps and documents
- Manage both physical and financial assets together
- Including real estate



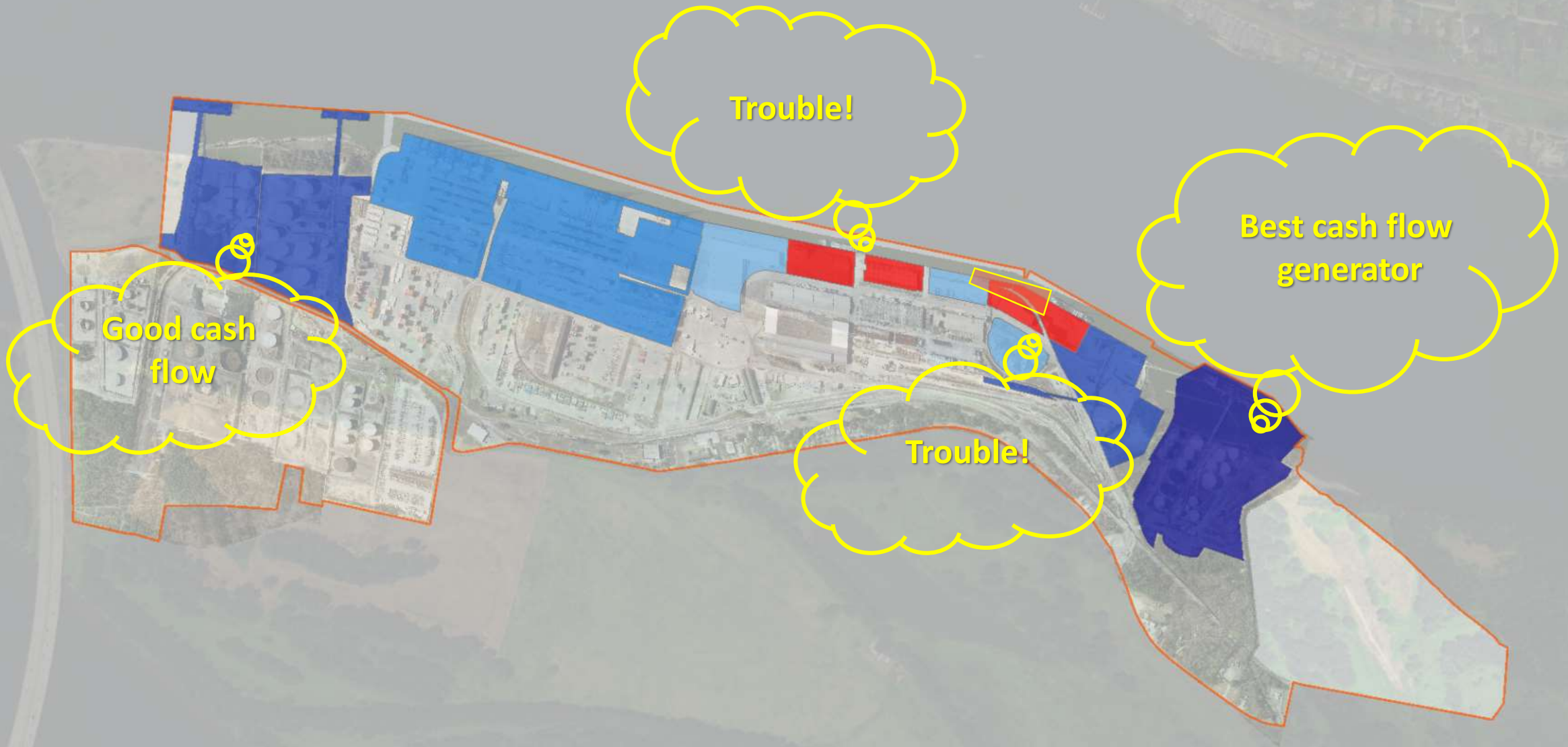
Map Your Billing System



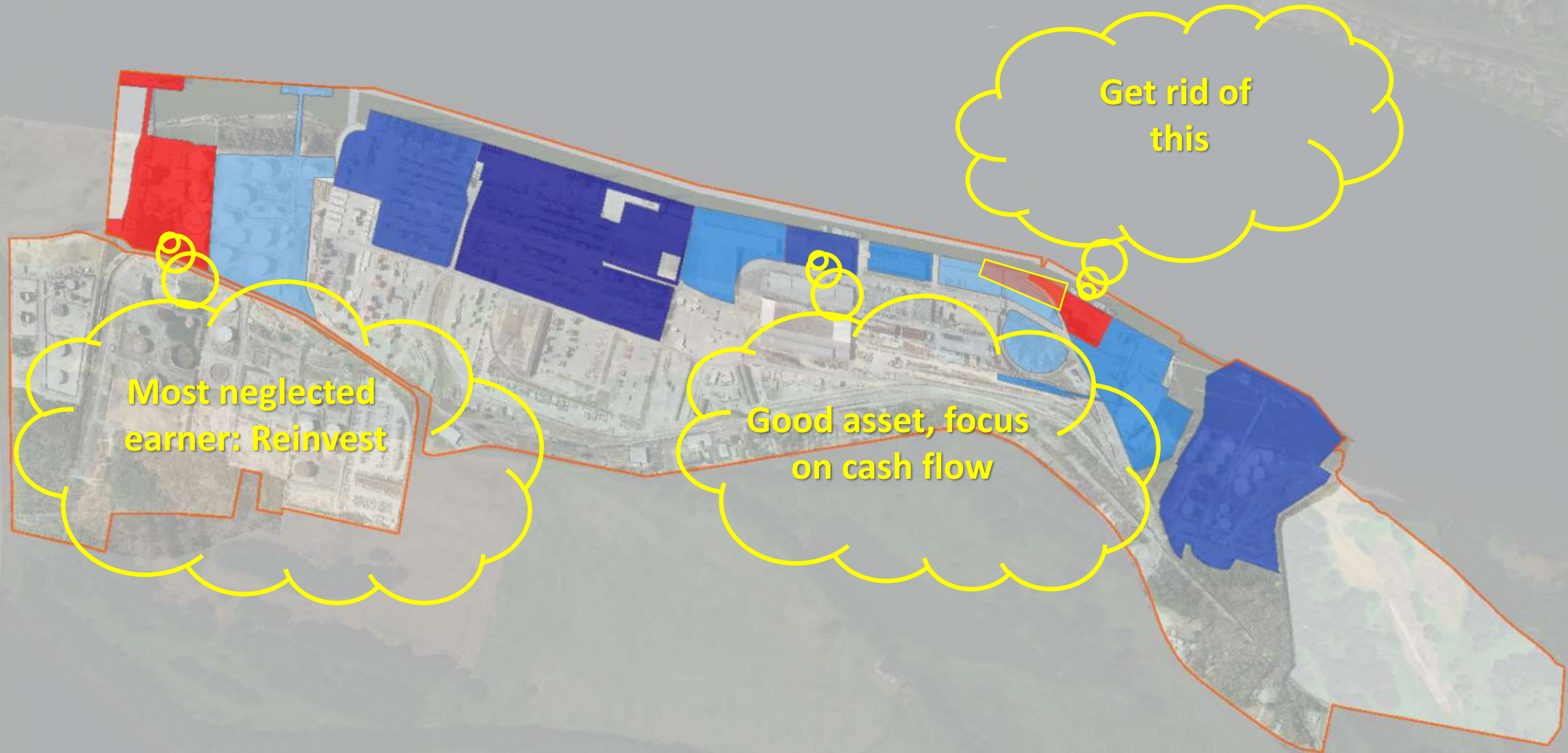
Connect To Your Work Order System



Visual Profit & Loss Report: Cash Flow Map



Visual Balance Sheet: Net Asset Values



Visualize Your Utilities, Infrastructure, Leases

Current Lease: Many Grains ◀ 2 of 2 ▶ ✕

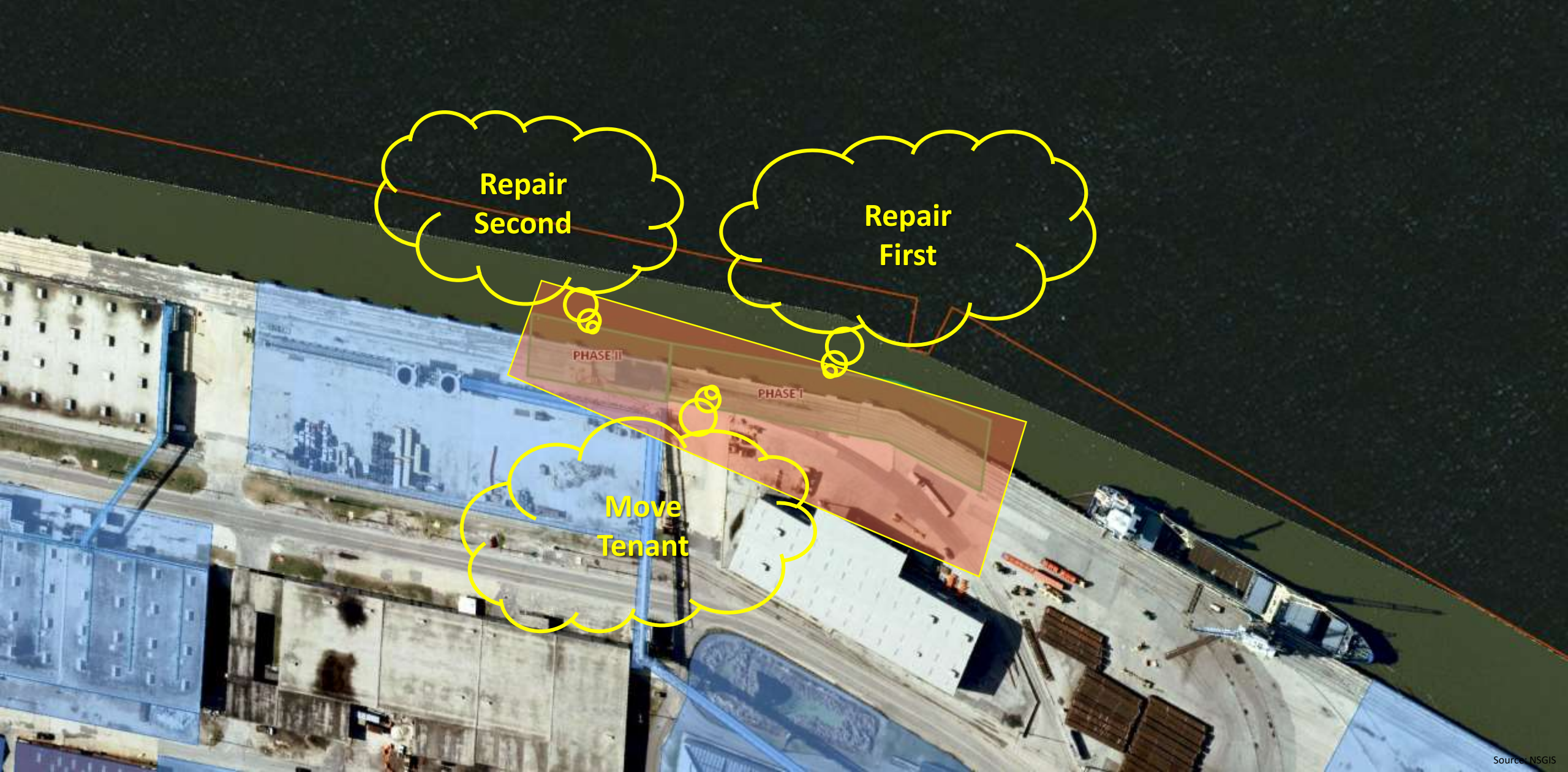
Current Lease: Many Grains

Tenant: Many Grains
Address: 1209 Grains Ctr
Lease ID: 1
Amendment ID: 1
Agreement Start Date: Feb 14, 1994 4:00 PM
Agreement End Date: Dec 30, 2078 4:00 PM
Term Type: Term
Port Contact: Andre Doe -- 123-456-7890
Emergency Contact: Noam Doe -- 147-852-3690

[View Additional Details](#) | [Run a Report](#)



Use a Map-Based Dashboard



Repair
Second

Repair
First

Move
Tenant

Let's Recap

- Spatial Accounting™ is the concept of:
 - Connecting different Systems of Record using GIS
 - Implementing the principles of Strategic Asset Management as a Decision Support System
 - Delivering it as a map-enabled System of Engagement
- This requires:
 - Existing systems to be connected
 - New systems to be added
 - Collaboration across the enterprise



