Headquarters U.S. Air Force

Integrity - Service - Excellence

Sustainable Installation Assessments

"Condition & Performance Monitoring"

Mr Steve L. Shoaf, PE
AFCESA \CEOA

U.S. AIR FORCE

Asset Management

Agenda

AFCESA - The Air Force asset management experts for driving operational business practices and systems to meet a required level of service, in the most cost effective manner.

- The Mandate
- Q-Rating Formula – Requirements/PRV
- The Facility Sustainment Model, FSM
- Asset Management Lifecycle
- Assessments – Condition & Performance Monitoring
- The Way Ahead
- Questions & Discussion

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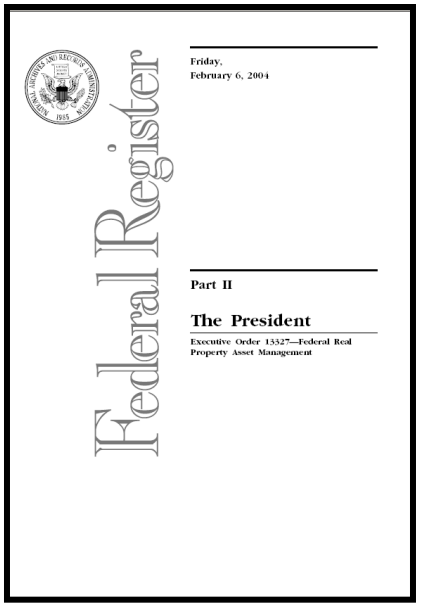
Executive Order 13327: Federal Real Property (RP) Asset Mgt

- **Published Feb 04, EO 13327 mandates:**
  - **Development of Asset Mgt Plans to promote efficient & economical use of federal RP assets**
  - **Establishment of appropriate performance measures to include evaluating costs and benefits involved with acquiring, repairing, maintaining, operating, managing, & disposing of RP**
  - **Determination of life-cycle cost estimates associated with prioritized actions to be taken to improve the operational and financial mgt of RP inventory**



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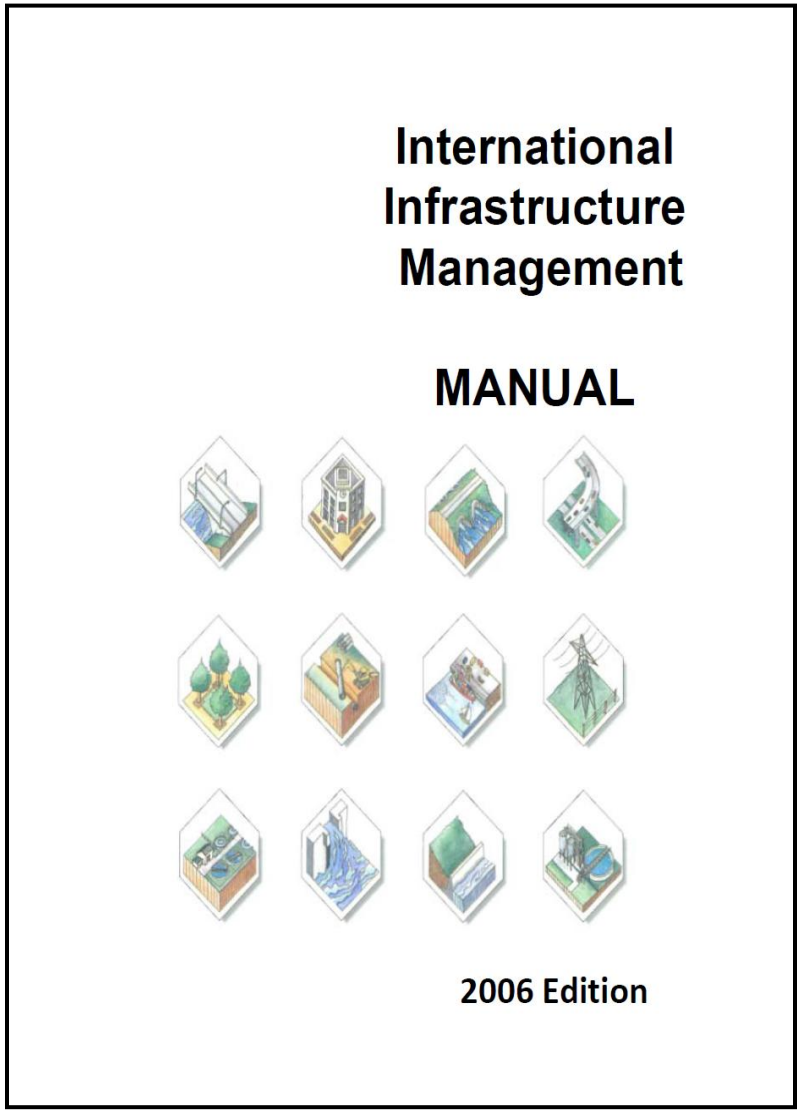
International Infrastructure Management



- Conducted "Core of Discovery" with Commercial Portfolio Managers
- Reorganized establishing the Air Force "Asset Optimization Flight"
- Adopted the "International Infrastructure Management" Process

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Asset Management Lifecycle

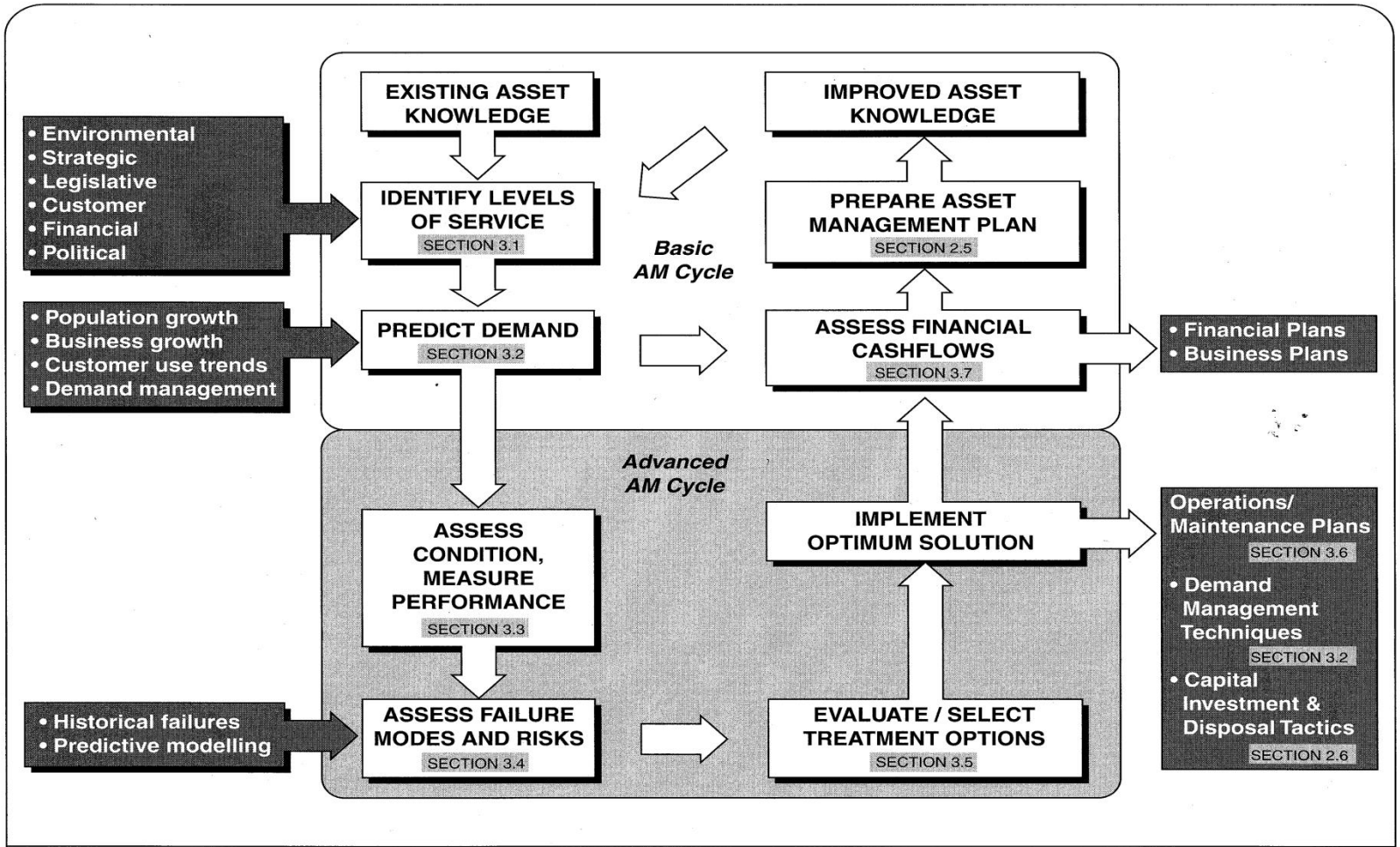

Figure 3.1: Asset Management Process and Developing Asset Management Strategies

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Standardized AMP Structure

Consolidated All Assets into 5 AMPs

CORE ACTIVITIES	COMPONENTS
Provide Facilities	Facilities
	Housing (GOQs, Dorms & MFH)
	Custodial Services
	Provide flight & space ops (except pavements)
Provide Utilities	Water / wastewater / storm water / electric / gas / other
Provide Pavements	Roads and Airfields
Provide Natural Infrastructure	Land
	Grounds Maintenance
	Environment
Provide Waste Management	Integrated Solid Waste
	Hazardous Waste

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What's In an AMP: Tab Structure

A Overview of Activity
B Activity Goal, Levels of Service, and Performance Measures

Financial

C Asset Values (PRV & Depreciated PRV)
D Sustainment (O&M)
E Restoration
F Modernization
G Demolition & Consolidation
H Facilities Operation
I Env. Conservation
J Pollution Prevention
K Env. Compliance
L Env. Restoration
M Military Munitions Response Program
N Family Housing (O&M)
O Unaccompanied Housing (O&M)
P Family Housing Construction
Q Base Operating Support
R GeoBase Services
S Management & Overhead
T Depreciation & Deferred Maintenance
U Funding Sources
V Financial Summary

Non-Financial

W Environmental Management
X Activity Specific Issues
Y Demand Management
Z Assumptions, Uncertainties & Risk
AA Stakeholders, Legislation and Planning Documents
BB Org Structure, Management Processes, Human Resources
CC Infrastructure Details
DD Service Delivery Options
EE Action Plan

Not all Tabs applicable to every activity

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Q-Rating Formula

Q-Rating Formula: $Q = \left(1 - \frac{Requirements}{PRV}\right) \times 100$

Q-Rating Bands: Bands allow OSD, Military Services and Defense Agencies/Activities to group facilities by condition for the purposes of developing investment strategies.

Band	Calculated Rating	Term that generally describes the mid-point of the Bands
"Q-1"	100% to 90%	Good condition
"Q-2"	89% to 80%	Fair condition
"Q-3"	79% to 60%	Poor condition
"Q-4"	59% to 0%	Failing condition

Note: apply standard rounding rules if a calculation falls between bands; example 89.6% rounds to Q-1.

