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Great Lakes and Ohio River Asset Management Program for O&M

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Purpose

Review – LRD Asset Management Program Development for O&M addressing Inland Navigation and Flood Risk Management Projects

Asset Management - Is the art of managing the life cycle cost of infrastructure assets with innovative and adaptive strategies to ensure those assets continue to provide value to the nation and meet expected levels of service while mitigating risk

Primary Directive - Background

Provide a Consistent, Unbiased, Defendable AM Process to Identify and Prioritize O&M Asset Needs ….for NAV and FRM Business Lines Based Upon the Following:

- **Greatest Need**
- **Greatest Risk**
- **Greatest Regional Impact**
- **Sound Investment Decision**
- **Other Priorities**

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Critical Concept - Background

- To most effectively use our O&M funds, NEED should first be based upon sustaining a required

  "Minimum Acceptable Level of Service or Performance "

- Asset Management for O&M requires that we define the "Minimum Acceptable Level of Service or Performance" by business lines or project.

- Sustaining the minimum acceptable level of service is first priority for O&M. What level of risk is tolerable when we address minimum level of acceptable service?

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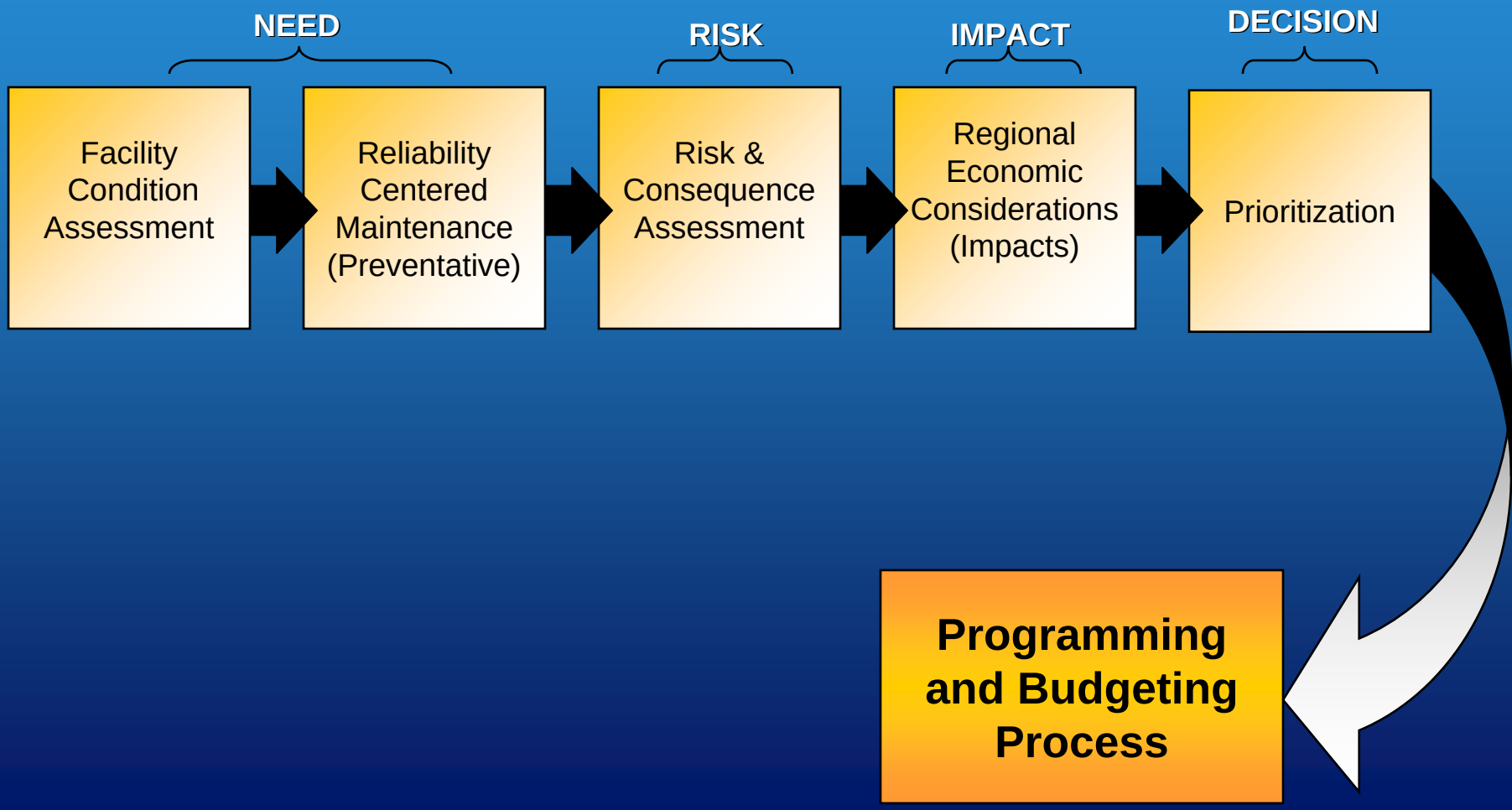
LRD Asset Management for O&M Process Framework - Background



