Fundamentals of Asset Management

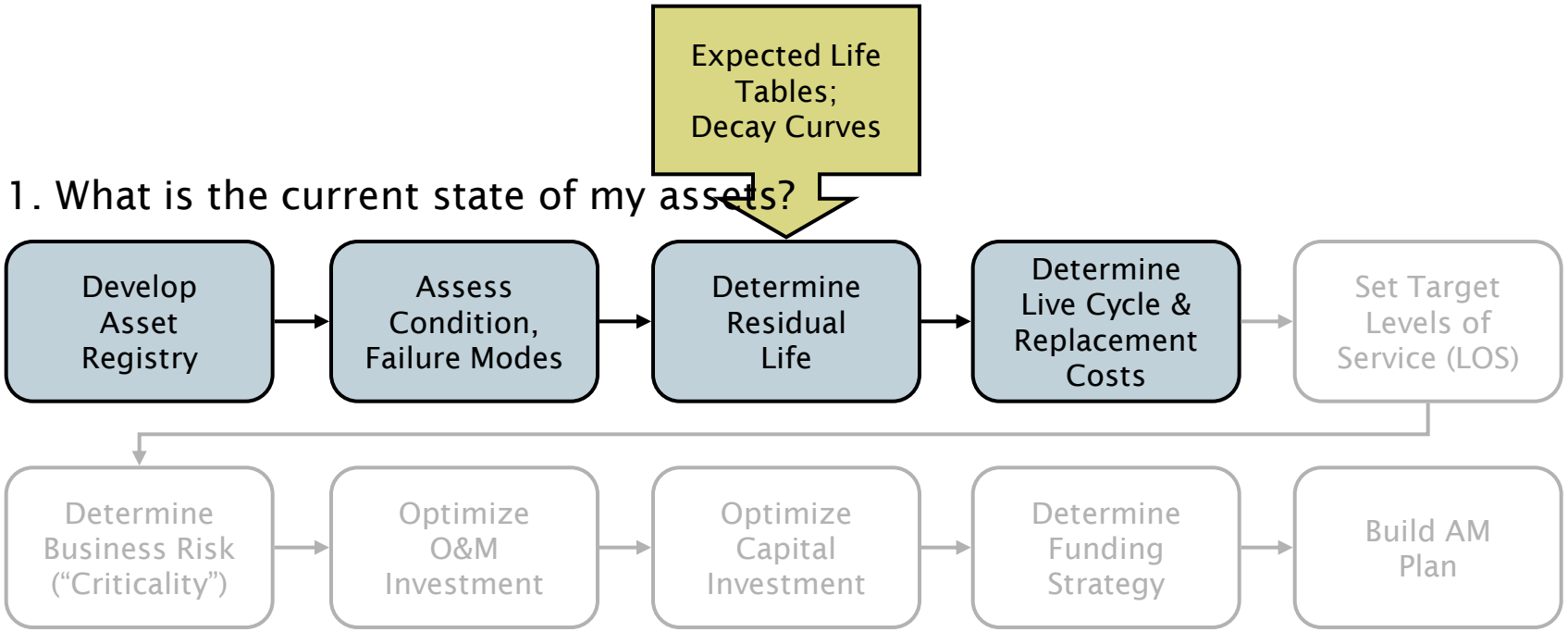
Step 3. Determine Residual Life

A Hands-On Approach

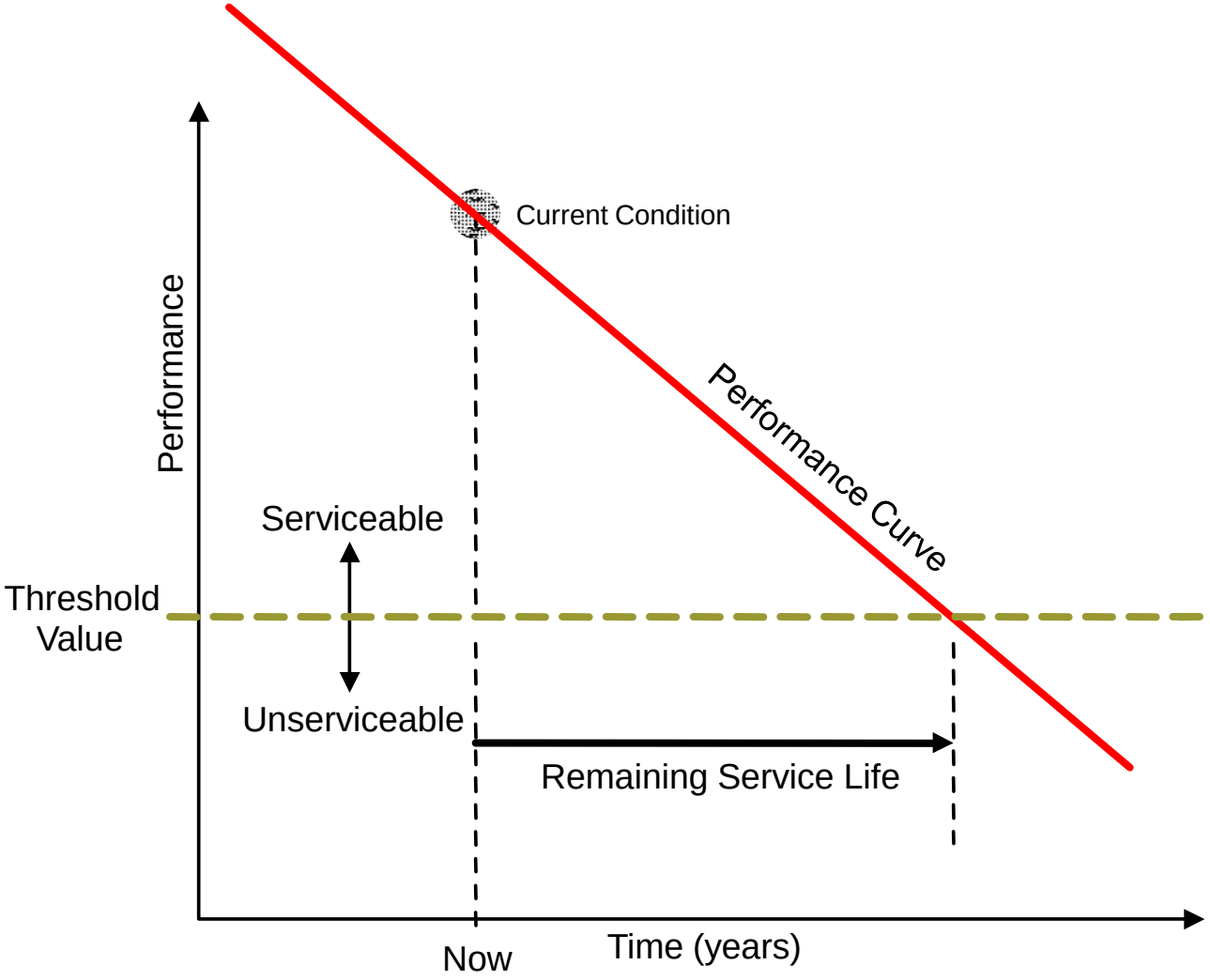
First of 5 core questions, continued

1. What is the condition of my assets?
   - What is the *importance* of *remaining useful life*?
   - How might we *determine* remaining useful life?