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Requirements (for Q-Rating Calculations)

- **Requirements – Per FRPC, "the amount of repair needs necessary to ensure that a constructed asset is restored to a condition substantially equivalent to the originally intended and designed capacity, efficiency or capability." (FRPC, para 11, page 10)**
- **For DoD Q-Rating calculations that equates to work required to correct existing facility deficiencies through sustainment, restoration and modernization, or replacement to achieve a fully serviceable condition; fully able to support the current mission or function of the facility.**

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Plant Replacement Value – PRV (for Q-Rating Calculations)

- **The Q-Rating formula denominator, PRV, is a well defined formula is repeatable across the AF**
- **Plant Replacement Value (PRV) – Cost of replacing the existing constructed asset at today's standards; adjusted by area cost. Includes overhead costs such as planning and design, supervision and inspection, and other construction overhead costs (reference UFC 3-701-06, para 3-2.2.)**
- **The formula for PRV - *Plant Replacement Value* = facility quantity x replacement cost factor x location factor x planning & design (P&D) factor x historical factor x contingency factor x SIOH x inflation (FMR Vol. 2B, Chapter 8, para 080105)**

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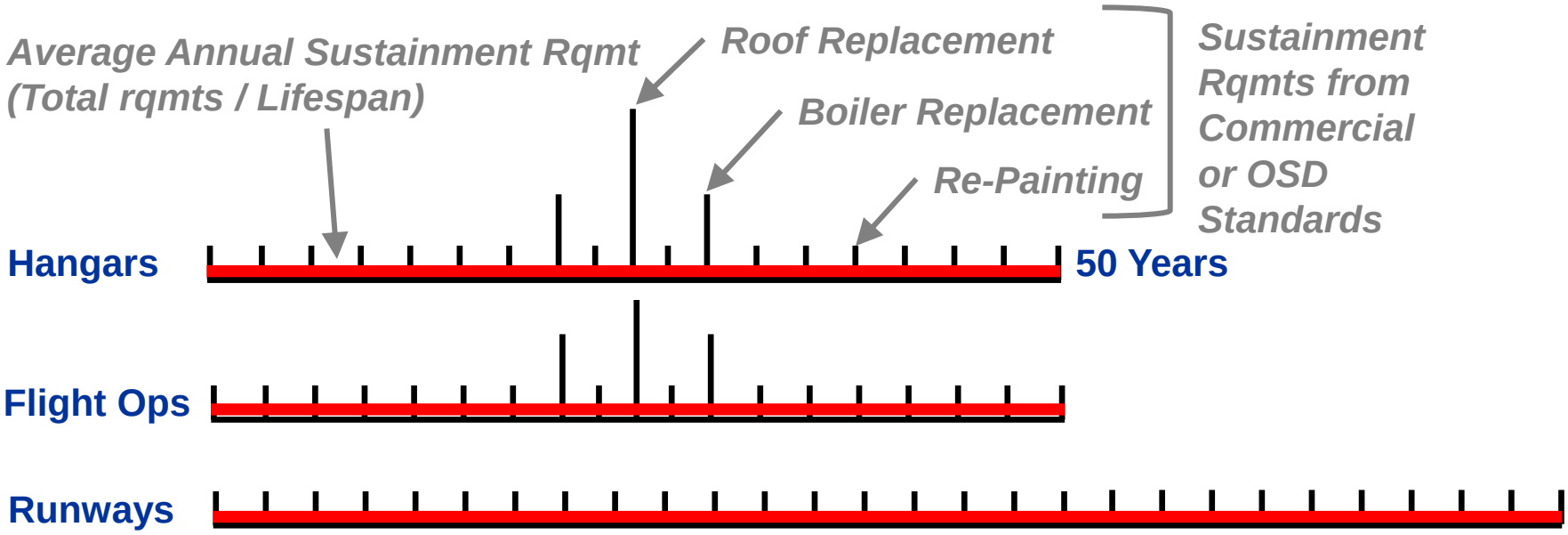
Requirements Generation

Facility Sustainment Model Approach



- **FSM determines avg annual Sustainment rqmt at a Catcode level**
  - **Reasonable representation of <u>total</u> annual Sustainment rqmts**
  - **Does not consider facility condition / existing deficiencies**
  - **Accurate at macro level but not at installation or facility level**
  - **Not linked to actual requirements**

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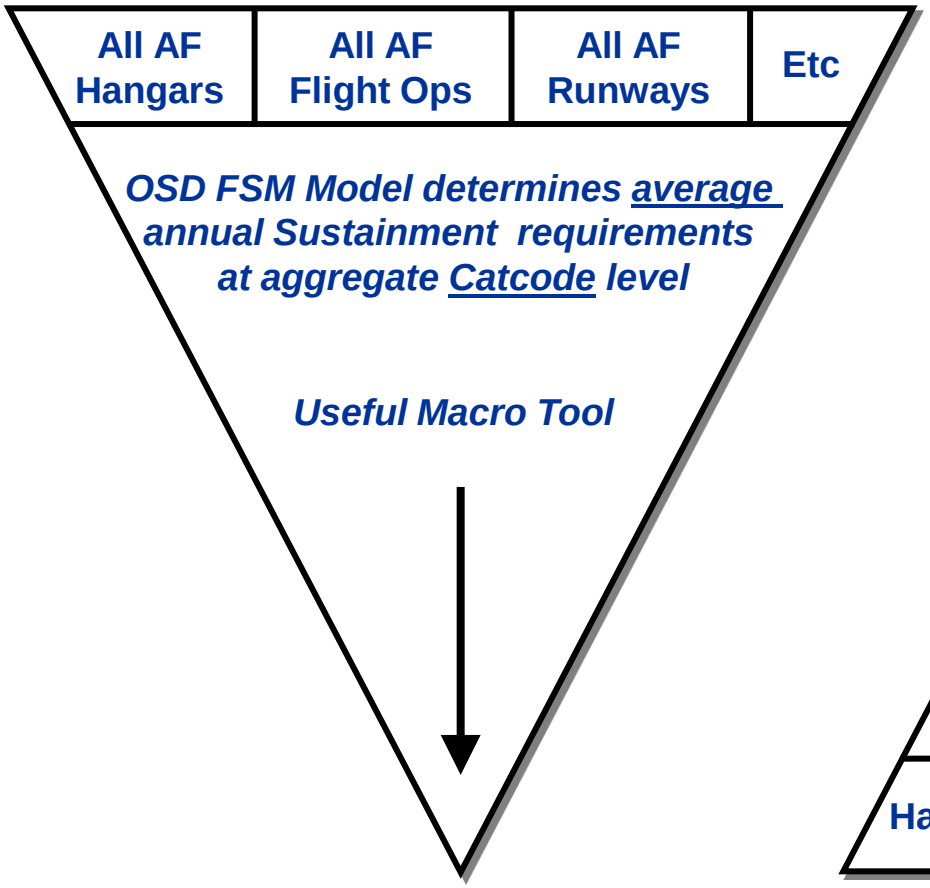
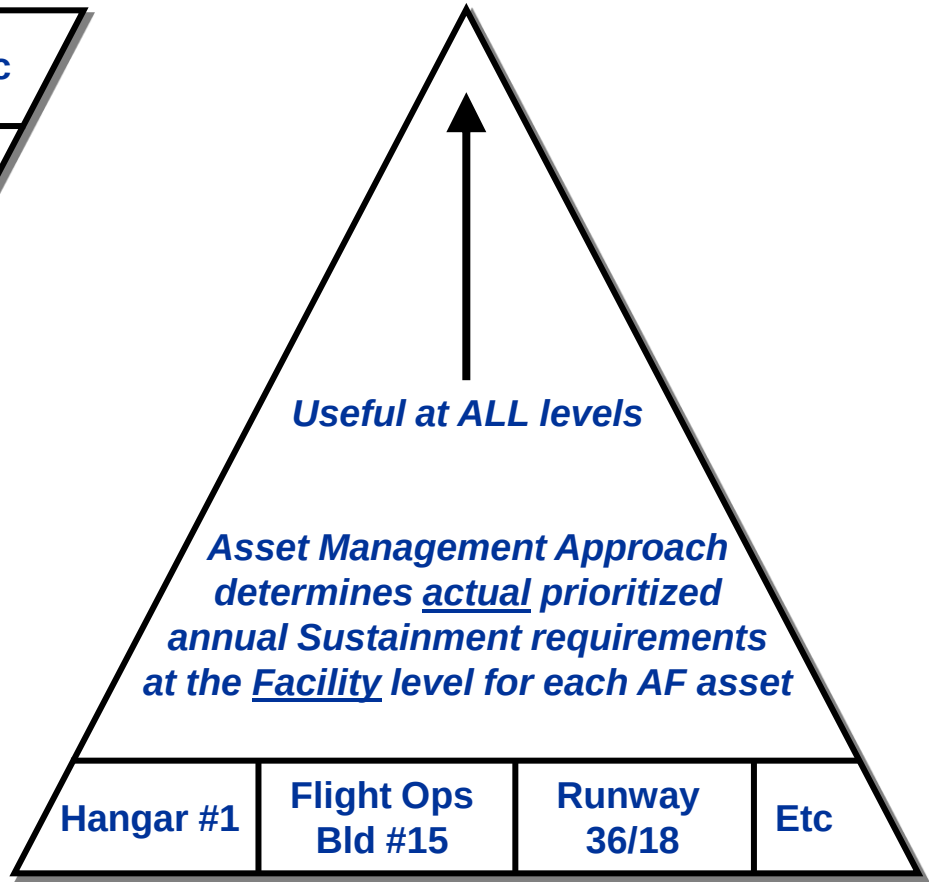
Investment Priority Program

Linking Models to Requirements



"Top Down"
Model-Driven Approach



"Bottom Up"
Asset Management Approach

Asset Management Approach will complement existing OSD Models

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Asset Optimization:
Mission Dependency Index

- No clear Industry or OSD standard method to calculate MDI

- Evaluated Industry, Navy, and National Park Service (NPS) methods
  - Navy method proven, but complex and expensive to support
    - Evaluates every asset on every base every three years
    - Successful beta test w/Navy method at Langley & Fairchild
  - NPS uses CATCODE-level scores, but has incompatible missions

- Implementing hybrid Interim MDI method to support AMPs
  - Performed statistical analysis of Navy MDI data
  - Created CATCODE-level interim MDI scores for Air Force
    - Uses Air Force Mission perspective--not MAJCOM specific
  - Implemented in ACES-PM / RP in Feb 09 by ELSG