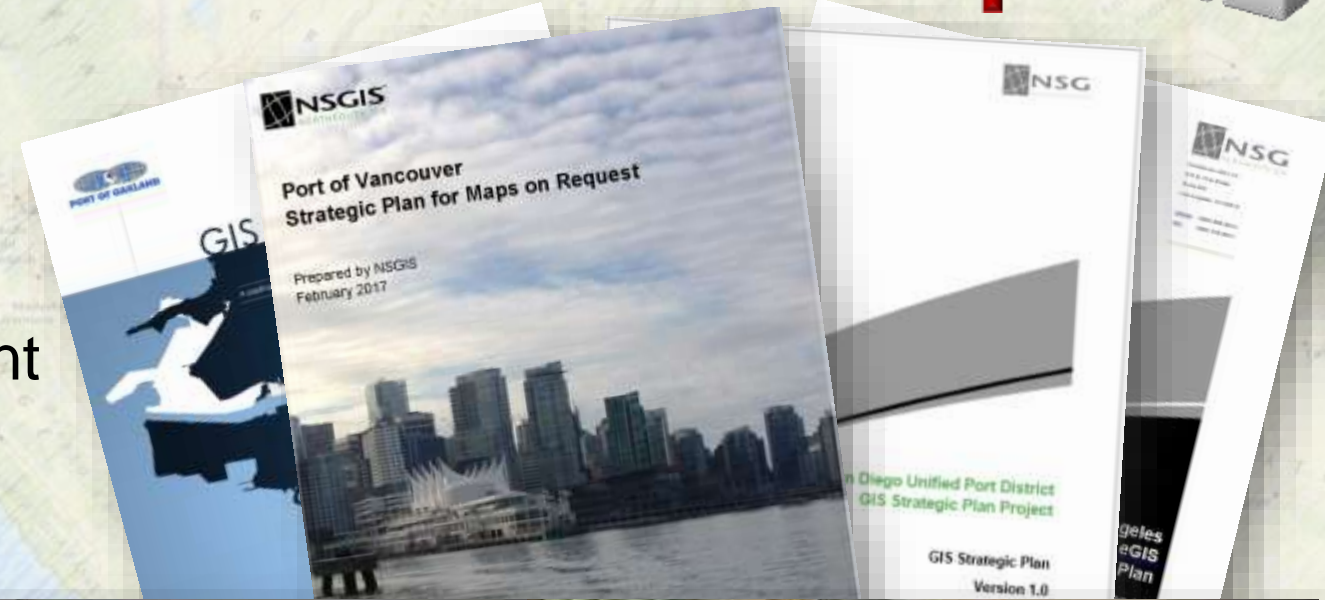
How Does One Get There, Incrementally?

- “We have nothing” or “We have pieces”
- “We don’t have the experts to do this”
- “I’ve heard this is very expensive”
- “We’ve tried this before, it failed”
- “I already *have* a day job!”
- “We’re just a small organization”
- “Cyber-security”
- “Something urgent came up”
- “My management doesn’t get it”



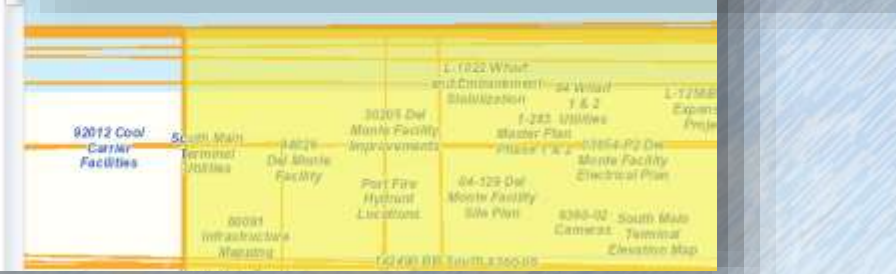
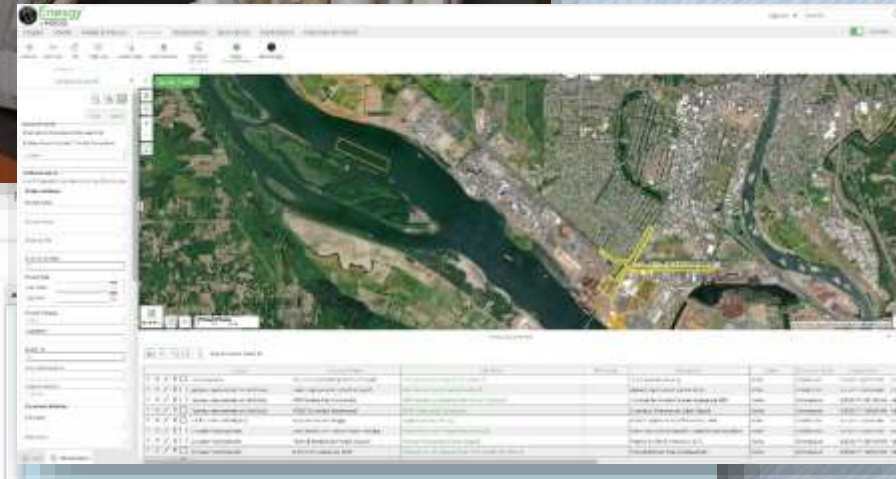
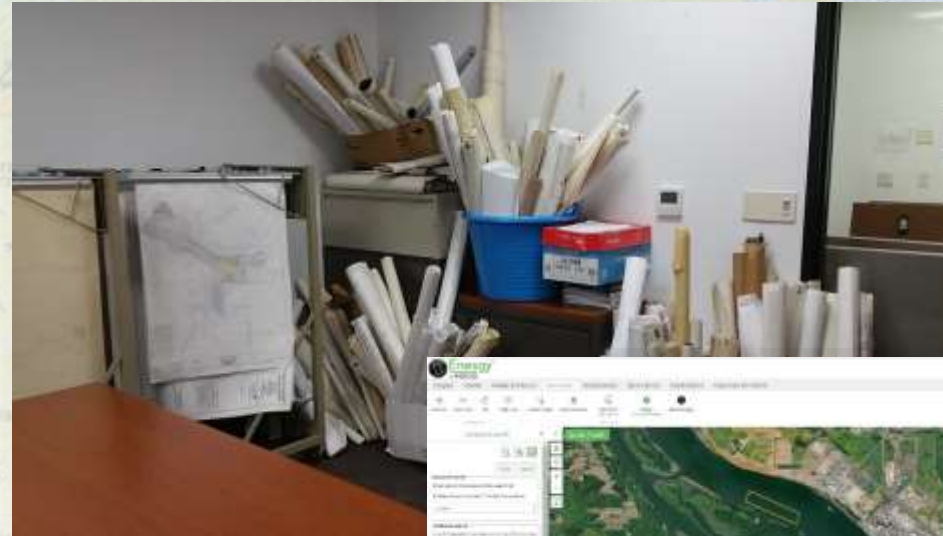
GIS Strategic Plans

- **What:** Interviews across organization, providing budget, staffing, action plans
- **ROI:**
 - Coordinated vision & a road map
 - Sync with organization's master plan & strategic asset management plans
 - Basis for budget requests
 - Bridge gap with IT
 - Better communication with leadership



Assessment of Paper Records

- **What:** Catalog paper, scanned and digital documents
- **ROI:**
 - Catalog of available data
 - Prioritization for conversion to GIS so only most reliable data is used
 - Gain value from GIS even before starting on data conversion and even from documents that are never converted
 - Map- and metadata-based search and retrieval of documents



