

Age Is A Poor Proxy

Why relying on age-based replacement is imprudent

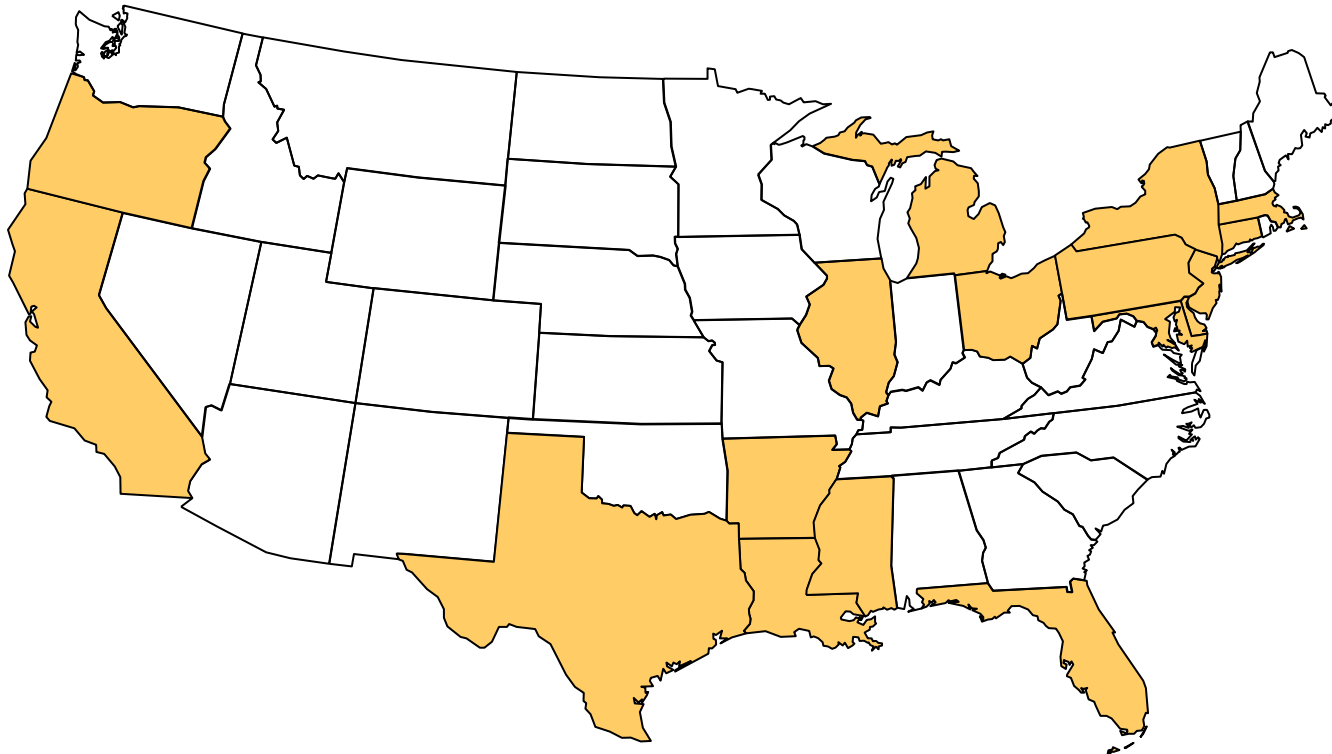
Presented by Dan O'Neill
to the
EUCI Aging T&D Infrastructure Workshop

February 21, 2001



Navigant
CONSULTING, INC.

Number of states with new electric reliability rules



Source: Article by Navigant Consulting Inc.'s Dan O'Neill, Public Utilities Fortnightly, March 1999, updated

...Public cries to replace aging infrastructure increase



July 15, 1999, Thursday
Metropolitan Desk

And yesterday, **Mr. Giuliani** continued his attacks on Con Edison's response as too passive. "What **Con Edison** should be saying is here are the things that have to be done to make it virtually impossible for blackouts to take place," he said. "We need more power. We need to purchase more power. We need more alternatives. **We need a more modern infrastructure**, meaning we have to improve the feeder cables so we have better material. We need to insulate them better."