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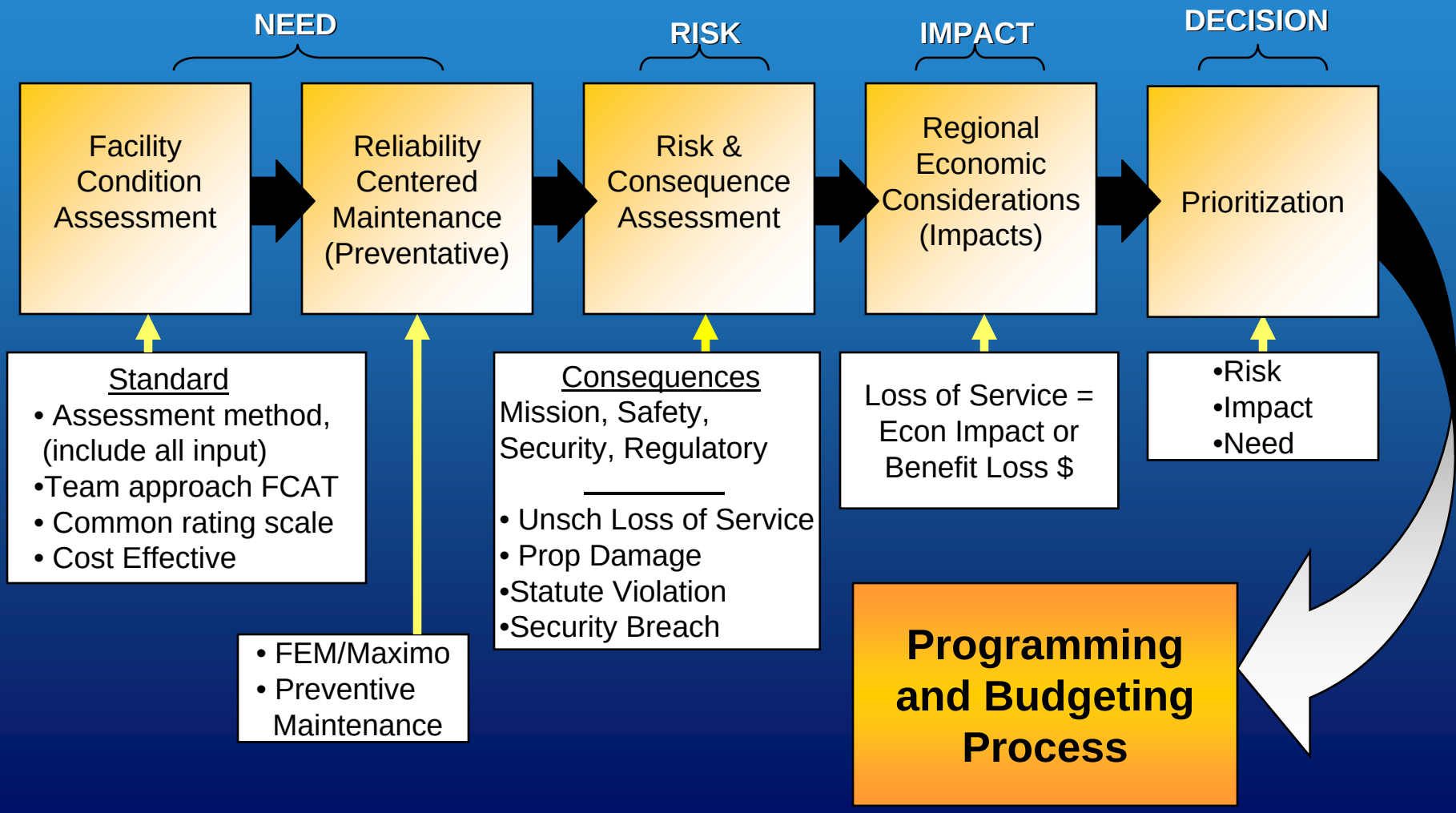
LRD Asset Management for O&M Process Framework