Spatial Index of Digital Documents

- **What:** Spatially search and retrieve record drawings
- **ROI:**
 - Reduced risk of using wrong or incomplete document sets
 - Easier for new staff to find documents
 - Some organizations have reported 90%+ reduction in search for as-builts



The screenshot displays the Energy by NSGIS web application. At the top, there is a search bar and a 'Sign out' button. A drawing information panel is open, showing details for 'Drawing: Sundowner Terminal Water Main Master Plan' with fields for Number (ST-5400), Type, Date, Series (Record Drawing), Work Order, and Project Number. Below this, a 'View Documents' panel shows a table of documents:

	Drawing	Document Name	Description	Document Type	File Name
	Yam-10200	Yamaguchi Potable Mains Plan	Initial drawing specs for potable mains at Yamaguchi	PDF	TH-438(1).pdf
	Yam-10200	Yamaguchi Detail Plan Final Edition	Final version of plans showing mains detail and booster	PDF	TH-543(1).pdf

The interface also includes a map of an urban area with various colored overlays, a scale bar, and a 'Tools' menu. A status bar at the bottom indicates 'Still working. Loading further map data.'

Rectification of Scanned CAD Drawings



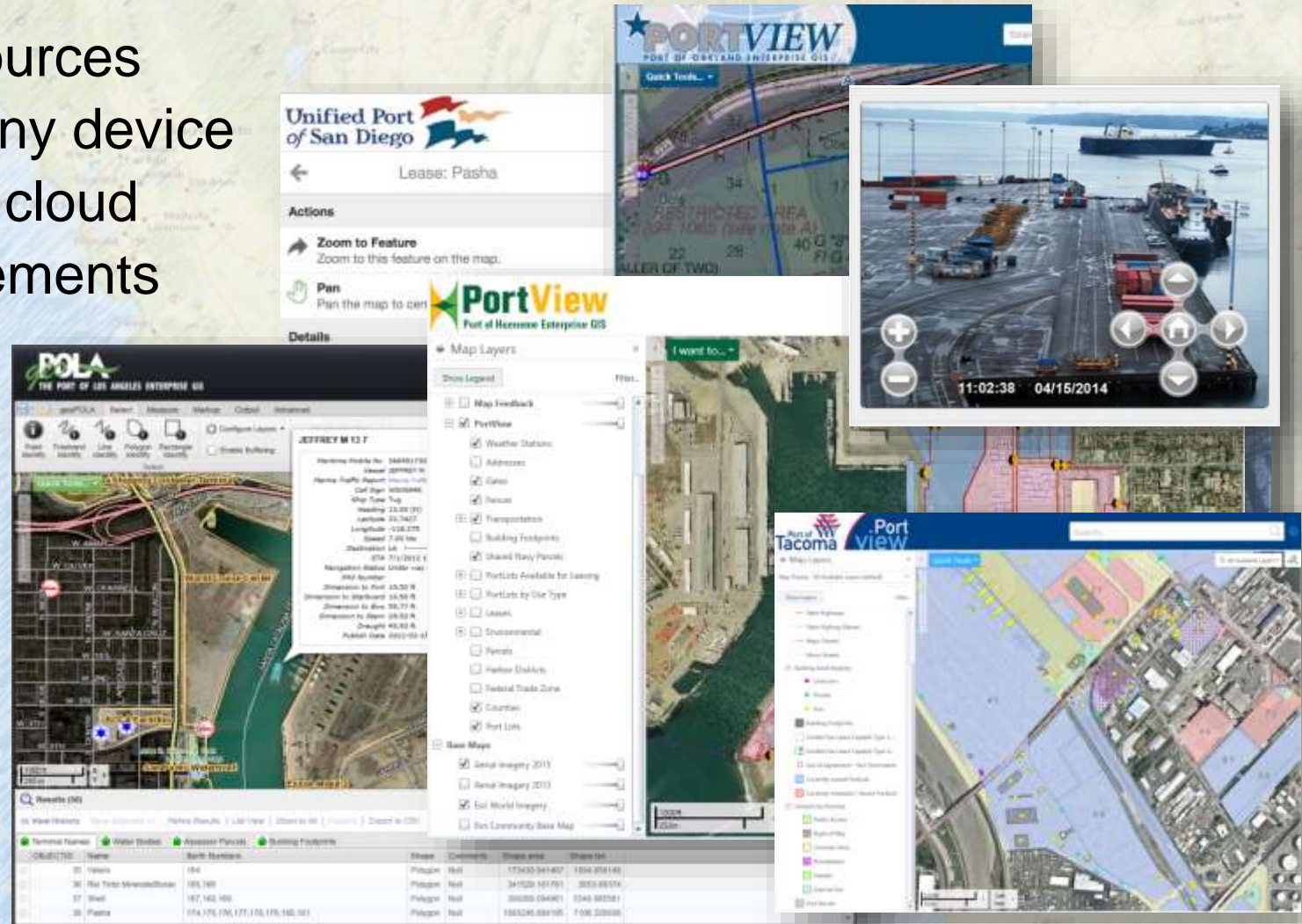
- **What:** Overlay images spatially without conversion to GIS
- **ROI:**
 - Much easier to use than disjointed standalone scanned drawings
 - Can stitch drawing sets together
 - Retain details that will never be converted to GIS
 - Save one-of-a-kind drawings before they are destroyed
 - Tangible value from document scanning



Data Conversion and Publication



- **What:** Conversion of 100s map layers from paper, CAD, GIS
- **ROI:**
 - Vetted, authoritative data sources
 - Available any time and on any device
 - Stored on-premise or in the cloud
 - Tools for sketches, measurements
 - Integrates external data sources from city, county, state, federal agencies, etc.
 - Integrates dynamic data with static data sources



Data Storage and Management

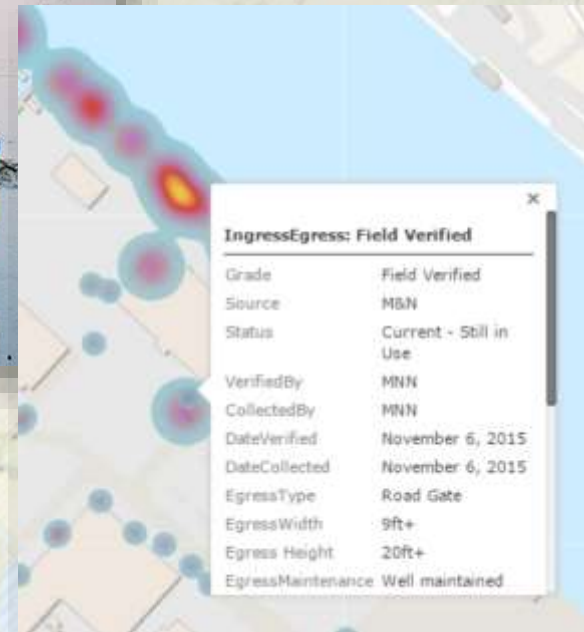
- **What:** On-premise or cloud storage and management
- **ROI:**
 - Complete systems of record and engagement
 - Options for economical cloud data streams, storage, analysis
 - Web GIS available on any device, anytime and anywhere (including offline)
 - Supports third-party software



