Fundamentals of Asset Management

Step 7. Optimize Operations & Maintenance (O&M) Investment

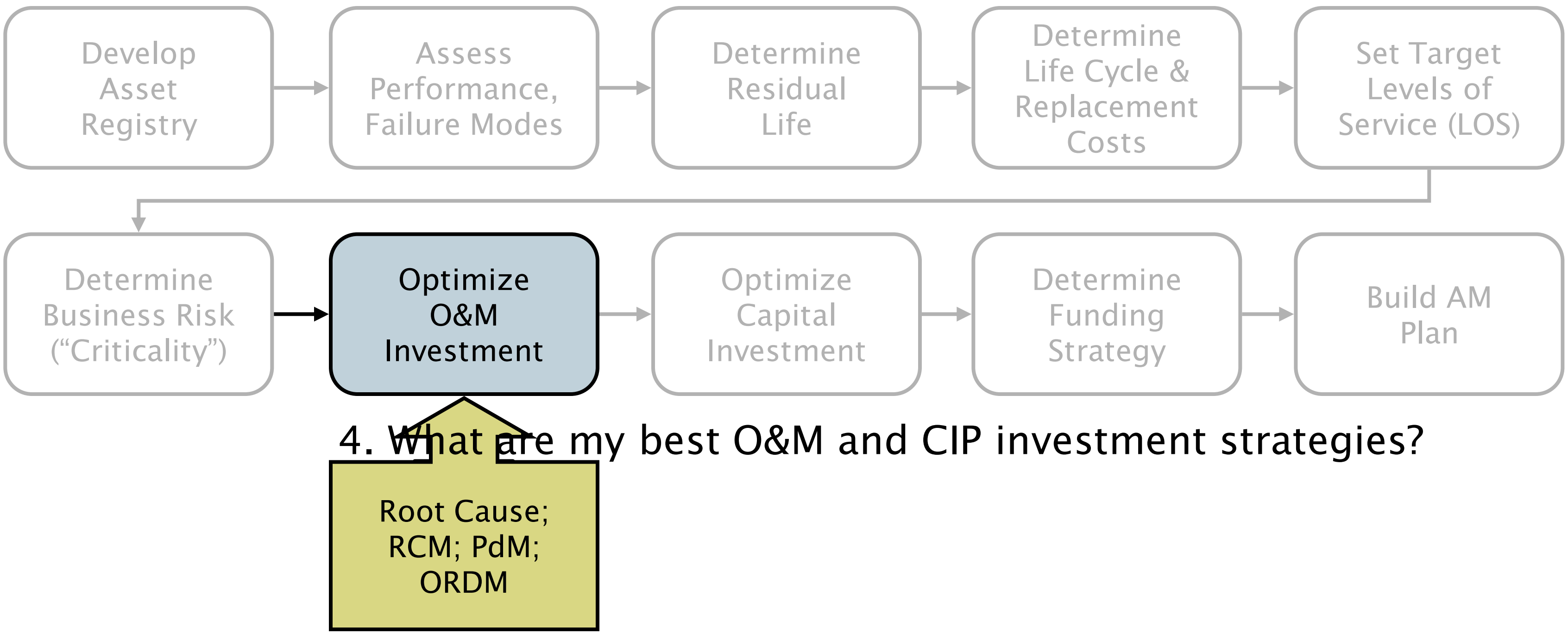
A Hands-On Approach

Tom's bad day…

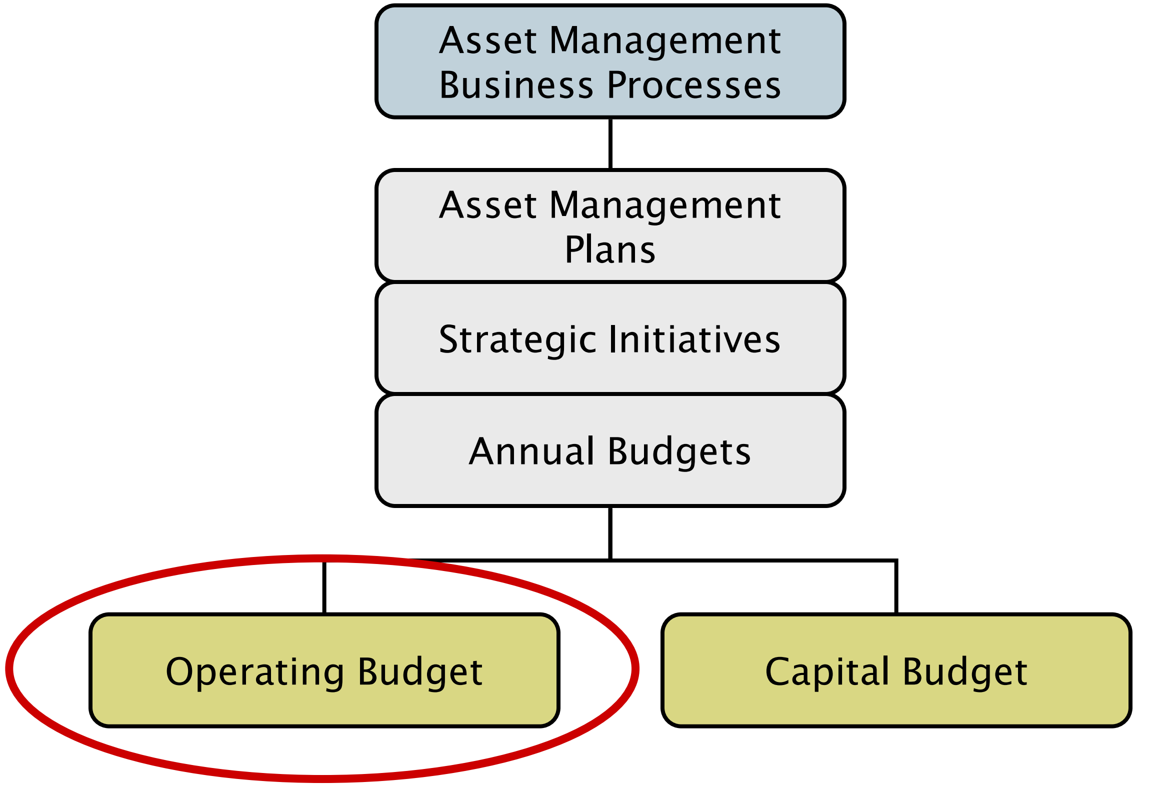
Fourth of 5 core questions

4. What are my best O&M and CIP investment strategies?
   - What alternative management *options* exist?
   - Which are the *most feasible* for my organization?

AM plan 10-step process



Recall view 4: Management framework

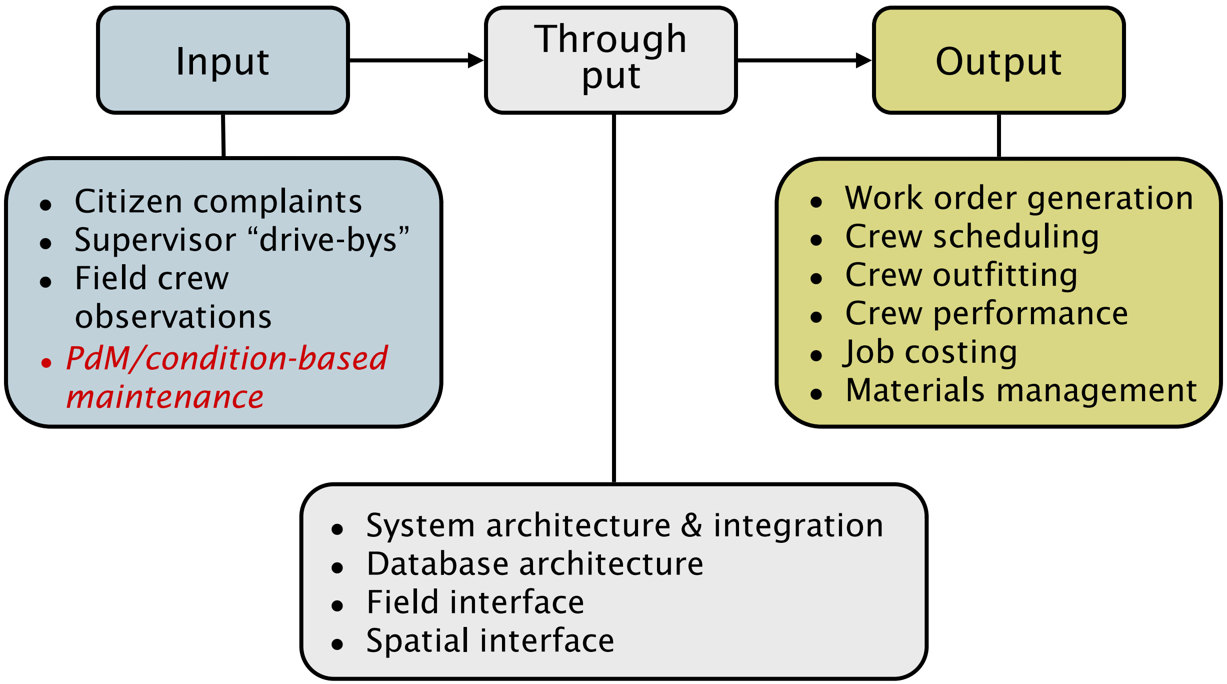


Definition

Maintenance - normal support, periodic and minor in nature, required to sustain performance, reliability, and functionality of an asset consistent with design, manufacturer, and operational requirements

What triggers a work order?

Computerized Maintenance Management System (CMMS)



Importance Of The Work Order: Asset Level

WORK ORDER

Type: PM or UM

- Estimated bill of quantities
- Actual
  - Labor
  - Plant
  - Materials
- Procedure followed
- Failure mode noted
- Primary cause of failure

Memos

- Impact on customers
- Unproductive time
- Other issues

Tells us planned (PM) or unplanned (UM) maintenance costs

Builds life cycle cost history; ties to warehouse management

Tells us actual direct costs of activity

Tells us the procedures to be applied

Useful in *failure mode analysis*

Necessary for *causal analysis*

Indirect costs on business; impact on customers (*consequence analysis*)

Used in *efficiency analysis*

Data feedback enables substantive analysis

Standard Maintenance Procedures (SMPs)

X–29 Chemical Feeder

Application:

This guide card applies to tank type water chemical feeders with pumps and agitators.

Frequency

Semi–annual

Special Instructions:

1. Review the Standard Operating Procedure for "Selection, Care, and Use of Respiratory Protection".

Check Points:

1. Drain chemical from feeder into storage containers.
2. Flush and clean feeder tank.
3. Flush piping with water.
4. Remove agitator and clean shaft and propeller; lubricate as required.
5. Check oil in pump reservoir.
6. Lubricate pump pistons.
7. Check operation of pressure relief valve.
8. Lubricate motors.
9. Replace chemicals into feeder storage tank.

Tools and Materials:

1. Standard tools – basic
2. Rubber gloves and apron
3. Filter air mask
4. Goggles
5. Grease gun and oiler
6. Cleaning materials. Consult the Material Safety Data Sheets (MSDS) for hazardous ingredients and proper personal protective equipment (PPE).

