Maintenance Planning

Post Executive Order 13514

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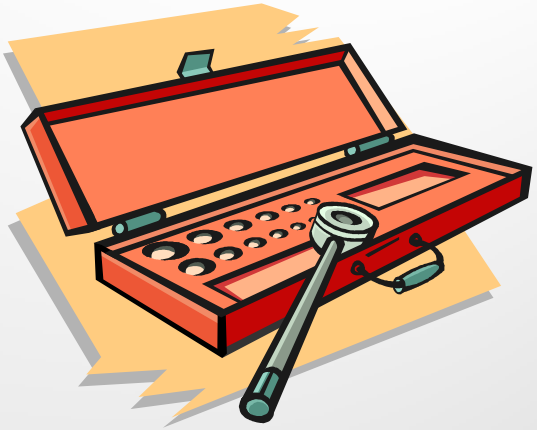
U.S. DEPARTMENT OF ENERGY

Agenda

- EO 13514 and maintenance
- Purpose of Maintenance
- Approaches to prioritizing maintenance
- Connecting sustainability to maintenance



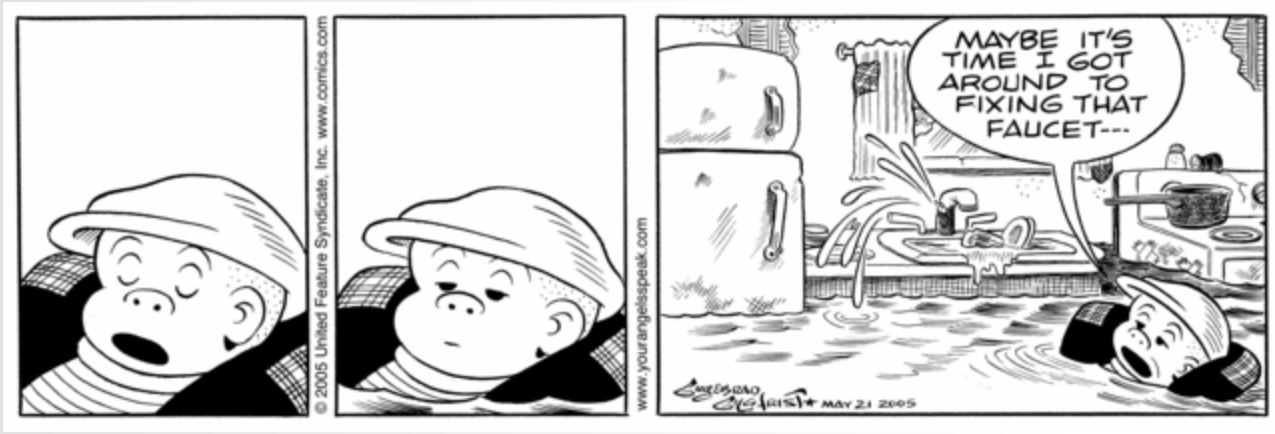
EO 13514 and Maintenance

Section 2 *Goals for Agencies*
(g) implement high performance sustainable Federal building design, construction, operation and management, maintenance, and deconstruction including by:

Entire Lifecycle

(v) managing **existing** building systems to reduce the consumption of energy, water, and materials, and identifying **alternatives to renovation** that reduce existing assets' **deferred maintenance costs**;

Fix to Conserve



"Yes, but what about rainwater harvesting?"