A screenshot of the Port of NSGIS web application interface. The main header features a navigation menu with links for Home, Gallery, Map, Scene, Groups, Content, and Organization. Below the menu is a large aerial view of a port facility with the text "PORT OF NSGIS" overlaid in large, stylized letters. To the right of the main view is a sidebar with a search bar and a list of items, including "Storm Drains" and "Port of NSGIS". Below the main view are four numbered tiles: 1. Leases Dashboard (showing a map and data), 2. Documents (showing a 3D model of a facility), 3. Energy Documents (showing the "Energy by NSGIS" logo), and 4. Smarter Asset Mapping (showing a night view of a facility).

Field Data Capture and Verification

- **What:** Verification and documentation of assets in the field
- **ROI:**
 - Increase confidence in data
 - Field apps eliminate paper
 - Can inspect conditions while verifying locations
 - Capture photos
 - Instant feedback to office



Condition Assessment Management



- **What:** Combine data, reports, maps, photos in one system
- **ROI:**
 - Faster, more precise access to condition data, not just recommendations
 - Comparison of conditions across space and time
 - Integration with engineering data to plan for project design and operations
 - Integration of data from different consultants and from internal assessments
 - Overlay with other map layers

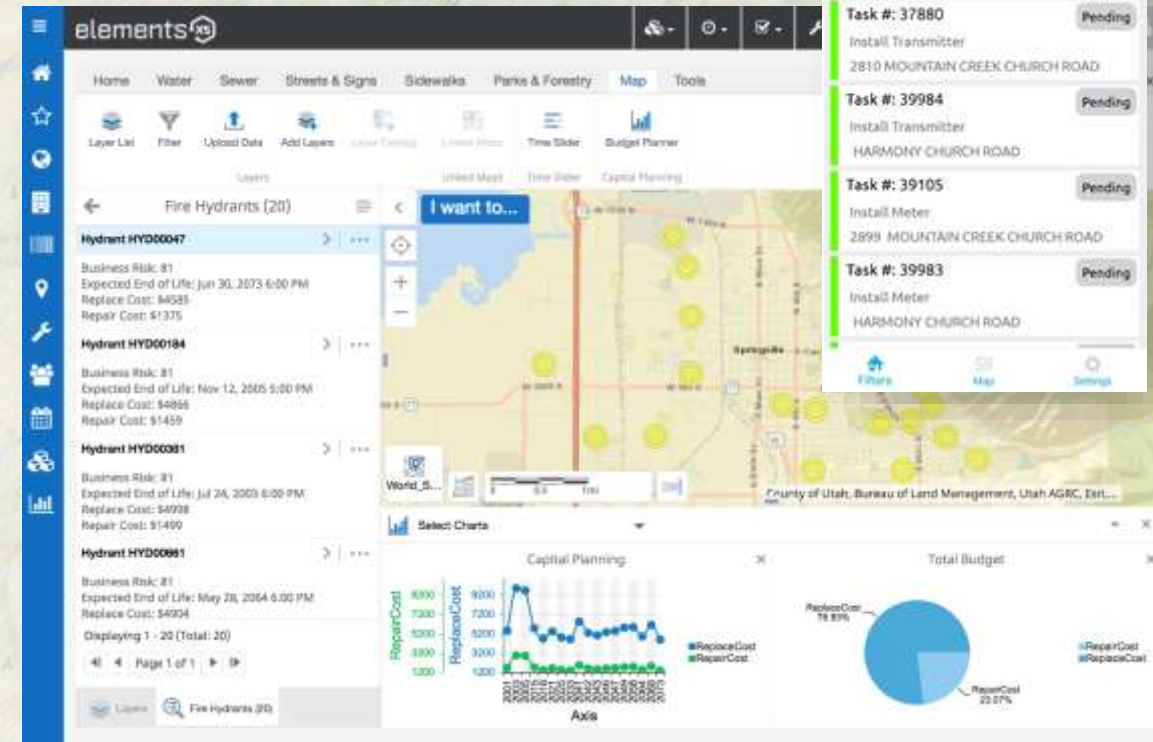
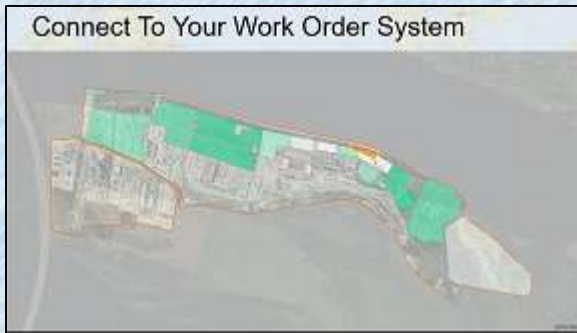
Quantify All Liabilities



Last Edited By	Document Name	Date
NorthSouth GS	Planstate Project	3/2/2017, 3:00:00 PM
NorthSouth GS	Planstate Elemental Inspection	7/17/2017, 5:00:00 PM
NorthSouth GS	Berth 12: Follow Up Action	9/13/2018, 5:00:00 PM
NorthSouth GS	Berth 12: Inspector Summary	4/5/2017, 3:00:00 PM
NorthSouth GS	Planstate Elemental Survey Summary	3/2/2017, 3:00:00 PM

Facilities and Work Order System

- **What:** GIS-based work order system, linked to finance & docs
- **ROI:**
 - Electronic work orders based on mapped assets
 - Work, labor and cost history retained in a database
 - Correlated to other systems through location information
 - Built-in scheduling and load balancing
 - Inventory control
 - Preventive maintenance planning
 - No paper records
 - Risk-based prioritization



Long-Term Lease Management

- **What:** Management of commercial property portfolio
- **ROI:**
 - Single map-based view of all properties
 - Differentiate between leased, available, expiring leases
 - Searchable, integrated data, maps and documents
 - Lease abstract and other reports
 - Query and analysis capabilities
 - Alerts and email notifications
 - Linkable to document management system
- Executive dashboard



Energy by NSGIS

View Lease

Lease ID: 52 - Sundowner Terminal Amendment # 2

1600 Interis Ave
Aurora, MI 48813
125-496-1886

Lease Type: Long Term
Start: Mar 31, 1995 4:00 PM
Expiration: Mar 30, 2074 3:00 PM