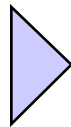
(emphasis added)

But if the public knew the facts about age & reliability

They would say that relying on age-based replacement is imprudent

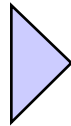
Relying on age-based replacement for reliability is

Not cost-effective



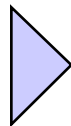
Replacing infrastructure components based on age is one of the least cost-effective ways of improving service

Not method-efficient



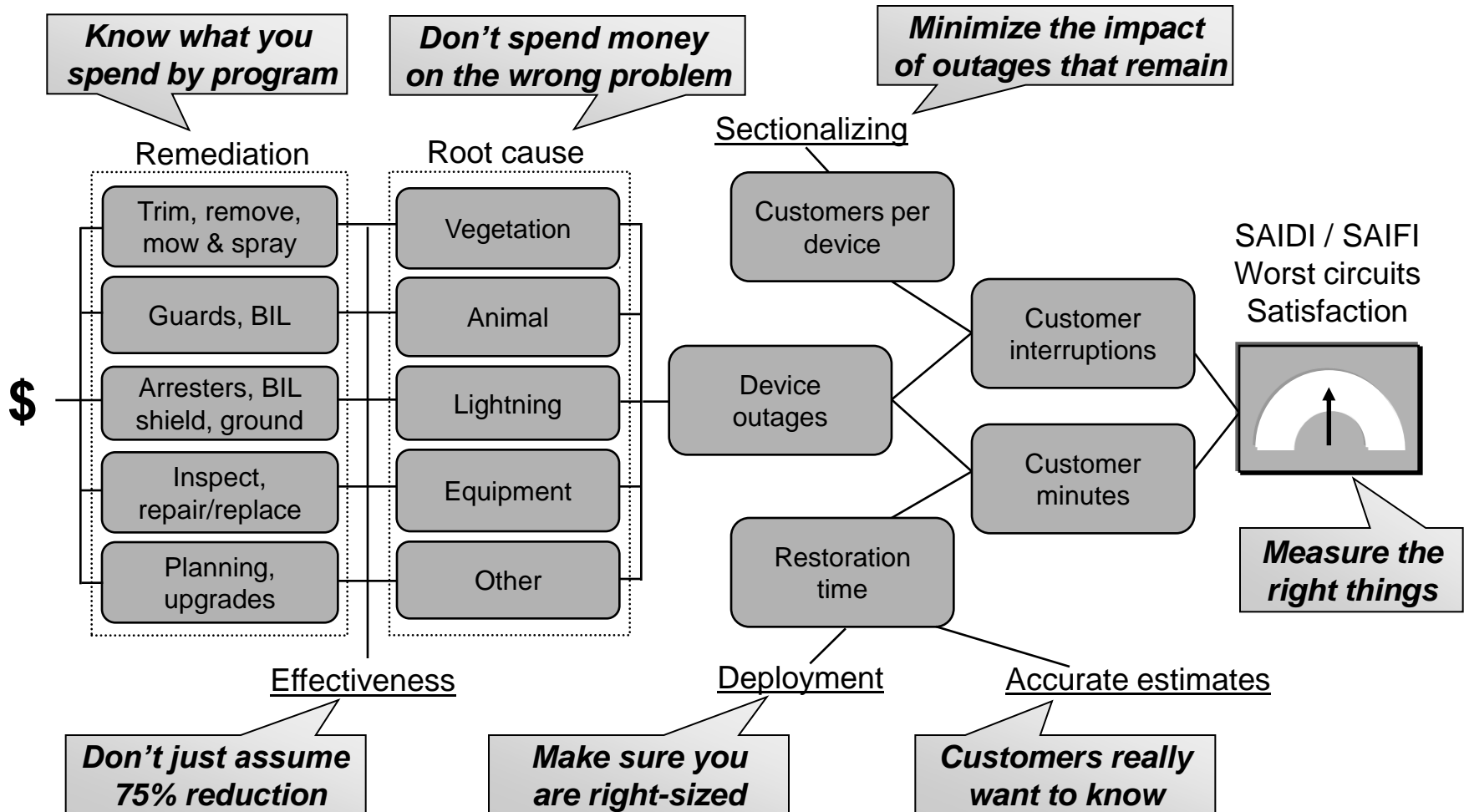
There are better indicators of deterioration than age, e.g., specific failure history, test results, defective types

Not best practice



Other industries have learned not to rely on age for reliability management, e.g., aerospace, automotive, even natural gas pipelines and LDC's

Asset management is key in the distribution business model



Replacement is only one of the asset management strategies
And there are usually much better ways to improve customer service