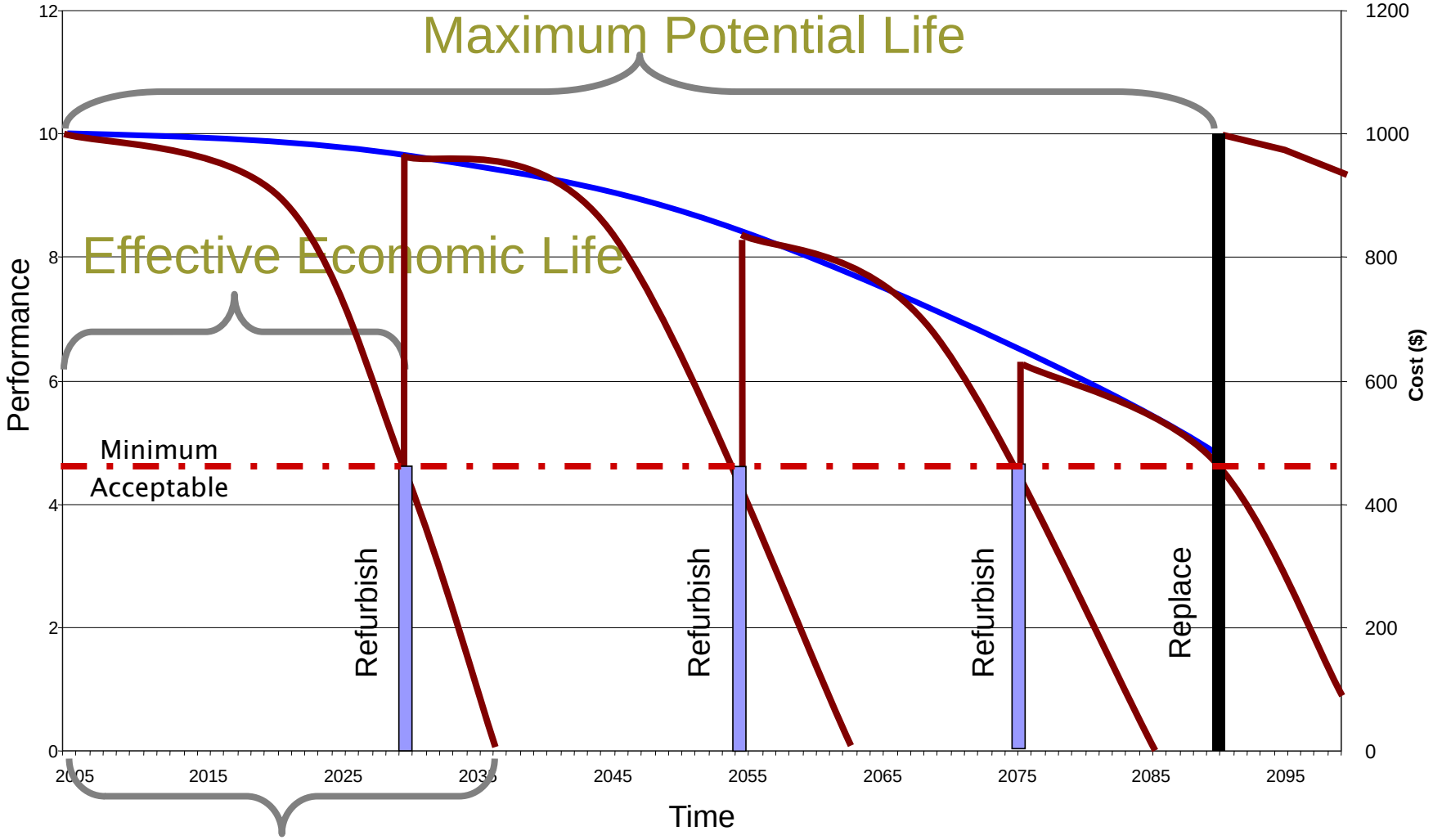
AM plan 10-step process



Determining Residual Life



Asset Lives

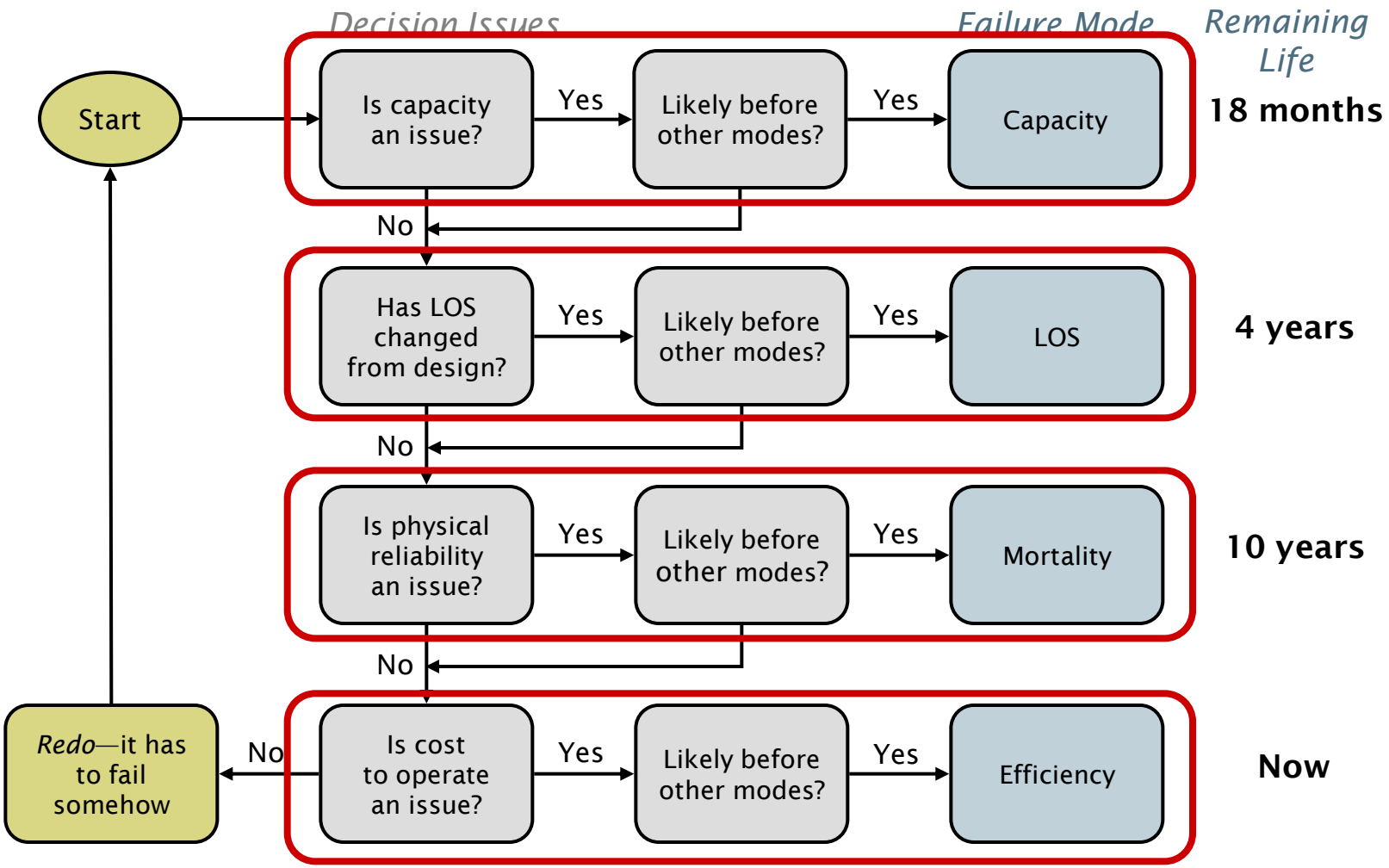

Maximum Potential Life
Effective Economic Life
Effective Physical Life
Minimum
Acceptable
Refurbish
Refurbish
Refurbish
Replace
Performance
Cost ($)
Time
0
2
4
6
8
10
12
0
200
400
600
800
1000
1200
2005
2015
2025
2035
2045
2055
2065
2075
2085
2095

“Physical life” vs. “economic life”

Effective Economic life is

- The period from the acquisition of the asset to the time when the asset, while physically able to provide a service, *ceases to be the lowest cost alternative to satisfy a particular service requirement*.
- At a maximum, equal to the physical life, but obsolescence often will ensure that *the economic life is less than the physical life*.