Asset Management for O&M - Assessment Data Sources

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Major Features of First Effort
(Expert Elicitation Based)

- Identified assets and established component hierarchy
- Assessed component condition – (Adequate to Fail w/ 5 Levels)
- Established "Criticality Weight" of component - based upon Consequences of Failure in 4 categories (Mission, Safety, Security and Compliance)
- Calculated "Relative Risk Index" = Probability of Failure x Consequence of Failure
- Identified & Calculated measureable impacts of failure
  - NAV Impact $ = Recovery Days x $/Day x Probability of Failure,
  - FRM Impact $ = Loss of Annual Benefits x Probability of Failure
- Identified Redundancy and Dependency relationships

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First Efforts: Calculating Relative Risk

Probability of Failure x **Consequence of Failure**

- *% Failure values not readily available for components*
- *Assumed equal or proportional to condition (condition index value)*

- *Weighted Categories of Failure Consequence (Mission, Safety, Security, Compliance)*
- *Failure Severity Levels (Low, Medium, High Severity)*

*

Algorithm: Relative Risk Index "RRI" (1 High Risk → 100 Low Risk)

RRI = Condition Index x Normalizer x (Mission Wt. x Mission Severity + Safety Wt. x Safety Severity + Security Wt. x Security Severity + Compliance Wt. x Compl Severity)

Standard Condition Rating Scale

Asset Management – Condition Assessment Standards	
Condition Classification	**Definitions**
A Adequate	- There is a high level of confidence that the feature will perform well under the designed operating conditions. This confidence level is supported by data, studies or observed project characteristics which are judged to meet current engineering or industry standards. - There is a limited probability that the verified degraded conditions will cause an inefficient operation, or degradation or lose of service.
B Probably Adequate	- There is a low level of confidence that the feature will perform well under designed operating conditions, and may not specifically meet engineering or industry standards. The feature may require additional investigation or studies to confirm - There is a low probability that the verified degraded conditions will result in inefficient operation, or degradation or loss of service.
C Probably Inadequate	- There is a low level of confidence that the feature will not perform well under designed operating conditions, and may not specifically meet engineering or industry standards. The feature may require additional investigation or studies to confirm adequacy. The feature does not meet current engineering or industry standards. - There is a moderate probability that the verified degraded conditions will result in inefficient operation, or degradation or loss of service
D Inadequate	- There is a high level of confidence that the feature will not perform well under designed operating conditions. Physical signs of distress and deterioration are present . Analysis indicates that factors of safety are near limit state. The feature deficiencies are serious enough that the feature no longer performs at a satisfactory level of performance or service. - There is a high probability that the verified degraded conditions will result in inefficient operation, or degradation or loss of service.
F Failed	- The feature has FAILED - Historically the feature regularly experiences scheduled or unscheduled closures or loss of service for repairs.

CY 2007 Accomplishments

- Developed a facility condition assessment process
- Completed “baseline assessments” for 147 projects; 60 NAV & 87 FRM
- Developed, applied, and reported an AM based project summary for FY-10 budget prioritization (for condition only)
- Developed automated tools for AM
  - Gather and Store Project Condition Field Data
  - Analyze Data
  - Present Project Analysis - Regional Perspective using GIS Graphics