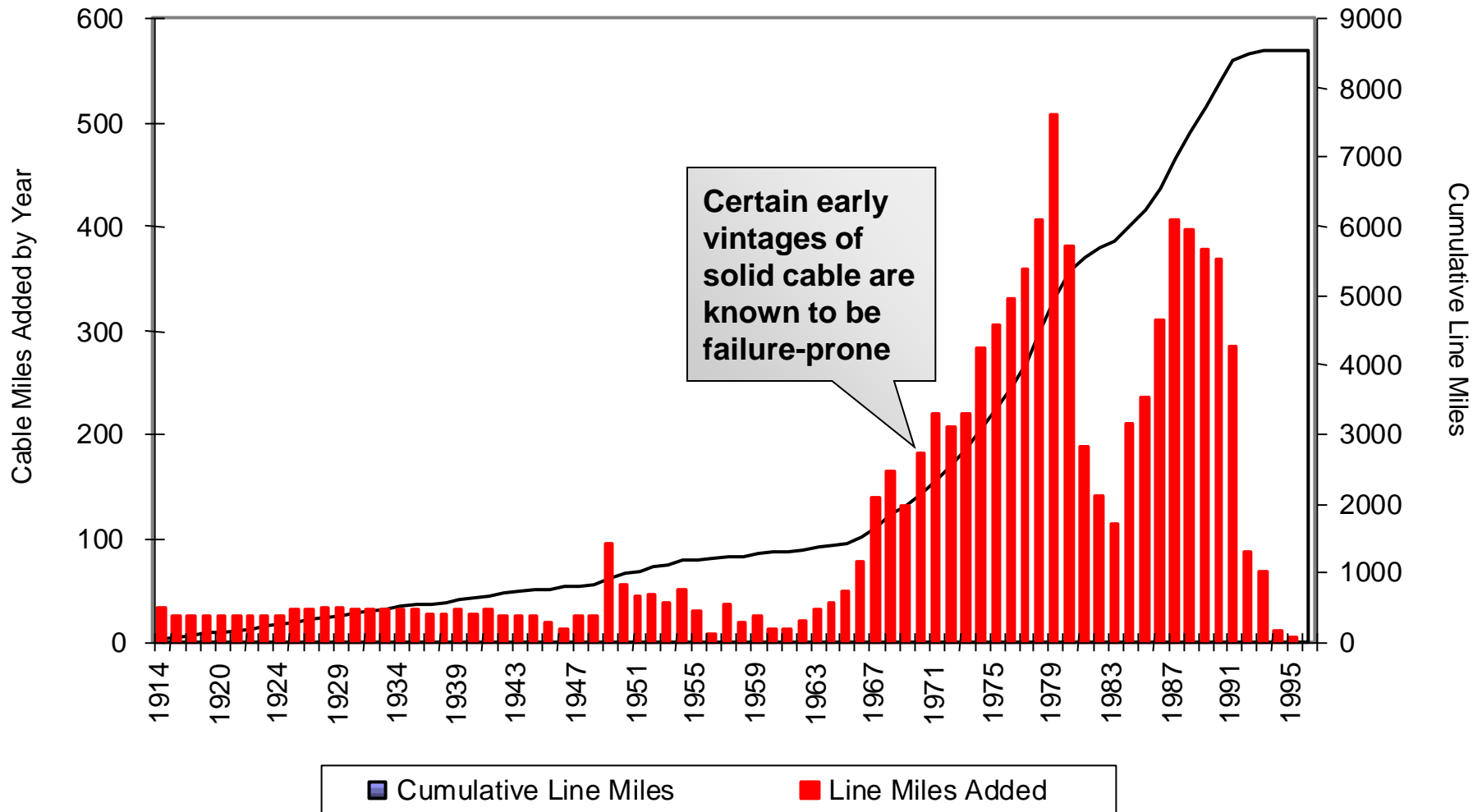
And it is not
usually the
most cost-
effective...

...except when
combined with
inspection and
monitoring to
replace only
just-in-time