MDI = Relative Asset Mission Importance

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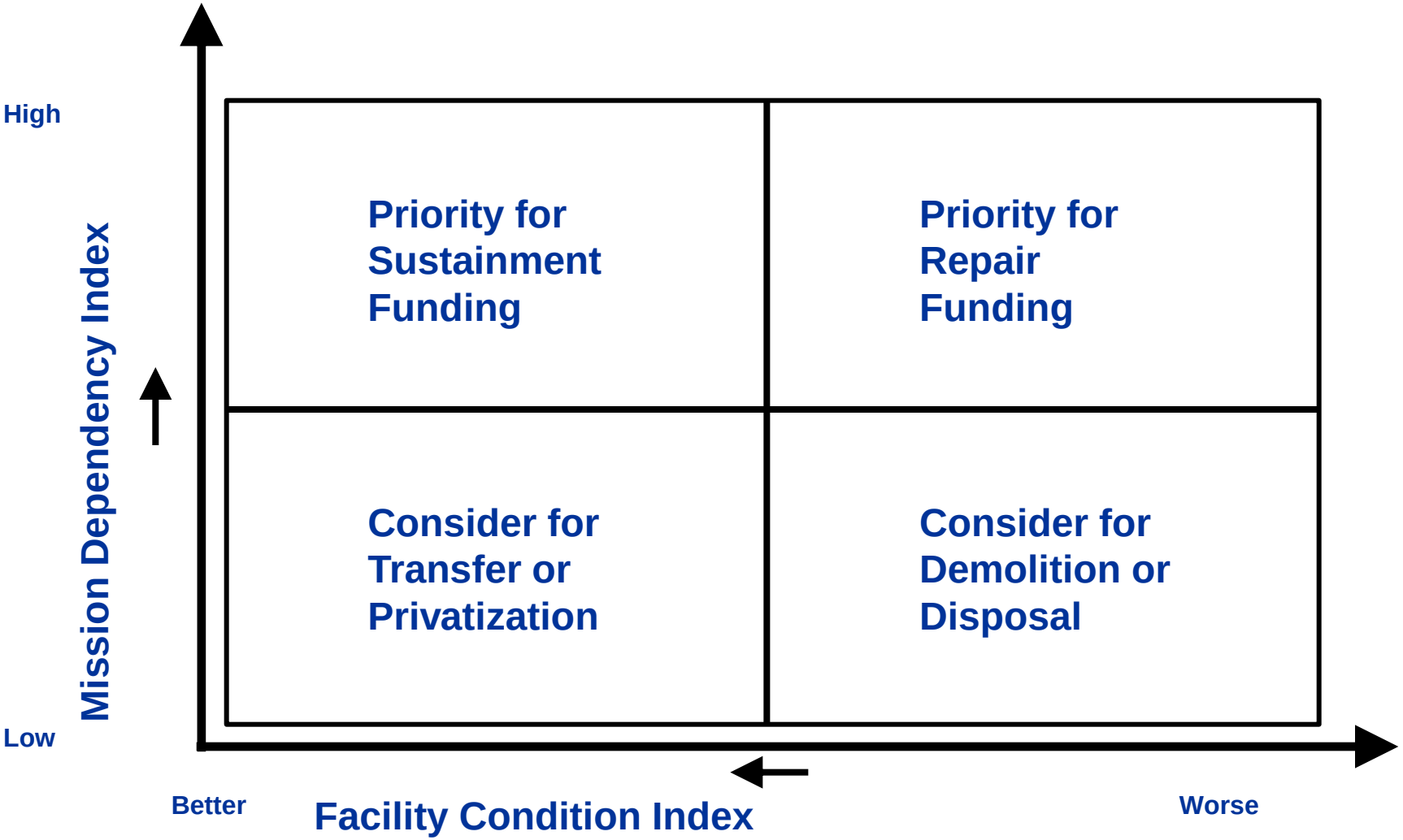
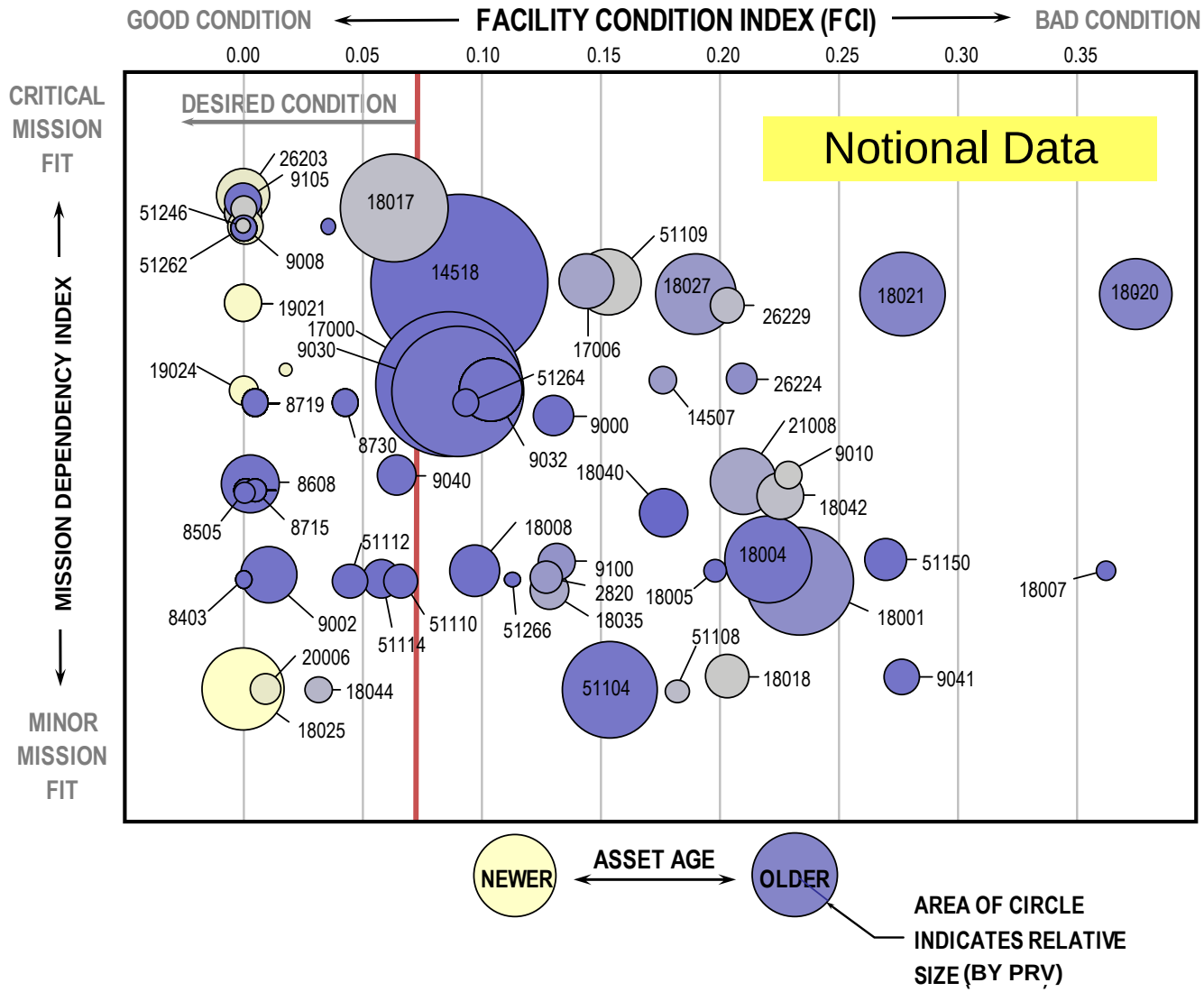
Asset Optimization:
Investment Planning Concept



FCI & MDI Work Together to Provide an Initial Prioritization

MDI, integrated with other asset data, provides support asset portfolio management decisions



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Condition Assessment

Process Development

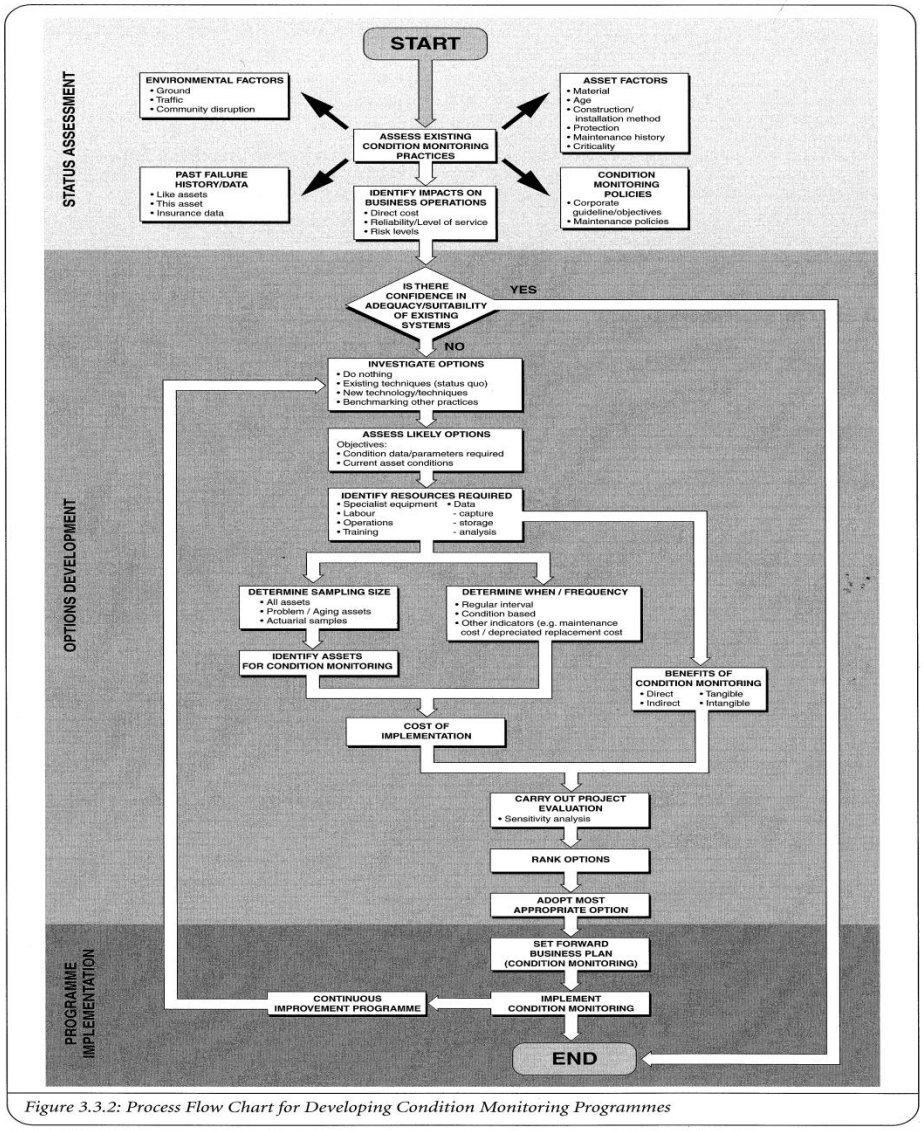

Figure 3.3.2: Process Flow Chart for Developing Condition Monitoring Programmes

- **All assets don't necessitate detailed condition assessments**
- **Perform no action and choose to repair following failure (Run-to-Failure).**
- **Determine that no maintenance action will reduce the probability of failure and install redundancy.**
- **Perform Interval (Time/Cycle) Based Modeling(RWP/PM).**
- **Perform Knowledge Based Condition Modeling (CM).**

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Assessments:

Condition & Performance Monitoring

- **Operation's Assessment – CE Ops Mechanic reports findings while executing "Recurring Work Program" and/or "Direct Scheduled Work".**
- **Engineering Condition Assessment – Use of engineering checklist, scores asset banding them into; Adequate, Degraded, & Unsatisfactory. Degraded triggers project development, bringing asset back to Adequate.**
- **Time Based Modeling – Building component repair and replacement models based on historical lifecycle data. Examples are Whitestone Research's modeling used in DoD's FSM and FOM.**
- **Condition Based Modeling – This is knowledge based modeling based on asset condition. Predicts system/component failure, project requirements and return on investment.**

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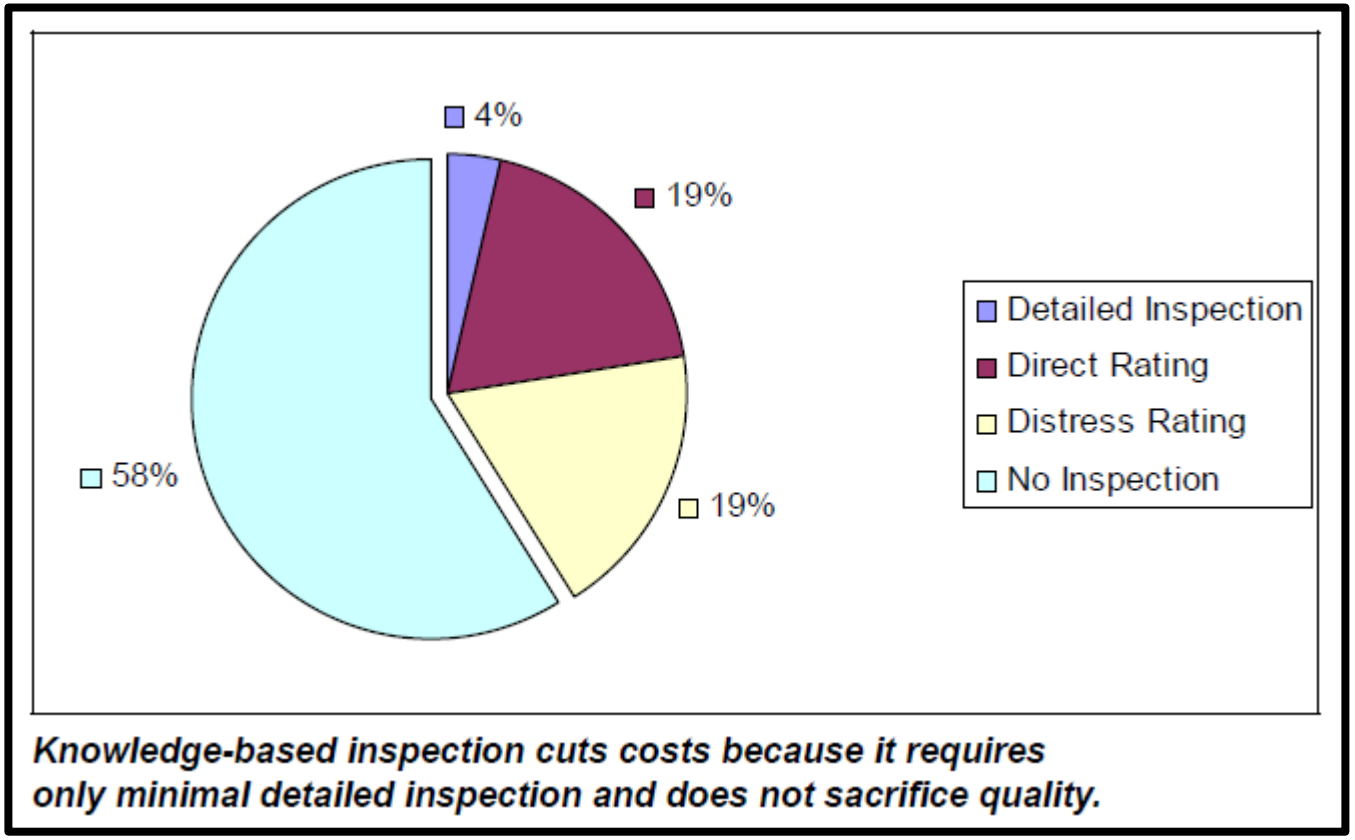
Assessment Time Savings



Knowledge-based inspection cuts costs because it requires only minimal detailed inspection and does not sacrifice quality.