Recognizing the potential

- Let's look at the most common deficiencies cited in FIMS *(FY 2008 Snapshot)*

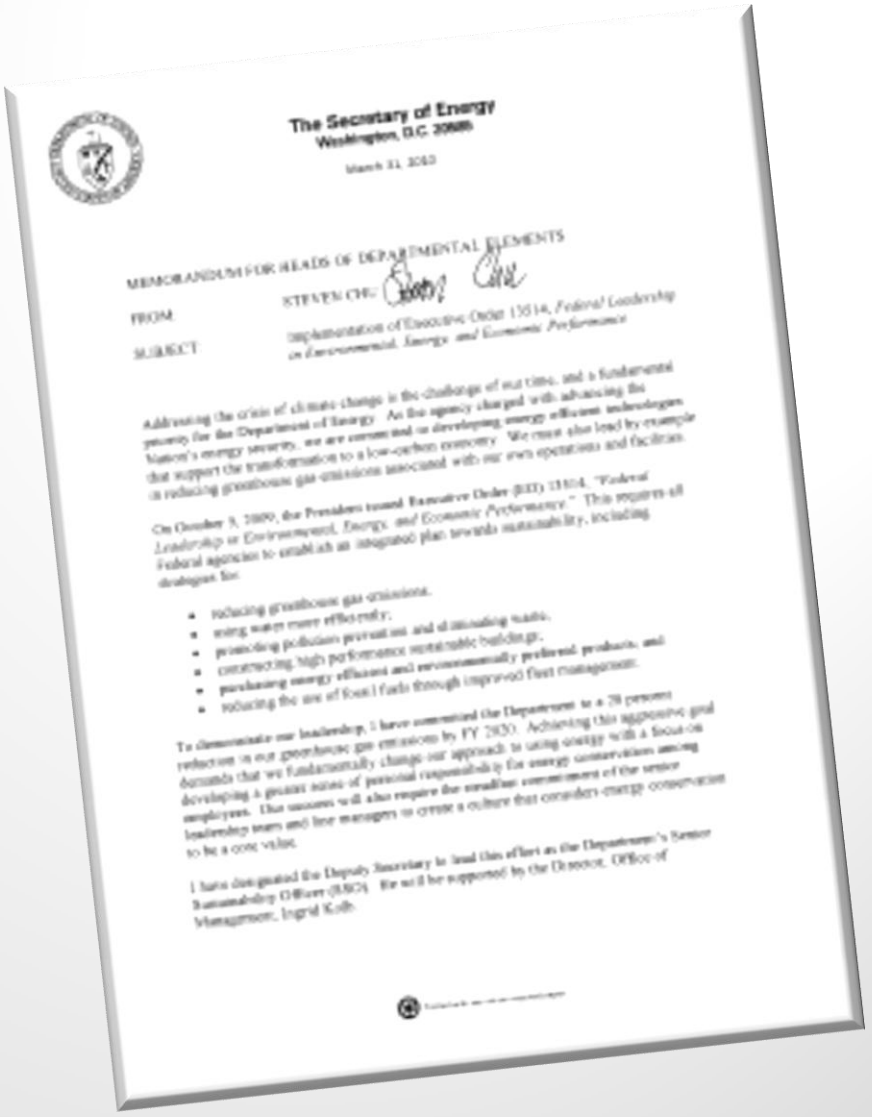
B 20	Exterior	18%
D 50	Electrical Systems	16%
D 30	Mechanical Systems	15%

- If these systems have DM, they do not operate optimally
- Resolving DM improves conditions, reduces resource consumption, reduces GHG emissions

Sustainability *is* our mission

"Implementation of Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*"

– March 31, 2010



The Secretary of Energy
Washington, D.C. 20585

March 31, 2010

MEMORANDUM FOR HEADS OF DEPARTMENTAL ELEMENTS

FROM: STEVEN CHU

SUBJECT: Implementation of Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*

Addressing the crisis of climate change is the challenge of our time, and a fundamental priority for the Department of Energy. As the agency charged with advancing the Nation's energy security, we are committed to developing energy efficient technologies that support the transformation to a low-carbon economy. We must also lead by example in reducing greenhouse gas emissions associated with our own operations and facilities.

On October 5, 2009, the President issued Executive Order (EO) 13514, "Federal *Leadership in Environmental, Energy, and Economic Performance*." This requires all Federal agencies to establish an integrated plan towards sustainability, including strategies for:

- reducing greenhouse gas emissions;
- using water more efficiently;
- preventing pollution prevention and eliminating waste;
- constructing high performance sustainable buildings;
- purchasing energy efficient and environmentally preferred products; and
- reducing the use of fossil fuels through improved fleet management.

To demonstrate our leadership, I have committed the Department to a 28 percent reduction in our greenhouse gas emissions by FY 2020. Achieving this aggressive goal demands that we fundamentally change our approach to using energy with a focus on developing a greater sense of personal responsibility for energy conservation among employees. This success will also require the steadfast commitment of the senior leadership team and line managers to create a culture that considers energy conservation to be a core value.

I have designated the Deputy Secretary to lead this effort as the Department's Senior Sustainability Officer (SSO). He will be supported by the Director, Office of Management, Ingrid Kolb.

Sustainability *is* our mission

"Addressing the crisis of climate change is the challenge of our time, and a **fundamental priority** for the Department of Energy."

"We must also **lead by example** in reducing greenhouse gas emissions associated with our own operations and facilities."

"This requires . . . An integrated plan towards sustainability, including strategies for:

- Reducing greenhouse gas **emissions**;
- Using **water** more efficiently;
- Promoting pollution prevention and **eliminating waste**;
- Constructing high performance sustainable buildings;
- Purchasing energy efficient and environmentally **preferred products**; and,
- Reducing the use of fossil fuels through improved **fleet management**."

"Why bother maintaining assets?"

"[M]aintenance will be used to ensure real property asset availability for planned use . . ." – O430.1B § 4(d)(5)

Answer: *to sustain the mission*

Question: *but who sets the mission?*

Setting mission . . .