The role of failure modes in determining residual life



Determining residual life

- *Approach 1* Effective life table
- *Approach 2* Effective life table, plus modification factors
- *Approach 3* Direct observation table
- *Approach 4* Condition and decay curve table

Approach 1, effective life table

Class	Asset Type	Effective Life	Class	Asset Type	Effective Life
1	Civil	75	6	Motors	35
2	Pressure pipework	60	7	Electrical	30
3	Sewers	100	8	Controls	25
4	Pumps	40	9	Building assets	30
5	Valves	30	10	Land	NA

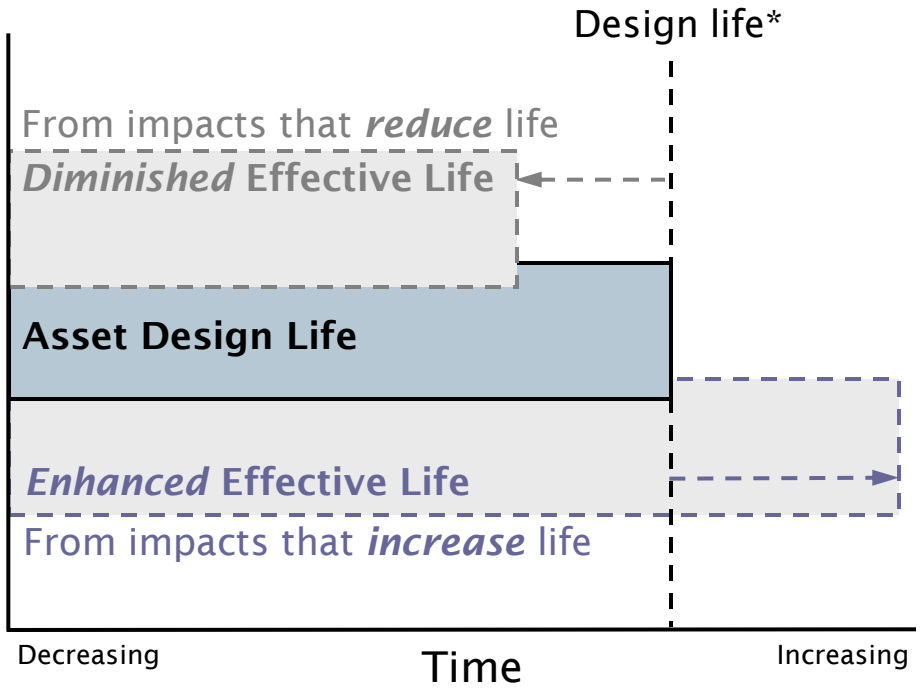
Sources: manufacturers, industrial associations, GASB, colleagues, consulting engineers, research (professional associations, universities), international community