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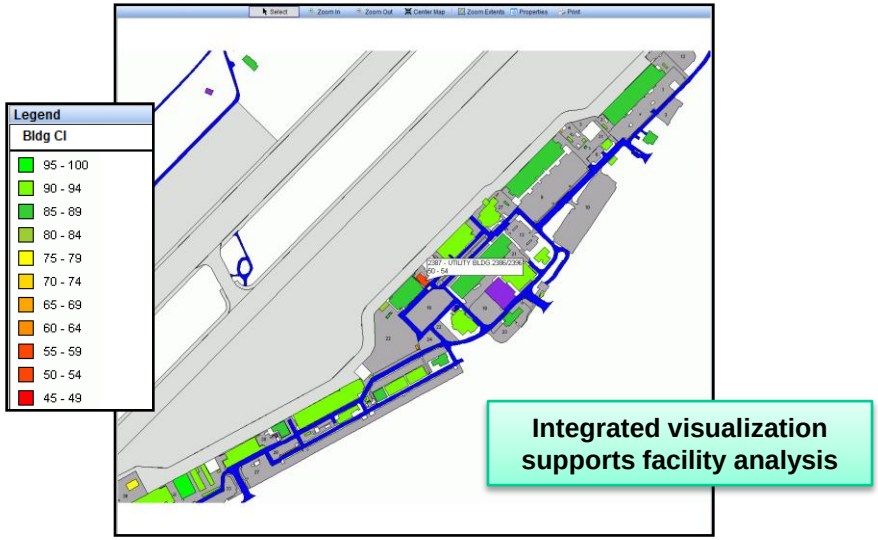
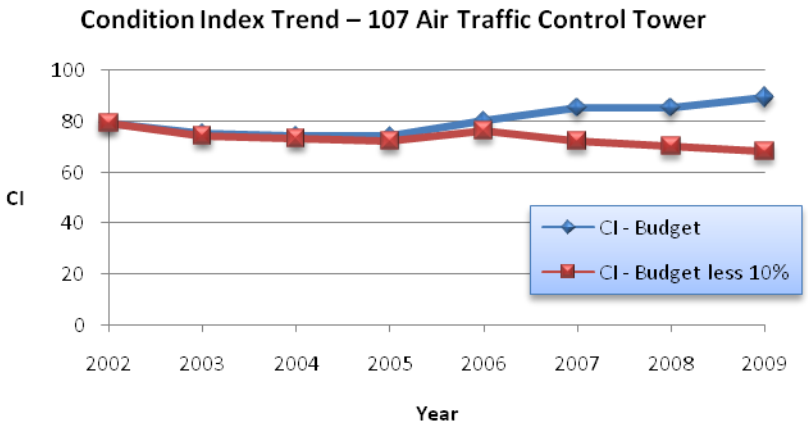
Sustainment Management Systems

Provide objective facility investment guidance to:

- Identify maintenance requirements for increased reliability
- Analyze investment timing to optimize return on investment
- Prioritize scarce resources according to economic and mission priorities
- Predict effects & consequences of decisions to ensure mission readiness





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Sustainment Management Systems

Provides practical toolset to manage various facility types using sound engineering principles:

- **Inventory** existing assets
- **Inspect** assets to objectively determine condition and functionality **based upon need**
- **Predict** assets' future condition and remaining service life
- **Automate work planning and prioritization** to determine most cost-effective repair strategies
- **Visualize** and **Integrate** with work execution tools

Engineering Processes Branch

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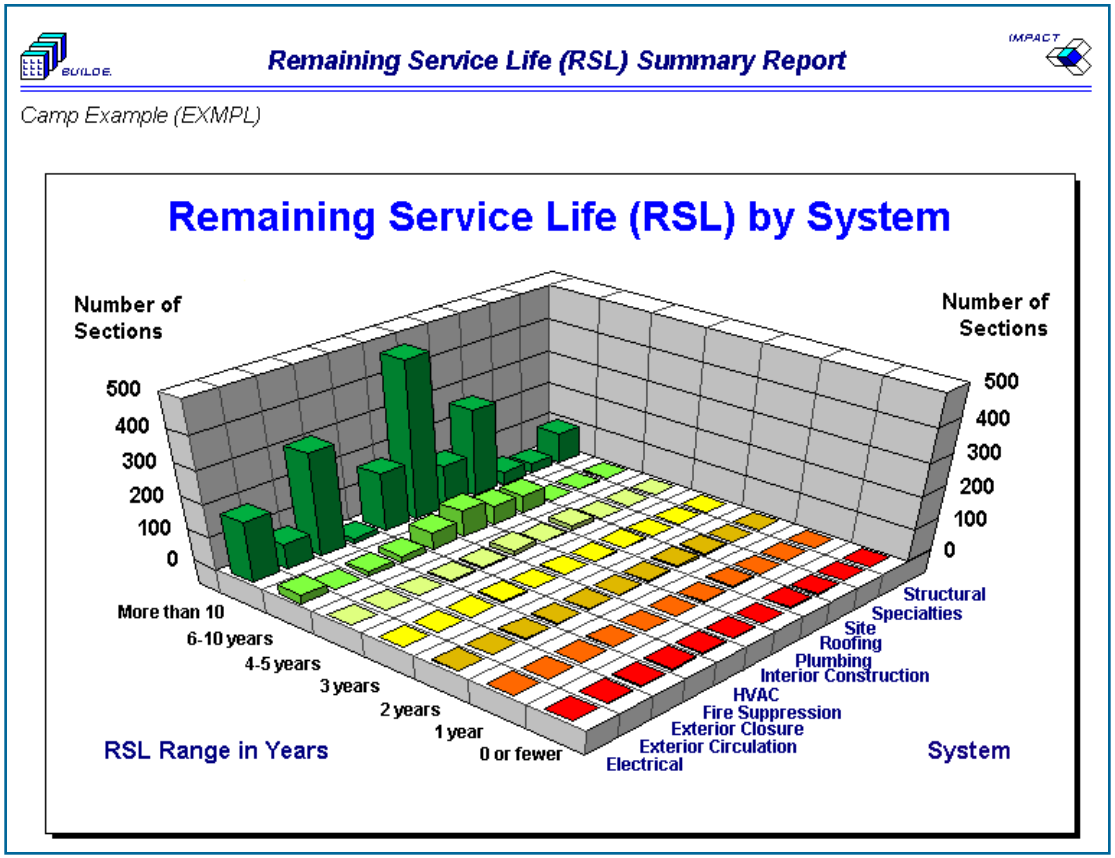
Dashboard

- Develop User Friendly Dashboard Interface
- Align Dashboard with AMP "Key Performance Indicators" and "Levels of Service"
- Easy drill down to underlying data
- Centralized contracting support



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Inspection Results

Examples of the many inspection related reports.

BUILDS — *Remaining Service Life (RSL) Detail Report* — IMPACT

Camp Example (EXMPL)

6709 Classroom Building — **Complex: Airfield**

System	Component	Section Description	Age (yrs)	RSL (yrs) Remaining Service Life	RPL (yrs) Remaining Paint Life
Interior Construction	Interior Floor Finish/Covering	Wood	24	6	5
Interior Construction	Interior Wall	Masonry	24	95	10
Interior Construction	Interior Wall Finish/Covering	Wood Paneling	7	9	9
Interior Construction	Interior Door	Wood Personnel	24	27	4
Interior Construction	Interior Floor Finish/Covering	Resilient Tile	24	30	
Interior Construction	Cabinet	Wood Base	24	31	7
Interior Construction	Interior Wall Finish/Covering	Vinyl/Plastic Wallpaper	7	5	
Interior Construction	Interior Wall Finish/Covering	Ceramic	24	70	
Interior Construction	Countertop	Laminated Plastic	24	15	
Interior Construction	Interior Wall	Drywall	24	95	0
Interior Construction	Interior Ceiling	Drywall	9	116	0
Interior Construction	Interior Ceiling	Acoustical Suspended	9	9	10
Interior Construction	Interior Floor Finish/Covering	Carpet	12	8	
Interior Construction	Interior Door	Glass Personnel	24	27	5
Plumbing	Plumbing Fixtures	Enamel (China) Toilet (Water Closet)	24	24	25
Plumbing	Plumbing Fixtures	Metal Drinking Fountain	12	10	20
Plumbing	Plumbing Fixtures	Enamel (China) Shower Unit	24	25	25
Plumbing	Plumbing Fixtures	Enamel (China) Urinal	24	25	25
Plumbing	Plumbing Fixtures	Fiberglass Service Sink	13	7	10
Plumbing	Plumbing Fixtures	Enamel (China) Sink (Lavatory)	24	25	25
Roofing	Roof Surface	Roof A Asphalt Built-Up w/Reflective Coating	6	20	9
Roofing	Roof Surface	Roof B Asphalt Built-Up w/Reflective Coating	6	22	9
Roofing	Roof Insulation	Roof B Rigid	6	14	6
Roofing	Roof Deck	Roof B Metal	24	6	15
Roofing	Flashing	Roof B Metal	6	19	15
Roofing	Flashing	Roof A Metal	6	19	15
Roofing	Roof Drainage	Roof A Metal Interior	24	20	20
Roofing	Roof Deck	Roof A Metal	24	6	15
Roofing	Roof Drainage	Roof B Metal Interior	24	20	20

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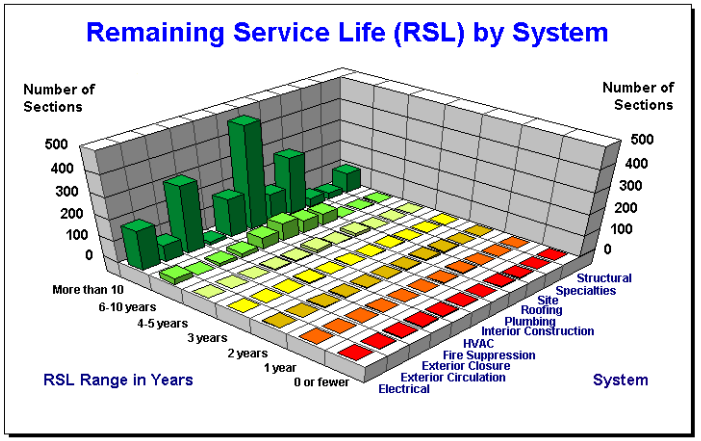
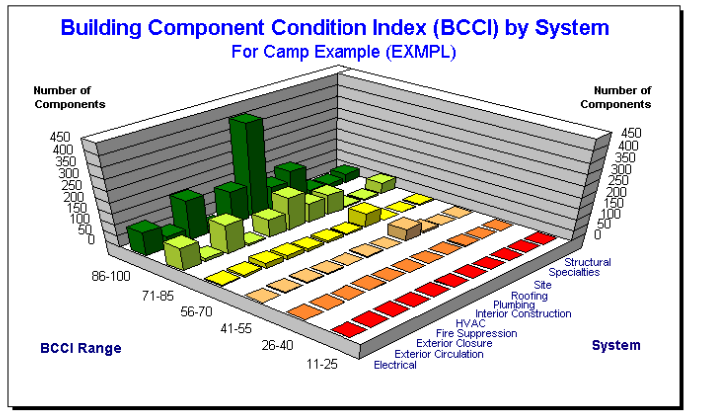
BUILDS — *Remaining Service Life (RSL) Summary Report* — IMPACT

Camp Example (EXMPL)



BUILDS — *Building Component Condition Index (BCCI) Summary Report* — IMPACT

Camp Example (EXMPL)