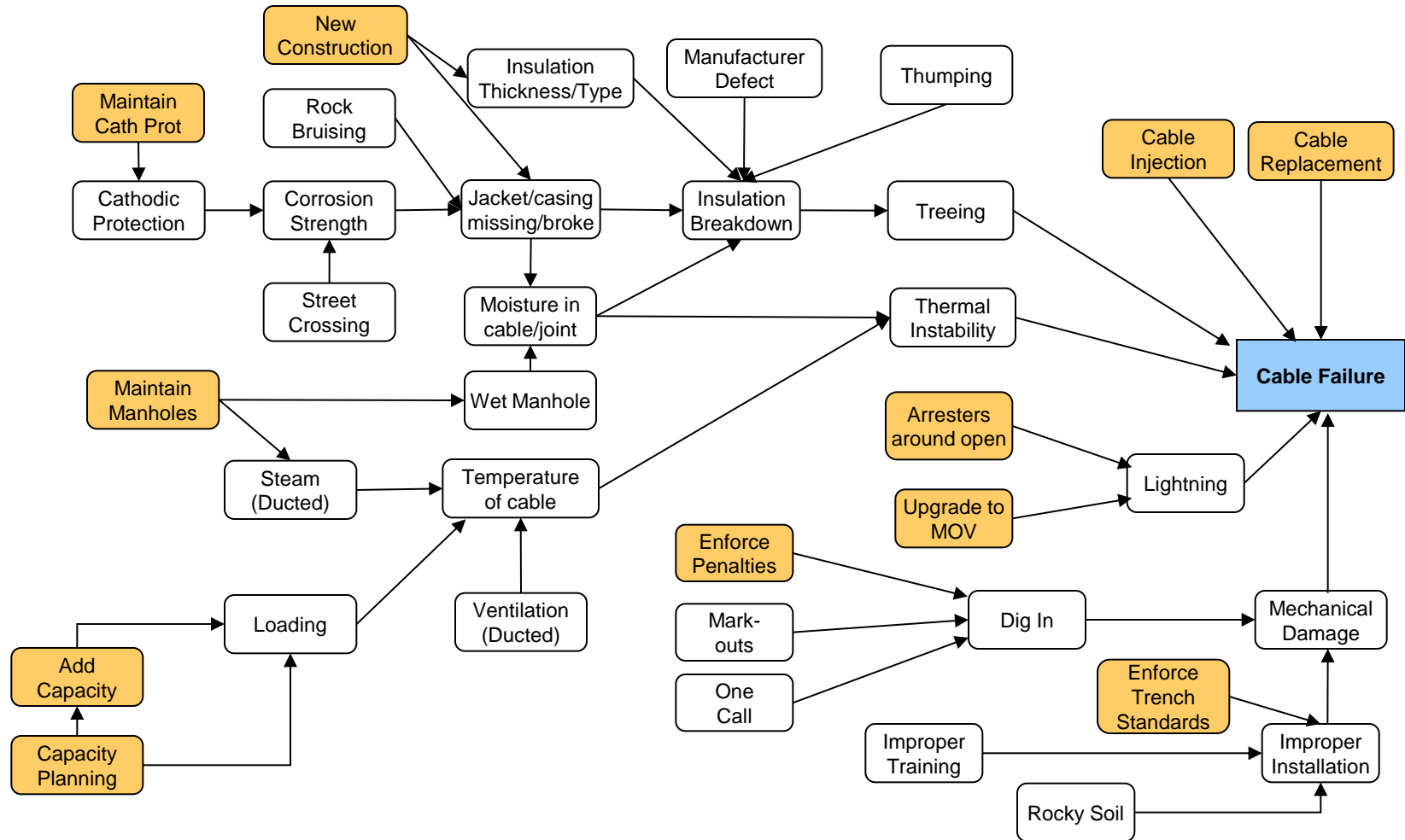
Asset Management Strategies

- Improved standards for new construction
- Preventive maintenance
- Remediation of failure-prone conditions
- Replacement of failure-prone components
- Re-design for redundancy
- Reinforce for capacity
- Inspection and condition monitoring
- Mitigation of effects on customer satisfaction
- Rapid repair and restoration

'Age' is not the same as 'vintage' if the real issue is defects
Manufacturing problems in certain 'vintages' are not really 'age-based'