Bottom-line maintenance “KPIs” from an AM perspective

Metric	*Definition*	*Target*
Availability	The portion of time that a plant or major system is available for producing output of the required quality and quantity	99%
% Failure analysis	The portion of equipment downtime events that undergo a thorough analysis of failure modes, effects, and root causes	85 – 100%
% Planned work	The portion of corrective maintenance work hours that are planned and scheduled in advance (not unplanned breakdowns)	85 – 95%
% Overtime	The portion of maintenance work hours that are performed at an overtime rate	5 – 8%
Relative maintenance cost	Annual maintenance spending as a percentage of asset replacement value of the plant being maintained	1.5 – 2.5%
Technician productivity	The percent of work hours spent on productive activities versus nonproductive (rework, waiting for parts, etc)	70 – 85%
% Rework	The portion of maintenance work that has to be redone due to poor installation, shoddy workmanship or incorrect diagnosis	2 - 5%

Importance of the work order: *the asset perspective*

WORK ORDER

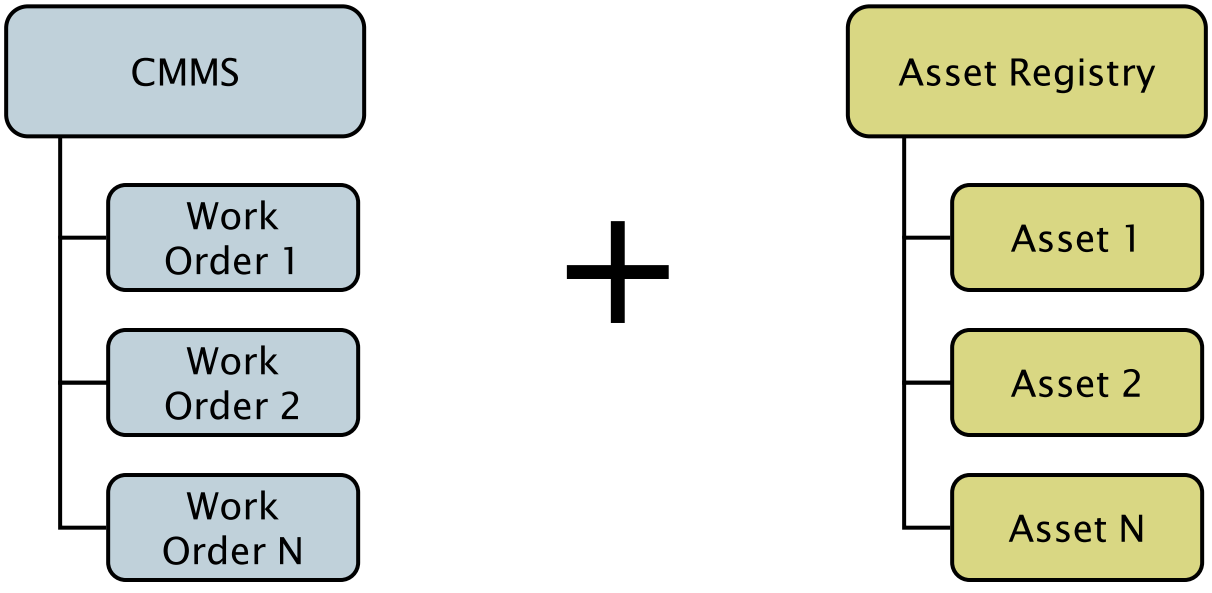
Asset details

- Type
- Category
- Size
- Condition
- Performance history
- Failure modes

Asset-linked costs enable significant analysis…

1. What type of sewer suffers the greatest number of blockages caused by tree roots?
2. How many failures are experienced by water mains of different ages in different ground conditions?

What Distinguishes EAMS from CMMS?



Focus is on the *maintenance work order* and maintenance performance for a defined period

Focus is on an *asset's performance* over its life cycle and on aggregate performance of asset groups

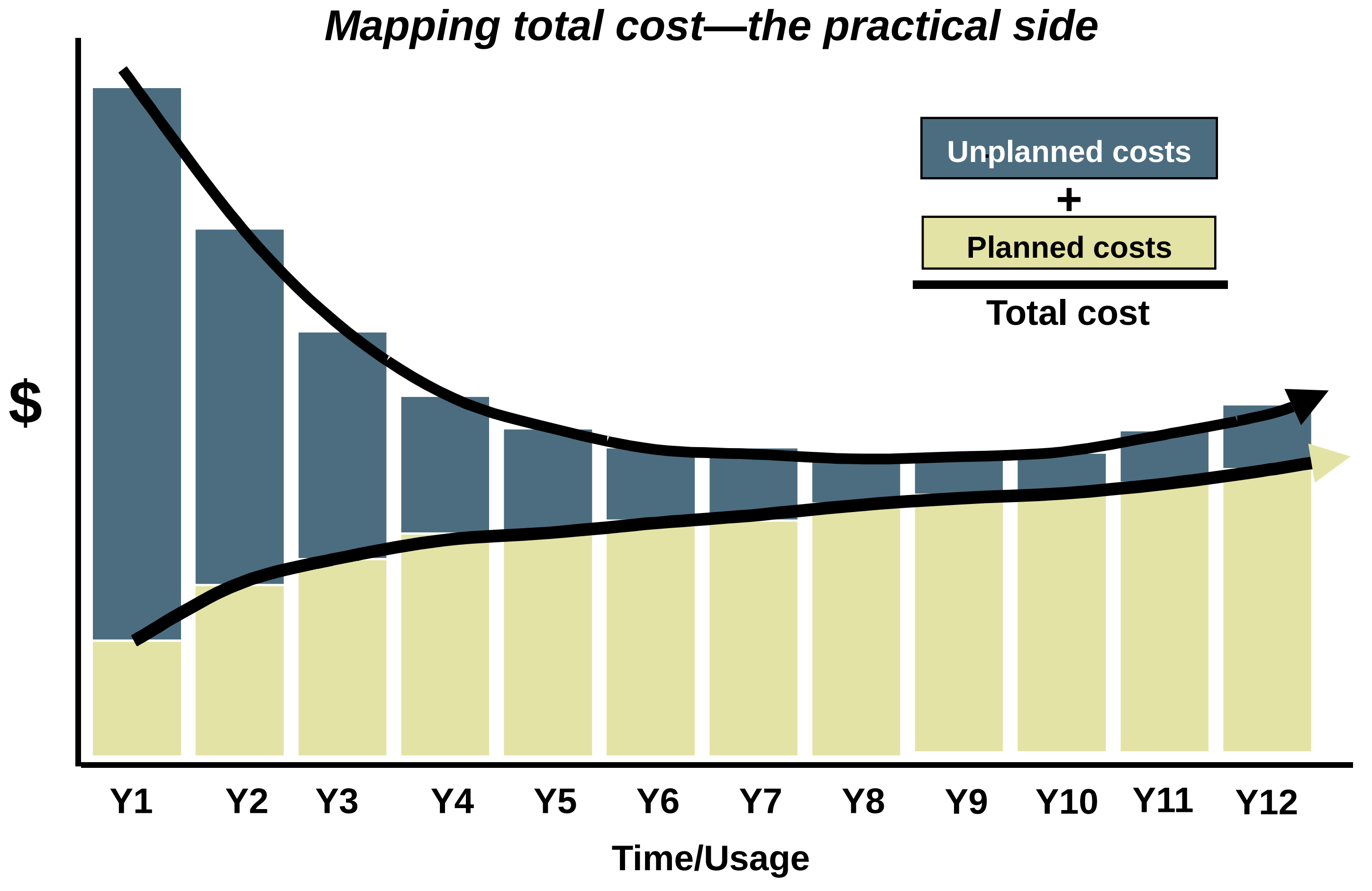
EAMS is Enterprise Asset Management System; CMMS is Computer-based Maintenance Management System

The Cost of Maintenance

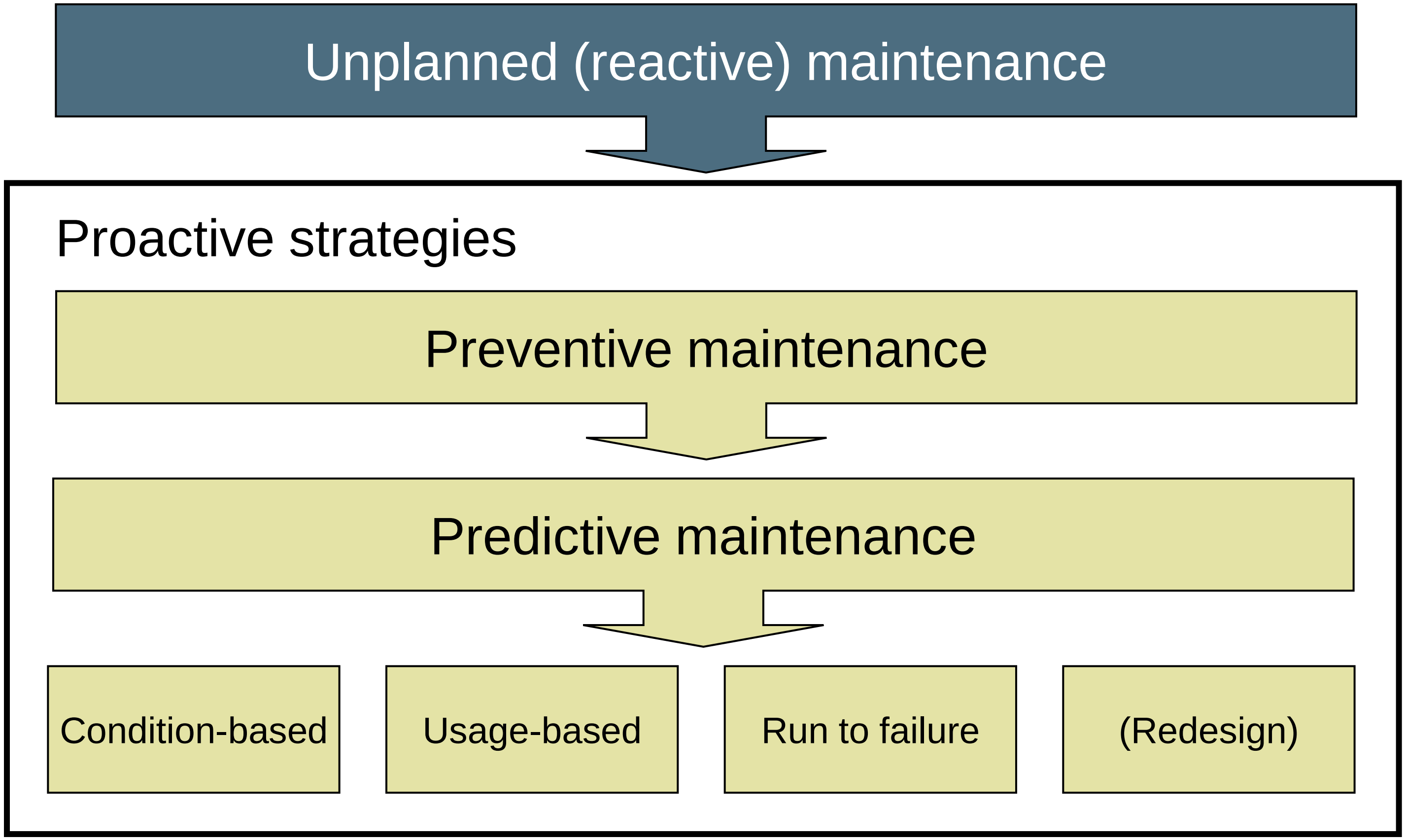
Rule of thumb

Roughly speaking, planned maintenance costs *one-third less* than unplanned maintenance for the same task