Tying age to effective life

% of Effective Life Consumed	*PoF Rating*
0	1
10	2
20	3
30	4
40	5
50	6
60	7
70	8
80	9
90	10

PoF is probability of failure

Approach 2, amending standard effective lives



*Asset *design life* is from average effective life tables

Modification factors for effective life tables

	Impact Rating Factor				
Condition Variables	***1***	***2***	***3***	***4***	***5***
Design standards	+10%	+5%	0	-5%	+10%
Construction quality	+10%	+5%	0	-5%	+10%
Material quality	+10%	+5%	0	-5%	+10%
Operational history	+10%	+5%	0	-5%	+10%
Operating environment	+10%	+5%	0	-5%	+10%
External stresses	+10%	+5%	0	-5%	+10%

Approach 3: Direct observation table

Assessment (Likelihood of Occurrence within One Year	*Description*
Almost certain	Expected to occur within 1 year
Very high	Likely to occur within 1 year
High	Estimated 50% chance of occurring within any year
Quite likely	Expected to occur within 5 years; estimated 20% chance of occurring in any year
Moderate	Expected to occur within 10 years; estimated 10% chance of occurring in any year
Low	Expected to occur within 50 years
Very low	Expected to occur within 100 years

Approach 4, condition and decay curve table

Asset Type	Effective Life, Years	Condition Rating & Residual Life				
		1	2	3	4	5
Civil	75	75	60	45	30	15
Pressure pipework	60	60	48	36	24	12
Sewers	100	100	80	60	40	20
Pumps	40	40	32	24	16	8
Motors	35	35	28	21	14	7
Electrical	30	30	24	18	12	6
Controls	25	25	20	15	10	5
Building assets	60	60	48	36	24	12

Condition rating and residual life factors

	Condition Rating & Residual Life Factor									
Asset Type	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Motor bearing	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
Bearing temp sensor	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
Cooling motor	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
Electric motor	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
Coupling	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
Blower bearing	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
Centrifugal blower	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
Front blower bearing	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
Discharge check valve	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
Input butterfly valve	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
Silencer	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0

Condition rating and residual life

0.5 Residual Life Factor

Times

Yields

Asset Type	Effective Life, Years	Condition Rating & Residual Life									
		1	2	3	4	5	6	7	8	9	10
Motor bearing	25	22.5	20	17.5	15	12.5	10	7.5	5	2.5	0
Bearing temp sensor	20	18	16	14	12	10	8	6	4	2	0
Cooling motor	40	36	32	28	24	20	16	12	8	4	0
Electric motor	75	67.5	60	52.5	45	37.5	30	22.5	15	7.5	0
Coupling	15	13.5	12	10.5	9	7.5	6	4.5	3	1.5	0
Blower bearing	25	22.5	20	17.5	15	12.5	10	7.5	5	2.5	0
Centrifugal blower	75	67.5	60	52.5	45	37.5	30	22.5	15	7.5	0
Front blower bearing	25	22.5	20	17.5	15	12.5	10	7.5	5	2.5	0
Discharge check valve	25	22.5	20	17.5	15	12.5	10	7.5	5	2.5	0
Input butterfly valve	25	22.5	20	17.5	15	12.5	10	7.5	5	2.5	0
Silencer	75	67.5	60	52.5	45	37.5	30	22.5	15	7.5	0

Key points from this session

What is its remaining life?

Key Points:

- Determining remaining useful life is as much art at this point as science
- Although good information is better, asset “decay curves” need not be highly detailed to be useful.
- Good CMMS data is key to building agency specific failure curves
- Good condition information is vital to assigning remaining useful life
- Incorporating good failure codes into the work order is important to building good failure curves

Associated Techniques:

- Remaining useful life assessment·
- Decay curves, useful-life tables
- Survivor curves
- Major failure modes