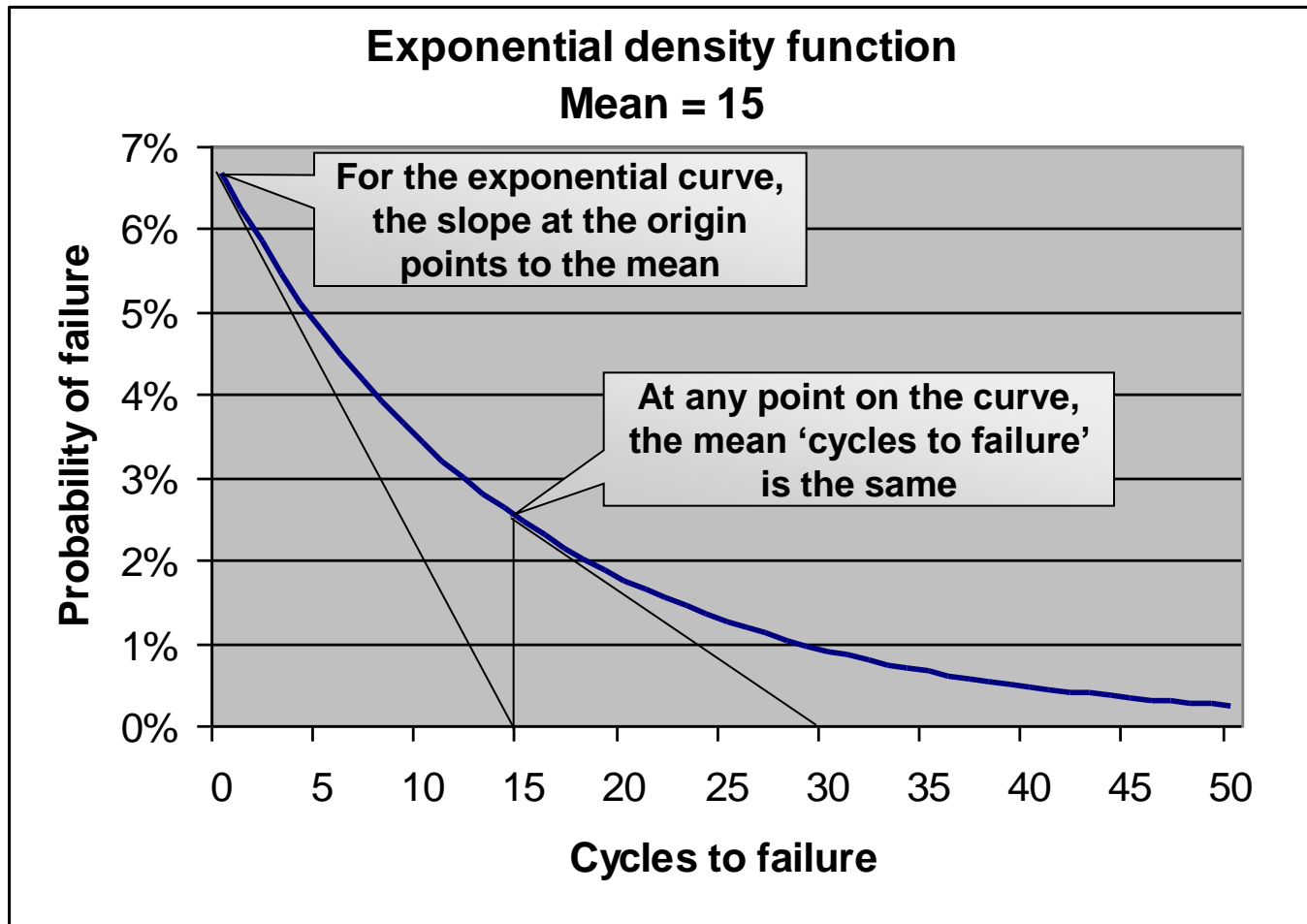


In root cause analysis, age is often a proxy for 'cycles'



Many components' failures fit the exponential process model

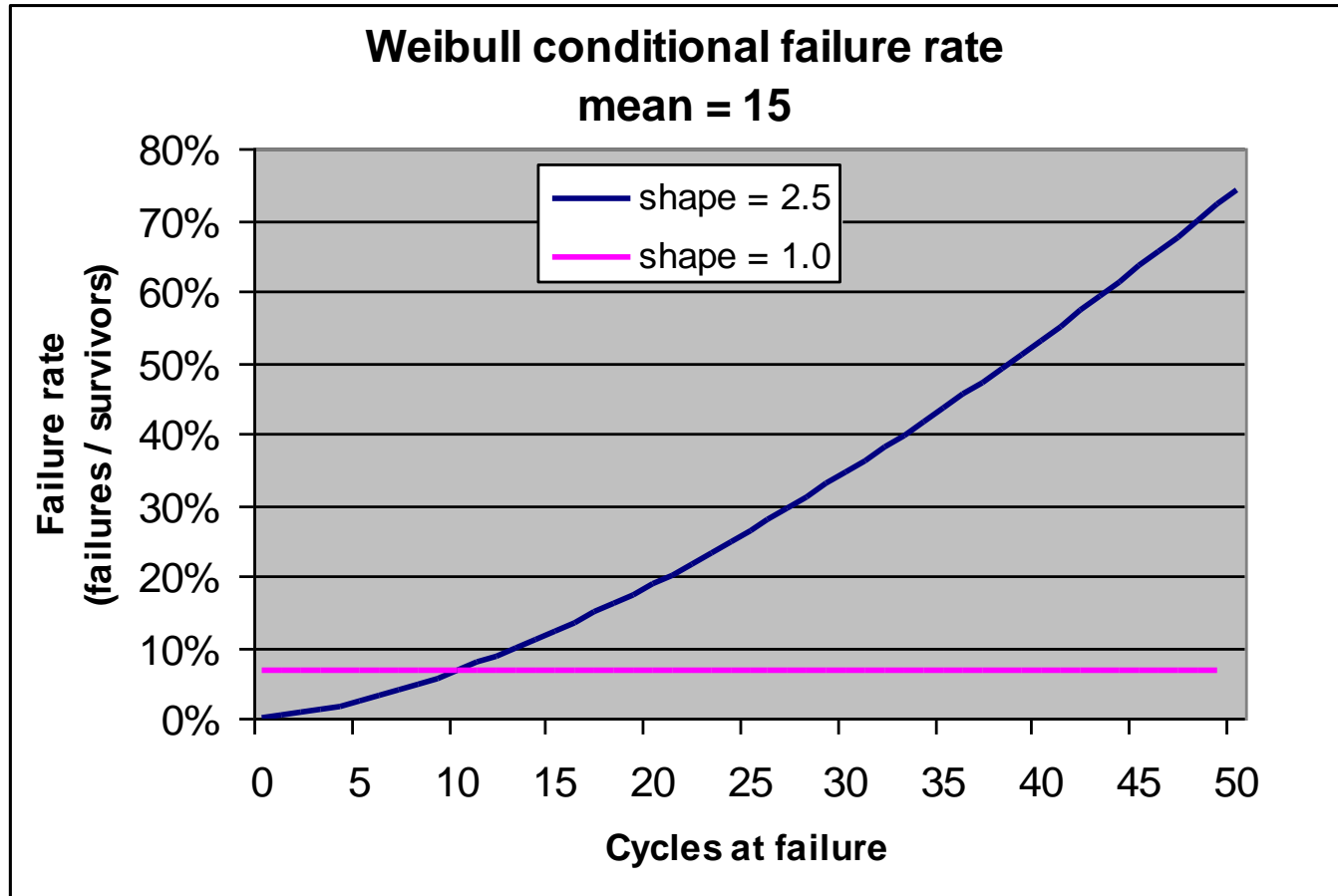
Which means they are 'memory-less' and independent of 'age' or 'cycles'