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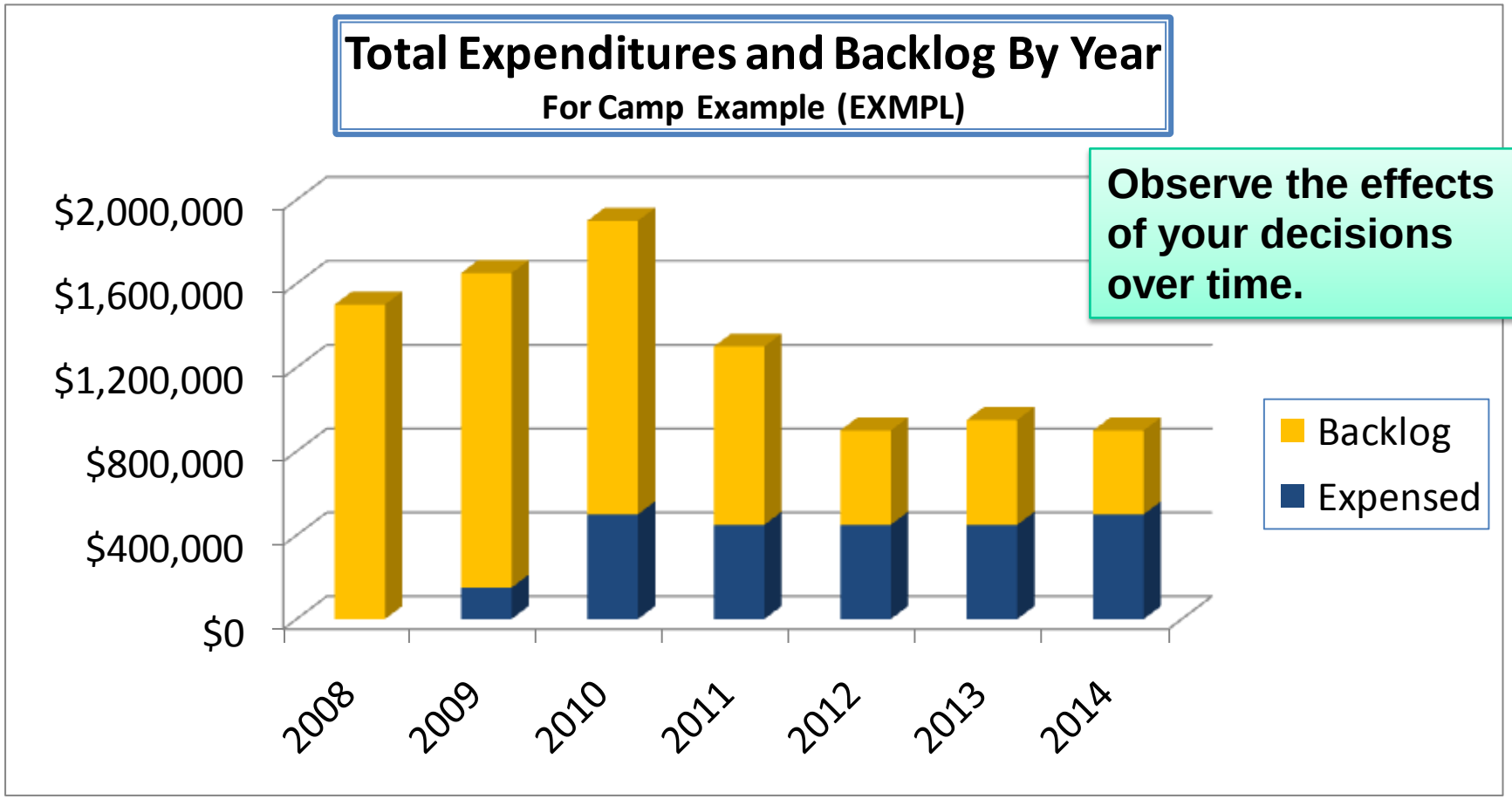
Consequence Analysis: Predict Funding Requirements



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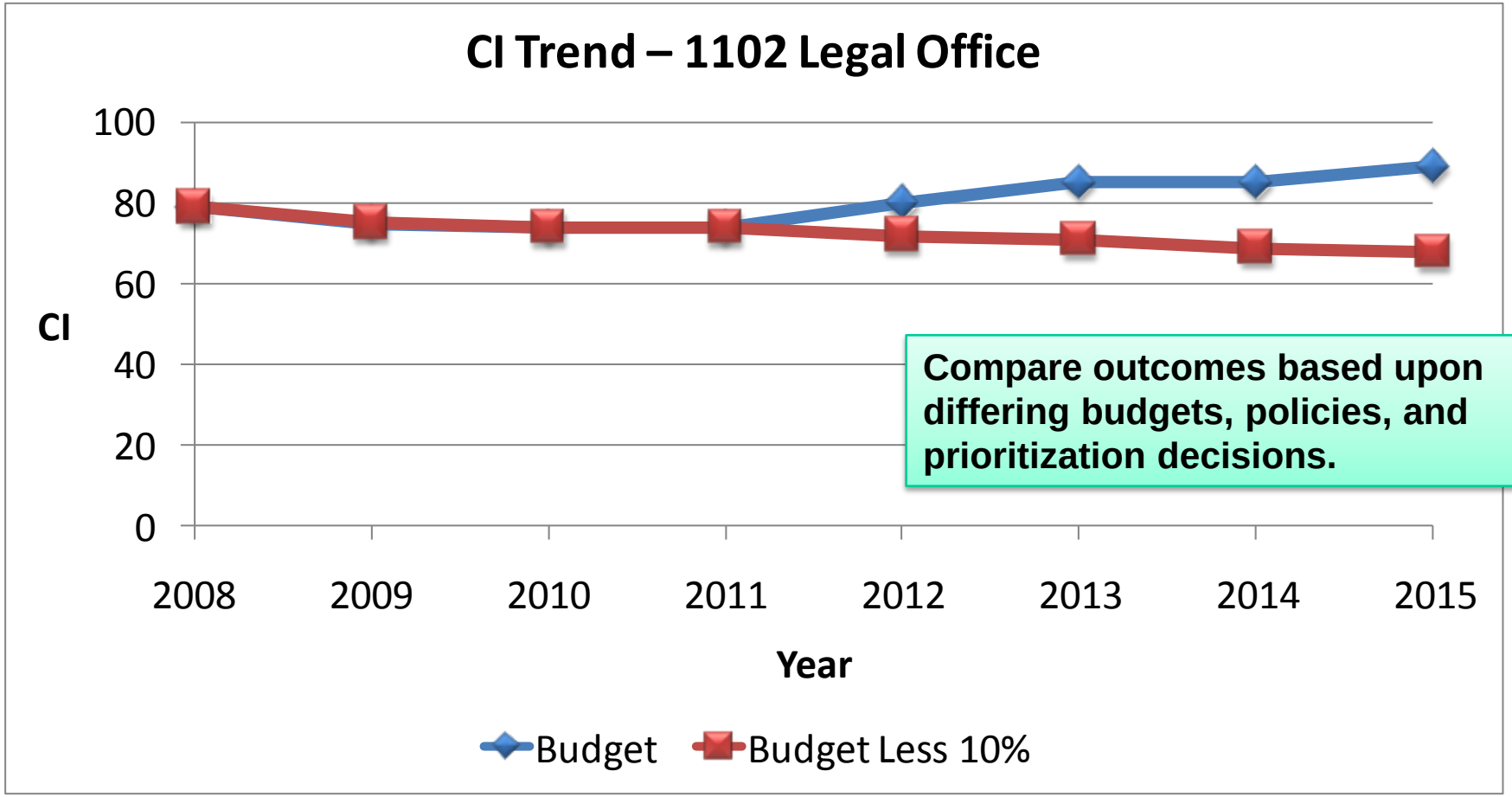
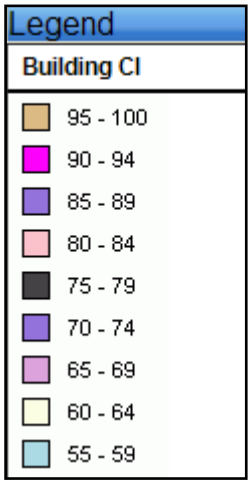
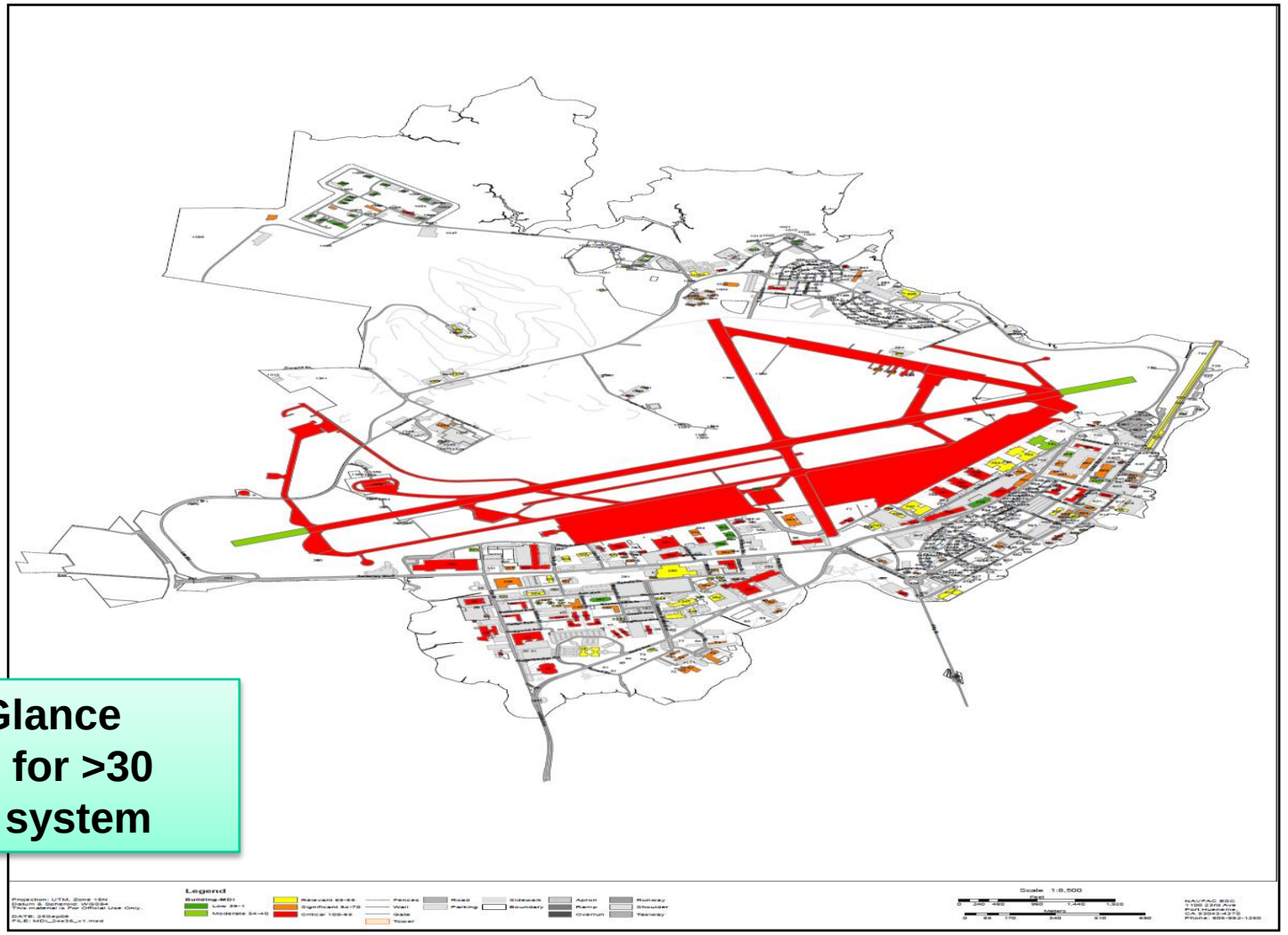
Consequence Analysis: Predict Future Condition Levels