- Clients
  - We work for clients
    - Examples:
      - Program management
      - Site management
      - Tax payers
- Customers
  - We service customers
    - Examples:
      - Tenants
      - Visitors

Both deserve a voice in
- Establishing service levels
- Prioritizing activities

How do I know I provide good maintenance?
- I meet the agreed to levels of service
- Assets I manage function adequately
- Satisfaction surveys return favorable opinions

Continuum of planning

- Acquisition & Disposition (*non-recurring*)
  - Mission
  - Financing
  - Construction
  - Deactivation & Decontamination
- Operations & Maintenance (*annual recurring*)
  - Operations [1]
  - Utilities
  - Routine Maintenance
  - Repairs & Replacements
- Recapitalization (*periodic recurring*)
  - Retrofits
  - Programmatic upgrade
  - Renewal

O 413.3A "Project Management" [2]

O 430.1B "Disposition"

O 430.2B "Executable Plan"

O 430.1B "Maintenance Program"

O 430.1B "Ten Year Site Plan"

O 430.1B "Ten Year Site Plan"

Source: APPA

Notes:
1. Partially addressed by O 450.1A
2. Except for projects under GPP / IGPP Limit

Maintenance planning in O 430.1B

- O 430.1B, § 4(d)(1) states:
  - The maintenance program will include:
    - Condition assessments of real property assets,
    - A work control system,
    - Management of deferred maintenance,
    - A method to prioritize maintenance projects, and
    - Cost accounting systems to budget and track maintenance expenditures.

Work Control Policy Elements

- Track all activities
  - Operations – custodial, grounds management, pest management, snow removal, waste handling, recycling, etc.
  - Maintenance – recurring, periodic, urgent, non-critical, etc.

- Upload your resources and systems
  - People
  - Assets
  - Supplies & Spares
  - Equipment and Assemblies

  } Uniformat II, CSI 2004

- Delineate roles
  - Who **creates** and **updates** records – *and when*?
  - Who **responds, resolves** and **verifies** – *and when*?
  - Who **communicates** with customers & clients – *and when*?

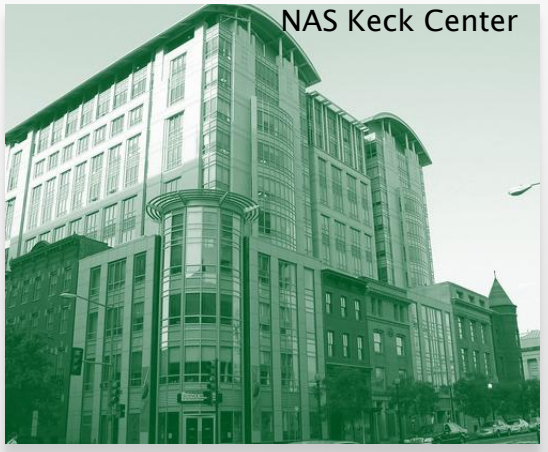
Work Control Policy Elements

- Commit to service level standards
  - Asset performance statements
  - Resolution *(not just response)* time by [choose one or more]:
    - Type of asset
      - e.g., office buildings, laboratories, chiller plant
    - Type of action required
      - e.g., planned maintenance, urgent repair, equipment replacement
    - Type of programmatic function impacted
      - e.g., mission priority
  - Reliability of workmanship
- Link all O&M activity to financial records

Is maintenance priceless?

- Maintenance and RETURN ON INVESTMENT
  - OMB convenes an interagency task force to advance maintenance (June – August 2009)
  - FASAB asks can ROI indicate "acceptable condition"? (April – May 2010)
  - NRC study: "Predicting Outcomes from Investments in the Maintenance and Repair of Federal Facilities" (December 2009 – 2011)