So, for an exponential process, preventive replacement will not work at all, e.g., light bulbs

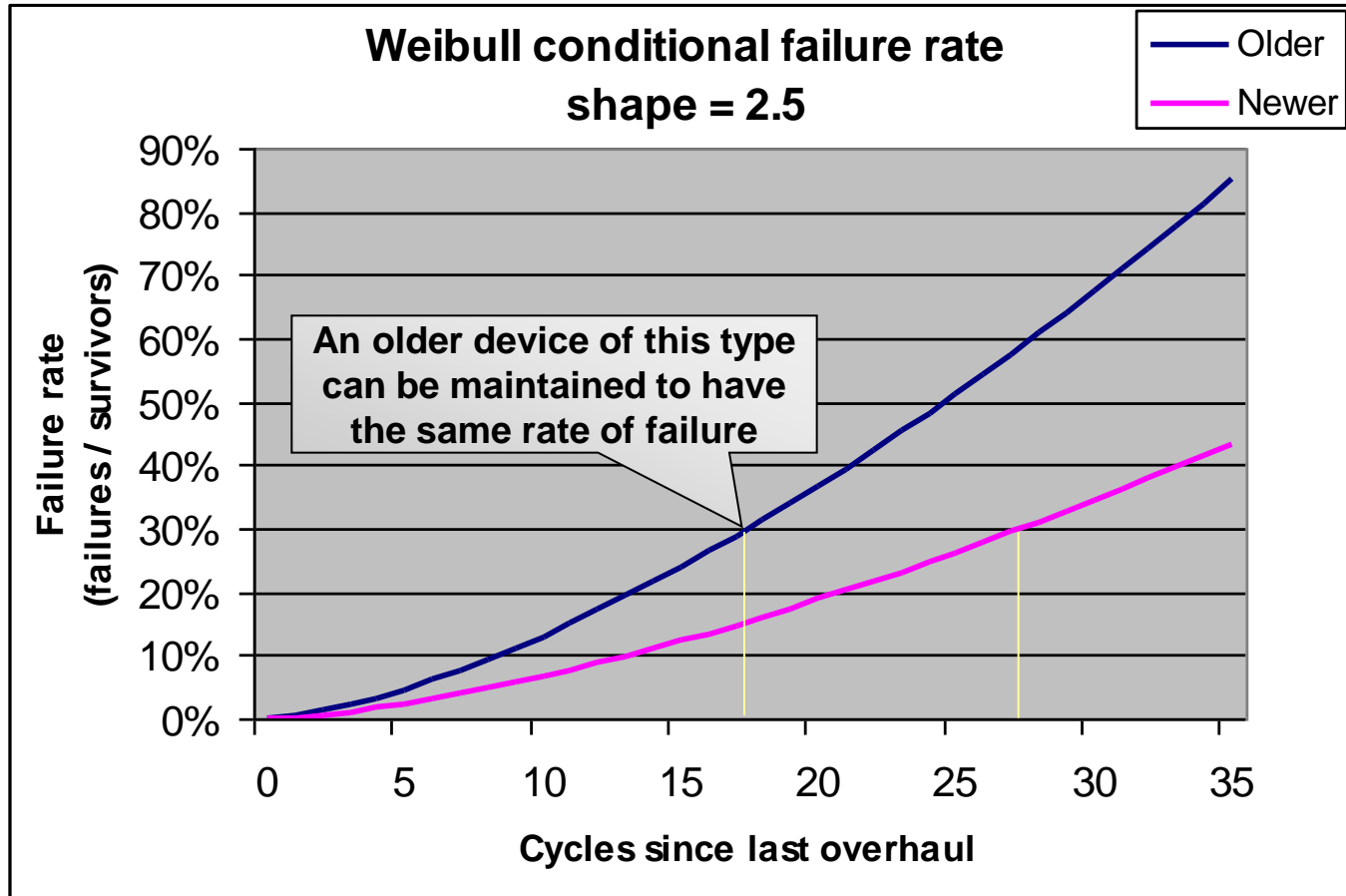
The Weibull curve assumes 'wearout' caused by cycles