GIS Analysis





Access At-A-Glance status reports for >30 metrics in the system

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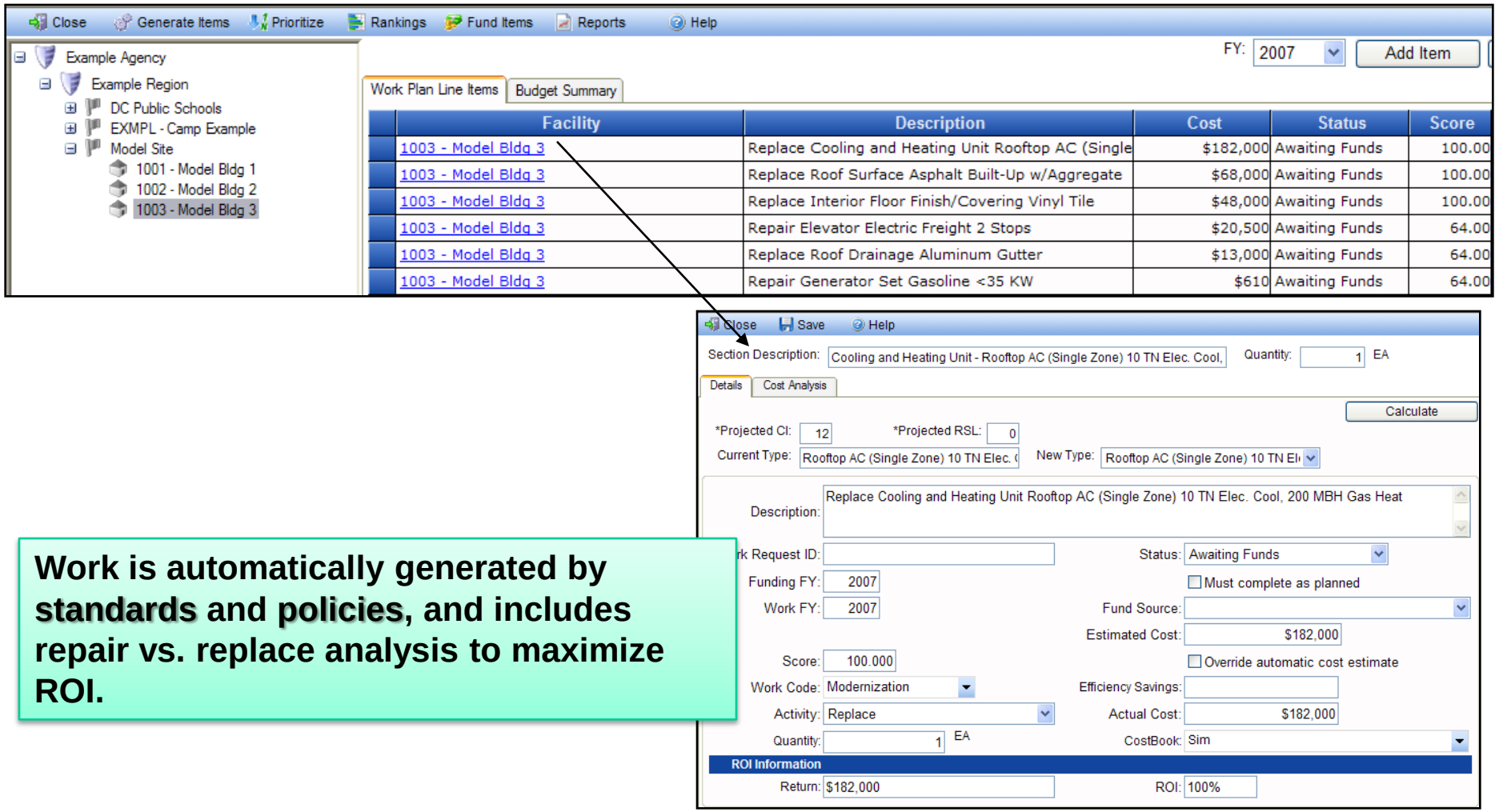
Work Plan Generation



Work is automatically generated by standards and policies, and includes repair vs. replace analysis to maximize ROI.

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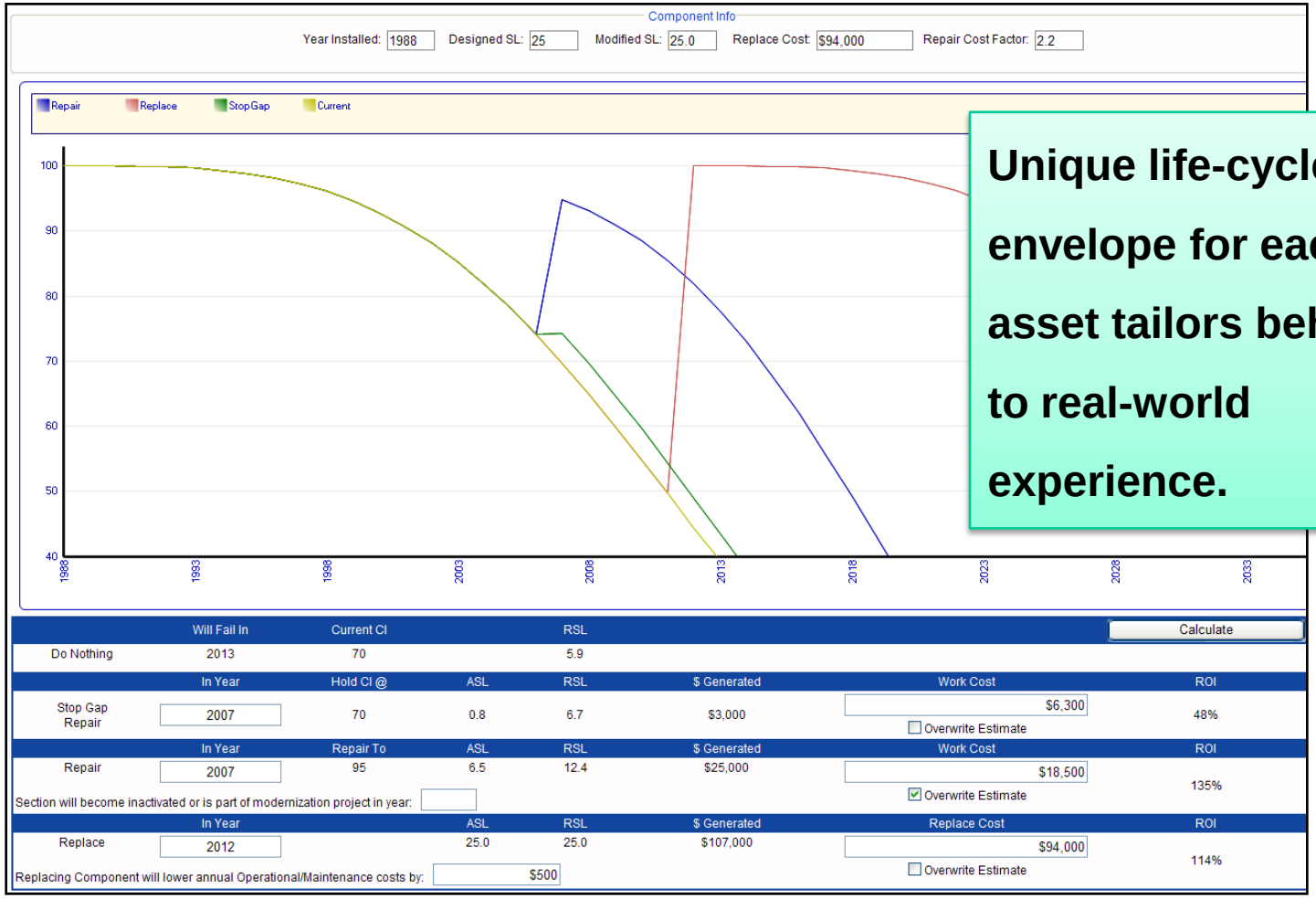
Lifecycle Cost Analysis



Unique life-cycle envelope for each asset tailors behavior to real-world experience.

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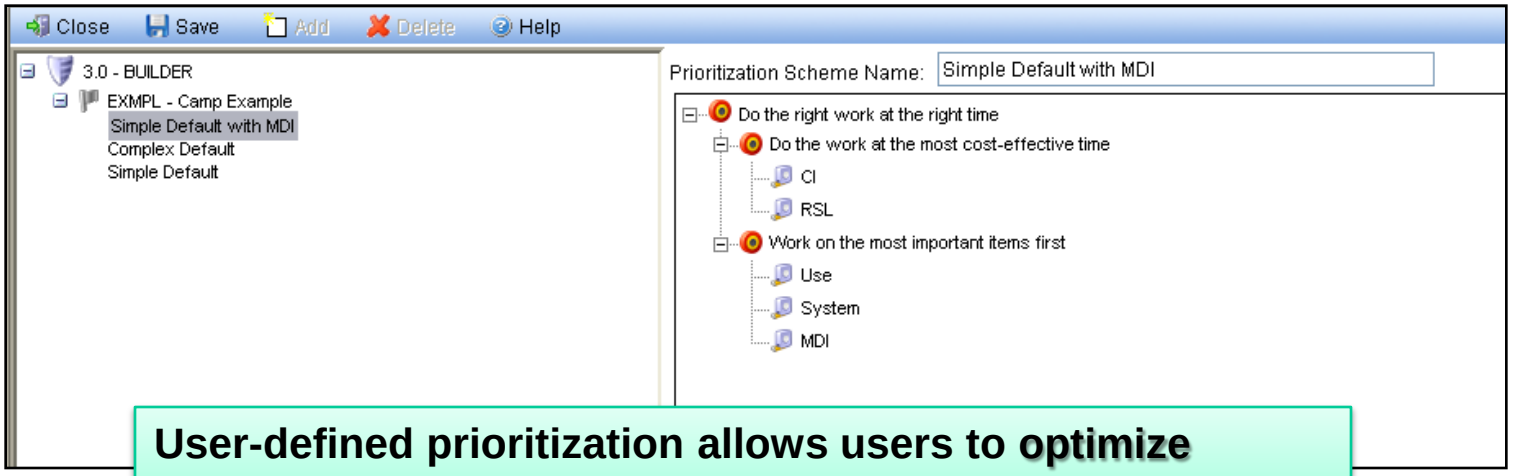
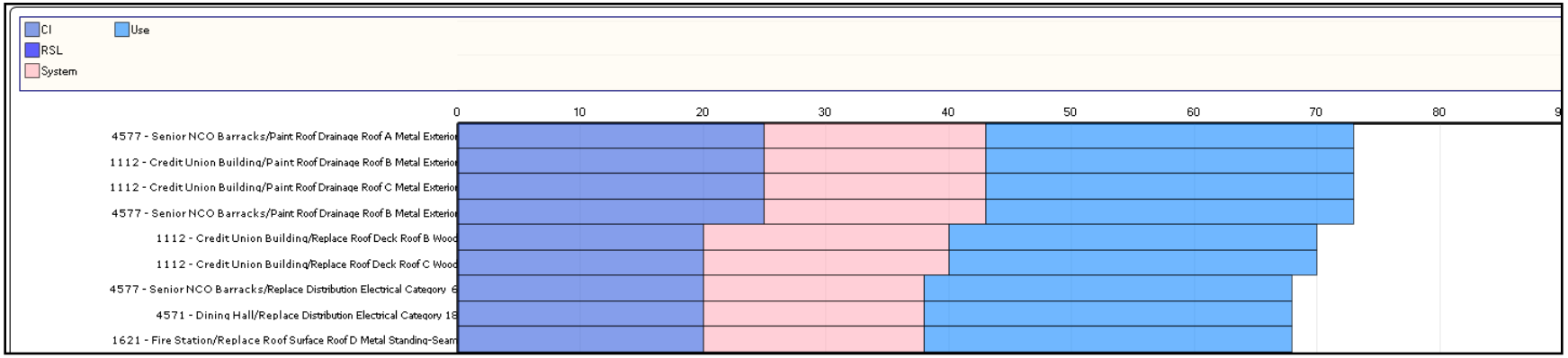
Work Prioritization



User-defined prioritization allows users to optimize multiple competing requirements for scarce funding.



