Cost Effective Replacement Management

Planning Replacement to Save Money

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34 ISMOR
19 July 2017

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Introduction To The Problem Space

With all equipment there are two major concerns:

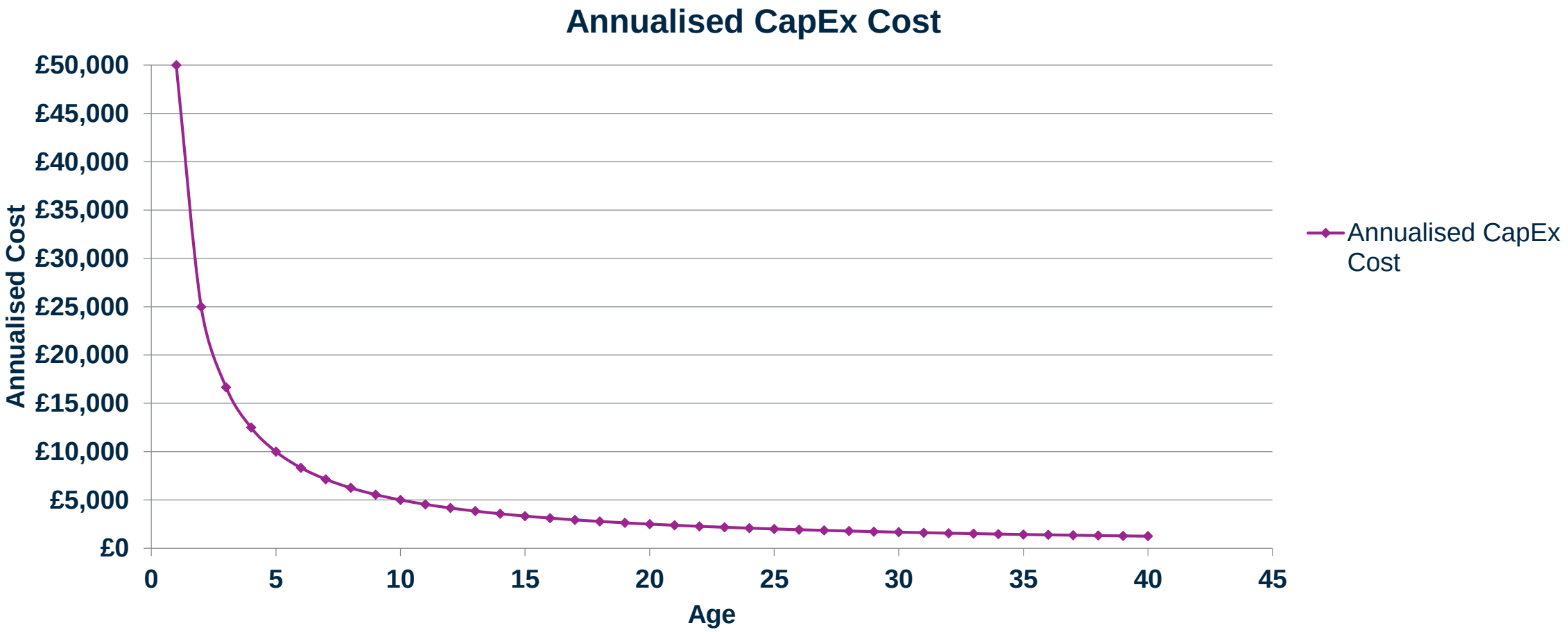
- How reliable will this equipment be?
  - Will it be serviceable for a threshold operating requirement?
  - Will breakdowns cause loss of operational effectiveness leading to mission failure?
  - What spares and reserve equipment will I need to keep in stock?
- Reliability Analysis is a mature field of study that answers these questions.

- How much will this equipment cost?
  - What is the procurement cost?
  - What are the running, maintenance and storage costs?
  - What is the disposal cost?
- Cost Analysis is a mature field of study that answers these questions.