With a failure rate that increases with 'age' or 'cycles'



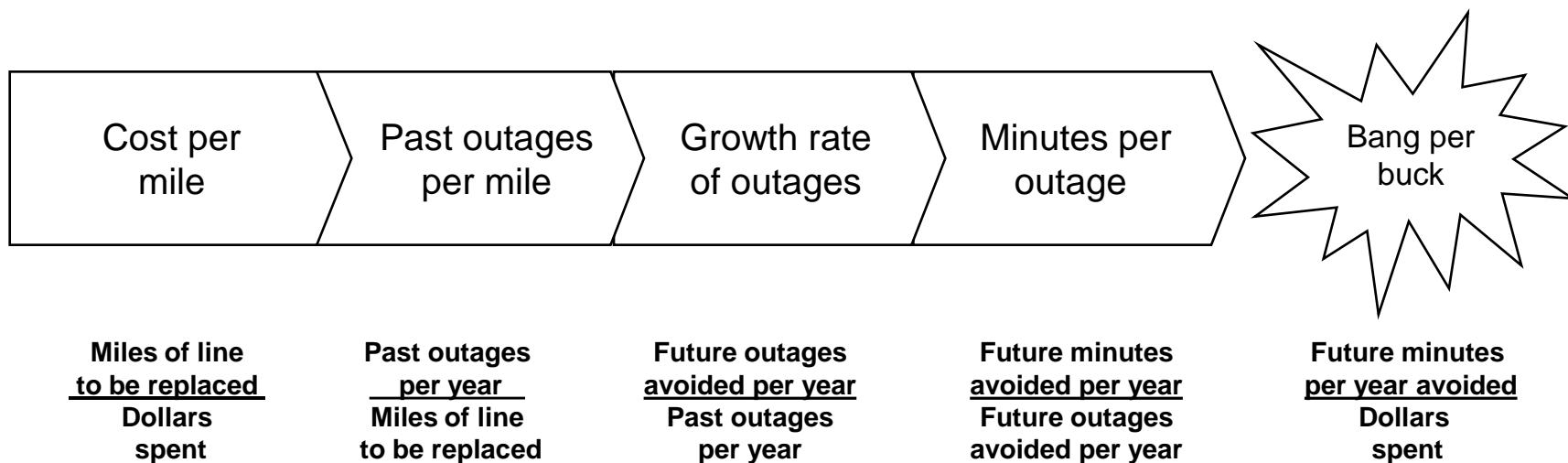
***This is
typical for
devices
like circuit
breakers,
where the
'cycles' are
fault
operations***

But for such components, overhaul often resets the 'clock'
Older devices may simply require fewer cycles between overhauls



*Usually, the
real reason
to replace
old devices
is due to
economics,
not for
reliability*

The key to optimal replacement is high failure rate



$$\frac{1}{\$90,000} \times 8 \times 1.25 \times 4500 = \frac{1 \text{ min.}}{\$2.00}$$