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Functionality Index

Save | New | Copy | Delete | Reports

Building: 1003 - Model Bldg 3 Current BFI:

Functionality Assessment | Functionality Trend

Assessment Date: 02/21/2007 Assessment BFI: 100

Description: Engineering Evaluation

Building Use Type: Office Building

Status: Active

Issue	Issue FI	Last Assessment
Location	100	02/21/2007
Building Size and Configuration	100	02/21/2007
Structural Adequacy	100	02/21/2007
Access	100	02/21/2007
ADA	100	02/21/2007
ATFP	100	02/21/2007
Building Services	100	02/21/2007
Comfort	100	02/21/2007
Efficiency and Obsolescence	100	02/21/2007
Environmental/Health	100	02/21/2007
Missing or Improper Components	100	02/21/2007
Aesthetics	100	02/21/2007
Maintainability	100	02/21/2007
Cultural Resources		

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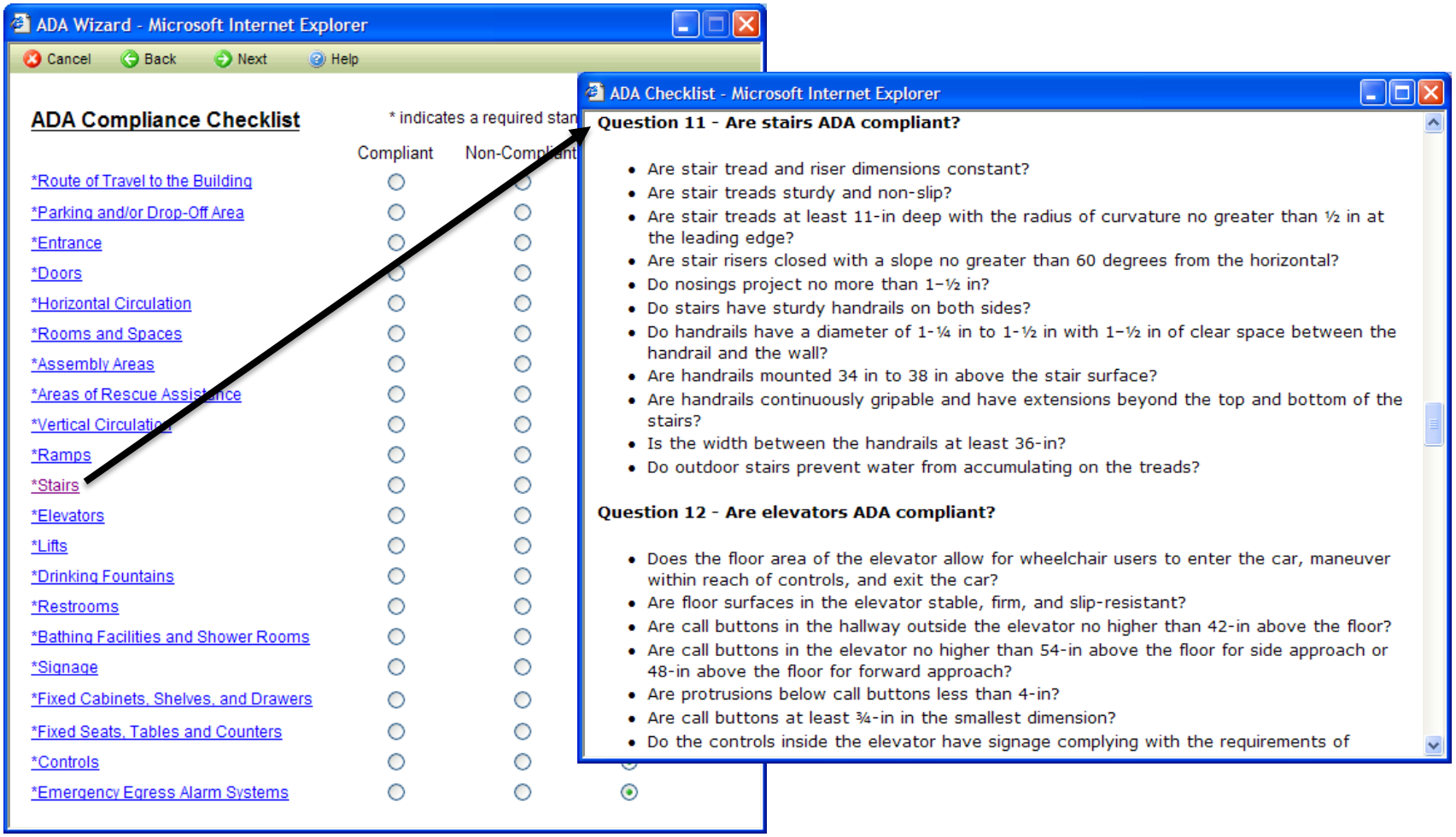
Assessment Wizards



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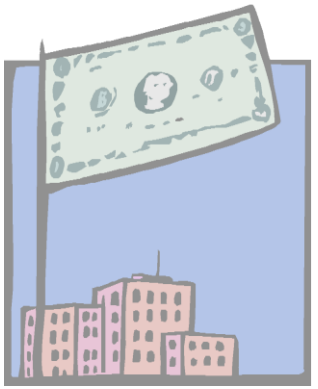
The Results

Better management of the sustainment, restoration, and modernization of our infrastructure

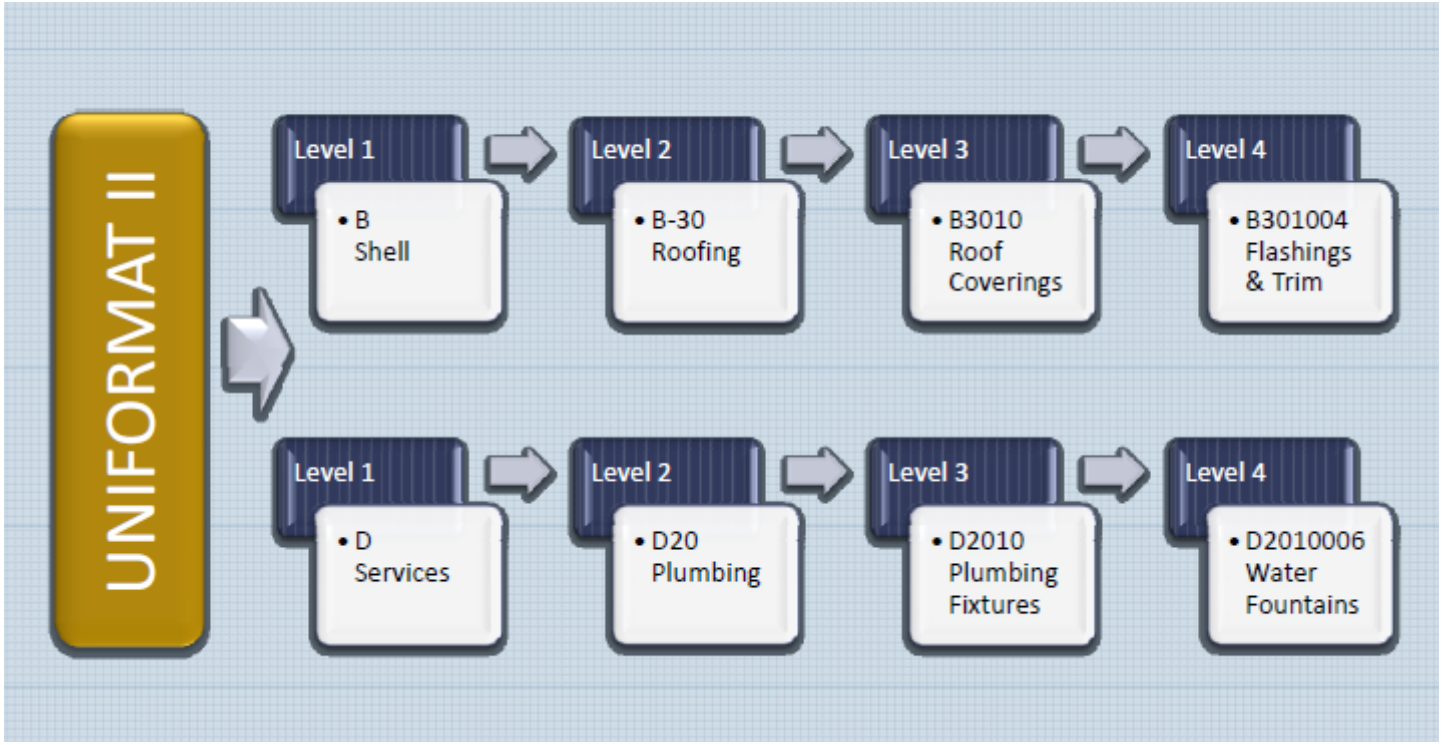
- ✓ **Systematic, objective, efficient assessment of sustainment requirements**
- ✓ **Mission ready infrastructure**
- ✓ **Prioritized use of scarce resources**
- ✓ **Avoidance of future shocks**
- ✓ **Realistic, defensible budget projections**
  - **Avoidance of long-term penalties**
  - **Awareness of today's decisions**

Gather the right data at the right time at the right level for when you need the information.



STANDARD DATA MODEL

- **Uniformat II Classification System – ASTM E1557**



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Uniformat II

CONDITION ASSESSMENT - WORK BREAKDOWN STRUCTURE UNIFORMAT II

SUBSTRUCTURE

FOUNDATIONS A10
- FOOTINGS
  - Spread
  - Strip
  - Grade Beam
- WALLS
- DAMP PROOFING WATERPROOFING
- EXCAVATION BACKFILL
- PILES CAISSONS

A20 SUB-STRUCTURE
- SLABS ON GRADE
- COLUMNS
  - CIP Concrete
  - Precast
  - Metal
  - Wood
- COLUMN FIREPROOFING

SHELL

SUPER-STRUCTURE B10
- BEAMS
  - Cast-in-Place
  - Precast Concrete
  - Steel
  - Wood
- PRE-ENGINRD BUILDINGS
  - Metal
  - Wood
- FLOORS
  - CIP Concrete
  - Precast Concrete
  - Steel
  - Composite
  - Wood
- ROOF STRUCTURE
  - CIP Concrete
  - Steel
  - Wood
  - Precast
- FIRE-PROOFING
- STAIRS
  - CIP Concrete
  - Precast
  - Steel
  - Composite
  - Wood
  - Ladders

EXTERIOR B20
- WALLS
  - Concrete
  - Masonry
  - Stucco
  - Gunite
  - Stone/ Stone Veneer
  - w/Straw Bales
- SIDING
  - Metal
  - Wood
  - Plastic
- EXTERIOR INSULATION & FINISH WALL
- DOORS
- WINDOWS & GLAZED WALLS
  - Windows
  - Glazed
  - Curtain Walls
- PAINT FINISHES / COATINGS
  - Conventional
  - Special
  - Finishes

ROOFING B30
- BUILT-UP MEMBRANE
- SINGLE-PLY MEMBRANE
- METAL
- COATED FOAM MEMBRANE
- SHINGLES
- TILES
- PARAPETS
- ROOF SPECIALTIES, HATCHES SKYLIGHTS DRAINAGE GUNITE CANOPIES

INTERIORS

INTERIOR C10-PARTITIONS C30-INTERIOR

PARTITIONS CONVENTIONAL
- Concrete / Masonry
- Structural Tile
- Drywall / Plaster

PARTITIONS SPECIALTY

TOILET PARTITIONS & ACCESSORIES

INTERIOR
- Doors
- Cabinets
- Fittings

C20 STAIRS
- CIP Concrete
- Precast
- Steel
- Composite
- Wood
- Ladders

FLOOR FINISHING
- Carpet
- Composition / Resilient Flooring
- Floor (Concrete)
- Terrazzo
- Cork Tile
- Tile
- Wood

CEILINGS
- Drywall /Plaster
- Acoustical
- Wood
- Concrete
- Metal

PAINT FINISHES / COATINGS
- Conventional
- Special
- Finishes

WALL COVERING
- Coverings
- Panelling
- Tile

SERVICES

CONVEYING SYSTEMS D10
- ELEVATORS
  - Hydraulic Elevator
  - Traction Elevator
  - Escalators
- SPECIAL
  - Pneumatic Tube Systems
  - Hoists and Cranes

D20 PLUMBING SYSTEMS
- PLUMBING
  - Domestic Water
  - Drain, Waste & Vent
  - Compressed Air
  - Vacuum
  - Natural Gas
- SPECIAL SYSTEMS
  - Drinking Water SYSTEMS

MECHANICAL SYSTEMS D30
- HVAC
  - All Inclusive
- COOLING
  - Centrifugal Chillers
  - Absorption Chillers
  - Packaged Reciprocation Chillers
  - Packaged Condensing Unit
  - Packaged HVAC
  - Refrigeration Compressors
  - Condenser
  - Cooling Towers
  - Chilled Water Distribution
  - Condenser Water
  - Chemical Water Treatment
  - Terminal Cooling Units
- HEATING & VENTILATING
  - Fuel Oil
  - Boilers
  - Hot Air Furnaces
  - Hot Water Distribution
  - Steam Distribution & Condensate Return
  - Chemical Treatment
  - Terminal Units
  - Air Handlers & Fans
  - Ductwork
- RENEWABLE
  - Fuel Cells
  - Solar Energy
  - Wind Energy
  - Energy Efficiency

FIRE PROTECTION D40
- FIRE PROTECTION
  - Wet Pipe Sprinkler
  - Dry Pipe Sprinkler
  - Standpipe
  - Halon Fire Suppression
  - CO2 Fire Suppression

D50 ELECTRICAL SYSTEMS
- SERVICE & DISTRIBUTION
  - Service Entrance
  - Low Voltage Distribution
  - Medium Voltage Distribution
- LIGHTING
  - Luminaries
- SPECIAL SYSTEMS
  - Cable Trays
  - Communication Circuits
  - Control Units
  - Data Proc. Elec. Equip.
  - Generators/ Standby Equip.
  - Standby+Emergency
  - Health Care Fac. Elec. Equip.
  - Heating Basboard Rad.
  - Lightning Prot. & Surge Supp.
  - Petrol. Disp.Fac.
  - Signal Circuits
  - Uninterruptible Power Supplies

SPEC. CONST.