Property Address: 1300 Sundowner St
Property Notes: Approx. 52 acres 27% as 1st warehouse #140

View Documents

Lease	Document Name	File Name	Document Type
Sundowner Terminal	Sundowner Ventures II, LLC and MULTNOMAH COUNTY	Gunderson_Contract_Canv1 Lease 21.9.03_001.pdf	Lease
Sundowner Terminal	Additional Grant funding for site	Approval_20141214.pdf	Memorandum
Sundowner Terminal	Contact Card	Contact_Card_1216	Contact Card

PORT by NSGIS

Part of NSGIS Lease Abstract

Lease ID: 52 - Sundowner Terminal Amendment # 2

1600 Interis Ave
Aurora, MI 48813
125-496-1886

Lease Type: Long Term
Start: Mar 31, 1995 4:00 PM
Expiration: Mar 30, 2074 3:00 PM

Property Address: 1300 Sundowner St
Property Notes: Approx. 52 acres 27% as 1st warehouse #140

View Documents

Lease	Document Name	File Name	Document Type
Sundowner Terminal	Sundowner Ventures II, LLC and MULTNOMAH COUNTY	Gunderson_Contract_Canv1 Lease 21.9.03_001.pdf	Lease
Sundowner Terminal	Additional Grant funding for site	Approval_20141214.pdf	Memorandum
Sundowner Terminal	Contact Card	Contact_Card_1216	Contact Card

Capital Projects Management



- **What:** Tracking capital projects, exposing through dashboard
- **ROI:**
 - Internal tracking, public sharing
 - Can be used from beginning to drive the process
 - Linkable to document management system

Capital Project Dashboard

43% on-budget 14% on-schedule \$29.5M

Active Projects: 7

- Cross Creek Outfall Inspection and Maintenance (Stormwater Drainage)
- Jackson Ave. Streetscape and Traffic Calming (Transportation)
- Naper Settlement Water Main Replacement (Water Distribution)
- Queensbury Sewer Rehab (Sewer Collection)
- Riverwalk Rehabilitation (Parks)
- Washington St. Bridge Replacement (Transportation)
- Water Retaining and Pipe Rehab (Water Distribution)

Riverwalk Rehabilitation
Project ID: PARK.17.001

Over Budget **Behind Schedule**

Description: Continuing rehabilitation of the Riverwalk between Eagle Street and Oliver Hoffman Pavilion.

Fiscal Year	Funding Source
2017	General Fund

Estimated Cost	Actual Cost
\$184,000	\$195,000

Estimated Start Date	Actual Start Date
January 1, 2017	March 1, 2017

Estimated End Date	Actual End Date
December 31, 2017	March 1, 2018

Phase: PreDesign, Design, Construction, Closeout

Status: Construction

Contact: John Smith, 555-555-1212, jsmith@naperville.gov

Add The Asset Register

View Documents

Project	Document Name	Document Id	Description
Storm drain modernization	Storm Drain Problem (Photo)	6f1284e5-4fe9-419e-b0d1-69c7fc114d06	Storm Drain SWM-3001
Storm drain modernization	5-Year budget	618d0d24-16f2-4372-a246-4b07e7c56968	Projections for CIP in Terminal 1, including Storm

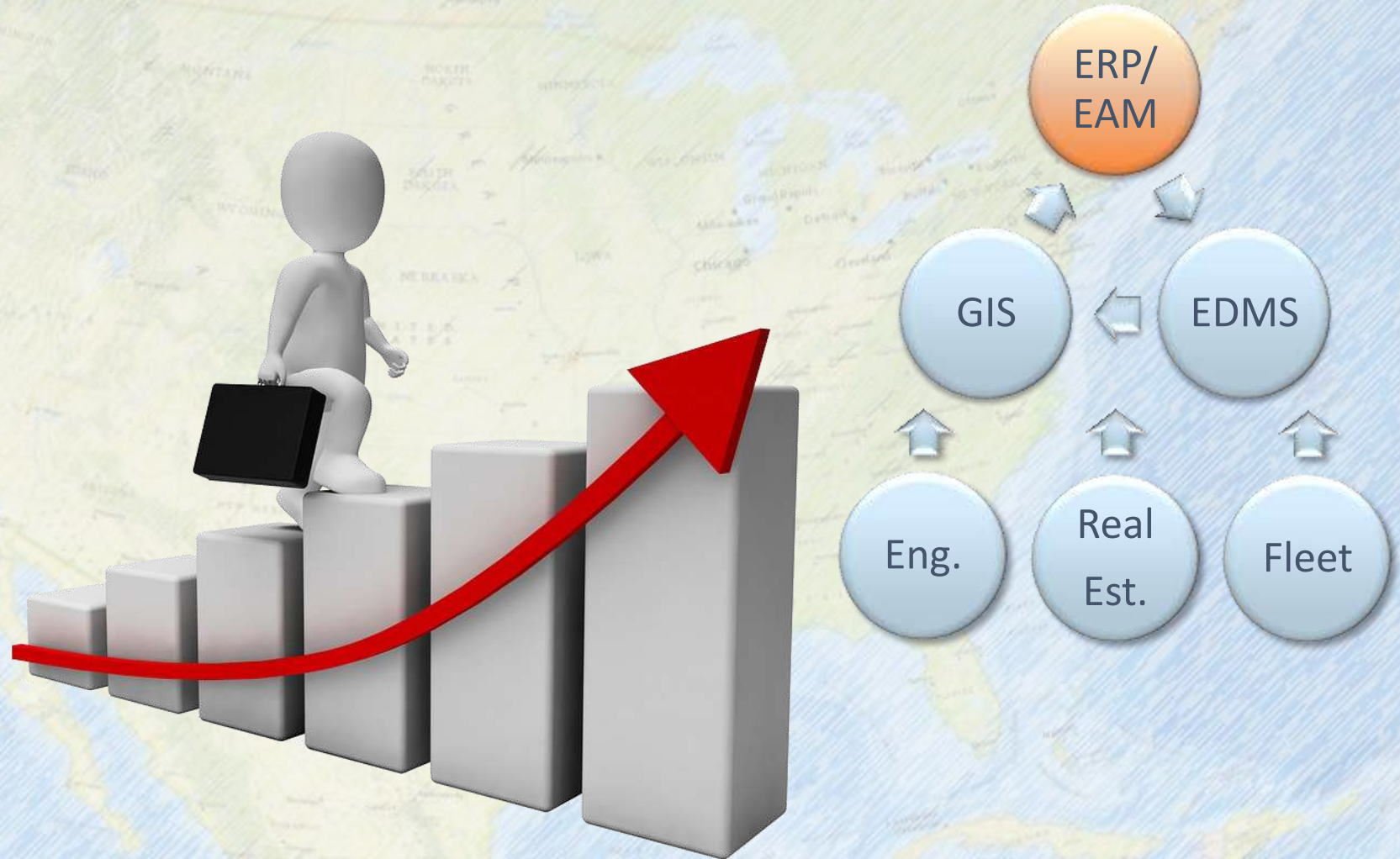
Where is Your Organization on This Path?