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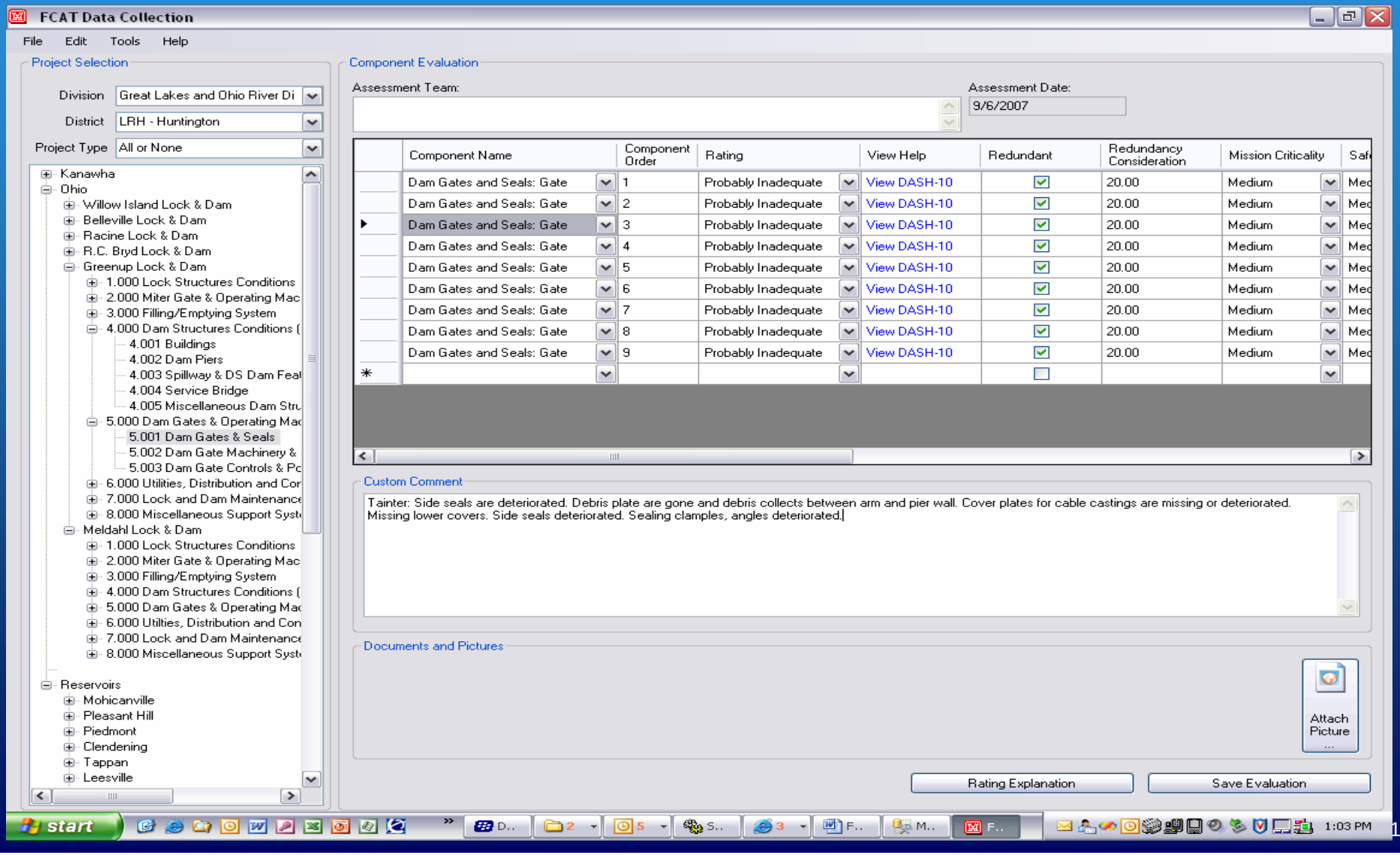
Condition Assessment Tool



