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Optimising asset management through predictive and proactive maintenance

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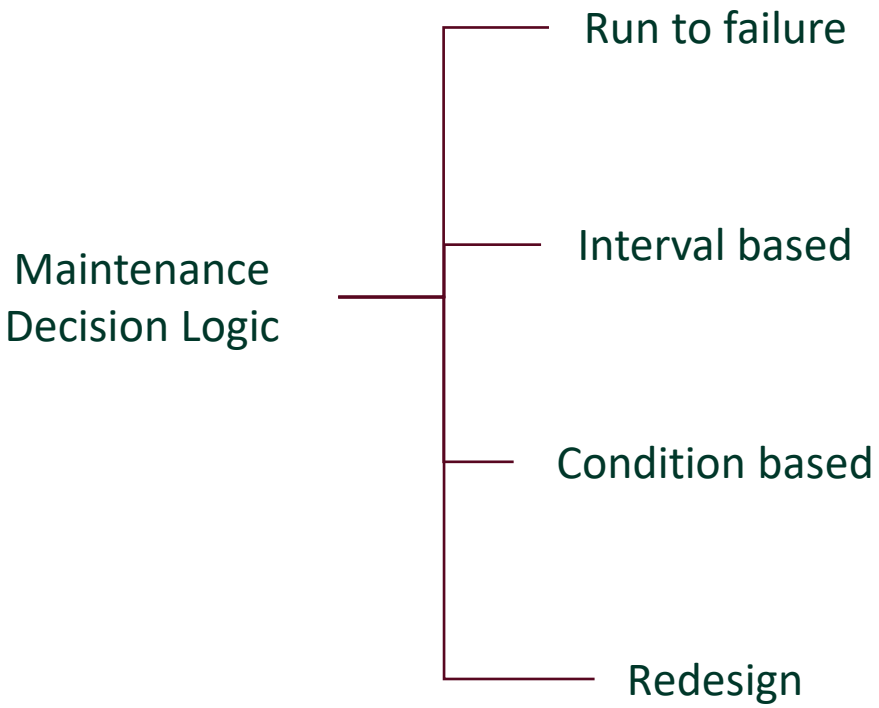
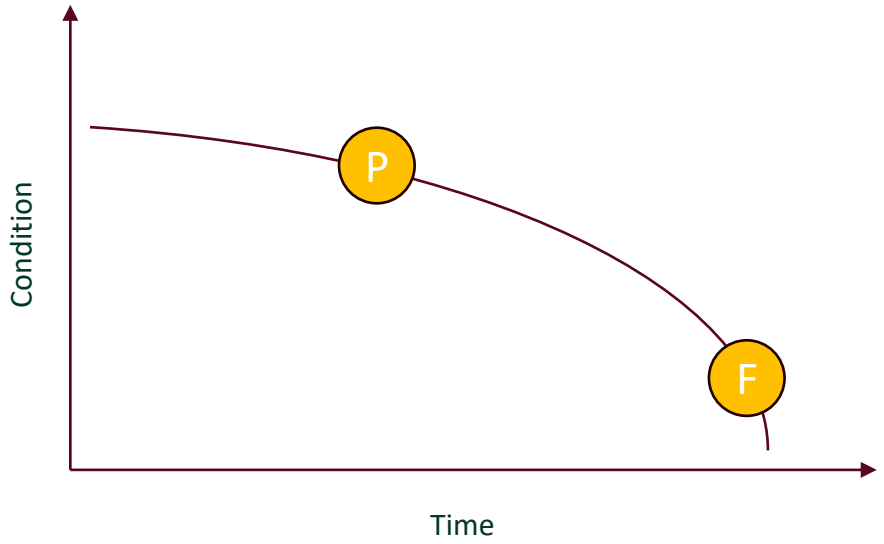
Traditional maintenance