- Do you lack systems or connectivity?



Where is Your Organization on This Path?

- Or only have enterprise systems for finance?



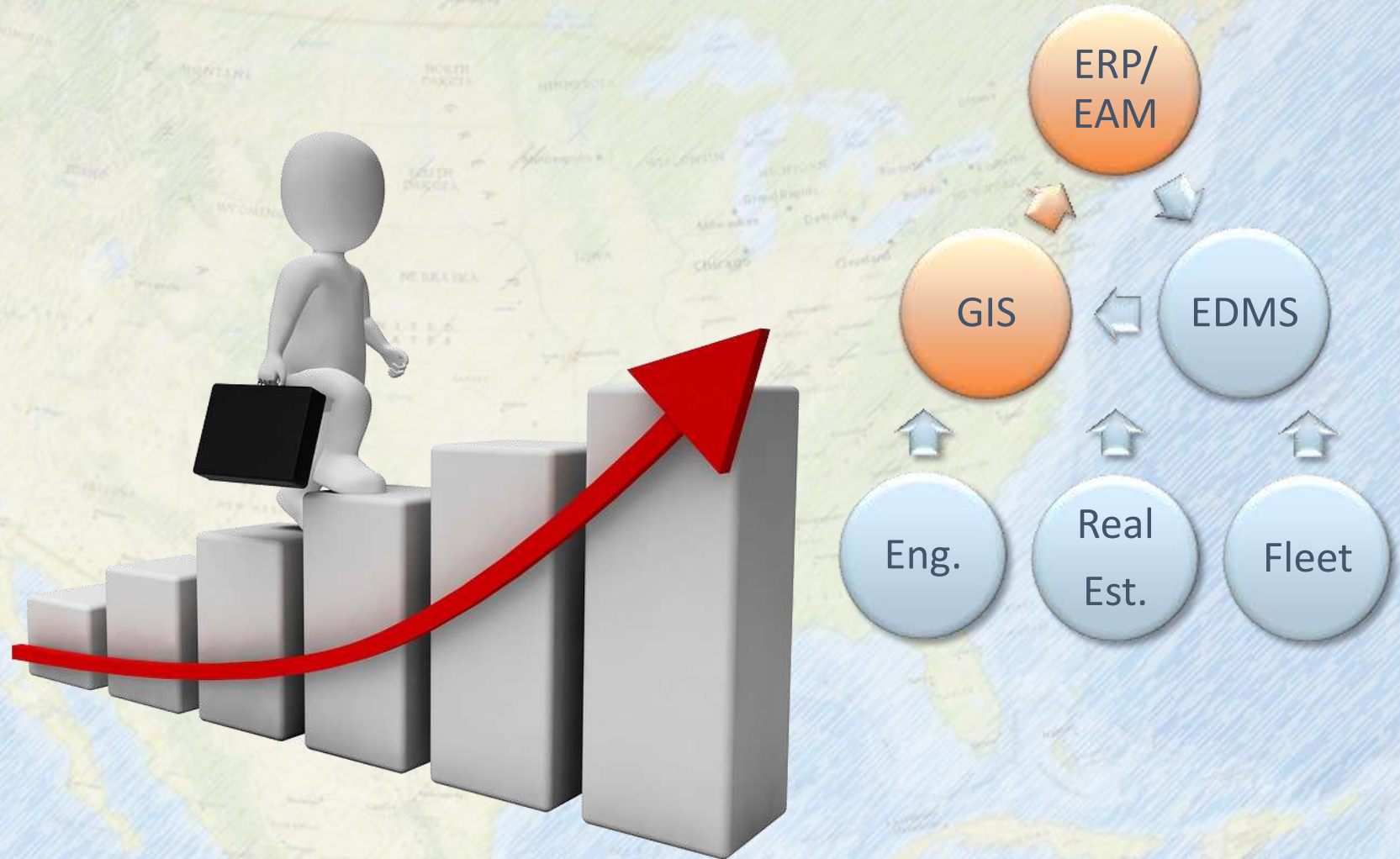
Where is Your Organization on This Path?

- Or have some GIS but it stands on its own?



Where is Your Organization on This Path?

- Or your GIS is connected to some enterprise systems but is not itself an enterprise system?



Where is Your Organization on This Path?

- Perhaps you are still managing everything with Word and Excel?



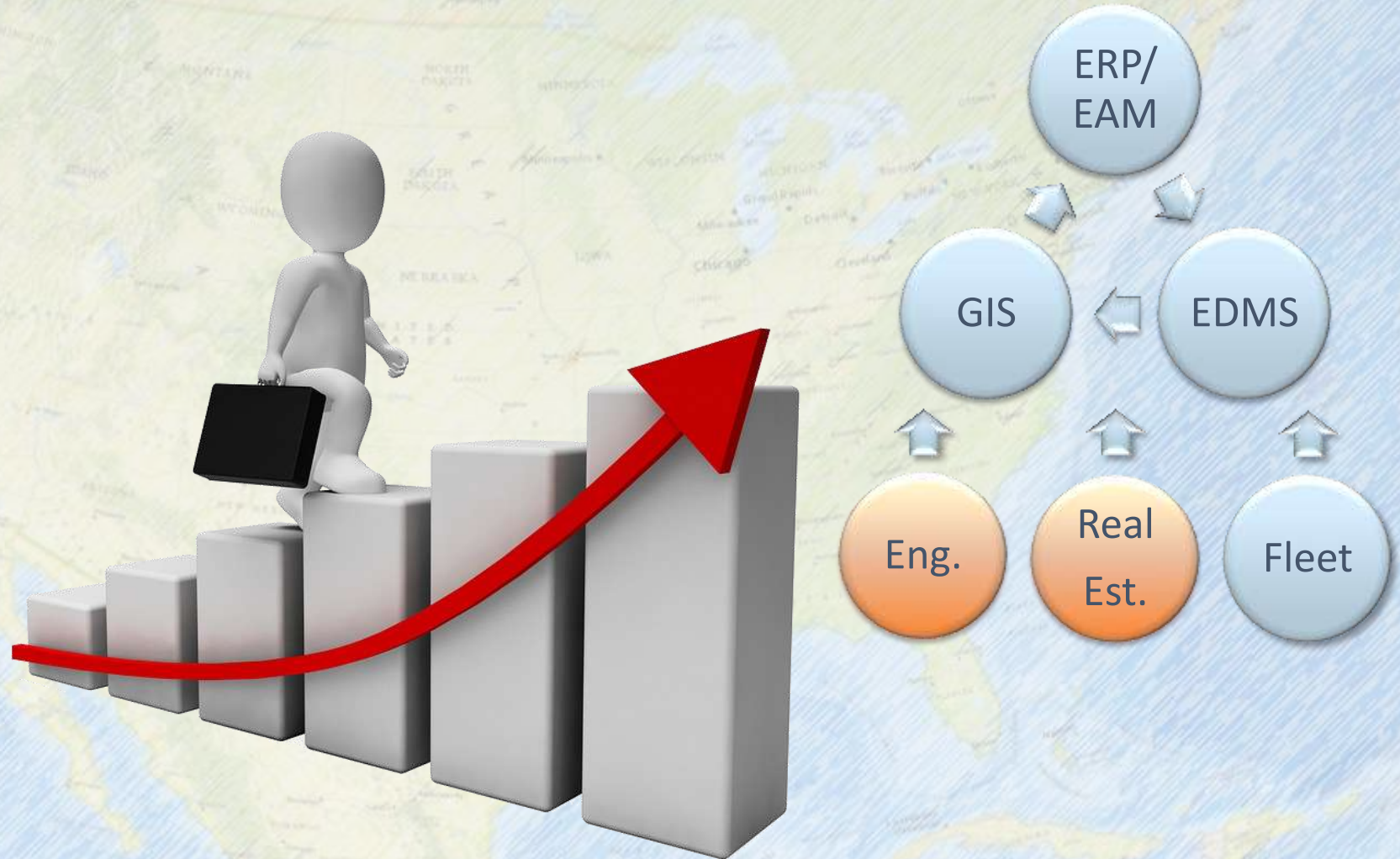
Where is Your Organization on This Path?