Linda Stanley, FFC



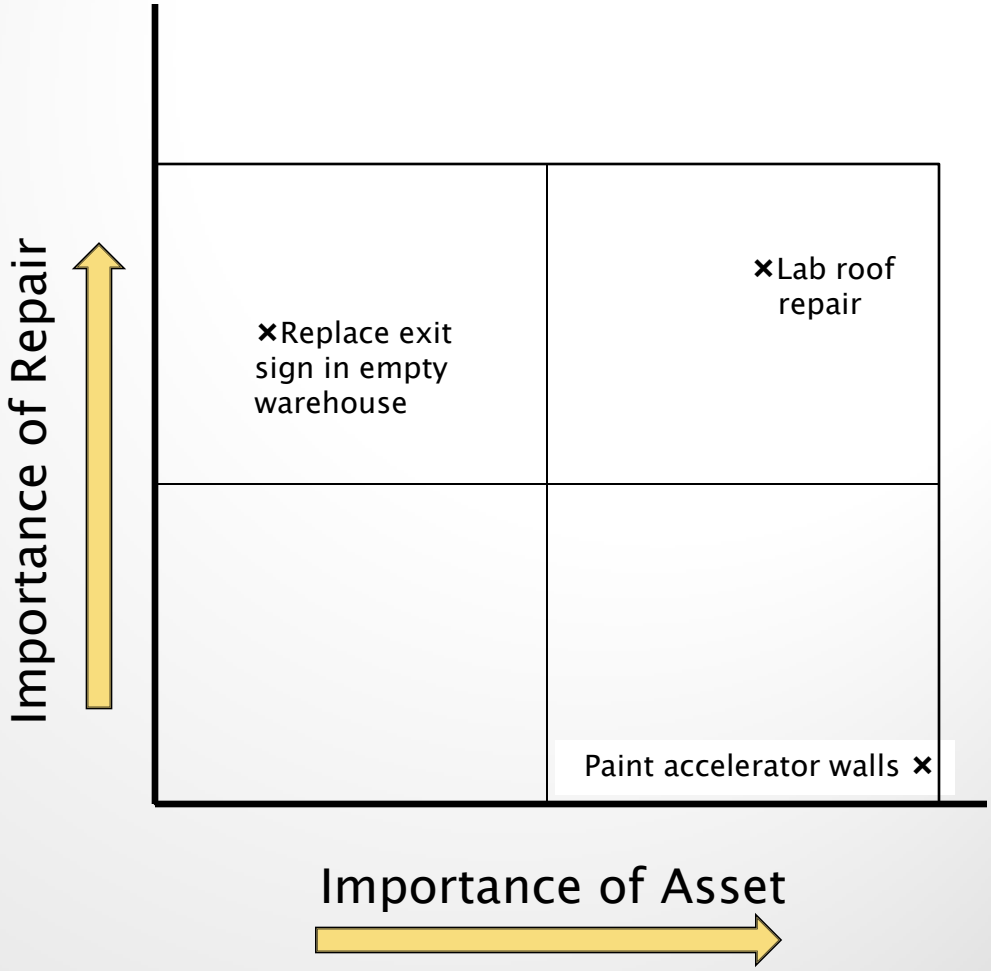
NAS Keck Center

Is maintenance priceless?

- Some questions the NRC study has asked of government and industry:
  - "Are there ways to **predict** . . . outcomes . . . from a given level of maintenance and repair investments?"
  - "Are there effective . . . strategies . . . to better inform decision-makers regarding the cost-**effectiveness** of levels of **investment** in facilities' maintenance and repair?"
  - "What . . . measures . . . [w]ould . . . determine the **actual outcomes** of facilities maintenance and repair investments?"
- The response: **PRIORITIZATION**

Prioritization Approaches

- By classification
  - Asset type or usage
  - System type



Prioritization Approaches

- By classification
  - Asset type or usage
  - System type
- By risk
  - Actual impacts
  - Potential impacts
- By mission
  - Activity importance
  - Risk to activity

"Let's get our priorities straight"

Two illustrative prioritization approaches

1. Smithsonian Institution
2. Navy

Note: Each approach has strengths and weaknesses. They appear here for informational purposes only.

Integrated Prioritization Methods
Smithsonian Institution

Priority Code Assignment Matrix

PRIORITY CODES PC 1 = BY PC 2 = BY +1 PC 3 = BY +2 PC 4 = BY +3 PC 5 = BY +4	PROJECT TYPE Maintenance A Shell/ System Failure	B Code Compliance/ Security	C Non-routine Maintenance Repairs	D Energy/ Operational Efficiency
CONDITION LEVEL I Catastrophic	PC 1	PC 1	PC 2	PC 2
II Critical	PC 2	PC 2	PC 3	PC 3
III Routine	PC 3	PC 3	PC 4	PC 4
IV Can Defer	PC 5	PC 5	PC 5	PC 5

Notes

Condition Level Description

Condition	Level	Description
Catastrophic	I	Significant projects requiring immediate funding in order to correct severe safety hazards, active failures, and prevent the loss of facilities. ***Asset Impact: Detrimental or irreversible failure, immediate implementation.***
Critical	II	High priority projects requiring funding in the next fiscal year to avoid failure or correct serious safety/security deficiencies. ***Asset/Program Impact: Imminent failure, program begins in 1 - 3 years.***
Routine	III	Predicted work that needs funding within four years. ***Asset/Program Impact: Moderate risk, program begins in 4 - 5 years.***
Can Defer	IV	Work that can be deferred for five years. ***Asset/Program Impact: Negligible risk, program begins within 5+ years.***

Project Type Description

Project Type	Category	Description
Shell/ System Failure	A	Examples: Roof and building piping leaks, utility system and equipment failures.
Code Compliance/ Security	B	Examples: Fire detections and suppression sustem replacement or upgrade, life safety and accessibility modifications, and security equipment replacement/improvement and building modifications.
Non-routine Maintenance Repairs	C	Examples: One time repair work to correct significant problem that cannot be addressed on a routine basis, i.e., refurbishing doors for an entire facility, and replacement of individual component of HVAC system.
Energy/ Operational Efficiency	D	Examples: Projects with a seven year cost-effective payback period.

Sustainability makes the "D" list

Integrated Prioritization Methods
Smithsonian Institution

Priority Code Assignment Matrix

CONDITION LEVEL	PROJECT TYPE: Maintenance — A: Shell/ System Failure	B: Code Compliance/ Security	C: Non-routine Maintenance Repairs	D: Energy/ Operational Efficiency
I Catastrophic	PC 1	PC 1	PC 2	PC 2
II Critical	PC 2	PC 2	PC 3	PC 3
III Routine	PC 3	PC 3	PC 4	PC 4
IV Can Defer	PC 5	PC 5	PC 5	PC 5

PRIORITY CODES
PC 1 = BY
PC 2 = BY +1
PC 3 = BY +2
PC 4 = BY +3
PC 5 = BY +4

Some examples, please:

1. Non-routine, routine project

   ANS: PC4

2. Roof replacement needed but NOT failed yet

   ANS: PC2 or PC3

3. Roof replacement needed but NOT failed yet . . . on a lab

   ANS: PC2 or PC3

. . . mission not considered

Integrated Prioritization Methods

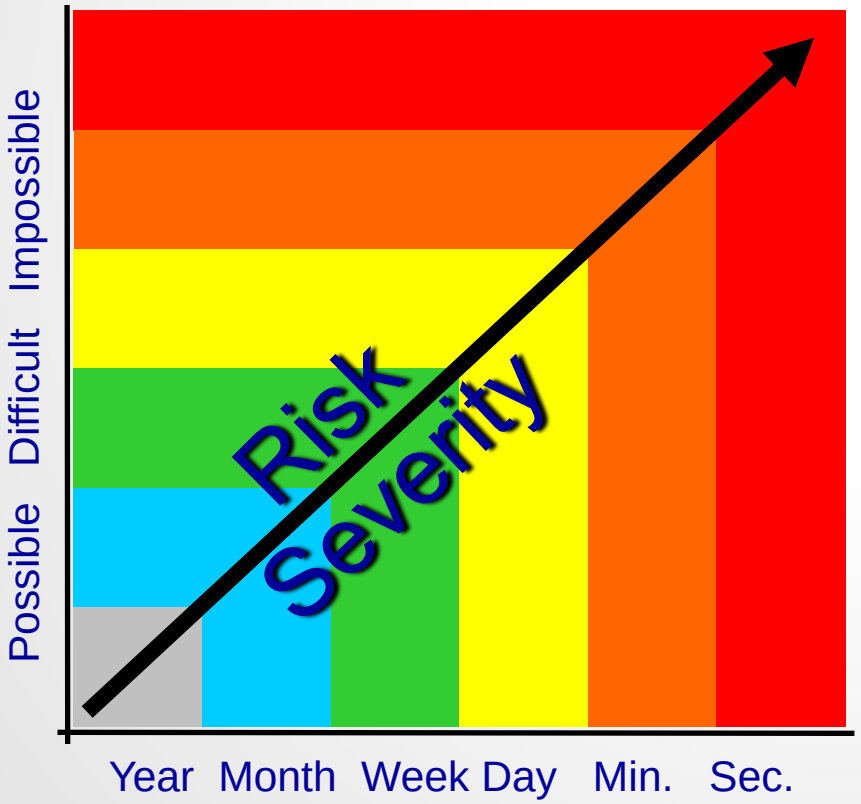
Navy

- Integrates three considerations:
  - Mission Dependency (MDI)
  - System Criticality (SCI)
  - Return on Investment (ROI)
- Developed by Parsons (2008)

Graphic look familiar from CAS Manuals?

Mission Dependency Index

Ability to Relocate or Replace



100
Critical
85
Significant
70
Relevant
55
Moderate
40
Low
0

Interruptability of Function/Service

Source: Navy

MDI Algorithm

MDI Mission Dependency Index: $1 \leq MDI \leq 100$

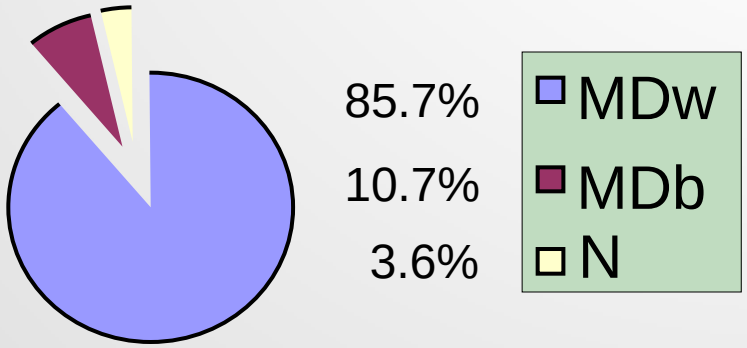
MD_w Mission Intradependency (Within Mission); $1 \leq MD_w \leq 6$

MD_b Mission Interdependency (Between Missions) $1 \leq MD_b \leq 6$

N Number of Mission Interdependencies

Weighted Average

$$MDI = \{16.5\,[MDw + \frac{MD_{bAvg}}{8} + 0.1\,\mathrm{Ln}(N)] - 15.5\}$$



Source: Navy

System Criticality Index (SCI)

Primary Facility Elements	SCI
Exterior Walls	93
Roof Coverings	79
Exterior Doors	75
Exterior Windows	74
Electrical Service & Distribution	74
Roof Construction	73
Floor Construction	64
Heat Generating Systems	63
Communication & Security	63
Energy Supply	62
Roof Openings	62
Cooling Generating Systems	62

Source: Navy

- Authority defines values
  (i.e., HQ, PGM, SO, etc.)
- Related to Uniformat II
- Similar to CAIS "Inspection Units"
- Two more levels . . .