Generally based on a combination of OEM recommendations, FMEA & RCM

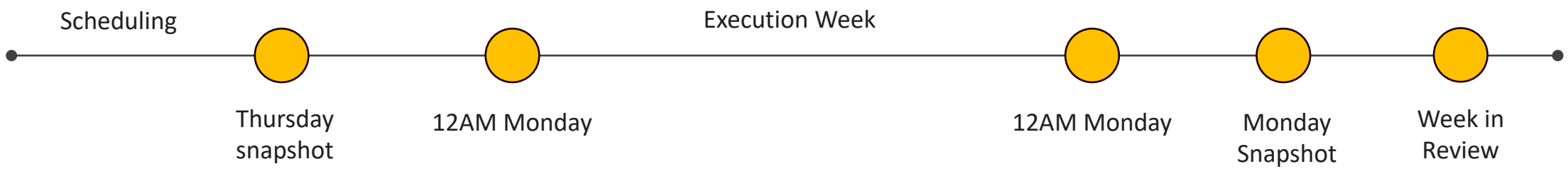


Is there an effective CM technology or approach?



Measuring the success of maintenance

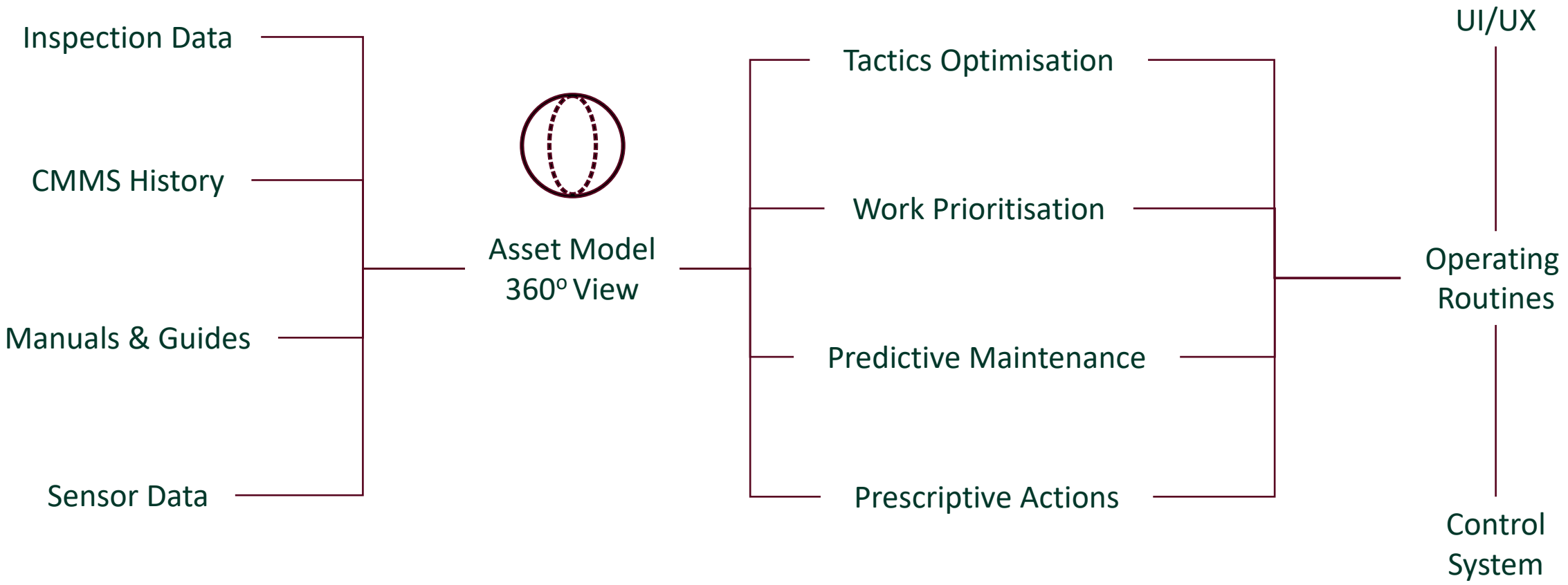
Plan & Schedule prior to w-1, snapshot, then measure against snapshot