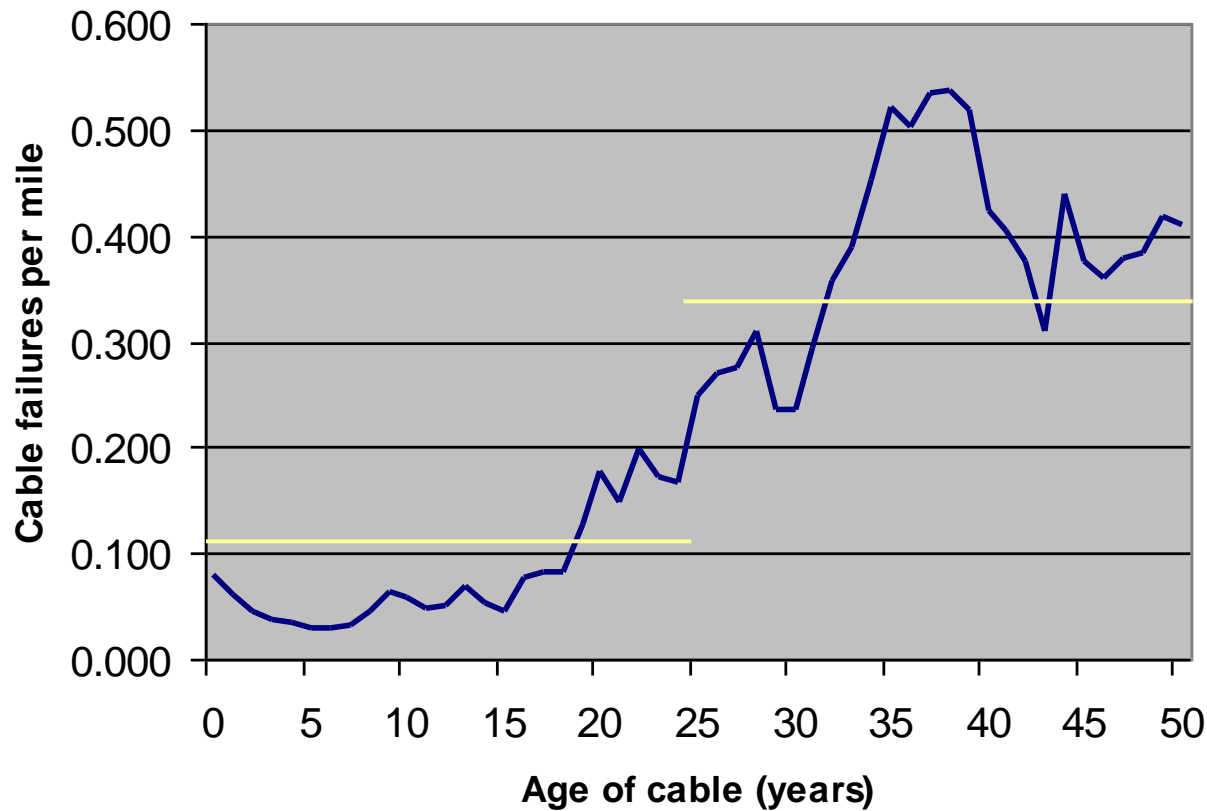
Where:

The higher the failure rate...

...the higher the bang per buck

- \$90,000 per mile = 5280 feet/mile x \$17 per foot to replace
- 8 outages/mile/year = 13 spans/mile x (3 outages per 400ft span in past 5 years)
- 25% growth rate = 3 outages in past 5 years becomes 3 outages in next 4 years
- 4500 minutes per outage = 50 customers per outage x 90 minutes per outage

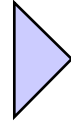
Typically, age-based failure rates are still low (~ 50% above average)
So age-based programs must replace a lot of good stuff to get the bad



Although a failure rate difference of 3x is significant, some conditions provide 10x, e.g., 250' cable sections that have failed 3 times in the last 5 years fail at 6.0 per mile

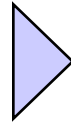
There is a better way than aged-based replacement

Refocus on satisfaction



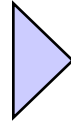
Understand what aspects of reliability truly affect customer satisfaction, so that you can do the right thing and not just do things right

Re-design the system



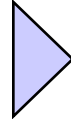
Look for ways to cost-effectively re-design the system to build in redundancy and to mitigate effects through sectionalizing and auto-restore

Research root causes



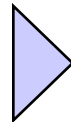
Find other conditions that are cost-effectively monitorable, and develop the predictive relationships that would allow more targeted action

Design solutions



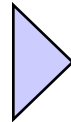
Find the best ways, including new ways, to remedy the root causes and to mitigate the effects, including faster restoration and informing customers

Prioritize the work



Compute the 'bang per buck' for each type of remediation, replacement, redesign, etc., then optimize and prioritize accordingly

Monitor the results



Monitor the effectiveness of the programs to see what is really working and to discover any new insights that come only 'after the smoke clears'

Here is a road map up to the 'next level'

Questions and answers



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Taking reliability programs to the 'next level'