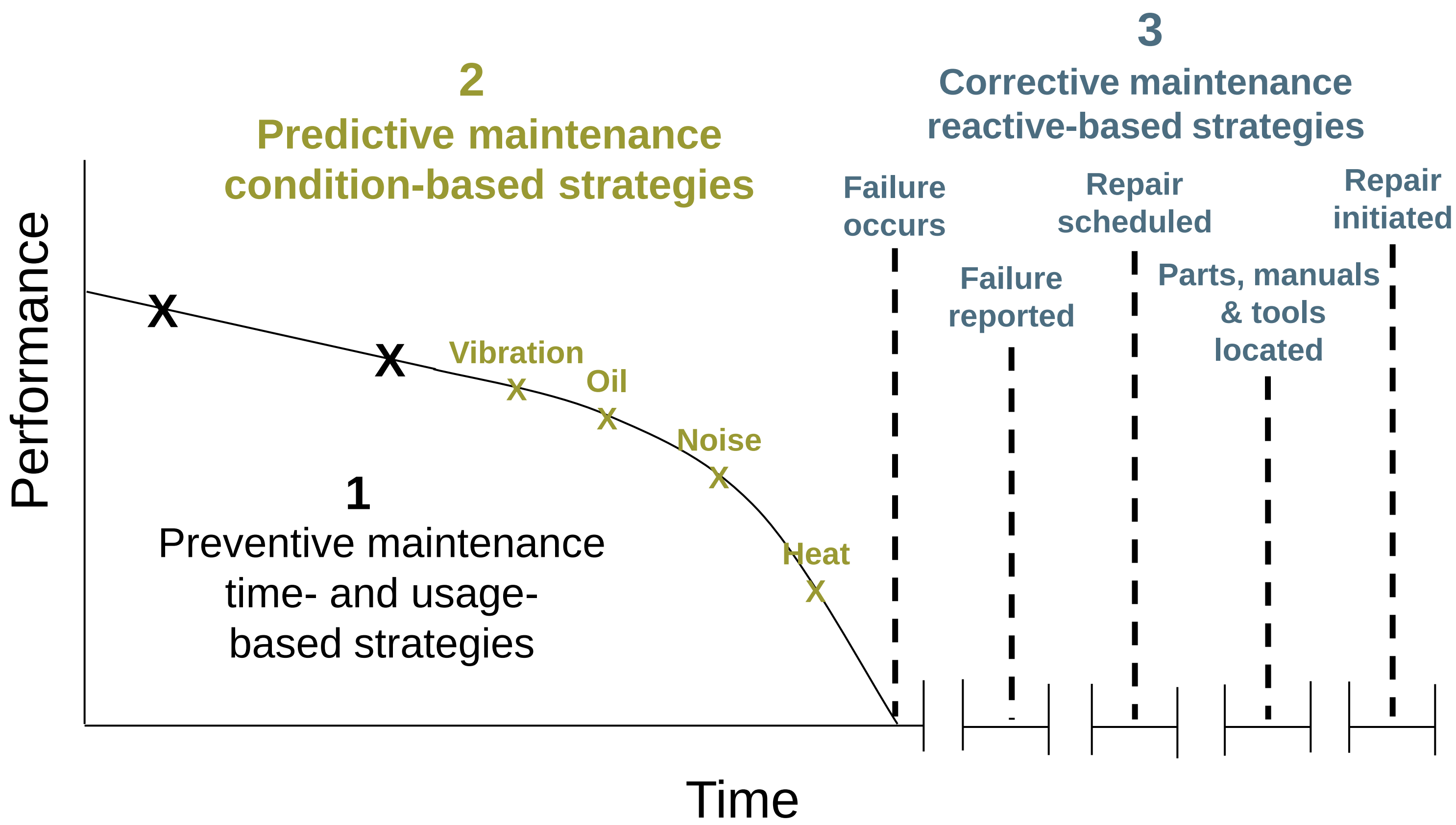
Transition to Planned Maintenance



Evolution of maintenance techniques



Fitting maintenance strategies to failure curve



The new “maintenance-theory” toolbox

Core strategies		
Total productive maintenance	Reliability centered maintenance	Zero breakdown maintenance

Operational tactics			
Design reliability analysis	Asset condition assessment	Early equipment management	Predictive (condition-based) maintenance
Accelerated deterioration elimination	Infrastructure, equip-ment, & component standardization	Root cause analysis	Design for maintainability
Failure lead-time analysis	Demand criticality classification	Location failure analysis	Standardized failure codes

Reliability-centered maintenance—the seven fundamental questions

1. What are the functions and associated performance standards of the asset in its present operating context?
2. In what ways does it fail to fulfill its functions?
3. What causes each functional failure?
4. What happens *mechanically* when each failure occurs?
5. In what way does each failure matter?
6. What can be done to predict or prevent each failure?
7. What should be done if a suitable proactive task cannot be found?

Techniques

- Function and performance standards
- Functional failures
- Failure modes
- Failure effects
- Failure consequences
- Proactive tasks

Example: RCM analysis on headworks screen

RCM II INFORMATION WORKSHEET © 1994 Aladon Ltd	SYSTEM *Bull screens*	No. 0	Compiled by	Date 18-Aug-02	Sheet 1
	SUB-SYSTEM	Ref. *Bull screens*	Reviewed by	Date	of 49

	FUNCTION		FUNCTIONAL FAILURE		FAILURE MODE (Cause of failure)	FAILURE EFFECT (What happens when it fails)
1	To remove all sedimentary and floating foreign matter greater than 1 inch from the effluent	A	Cannot remove foreign matter from the effluent	1	Bull screen shovel control cable worn	Over time the control cable wears and thins, strands start to break and eventually the cable looses enough tensile strength that it can no longer support the shovel's weight when open. The cable breaks and the shovel closes and cannot be opened. During its decent the shovel catches on the scraper and beaks it off. The shovel continues its cycle but does not open and cannot gather foreign matter. The excess material in front of the screen accumulates and the water level differential across the screen rises. The shovel tries to clean the screen more often and eventually the water level in front of the screen rises enough that the "high level" alarm sounds in the control room. With time the channel overflows. Repair time: 4 hours, Downtime: 5 hours. Special tools: mobile scaffolding and security bar. Spare parts: Wire rope in stock.
1		A		2	Bull screen shovel control cable extension worn	The control cable extension is positioned at the portion of the cable that flexes the most during normal operation. Over time the control cable extension wears and thins, strands start to break and eventually the cable looses enough tensile strength that it can no longer support the shovel's weight when open. The cable breaks and the shovel closes and cannot be opened. During its decent the shovel catches on the scraper and beaks it off. The shovel continues its cycle but does not open and cannot gather foreign matter. The excess material in front of the screen accumulates and the water level differential across the screen rises. The shovel tries to clean the screen more often and eventually the water level in front of the screen rises enough that the "high level" alarm sounds in the control room. With time the channel overflows. Repair time: 4 hours, Downtime: 5 hours. Special tools: mobile scaffolding and security bar. Spare parts: Wire rope in stock from which to make the extension.

IVARA-EAM
SPEED TO ACHIEVE

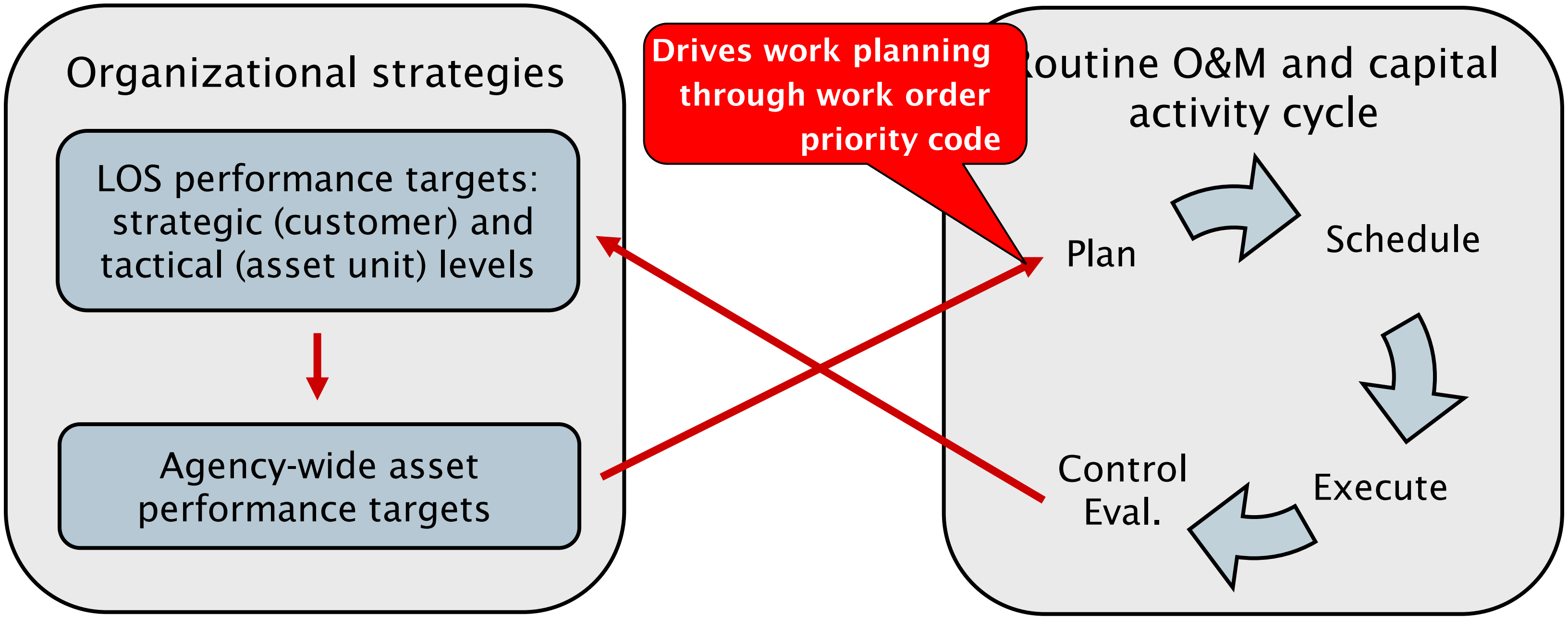
Example: RCM analysis on headworks screen

RCM II DECISION WORKSHEET © 1994 Aladon Ltd	SYSTEM: *Bull screens*	No. 0	Compiled by	Date 18-Aug-02	Sheet 1
	SUB-SYSTEM	Ref. *Bull screens*	Reviewed by	Date	of 9