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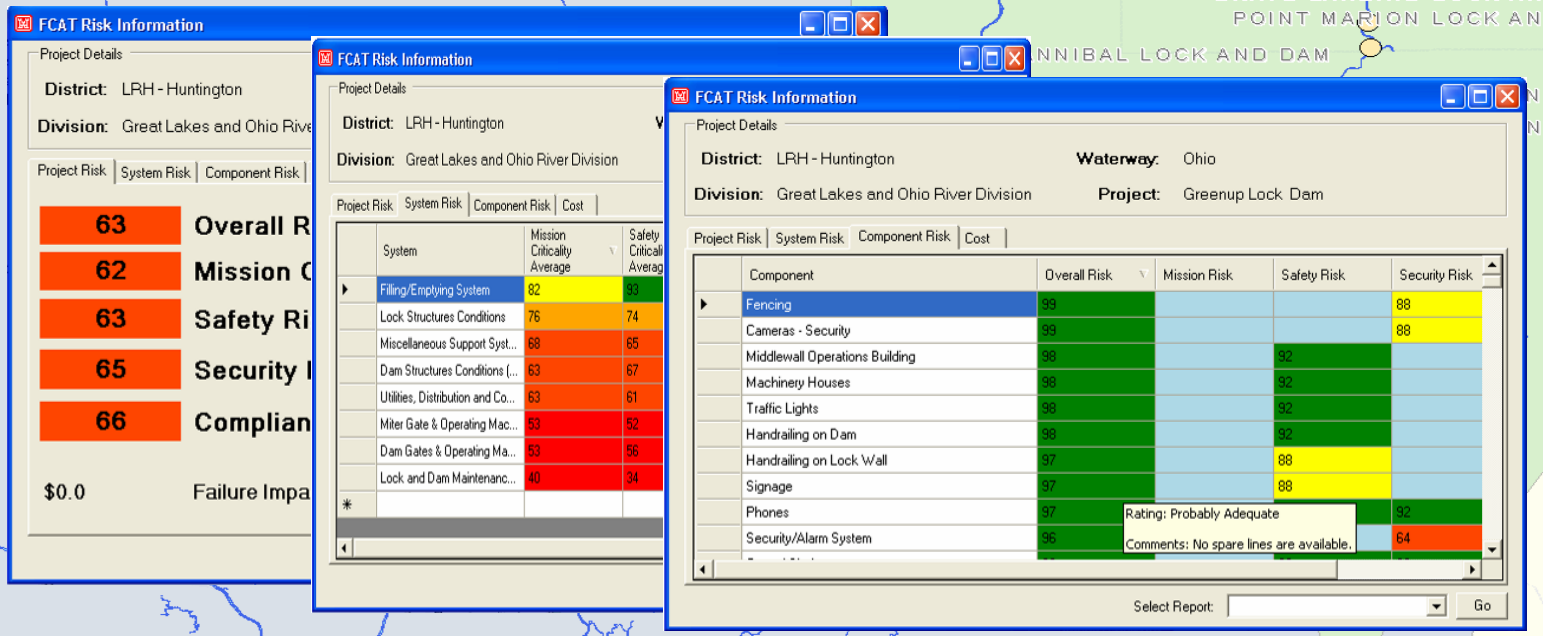
Automated Analysis and Presentation Tool

- GIS Display of Overall System Health
- "Drill Down" Capability by Project - "3-4 clicks"
- Auto Update from Condition Assessment Feature with Report Generator

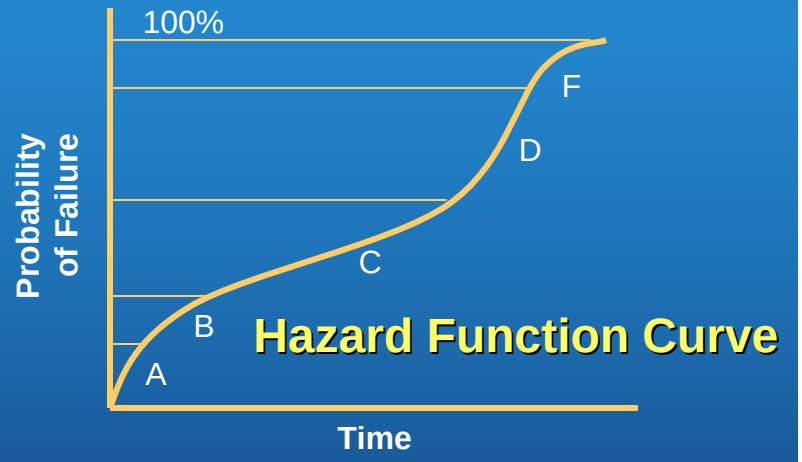


First Efforts – AAR Results

- Pros
  - Estimated ranking - 80% accuracy based on condition only
  - Cost effective, repeatable, unbiased assessments ($10K/Project)
  - Flexible tool designed for compatibility with FEM, CEFMS, etc.
  - Regional prioritization of both project and component by business line for greatest operational risk, impact and need
- Cons
  - 100% expert elicitation based
  - Lacked concurrence with District Ops Chiefs or process to resolve disputed assessments
  - Tools and data not available for District use/review (all laptop)
  - Default databases not customized for individual projects/districts
  - No quantitative probability of failure to adjust impacts
  - Major preventative maintenance not included in analysis

Where We Are Going
Risk & Reliability/Condition Assessment

- Merge "science" of Risk and Reliability with Expert Elicitation for condition assessment
- Establish relationship between "Probability of Failure and Condition Index A-F" for each component



Condition Index	
Condition	Definitions
A-Adequate	**•Limited probability of failure**
B-Probably Adequate	**•Low probability of failure**
C-Probably Inadequate	**• Moderate probability of failure**
D- Inadequate	**• High probability** of failure
F-Failed	• The feature has **FAILED**