- You can start with specific systems, perhaps to just manage your record drawings
- Or just your critical map layers in GIS



Where is Your Organization on This Path?

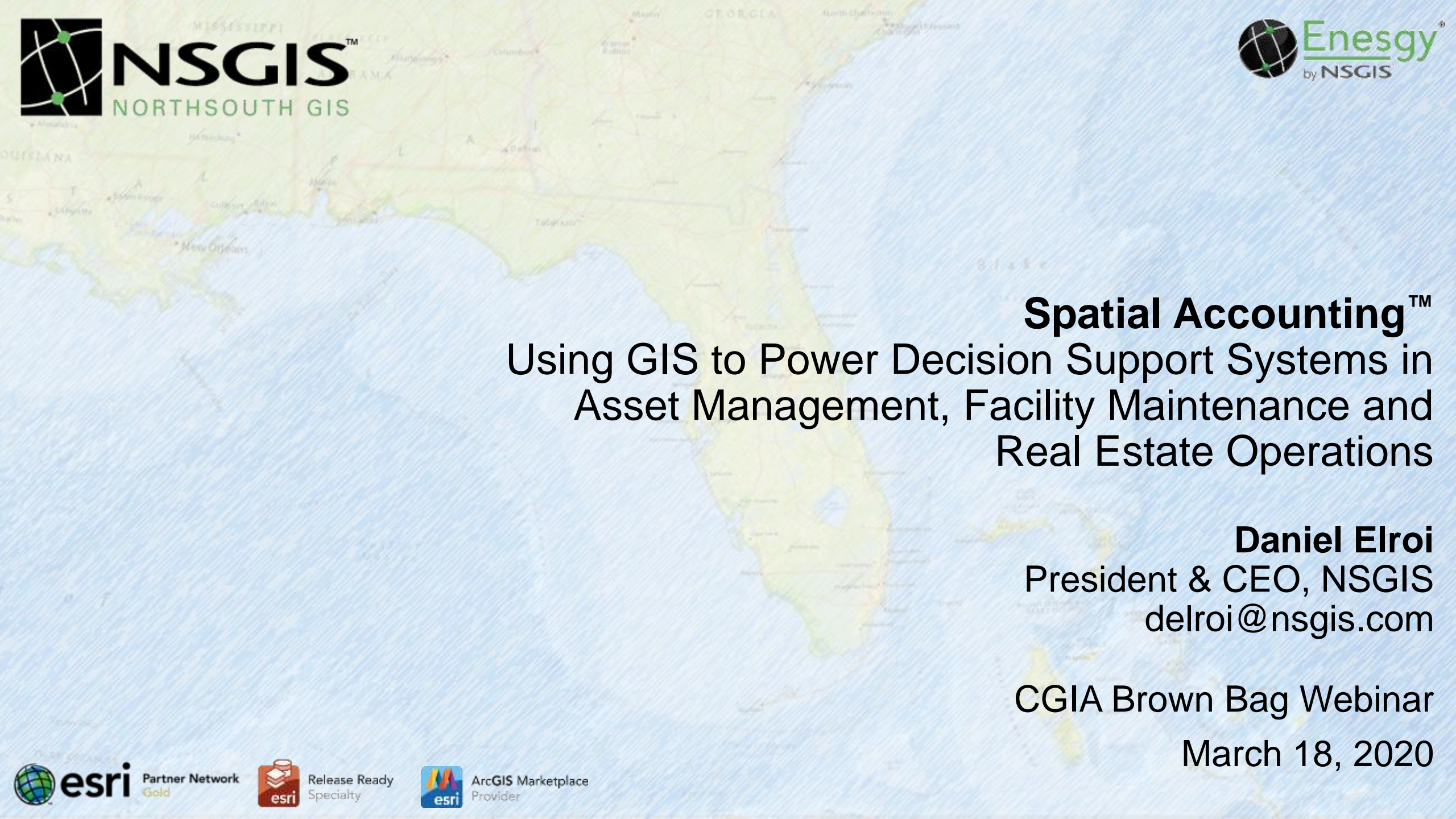
- Or have a couple of systems, one for engineering and one for real estate



Where is Your Organization on This Path?

- As long as you have a plan for how you will eventually bring these systems together using the principles of Spatial Accounting™
- Your organization too can build a Decision Support System that will reflect your Strategic Asset Management Plan
- Not surprisingly, best outcomes if you
 - Have a plan
 - Get buy-in and budget
 - Standardize on a common platform
 - Learn from your peers, contract with experts, grow and hire people to sustain and grow





Spatial AccountingTM
Using GIS to Power Decision Support Systems in
Asset Management, Facility Maintenance and
Real Estate Operations

Daniel Elroi
President & CEO, NSGIS
delroi@nsgis.com

CGIA Brown Bag Webinar

March 18, 2020