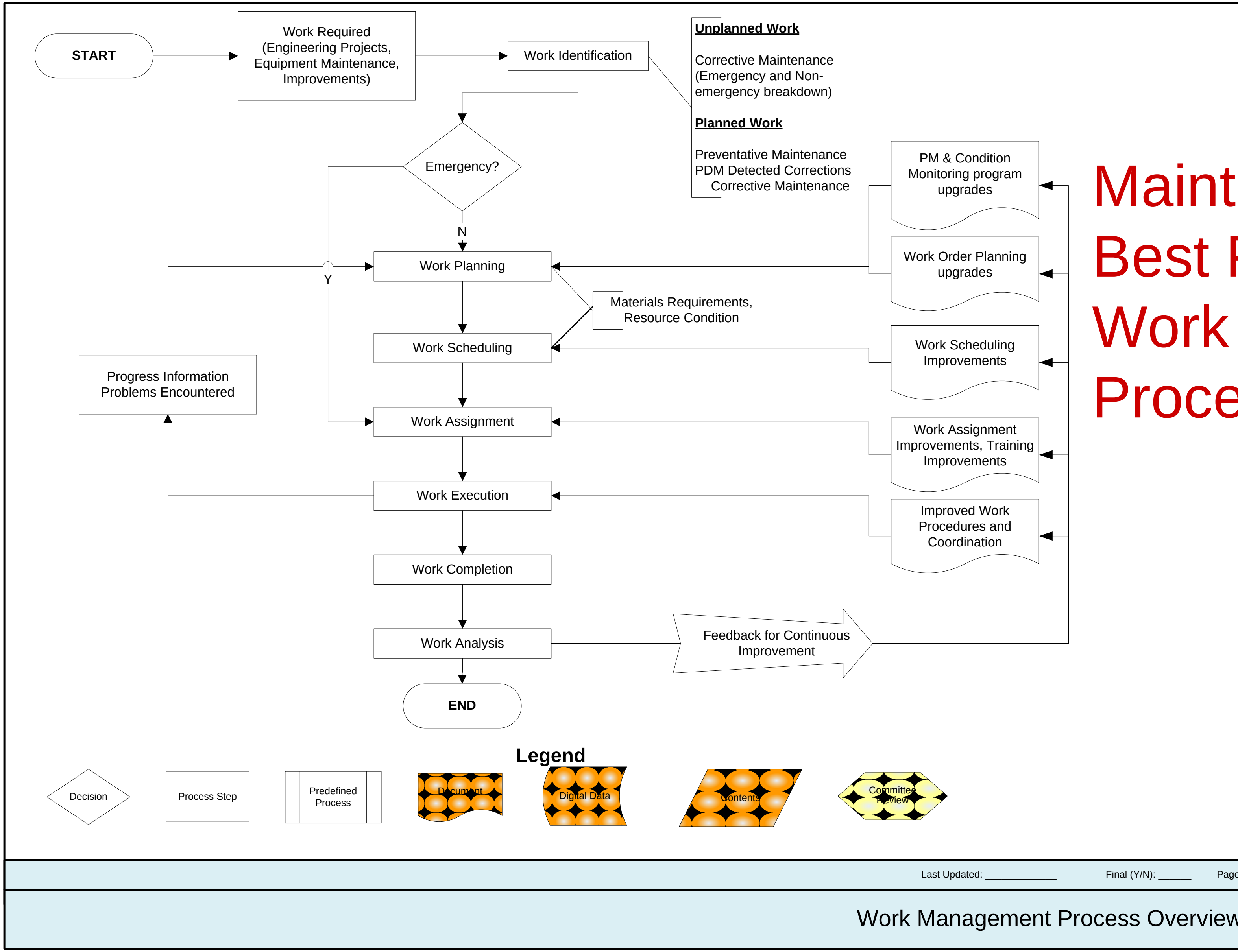
Information reference			Consequence evaluation				H1 S1 O1 N1	H2 S2 O2 N2	H3 S3 O3 N3	Default tasks			Proposed Task	Initial Interval	Can be done by
F	FF	FM	H	S	E	O				H4	H5	S4			
1	A	1	Y	N	N	Y	Y						Visual inspection of the shovel control cable for broken strands and reduced cable diameter. Standards to be established. Replace cable as needed.	5000 cycles	Mechanic
1	A	2	Y	N	N	Y	N	N	Y				Replace the bull screen shovel control cable extension	3500 cycles	Mechanic
1	A	3	Y	N	N	Y	N	Y					Shorten the bull screen shovel lift cable to eliminate the worn section, from the connector to the curvature. Ensure that both lift cables are the same length. The cable can be shortened twice before a new cable must be installed.	3500 cycles	Mechanic
1	A	4	Y	N	N	Y	Y						Visual inspection of the bull screen shovel lift cables for broken strands and reduced cable diameter. Standards to be established. Replace cable as needed. When replacing the cable, ensure that both lift cables are the same length.	5000 cycles	Mechanic
1	A	5	Y	N	N	Y	N	N	N				No scheduled maintenance		
1	A	6	Y	N	N	Y	Y						Visual inspection of the bull screen shovel's lift wench's drums for accumulation of foreign matter. Have the drum's surface cleaned when the accumulation affects cable seating.	Mensuel	Operator
1	A	7	Y	N	N	Y	Y						Visual inspection of the bull screen shovel's control wench's drum for accumulation of foreign matter. Have the drum's surface cleaned when the accumulation affects cable seating.	Mensuel	Operator
1	A	8	Y	N	N	Y	N	Y					Lubricate the bull screen shovel wench's bearings. Norms to be established.	Annuel	Mechanic

Alignment of O&M and capital activities with organizational Level of Service strategies

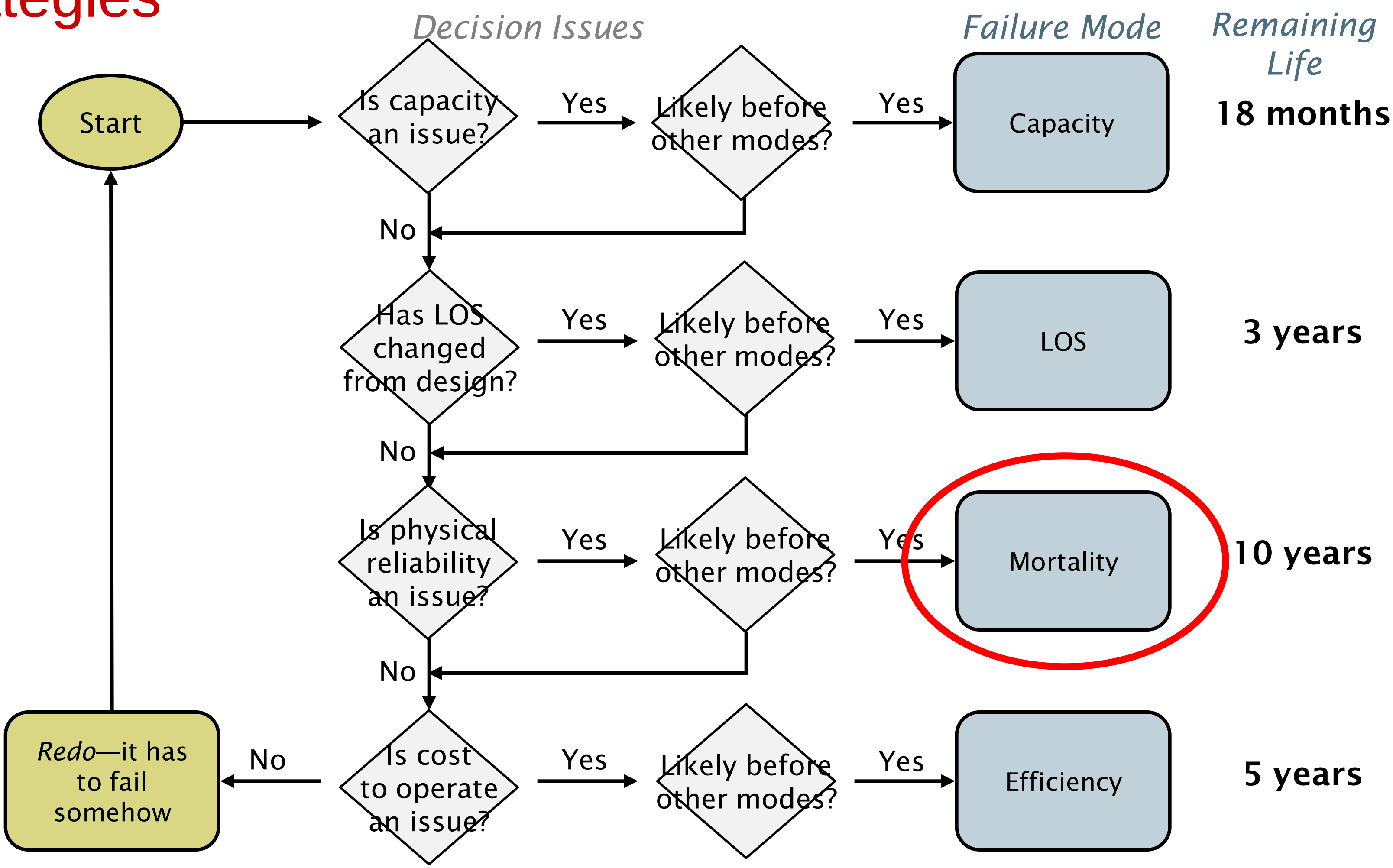
2.
Set minimum levels of performance at asset level



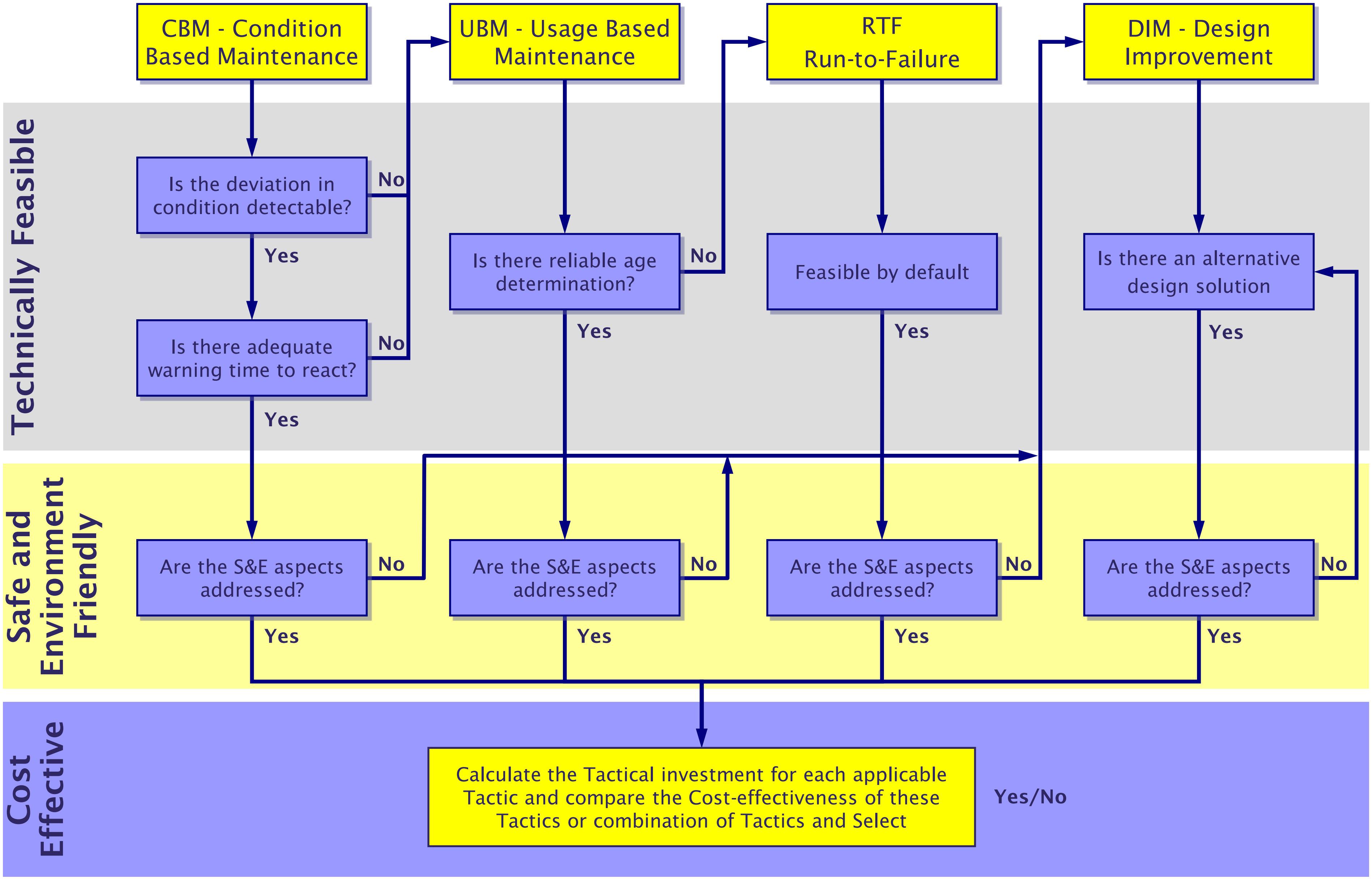
Maintenance Best Practice Work Processes