- Establish a suite of Hazard Curves for component types
- Use automation to provide references for condition assessment "-10 manual"
- Improve credibility

Risk & Reliability

- Create generic fault tree by system & component type
- Customize fault tree by project
- Generate Hazard Function Curves
- Use Automated Fault Tree and Curves as part of the “-10” reference to address
  - Probability of Component Failure
  - Major Preventative Maintenance
  - Redundant Components
  - Dependant Components

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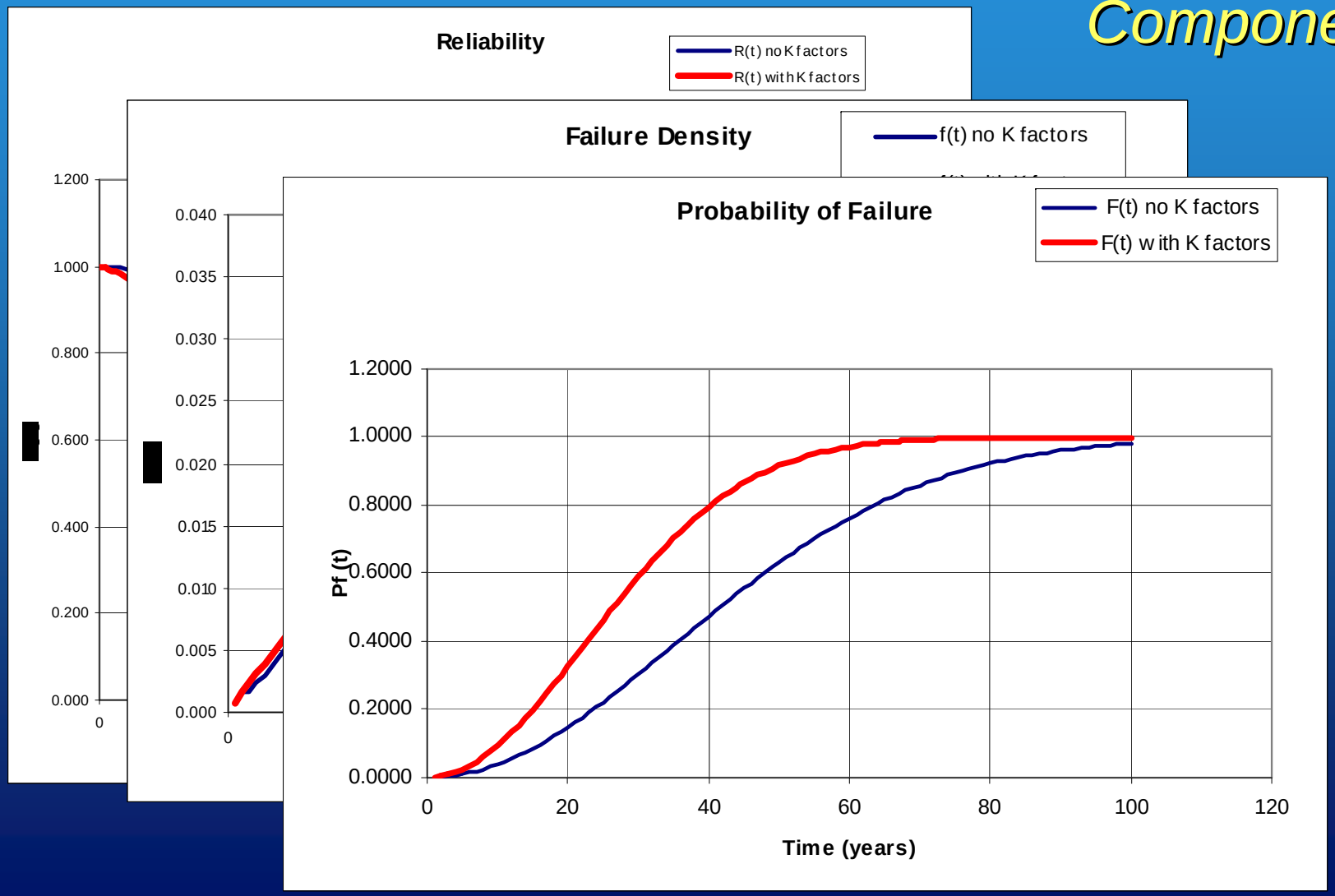
Suite of Risk Reliability Curves for each Component



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Where We Are Going "Criticality Index"