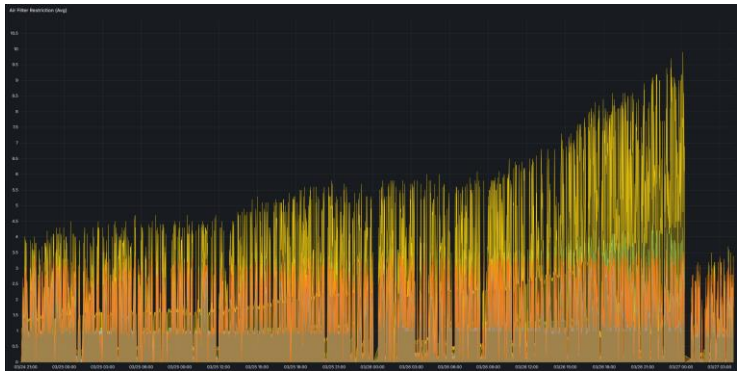
Success generally measured on backwards looking metrics. Typically focused on the efficiency of labour and completion of scheduled work.

- Schedule Loading
- Schedule Compliance
- Scheduled work %
- Schedule overrun
- Primary Call Compliance

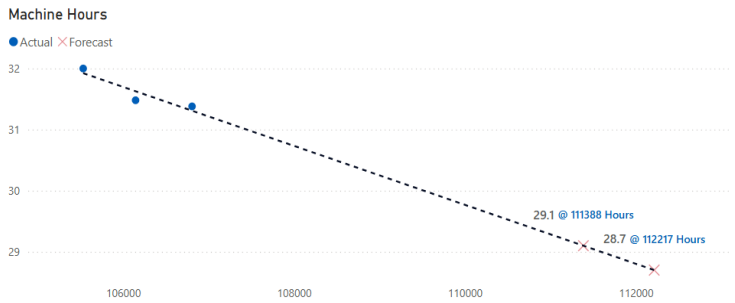
Data driven predictive maintenance



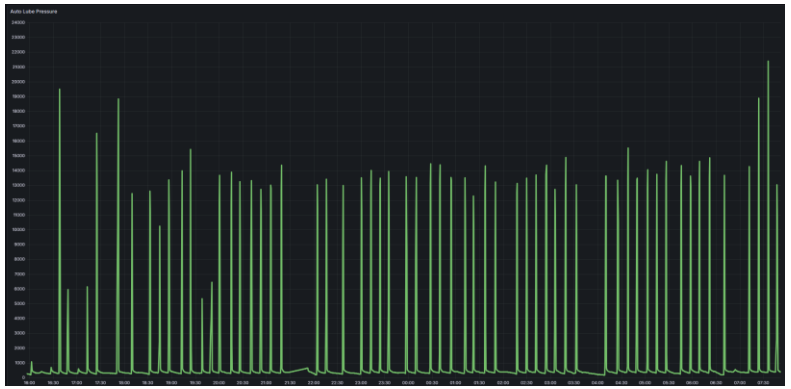
Data driven predictive maintenance



Remove fixed interval maintenance, using regression models like AFT to predict RUL.



Capturing & trending inspection data to predict future maintenance requirements.



Monitoring cyclic events for non-normal behavior, like in this auto-lube system.