SPECIALTY SYSTEMS F10
- CANOPIES
- LOADING DOCKS
- TANKS
  - Elevated
  - Buried
  - Ground Level
- DOMES BULK STORAGE, METAL FRAMING
- LOUVERS & VENTS
- ACCESS FLOORS
- INTEGRATED CEILINGS
- MEZZANINE STRUCTURES
- WASTE HANDLING

F20 SPECIALTY CONSTR. DEMO
- DEMOLITION
  - Building Elements
  - Electrical
  - Hazardous Components
  - Abatement

SITEWORK

PREPARATION G10
- PREPARATION
  - Clearing
  - Demolition
  - Earthwork
  - Haz Waste Remediation

G20 SITE IMPROVEMENTS
- Road and Walks
  - Parking
  - Roads
  - Landscaping
  - Walks
- LANDSCAPING
- FLAGPOLES
- SIGNAGE

UTIL DIST MECHANICAL G30
- COOLING
  - Rotary Screw Chillers
  - Chilled Water Distribution System
- UTILITY DISTRIBUTION SYSTEMS
- PLUMBING
  - Water Treatment Plant
  - Water Distribution System
  - Sewage & Drainage Collection Systems
  - Wastewater Treatment Plant
  - Gas Distribution System
- HEATING
  - Fuel Oil Storage & Distribution
  - Coal Handling Sys
  - High Temperature Water Distribution
  - Steam Distribution & Condensate
  - Boilers
- STORM SEWER
  - Well Systems
  - Headwalls & Catchbasins
- UNDERGROUND TRANSPORT

UTIL DIST ELECTRICAL G40
- ELECTRICAL
  - Switchyards
  - Substations
  - Overhead Transmission System
  - Underground Transmission System
  - Lighting
  - Communications/ Security
- UTILITY DISTRIBUTION INFRA
  - Steel Towers & Poles
  - Precast Concrete Poles
  - Wood Poles
  - Tower & Pole Foundations
  - Utility Service Tunnels
  - Utility Service Tunnels - Damp proofing / Waterproofing
  - Concrete Support Pads

SITE G90
- TUNNELS
- RAILWAYS & ROLLING STOCK
  - Trackwork
  - Signals & Comm.
- FOUNTAINS & POOLS
- SECURITY GATES & FENCES
- BRIDGES & ABUTMENTS

SHADING CAS INSPECTOR TYPE

Civil / Structural / Roof

Electrical

Mechanical

1-May-09

U.S. AIR FORCE

System Criticality Index

Number	System	Direct Mission Support Facilities	C3 Facilities and Systems/Utilities	Logistics Support Facilities (admin, logistics, storage, & utilities)	Training and Instructional Buildings	Housing and Community Support Facilities	Paved Surfaces, Civil Works and Land
A10	FOUNDATIONS	4	4	4	4	4	4
A20	BASEMENT CONSTRUCTION	4	4	4	4	4	4
B10	SUPERSTRUCTURE	3	3	2	3	3	1
B20	EXTERIOR ENCLOSURE	3	3	2	3	3	1
B30	ROOFING	4	4	2	3	3	1
C10	INTERIOR CONSTRUCTION	2	2	2	2	3	1
C20	STAIRS	3	3	3	3	3	3
C30	INTERIOR FINISHES	2	2	2	2	3	1
D10	CONVEYING	2	2	2	2	2	2
D20	PLUMBING	2	2	2	2	3	4
D30	HVAC	4	5	2	3	3	3
D40	FIRE PROTECTION	5	5	5	5	5	5
D50	ELECTRICAL	5	5	4	4	3	4
E10	EQUIPMENT	4	2	3	2	2	2
E20	FURNISHES	1	1	1	1	1	1
F10	SPECIAL CONSTRUCTION	3	3	3	3	3	3
F20	SELECTIVE BUILDING DEMOLITION	1	1	1	1	1	1
G10	SITE PREPARATION	1	1	1	1	1	1
G20	SITE IMPROVEMENTS	2	2	2	2	2	2
G30	SITE MECHANICAL UTILITIES	4	5	3	3	3	3
G40	SITE ELECTRICAL UTILITIES	5	5	4	4	3	4
G80	MARITIME CONSTRUCTION	4	2	3	2	1	4
G90	OTHER SITE CONSTRUCTION	2	2	2	2	2	3

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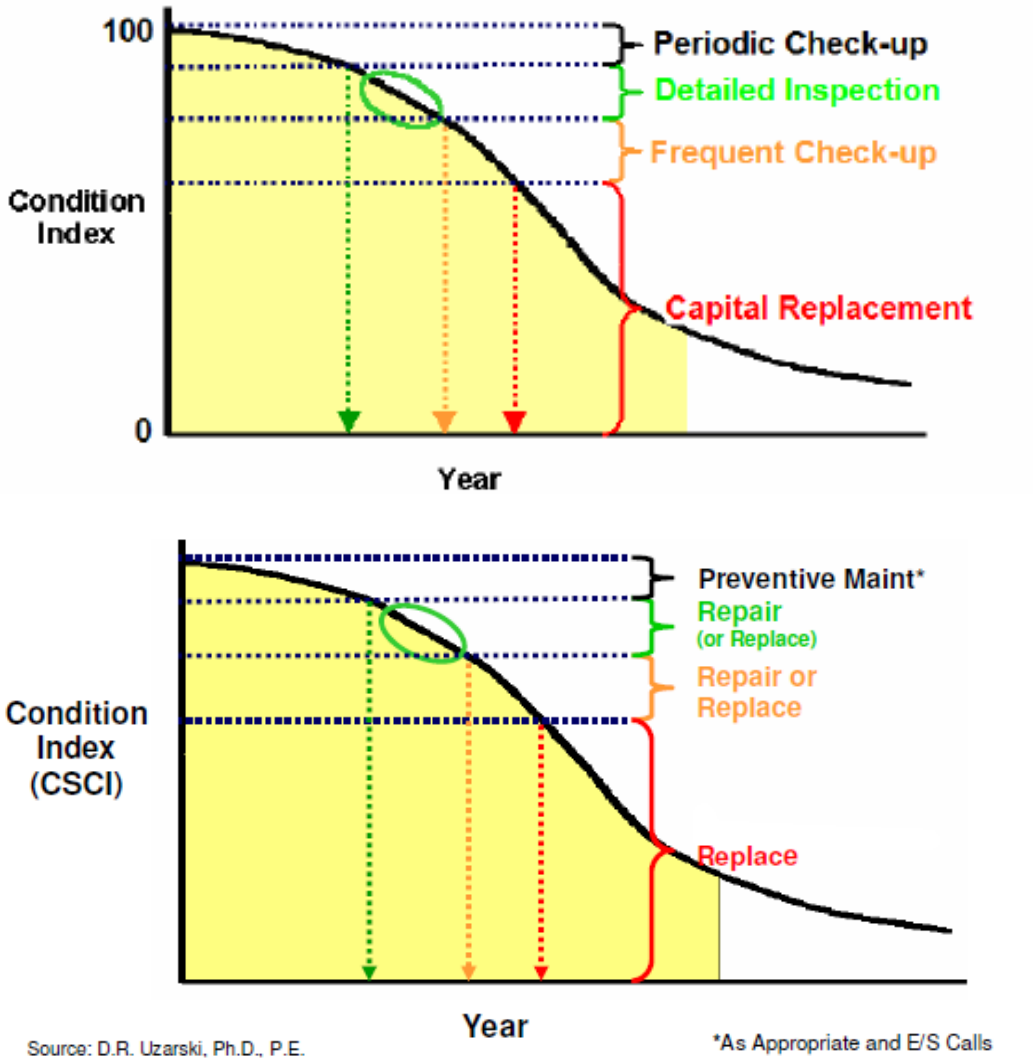
Component Degradation Curve



Provide objective facility investment guidance to:

- **Identify maintenance requirements for increased reliability**
- **Analyze investment timing to optimize return on investment**
- **Prioritize scarce resources according to economic and mission priorities**
- **Predict the effects/consequences of decisions to ensure mission readiness**

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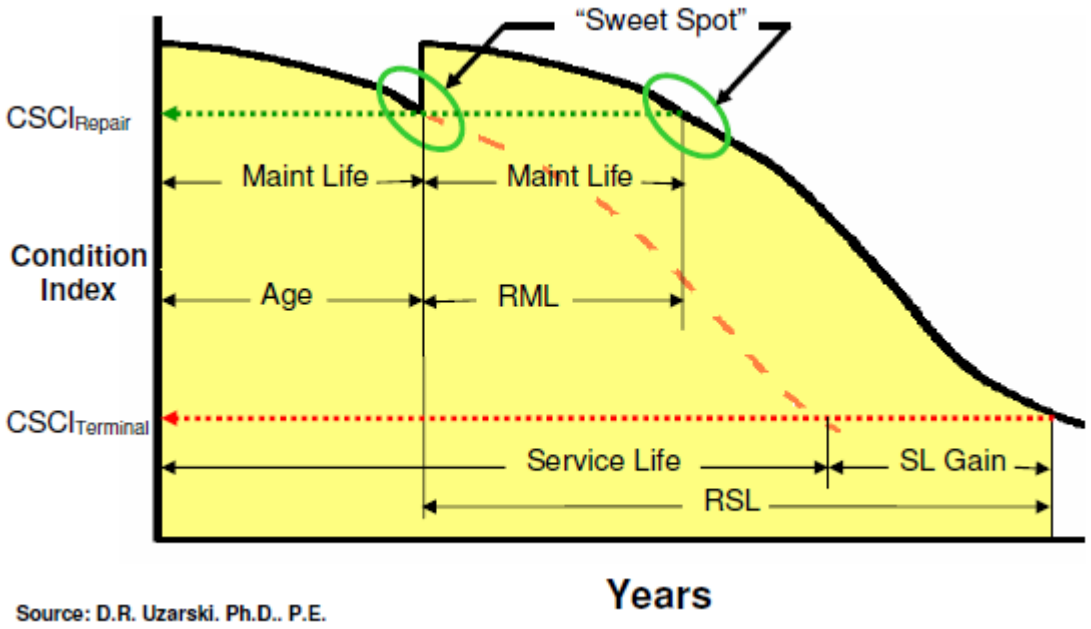
Extended Service Life



Source: D.R. Uzarski. Ph.D.. P.E.

- **Right Work at the Right Time**
- **60% Reduction in Inspection Time**
- **Increased Reliability w/ Decreased Risk & Economical Cost**

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The Way Ahead

- **Current – Maintain status quo. This assessment process is dominated by "Operator inspection" with limited "Engineering Condition Assessments". Upon request, assessments are augmented with special studies utilizing FCA modeling.**
- **Interim – Adopt a direct scoring (green, yellow, red, black) assessment standard across the AF. Similar to the Army's "Infrastructure Status Report".**
- **Final – Institute knowledge based facility condition assessment modeling. Utilize existing IT applications; Paver, Roofer, Builder, and Utilities (?)**

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Questions & Discussion