Probability of Failure x **Consequence of Failure**

- *Associate Condition Index (A-F) to Suite of Hazard Curves (% Failure)*
- *Fault tree logic and hazard curves best applies redundancy, dependency and preventative maintenance to % failure*

- *Consequence Modifiers*
- *Severity of Failure Affecting Mission, Safety, Security and Compliance*

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Revised Algorithm (Under Development): Criticality Index "CI"

% Failure x Weighted Severity Factor x Normalizer = "CI"

- Mission
- Safety
- Security
- Compliance

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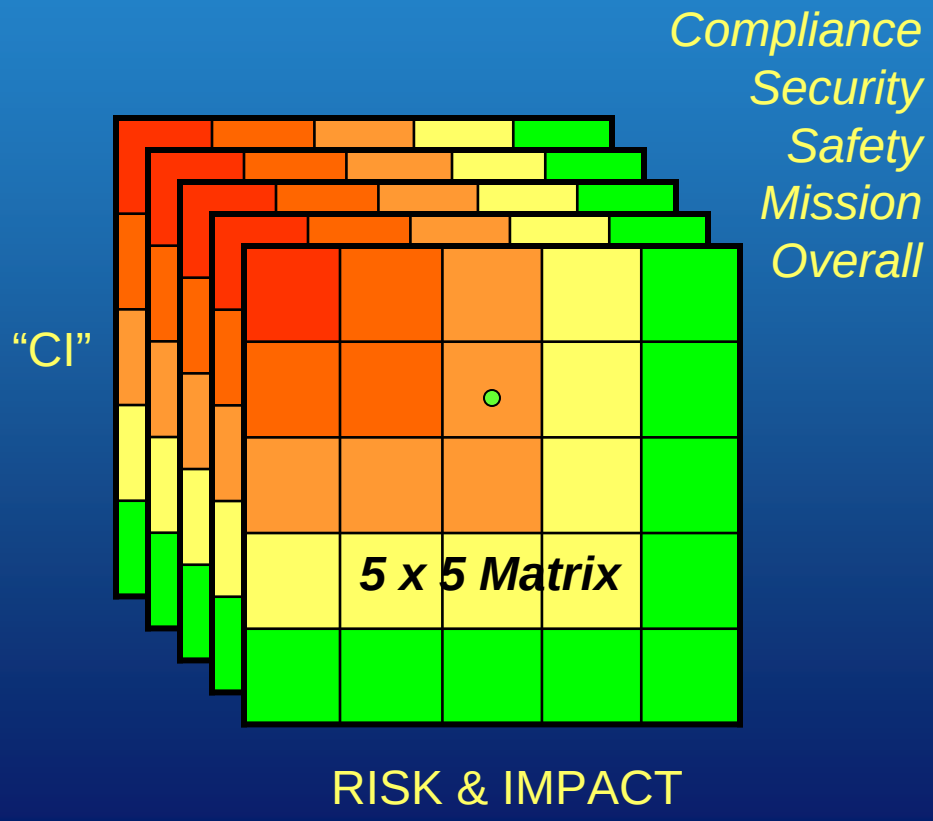
Asset Management Process Output Goals

- Decision making "TOOL"
- Relate component condition to a probability of failure value
- Establish both a component & project Criticality Index "CI" or risk index
- Compute Risk & Impact
  - Customer Cost = % Failure x $ Loss of Service/Benefits
  - Agency Cost = % Failure x $ Ren/Repr/Repl
  - Population at Risk
- Support Budget EC



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Asset Management Program for O&M CY 2008 Goals and Objectives

- Assess 33% of NAV & FRM projects using modified FCA process – *Underway, 33 scheduled for completion by Nov 08*
- LCMIS approval for continue automated system development for AM, *approval received thru COE Corporate Information & ACE-IT, May 08*
- Associate existing "Hazard Function Curves" with condition index to obtain probability of failure for analysis - Sept 08
- Evaluate COTS software (Fault Tree Plus) for use w/ AM tool to better address PM, dependency, redundancy and devlope curves.