CMMS History
Fuel burn
Oil samples
Alarm Log

Health Index, Remaining life or Risk score

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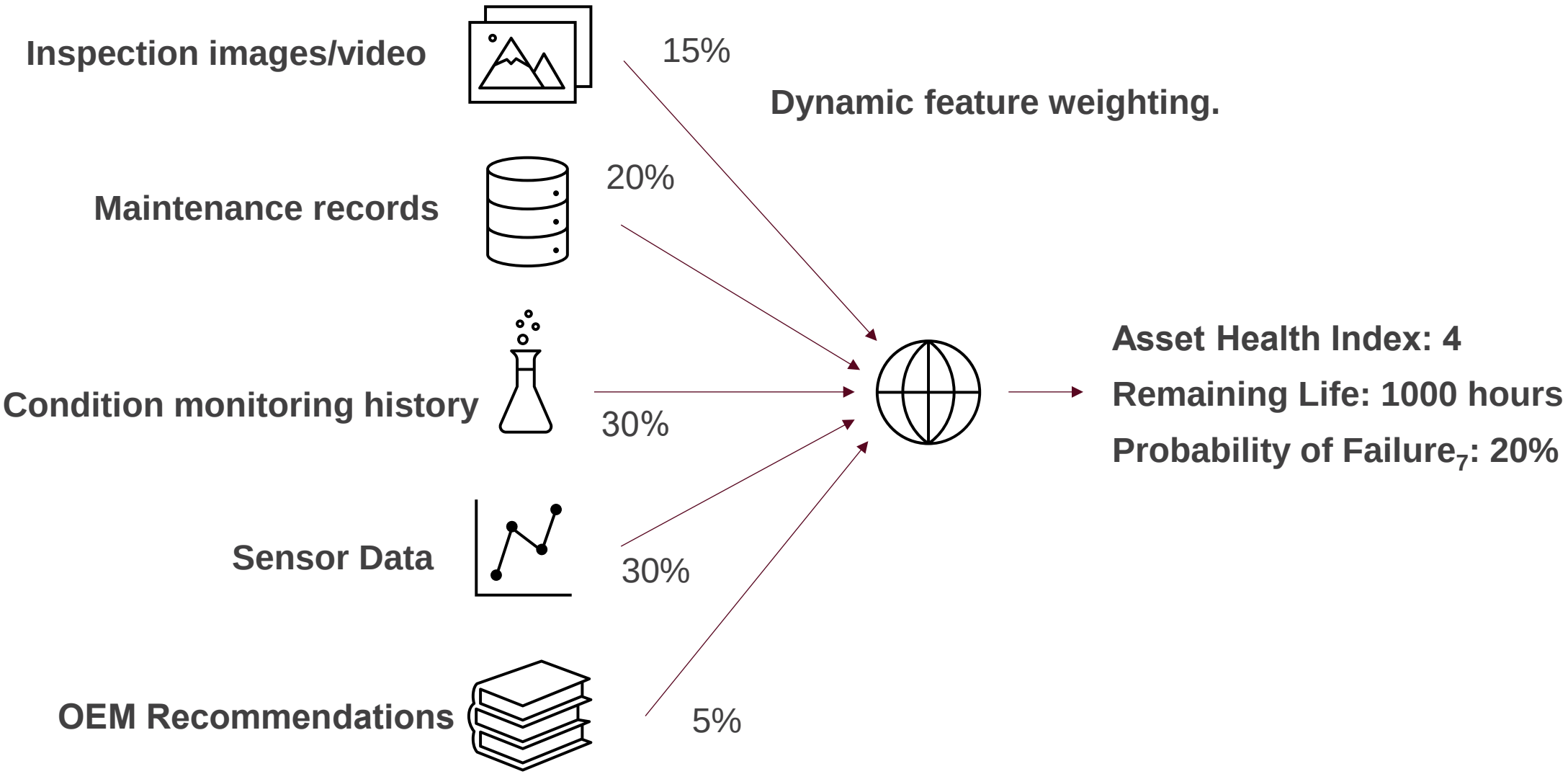
Building an asset health / risk score / RUL



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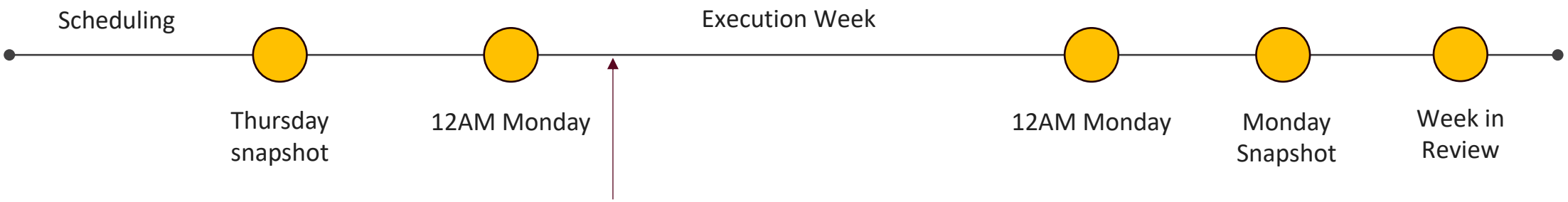
Can we truly be proactive using a rigid WM model?