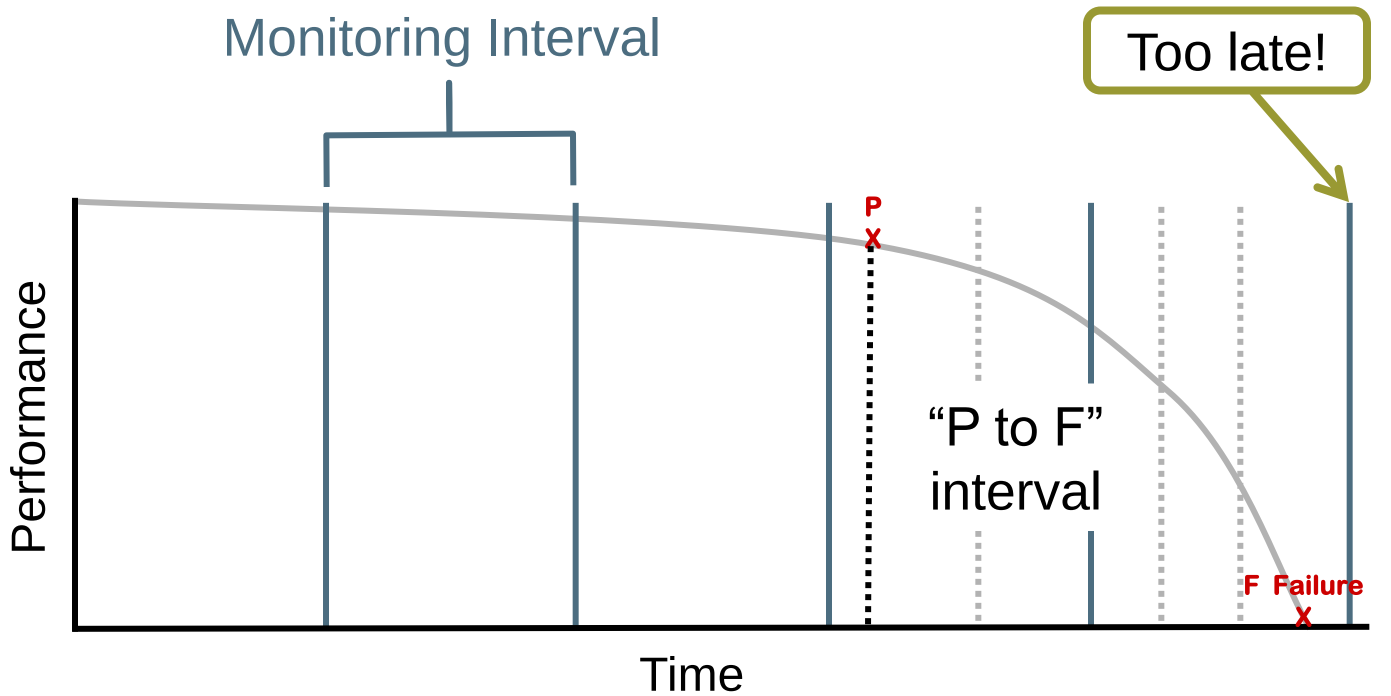
Using failure modes to determine maintenance strategies



Mortality Maintenance Tactics Selection Logic

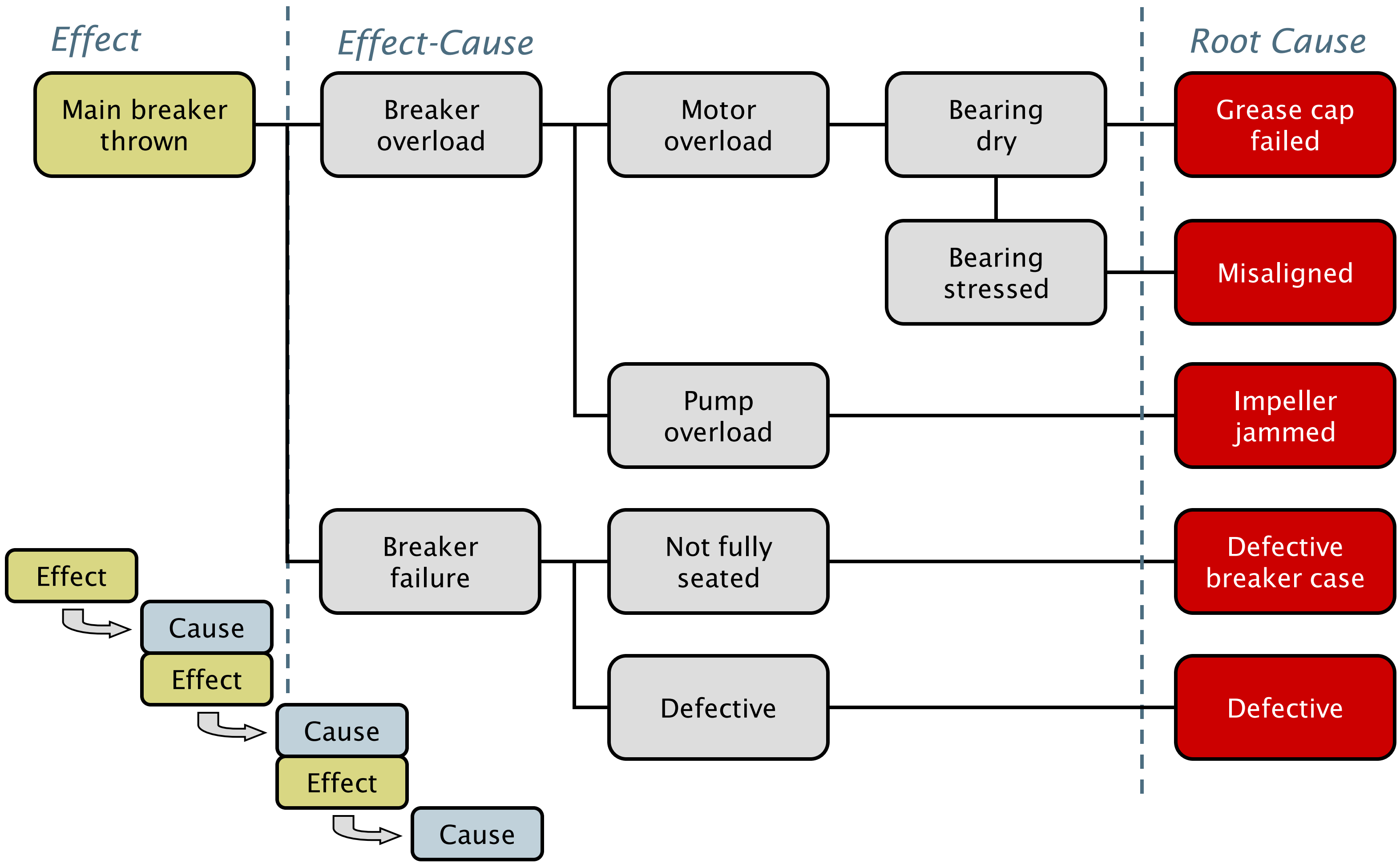


Predictive maintenance and the monitoring interval

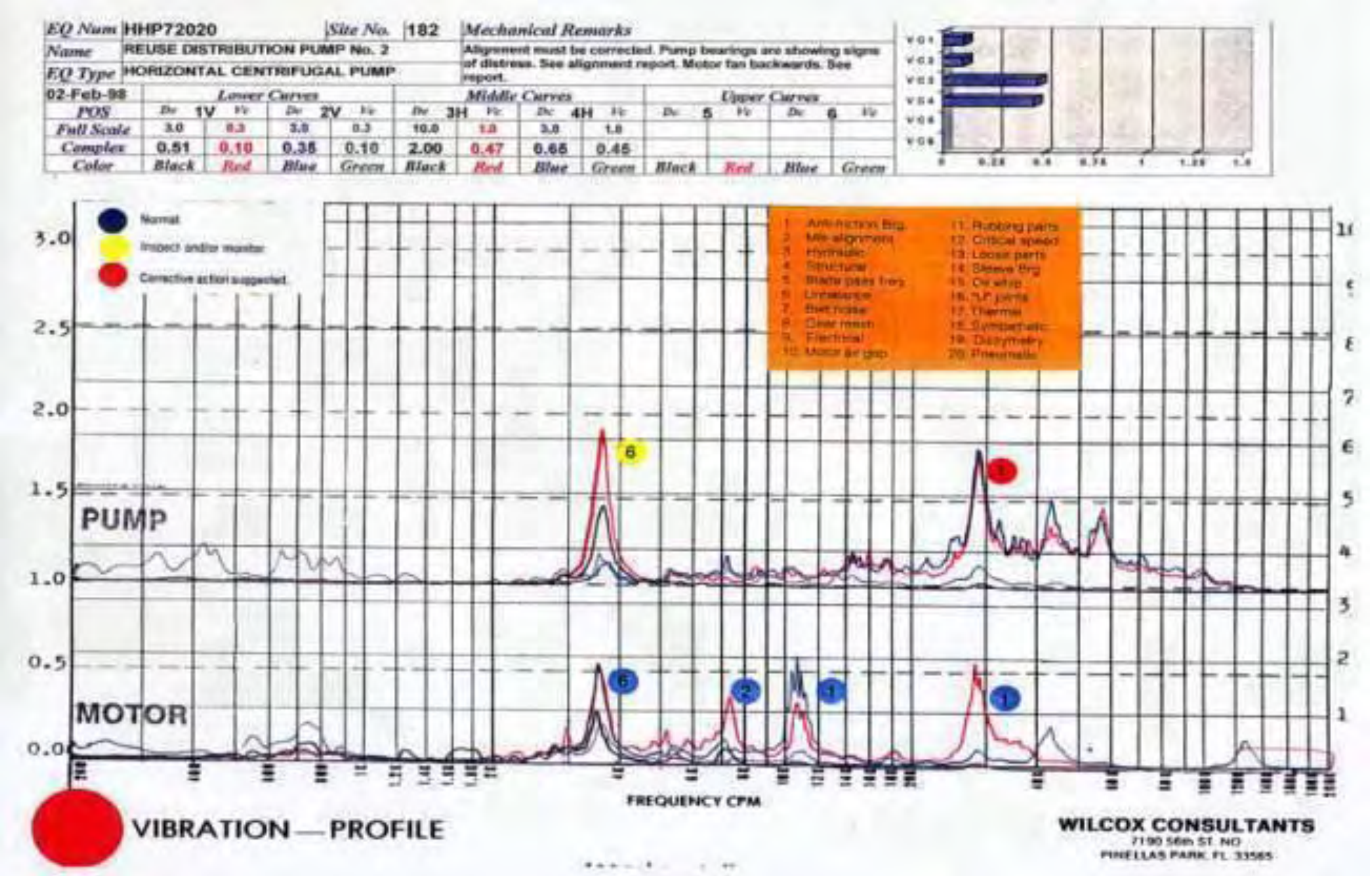


Can the progression of the failure be detected? Is there typically enough time to respond? Does consequence exceed cost of cure?