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Asset Management Program for O&M CY 2008 Goals and Objectives

- Continue to automated process thought *ERDC*
  - Migrate system to central server
  - Create intranet access
  - Automate and associate Hazard Function Curve to Condition for each component “-10”
  - Modify program logic and reporting features
  - Create interface between eFEM & Asset Mgmt system to associate equipment hierarchy and retrieve PM data
  - Associate Data to “Corps Globe” GIS Presentation

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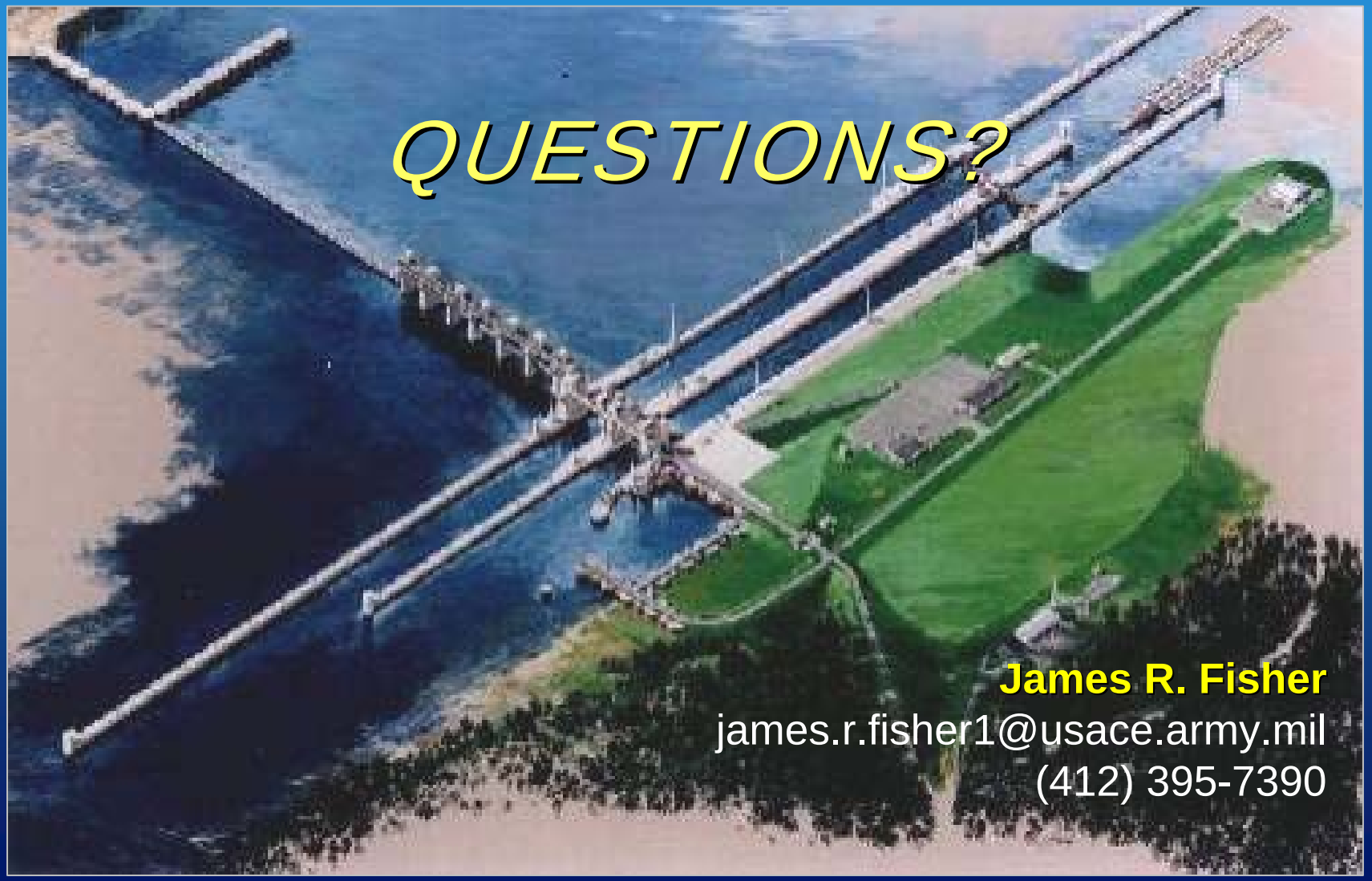
Asset Management Program for O&M CY 2008 Goals and Objectives

- Deploy FEM/Maximo in LRD – *New schedule Jan 09*
  - Early efforts to load data began Jan 08
  - Target to build all projects by Oct 08
- Hire two asset mgmt positions: Regional FCAT and FEM Coordinator – *Underway*
- Initiate asset management application to other business lines in LRD
- Incorporate into FY11 O&M Budget Process



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