System Criticality Index (SCI)

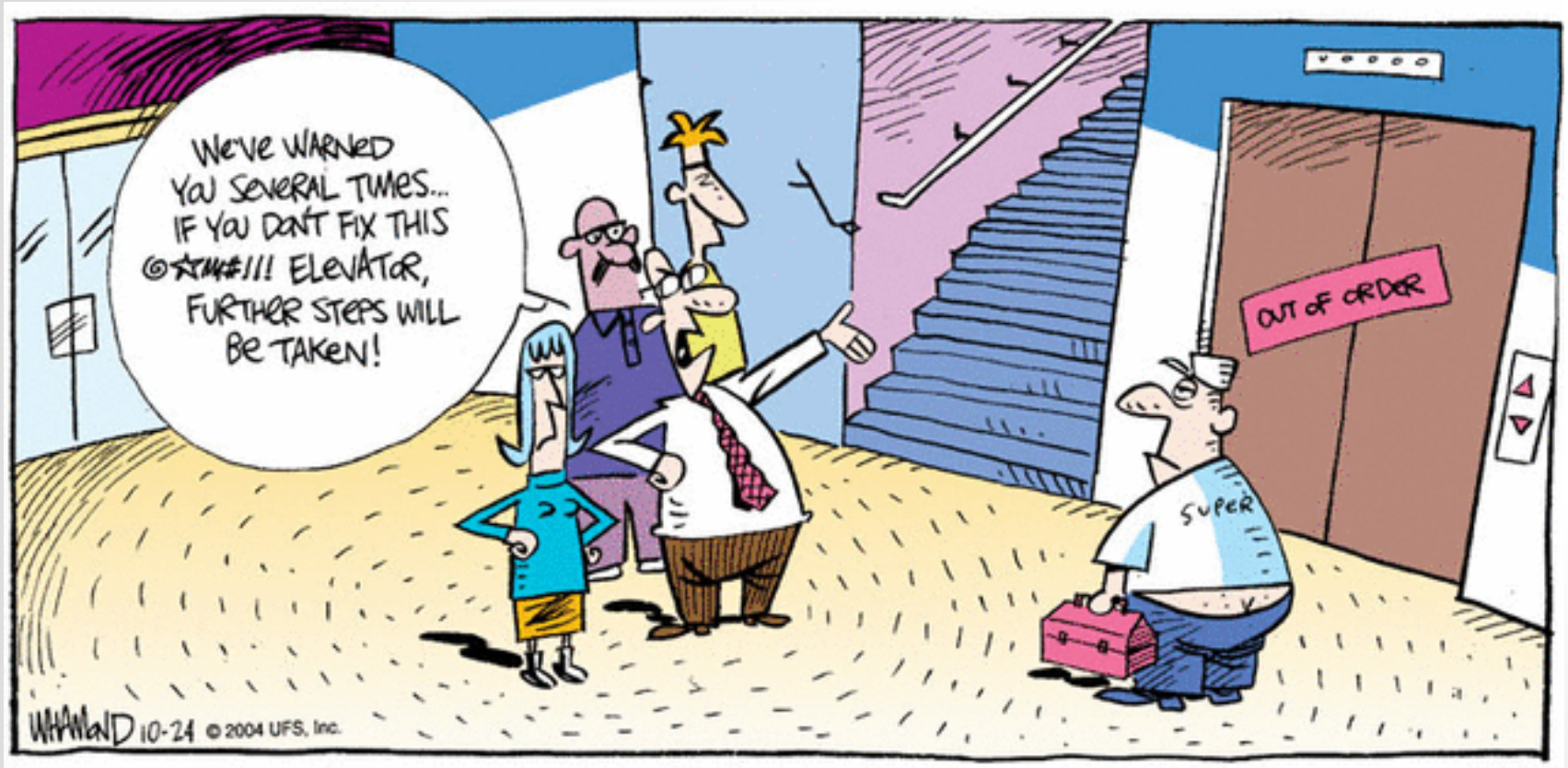
Secondary Facility Elements	SCI
Controls & Instrumentation	59
Sprinklers	59
Lighting & Branch Wiring	58
Other Fire Protection Systems	58
Basement Walls	57
Elevators and Lifts	56
Sanitary Waste	55
Standpipes	55
Domestic Water Distribution	54
Distribution Systems	53
Other HVAC Systems	53
Terminal & Package Units	49
Escalators & Moving Walkways	48
Other Electrical Systems	48
Slab on Grade	48
Plumbing Fixtures	45
Other Plumbing Systems	41
Liquid & Gas Storage Tanks	41

Source: Navy

Tertiary Facility Elements	SCI
Other Conveying Systems	39
Food Service Equipment	39
Aquatic Facilities	36
Interior Windows & Storefronts	36
Interior Doors	33
Floor Finishes	31
Kennels & Animal Shelters	30
Stair Finishes	30
Vehicular Equipment	28
Ceiling Finishes	28
Wall Finishes	26

for example:

Heat > Elevators > Dogs



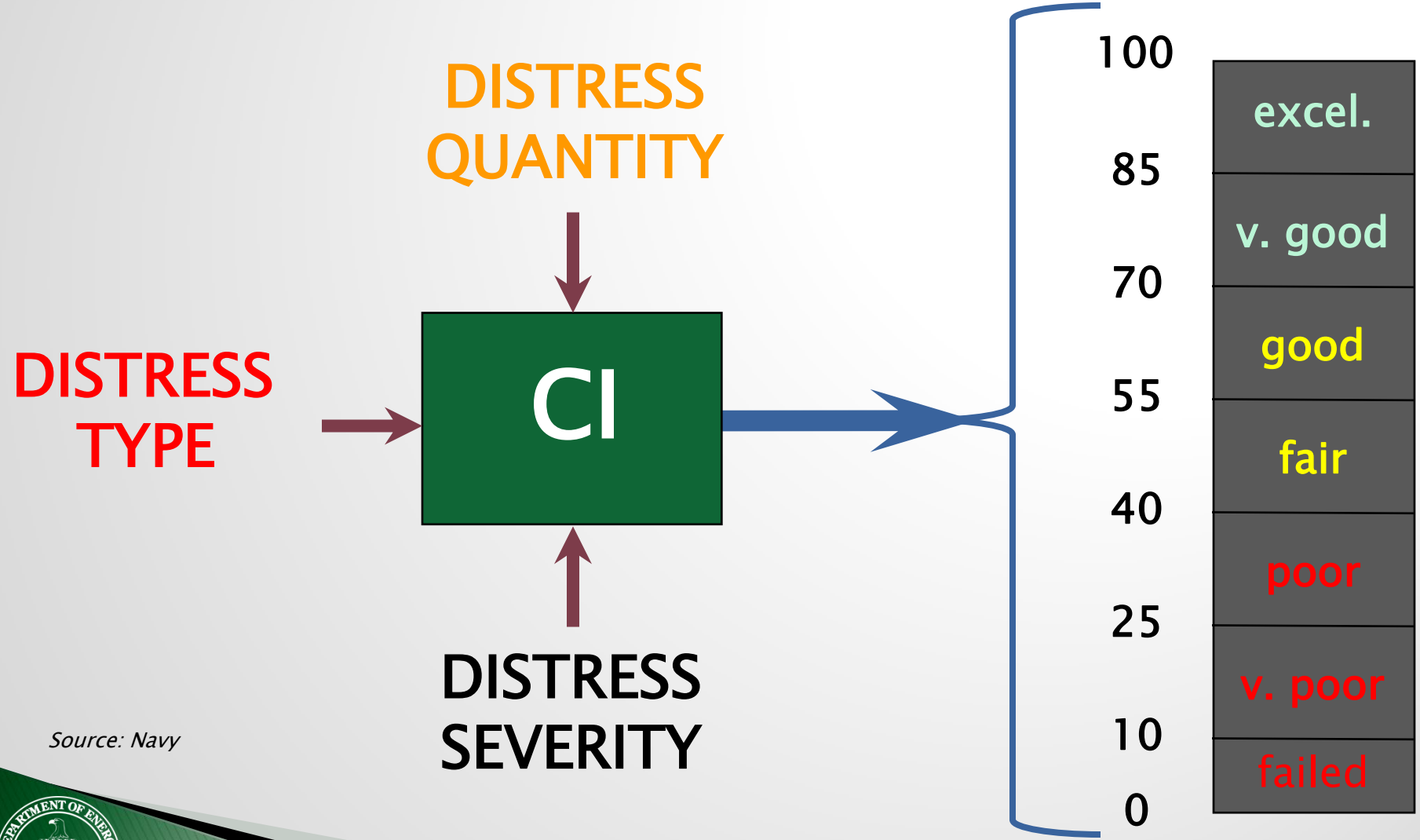
Vertical transportation »