Cause and effect diagram—what to monitor



Condition-based maintenance: Vibration analysis



Power evaluation

Sample County - Waste Water Utilities Systems																
Sewage Lift Stations - Electrical Report - Data as Recorded, June, 1998																
	Voltage Line to Line			Amperage			Voltage Drops			Power Data				Horsepower and Load Percent		
Equip. Number	A to B	B to C	C to A	A	B	C	A	B	C	KVA	KVAR	KW	PF	Calc.	Rated	Percent
20LS-RSP-002	244.0	243.0	244.0	24.2	23.7	24.3	0.09	0.08	0.09	9.7	6.9	6.8	90.0	9.1	15.00	60.7
ABLS-RSP-001	474.0	473.0	475.0	24.1	25.1	25.7				17.5	2.8	17.2	98.7	23.1	25.00	92.4
ABLS-RSP-002	474.0	474.0	475.0	27.5	26.7	29.1				18.8	3.2	18.5	98.6	24.8	25.00	99.2
ABLS-RSP-003	474.0	475.0	475.0	25.4	25.8	29.5				17.8	2.9	17.6	98.7	23.6	25.00	94.4
BELS-RSP-001	239.0	240.0	242.0	59.8	52.6	65.7	0.19	0.19	0.18	23.9	12.7	20.3	84.9	27.2	25.00	108.8
BELS-RSP-002	240.0	242.0	240.0	50.5	51.3	55.4	0.16	0.16	0.18	21.5	13.6	16.7	77.6	22.4	25.00	89.6
BGLS-RSP-001	242.0	241.0	242.0	8.5	8.6	8.8	0.30	0.30	0.35	3.6	2.4	2.7	74.5	3.6	3.00	120.0
BGLS-RSP-002	242.0	241.0	242.0	9.4	9.3	9.6	0.24	0.18	0.17	3.9	2.1	3.3	84.2	4.4	3.00	146.7
BLLS-RSP-001	479.0	475.0	468.0	3.9	3.8	3.9	0.08	0.08	0.07	3.0	2.0	2.3	75.3	3.1	2.00	155.0
BLLS-RSP-002	482.0	483.0	485.0	4.0	3.9	4.0	0.08	0.06	0.13	3.1	2.1	2.3	73.9	3.1	2.00	155.0
CMLS-RSP-001	457.0	456.0	456.0	6.6	6.6	7.2	0.40	0.40	0.42	5.1	3.6	3.7	71.3	5.0	7.50	66.7
CMLS-RSP-002	457.0	458.0	458.0	6.0	6.0	6.1	0.27	0.27	0.63	4.7	3.8	2.7	58.0	3.6	7.50	48.0
DWLS-RSP-001	486.0	485.0	486.0	22.1	22.9	24.0	0.14	0.21	0.14	19.0	10.9	15.6	82.0	20.9	20.00	104.5
DWLS-RSP-002	485.0	486.0	486.0	21.3	22.0	22.8	0.16	0.14	0.15	18.3	10.7	14.8	81.1	19.8	20.00	99.0
FDLS-RSP-001	239.0	239.0	239.0	21.1	22.1	22.8	0.21	0.25	0.20	9.0	6.6	6.1	68.2	8.2	10.00	82.0
FDLS-RSP-002	240.0	239.0	240.0	23.9	24.0	25.8	0.26	0.26	0.31	10.0	7.0	7.1	70.9	9.5	10.00	95.0
FRLS-RSP-001	212.0	213.0	215.0	4.9	5.4	5.9	0.23	0.22	0.26	2.0	1.5	1.3	66.5	1.7	2.00	85.0
FRLS-RSP-002	212.0	213.0	215.0	5.2	5.6	6.1	0.25	0.25	0.27	2.1	1.5	1.4	70.0	1.9	2.00	95.0
FSLS-RSP-001	238.0	240.0	240.0	33.7	36.8	42.7	0.14	0.14	0.13	14.8	10.3	10.6	71.7	14.2	15.00	94.7
FSLS-RSP-002	239.0	239.0	240.0	31.4	34.7	39.8	0.17	0.16	0.19	13.9	10.7	8.9	63.9	11.9	15.00	79.3
H6LS-RSP-001	244.0	242.0	242.0	9.2	8.8	9.5	0.62	0.79	0.73	3.8	2.5	2.9	74.7	3.9	3.00	130.0
H6LS-RSP-002	242.0	242.0	241.0	10.2	9.6	10.0	0.49	0.81	0.60	4.1	2.9	2.9	70.8	3.9	3.00	130.0
HCLS-RSP-001	242.0	242.0	243.0	28.4	27.1	26.0	0.12	0.10	0.12	11.2	9.0	6.7	59.3	9.0	15.00	60.0
HCLS-RSP-002	243.0	242.0	243.0	28.3	26.9	25.6	0.12	0.11	0.12	11.2	8.6	7.1	63.6	9.5	15.00	63.3
HKLS-RSP-001	241.0	241.0	242.0	60.3	60.1	38.2	0.45	0.30	0.72	27.1	20.6	17.7	65.1	23.7	40.00	59.3
HKLS-RSP-002	240.0	241.0	241.0	62.4	63.2	66.0	0.23	0.36	0.66	26.6	15.9	21.3	80.2	28.6	40.00	71.5
HSLS-RSP-001	208.0	206.0	208.0	240.3	26.2	28.1	0.19	0.19	0.28	9.0	5.8	6.9	76.5	9.2	10.00	92.0
HSLS-RSP-002	208.0	206.0	208.0	24.1	26.4	27.7	0.17	0.19	0.20	9.0	5.7	6.7	77.4	9.0	10.00	90.0
JHLS-RSP-001	244.0	243.0	243.0	50.9	52.4	51.6	0.21	0.63	0.19	21.4	15.4	14.9	69.6	20.0		
JHLS-RSP-002	245.0	244.0	245.0	44.1	42.9	45.1	0.36	0.54	0.32	18.4	12.7	13.4	72.7	18.0		
MWLS-RSP-001	241.0	240.0	241.0	11.0	11.6	12.4	0.19	0.13	0.14	4.7	2.5	4.0	84.8	5.4	7.50	72.0