Plan & Schedule prior to w-1, snapshot, then measure against snapshot



Predictive alert occurs

- Requires 6 hours to repair
- 2 x Mechanics
- Parts are available
- System doesn't require the asset on nightshift

Actioning the required repair, even if high probability of failure would cause a decrease in key work management metrics.

- Schedule Loading
- Schedule Compliance
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Rewarding decision making that leads to the best possible outcome

What outcome do we want?

Is it equipment availability or is it predictability? Ultimately, we want to asset performing its productive function when we require it too.

Bayes' theorem

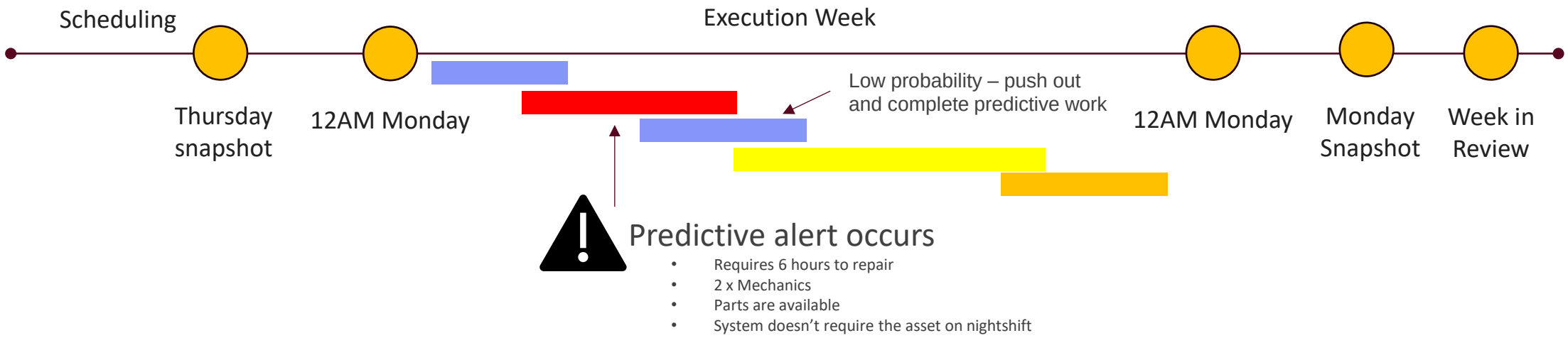
Bayesian decision-making is about making smart choices under uncertainty by continuously updating your beliefs as you get new information and then acting accordingly to get the best possible outcome.

$$P(\text{Failure}|\text{Data}) = \frac{P(\text{Data}|\text{Failure}) \times P(\text{Failure})}{P(\text{Data})}$$

- **Prior Probability:** Historically, 3% monthly failure chance.
- **New Evidence:** IoT sensor shows temperature anomalies increasing over a week.
- **Bayesian Update:** After applying Bayes, new failure probability jumps to 20%.

Moving towards being proactive with maintenance

- Each preventative task has an impact on failure probability, this will impact the priority of planned work.
- As predictive work comes in the schedule dynamically adjusts, based on balancing system priority with Bayesian decision making.



Low probability: Delay maintenance, save resources.
Medium probability: Schedule routine or preventive maintenance soon.
High probability: Immediate intervention required to prevent asset failure.

The pit falls

- Accuracy/completeness of historical data.
- Ignoring/not flexing for current operating context.
- Sensor / condition data quality.
- Priority placed on replacing sensors / repair instruments.
- Incorrect weighting of factors in calculations like RUL.