Warning: Importance may vary

ROI: Start with design life

Source: Navy

Influences on Condition Index

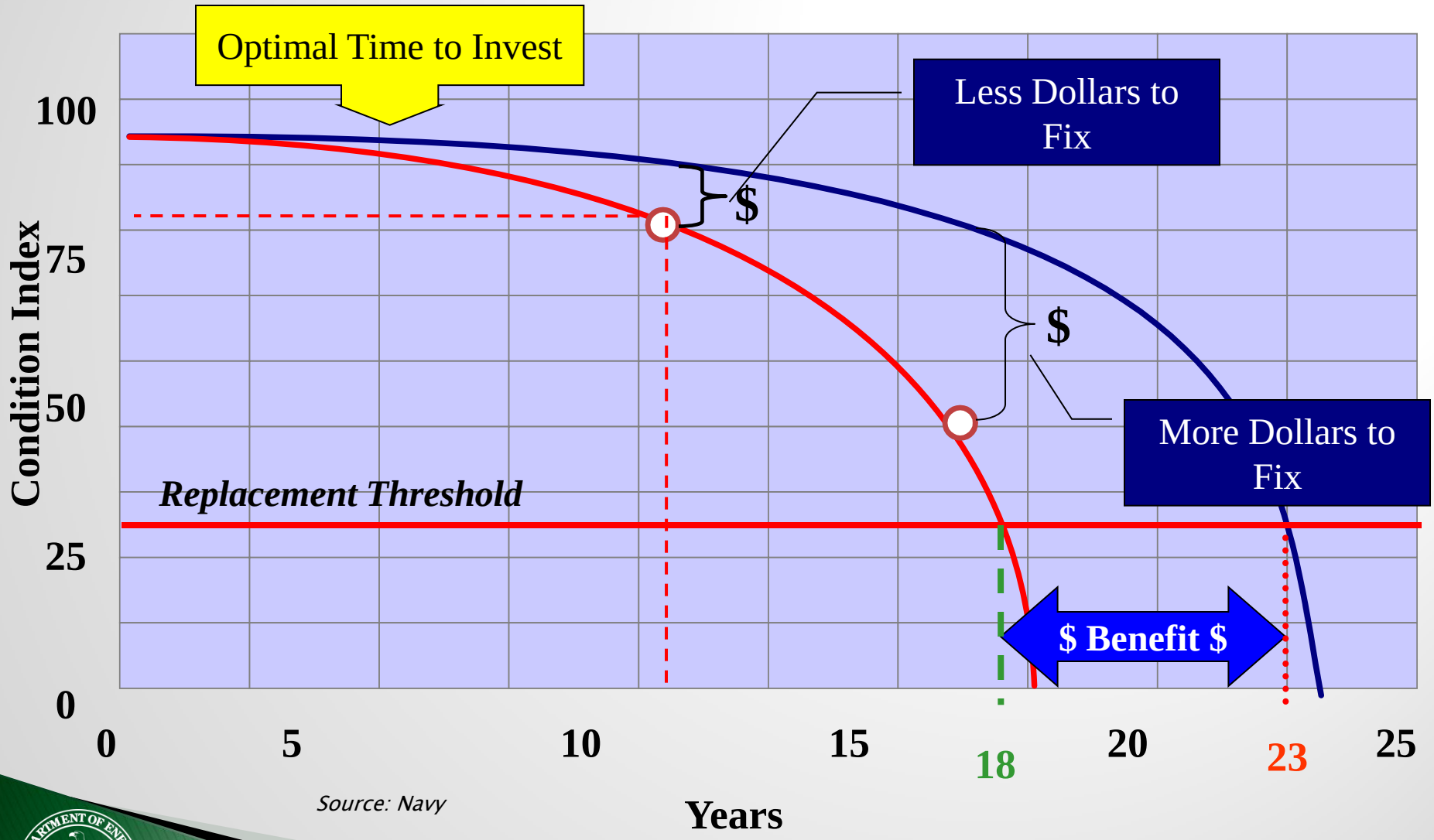


Source: Navy

DM Shortens Service Life

Source: Navy

Estimating ROI



Source: Navy

Integrated Prioritization Methods

Navy

How ?

Prioritized Maintenance

Ans: Analytical Hierarchy Process

Analytical Hierarchy Process

- Developed by Thomas L. Saaty
- A type of multi-criteria decision analysis
- Human judgments, not just the underlying information, drive the evaluations
- Recognizes ease of comparing pairs
- Clients and customers directly impact decisions

1. Layout the hierarchy: goal, alternatives, and criteria
2. Prioritize elements in the hierarchy
3. Synthesize into a set of overall priorities for the hierarchy
4. Check for consistency
5. Make a decision

Who uses the Analytical Hierarchy Process ?

How the Navy weighted its considerations:

	MDI	ROI	SCI	Total	Priority Index
MDI	1	5.00	5.00	11.0	0.59
ROI	0.20	1	0.20	1.4	0.08
SCI	0.20	5.00	1	6.2	0.33
				18.6	

Source: Navy

- What about your site?
  - Peer review, client, and customer input could replace all the pre-set numbers
  - Flexible approach suitable for program-wide or site implementation

ASTM References

- ASTM E 1765-07e1 Standard Practice for Applying Analytical Hierarchy Process (AHP) to Multi-attribute Decision Analysis of Investments Related to Buildings and Building Systems
- ASTM E 1057 – 06e1 Standard Practice for Measuring Internal Rate of Return and Adjusted Internal Rate of Return for Investments in Buildings and Building Systems
- ASTM E 1121 – 07e1 Standard Practice for Measuring Payback for Investments in Buildings and Building Systems

Incorporating sustainability

- Review your **work control** procedures and **maintenance prioritization** policy to ensure adequate incorporation of sustainability
- Consider the examples:
  - Smithsonian Institution
    - Project Type → Sustainability
    - Condition Level → Sustainability
  - Navy
    - Mission Dependency → Sustainability
    - System Criticality → Sustainability
    - Return on Investment → Sustainability

Net-Zero . . . everything

- Paper "*Buildings: The Gifts that Keep on Taking*" – APPA (2006)
  - Focus on total cost of ownership (TCO)
    - ex: Better cool roof now avoids future costs
  - Perception: "Deferred maintenance makes us look irresponsible"

- Ties nicely to ultimate sustainability
  - Net-Zero Energy
  - Net-Zero Water
  - Zero Waste
  - Carbon Neutrality

Questions & Comments

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