Prepared by Wilcox Consulting Inc. - Madeira Beach Office - 11/8/00

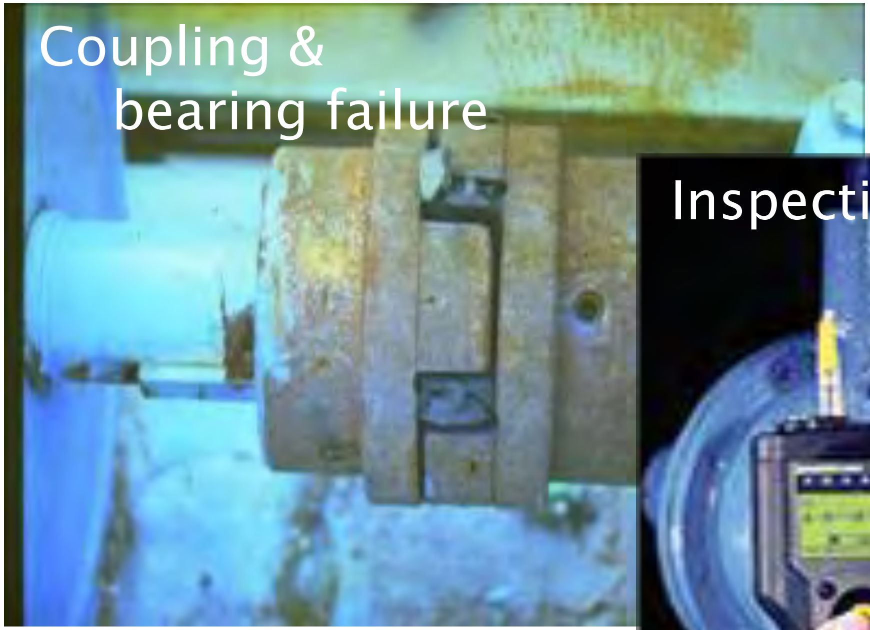
Page 1

Most condition indicators are not visible to the unaided eye

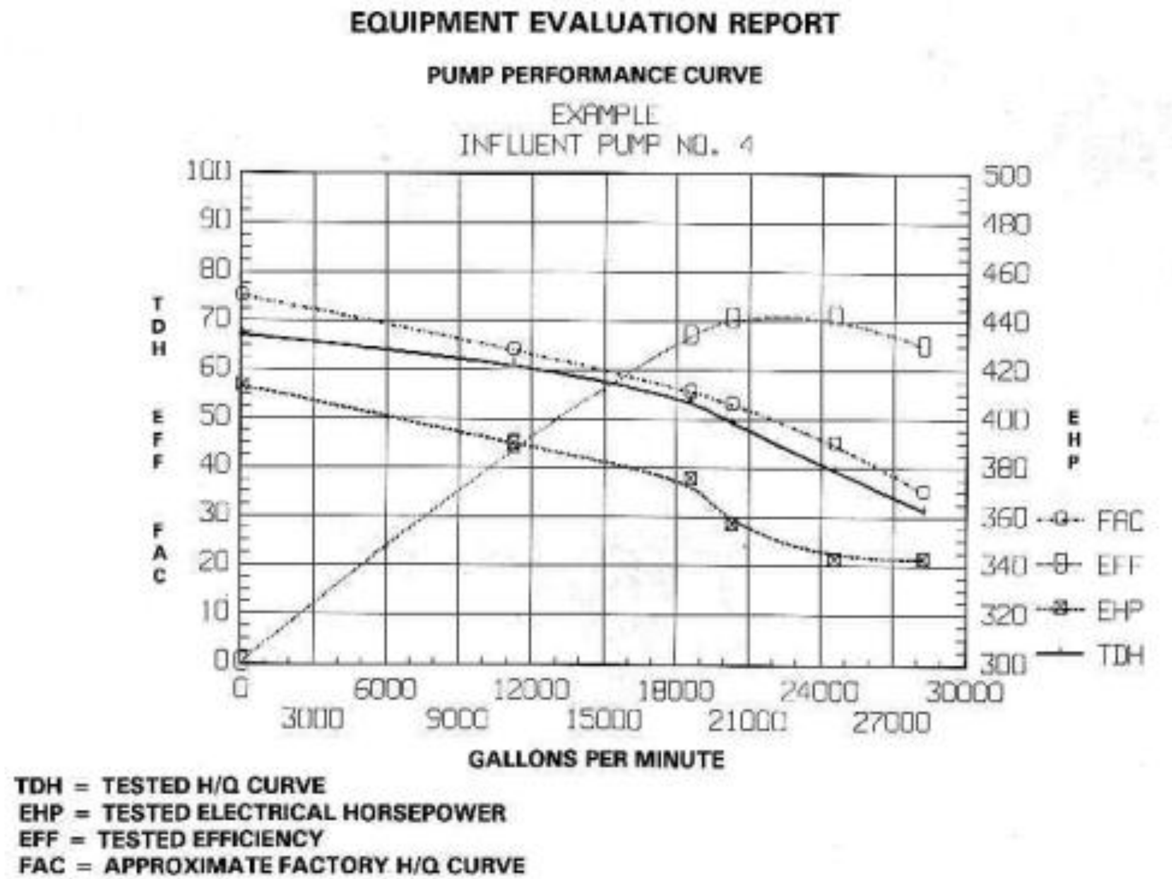
Visual inspection

Infrared view

Alignment of inspection and correction data

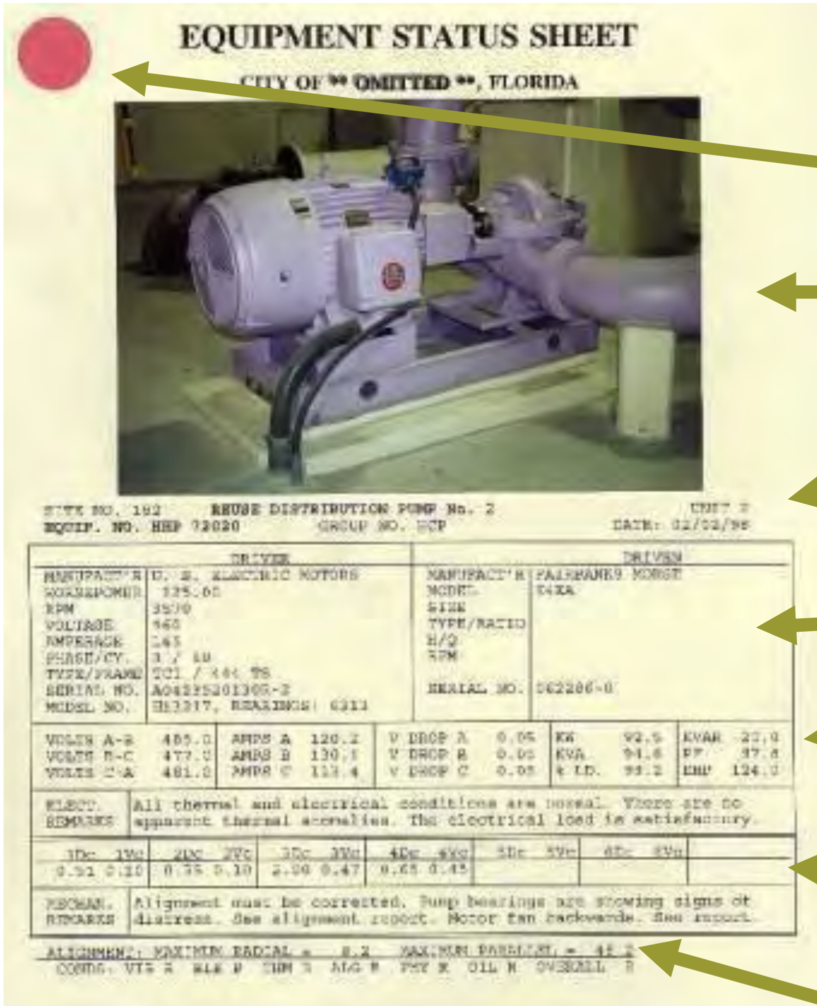


Baseline machine performance tests



Baseline at handover sets life cycle benchmark. Conforms to factory test curves?

Status sheet (summary)



EQUIPMENT STATUS SHEET

CITY OF ** OMITTED **, FLORIDA

SITE NO. 182 REUSE DISTRIBUTION PUMP No. 2 UNIT 2
EQUIP. NO. HHP 72020 GROUP NO. HCP DATE: 02/02/96

DRIVER		DRIVEN	
MANUFACT'R	U. S. ELECTRIC MOTORS	MANUFACT'R	FAIRBANKS MORSE
HORSEPOWER	125.00	MODEL	54XA
RPM	3570	SIZE	
VOLTAGE	460	TYPE/RATIO	
AMPERAGE	145	H/Q	
PHASE/CY.	3 / 60	RPM	
TYPE/FRAME	TCI / 444 TS		
SERIAL NO.	A04225201305-2	SERIAL NO.	562286-0
MODEL NO.	HE3317, BEARINGS: 6313		

VOLTS A-B	485.0	AMPS A	120.2	V DROP A	0.05	KW	92.5	KVAR	22.0
VOLTS B-C	477.0	AMPS B	130.1	V DROP B	0.05	KVA	94.6	PF	97.8
VOLTS C-A	481.0	AMPS C	113.4	V DROP C	0.05	% LD.	99.2	EHP	124.0

ELECT. REMARKS: All thermal and electrical conditions are normal. There are no apparent thermal anomalies. The electrical load is satisfactory.

1Dc	1Vc	2Dc	2Vc	3Dc	3Vc	4Dc	4Vc	5Dc	5Vc	6Dc	6Vc
0.51	0.10	0.75	0.10	2.00	0.47	0.65	0.45				

MECHAN. REMARKS: Alignment must be corrected. Pump bearings are showing signs of distress. See alignment report. Motor fan backwards. See report.

ALIGNMENT: MAXIMUM RADIAL = 8.2 MAXIMUM PARALLEL = 48.2
CONDS. VIB R BLE P THM N ALG P PSY R OIL N OVERALL R

- Overall condition
- Picture of machine
- Description
- All nameplate data
- Electrical data
- Vibration data
- Alignment data

Multiple factors - equipment status list

Severity color code

EQUIPMENT SUMMARY REPORT - STATUS LIST

June, 1998

Equipment Number	Site Number	Overall	Vibration	Electrical	Thermo-graphy	Alignment	Physical	Oil
LOCEQ	SITENO	OACC	VIBC	ELEC	THRC	ALGC	PHYC	OILC
20LS-RSP-001	113A	O	N	N	N	N	R	N
20LS-RSP-002	113B	Y	Y	B	B	N	B	N
ABLS-RSP-001	101A	Y	B	B	B	N	B	N
ABLS-RSP-002	101B	Y	Y	B	B	N	B	N
ABLS-RSP-003	101C	Y	B	N	N	N	R	N
ABTP-ADU-001	201	B	B	Y	B	N	B	B
ABTP-ADU-002	202	Y	N	N	N	N	B	B
ABTP-ADU-003	203	B	N	N	N	N	B	B
ABTP-ADU-004	204	R	N	N	N	N	B	B
ABTP-BC1-001	205	R	N	N	N	N	B	R
ABTP-BC1-002	206	R	N	B	B	N	B	R
ABTP-BC1-002	207	R	B	B	B	N	B	R
ABTP-MAC-001	225	N	B	B	B	N	B	N
ABTP-PFP-001	228	N	B	B	B	N	B	N
ABTP-SFP-001	223	N	N	N	N	N	N	N
ABTP-SFP-002	227	N	N	Y	B	N	Y	N
ABTP-SFP-002	224	N	R	R	B	N	R	N
ABTP-TBF-001	211	N	N	B	B	N	B	N
ABTP-TBF-002	212	N	N	B	B	N	B	N
ABTP-TBF-003	213	N	B	B	Y	N	B	N
ABTP-TBF-004	214	N	N	B	B	N	B	N
ABTP-TBF-005	215	N	Y	Y	B	N	Y	N
ABTP-TBF-006	216	N	N	Y	B	N	Y	N
ABTP-THK-001	220	R	N	N	N	N	N	R
ABTP-THK-002	221	B	B	B	B	N	B	N

Failure codes

- Use cause-effect diagrams to create codes
- Define codes by class of asset
- Use “drop-down” list

Failure Code

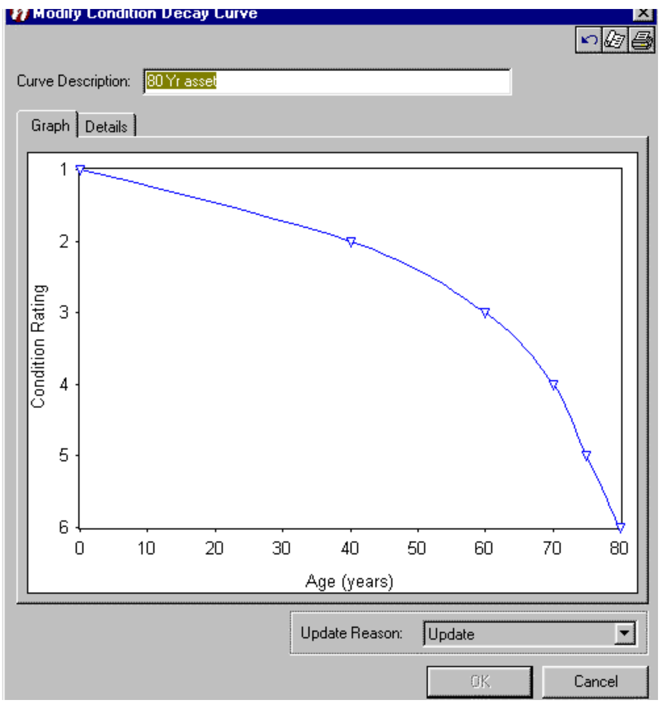
- Coupling failure
- Lube fault
- Misaligned
- Operator error
- Overloaded
- Water damage
- Worn

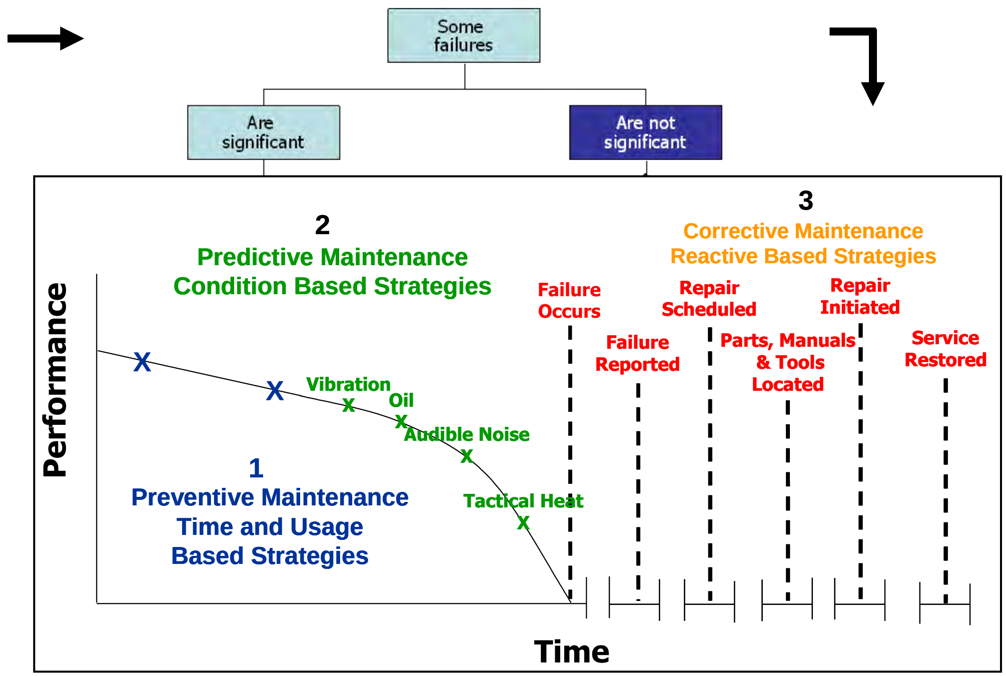
Condition-based maintenance

“Nameplate” Data

+

Vibration Signature	Sonic Signature	Thermal Signature	Electrical Signature	Performance Signature	Oil Residue Signature	Electro-magnetic Signature

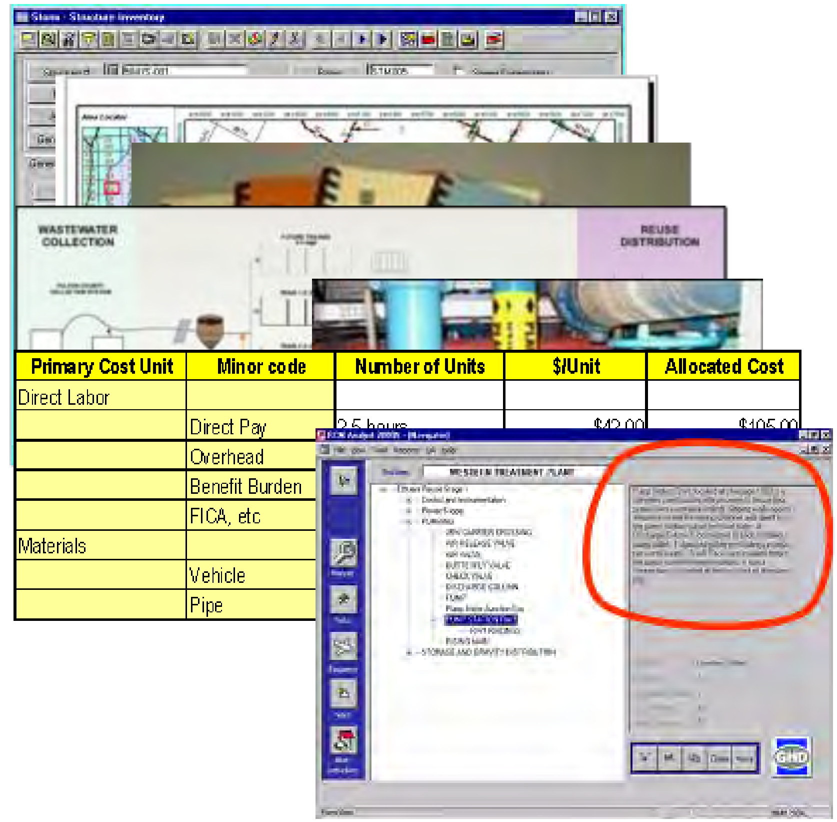




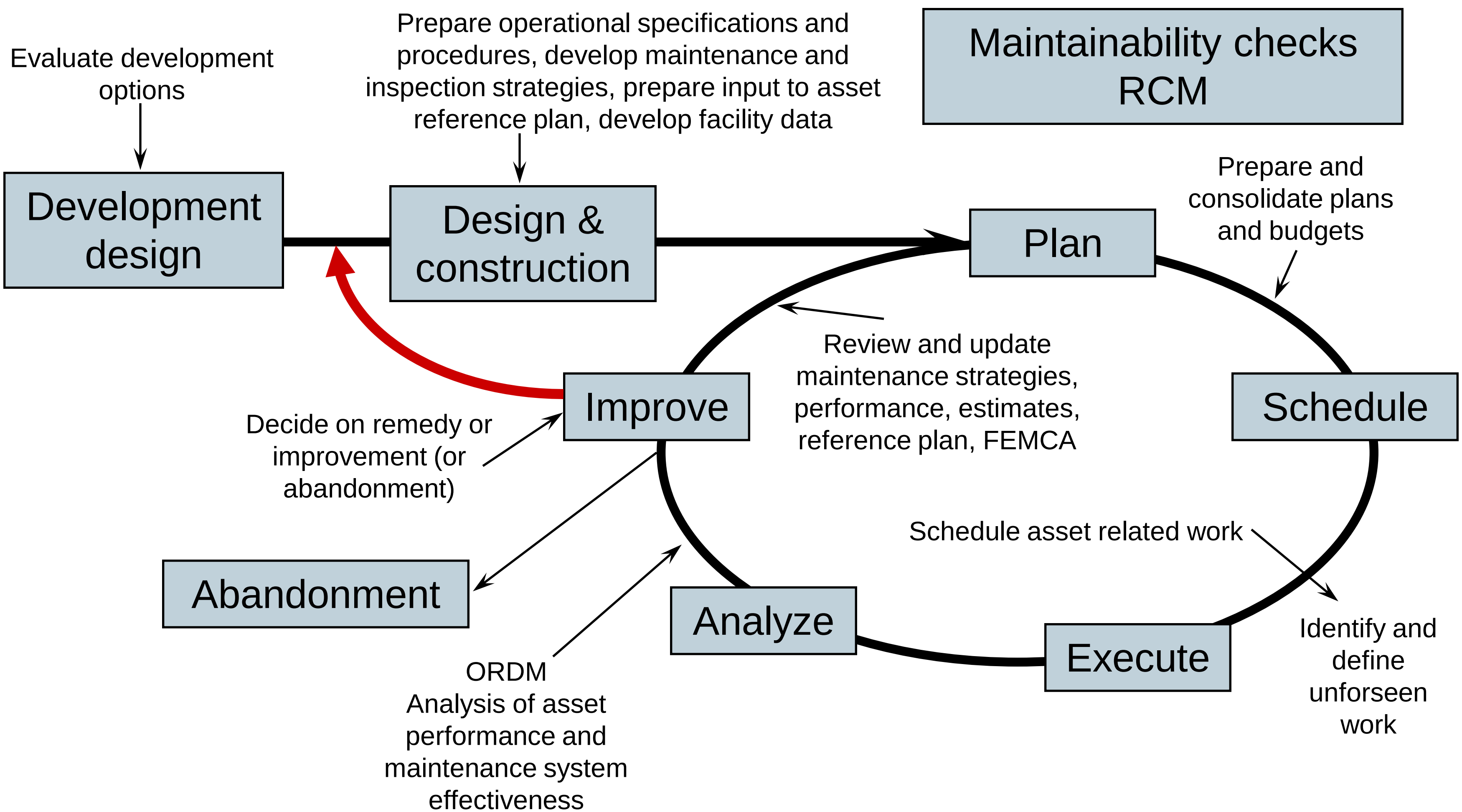
Store the maintenance strategy!

Used to *create an asset ID*…

- Physical attributes
- Geo-reference
- O&M manuals
- Drawings and photos
- Life cycle costs
- Knowledge and strategy



Linking maintenance and design



Key points from this session

Given my system, what are my best O&M strategies?

Key Points:·

- Reactive emergency maintenance can be the most expensive type of maintenance and should typically make up no more than 20% to 25% of total maintenance effort
- Preventive and predictive-based pro-active strategies should comprise the bulk of the effort
- Assets, especially dynamic assets, leave discernable clues as to their capacity to perform.
- The most cost effective maintenance strategy for a given asset is determined by the likelihood of failure and the consequence of failure.
- "Run to failure" may well be the most cost-effective maintenance strategy for a given asset, but only when coupled with a carefully developed failure response plan.

Associated Techniques:

- Condition-based monitoring plans and deployment
- Reliability Centered Management
- Root cause analysis
- Asset maintenance strategies (zero breakdown, total productivity, reliability centered maintenance)
- Failure response plans

Tom’s spreadsheet

Microsoft Excel - EPA Seminar Master.xls

	A	B	C	D	E	F	G	H	I	J	S	T	U	V	W	X	Y
6	Asset Register and Hierarchy					What is the State of My Assets?							Required LOS?		Which Are Most "Critical"?		
7						Installed Date	Asset Class	Original Cost	Estimated Effective Life	Condition Rating	Annual Dep	Accum Dep	Current LOS?	Minimum Condition	Backup Reduction (Redundancy)	Probability of Failure	Consequence o Failure
8	Curre	2006				Year		$	Years	1 to 10	$	$			%	Rating	1 to 10
9	Level 1	Level 2	Level 3	Level 4	Level 5	Act or Est	Tab A	Act or Est	Calculated	Tab A	Calculated	Calculated		Tab A	Tab D	Calculated	Tab C
10	Sanitation System																
11		Disposal System															
12		Treatment Plants															
13		Collection Systems															
14			Sewer Mains														
15			Pump Station														
16				Incoming Sewer									Avg 1500 cfm; peak 2100cfm				
17					Pipes	1963	3	$ 1,725	100	6	$ 17	$ 742		2	0%	4	5
18					Manhole	1963	3	$ 340	100	5	$ 3	$ 146		2	0%	4	5
19					Influent Gate Valve	1986	5	$ 442	30	8	$ 15	$ 295		2	0%	7	5
20				Incoming Power									20 kw peak				
21					Pole & Transformer	2006	4	$ -	40	1	$ -	$ -		2	0%	0	5
22					Connection	2006	7	$ -	35	1	$ -	$ -		2	0%	0	5
23				Control system													
24					Incoming Telephone	1985	8	$ 85	25	7	$ 3	$ 71		2	0%	8	2
25					PLC	1983	8	$ 8,600	25	8	$ 344	$ 7,912		2	0%	9	2
26					Manual controls	1978	8	$ 425	25	7	$ 17	$ 476		2	50%	5	2
27				Land & Improvemnts.													
28					Land	1950	10	$ 630	300	1	$ 2	$ 118		4	0%	2	1
29					Access Road	1963	1	$ 12,500	75	5	$ 167	$ 7,167		4	0%	6	1
30					Landscaping	2000	1	$ 595	75	6	$ 8	$ 48		3	0%	1	1
31					Security fence	1963	1	$ 1,360	75	7	$ 18	$ 780		2	0%	6	3
32				Sub Structure													
33					Cassion Outer	1963	1	$ 30,600	75	6	$ 408	$ 17,544		3	0%	6	4
34					Upper Floor	1963	1	$ 4,250	75	6	$ 57	$ 2,437		3	0%	6	4
35					Dry well	1963	1	$ 6,800	75	6	$ 91	$ 3,899		3	0%	6	4
36					Landings and Stairs	1963	9	$ 4,250	60	7	$ 71	$ 3,046		2	0%	7	4
37					Wet Well	1963	1	$ 5,100	75	6	$ 68	$ 2,924		3	0%	6	4
38					Shaped floor	1963	1	$ 850	75	6	$ 11	$ 487		3	0%	6	3
39					Sump pump	1963	4	$ 595	40	6	$ 15	$ 640		2	0%	10	4
40				Pumps									peak 2100cfm				
41					Drive shafts	2006	6	$ 12,560	35	1	$ 359	$ -		2	TBD	10	TBD
42					Pumps	2006	4	$ 29,750	40	1	$ 744	$ -		2	TBD	10	TBD

E - Renewal S

Ready