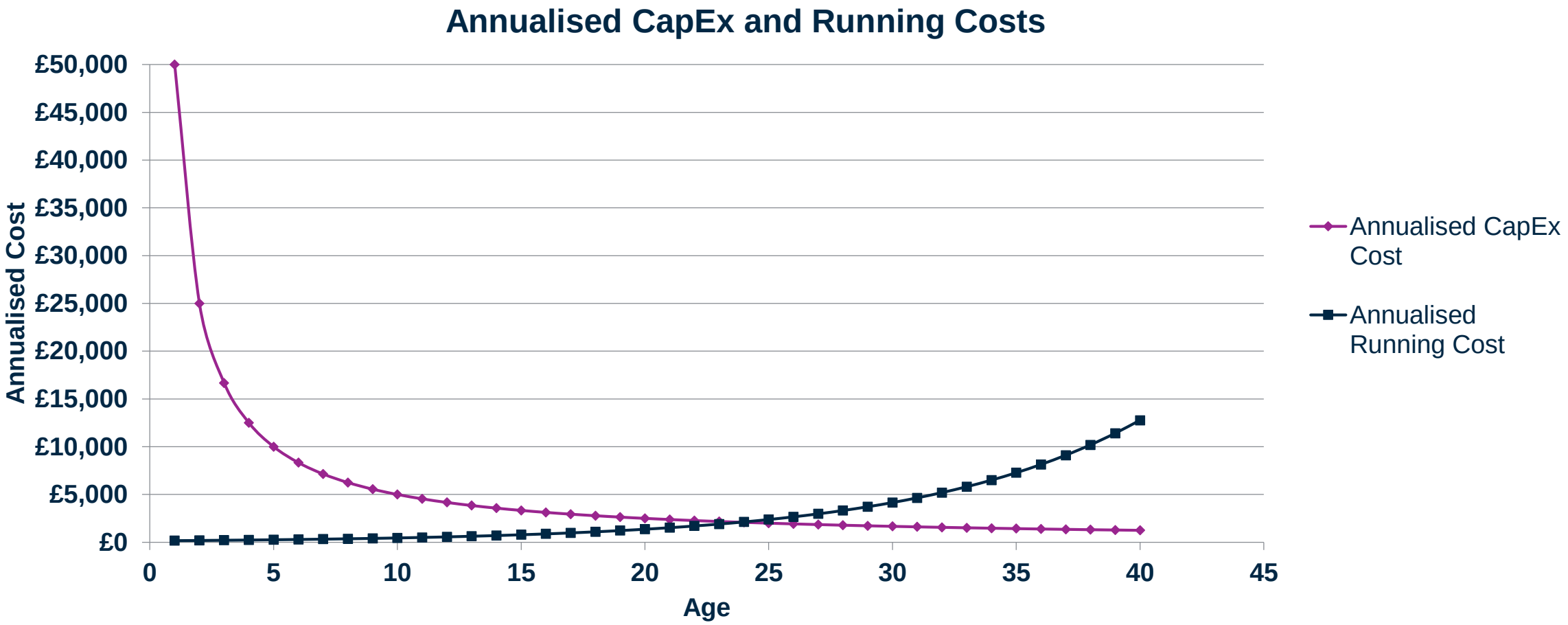
Introduction to the “Cost Effective Replacement Management” Method

- Traditional replacement activity is reactive; replacing failures on a 1-to-1 basis leading to mixed fleets.
- Cost Effective Replacement Management is a combination of reliability analysis and cost analysis.
- This method aims to provide a fleet level cost effective replacement strategy with zero impact on operational effectiveness.
- When considering a portfolio or fleet of fleets the results of the method can be utilised to inform a replacement strategy that flattens annual capital expenditure.

Annualised Cost Calculations



Annualised Cost Calculations



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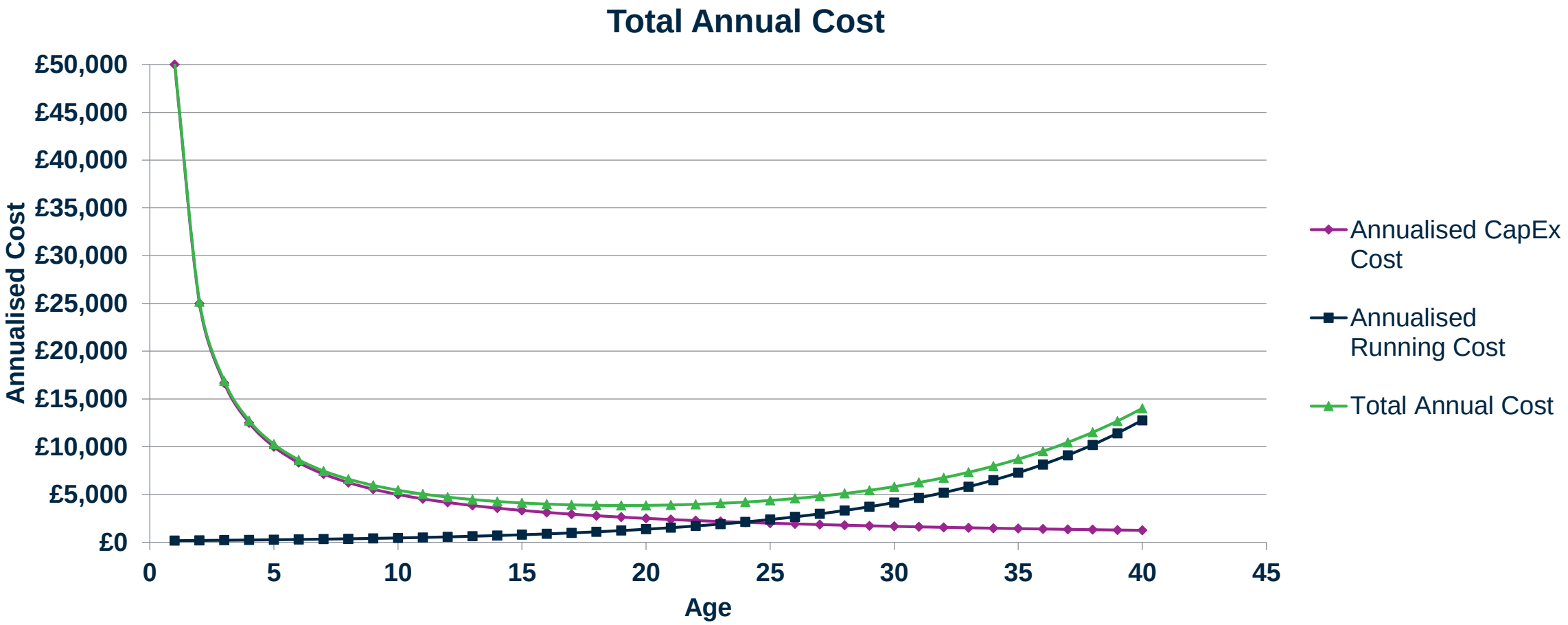

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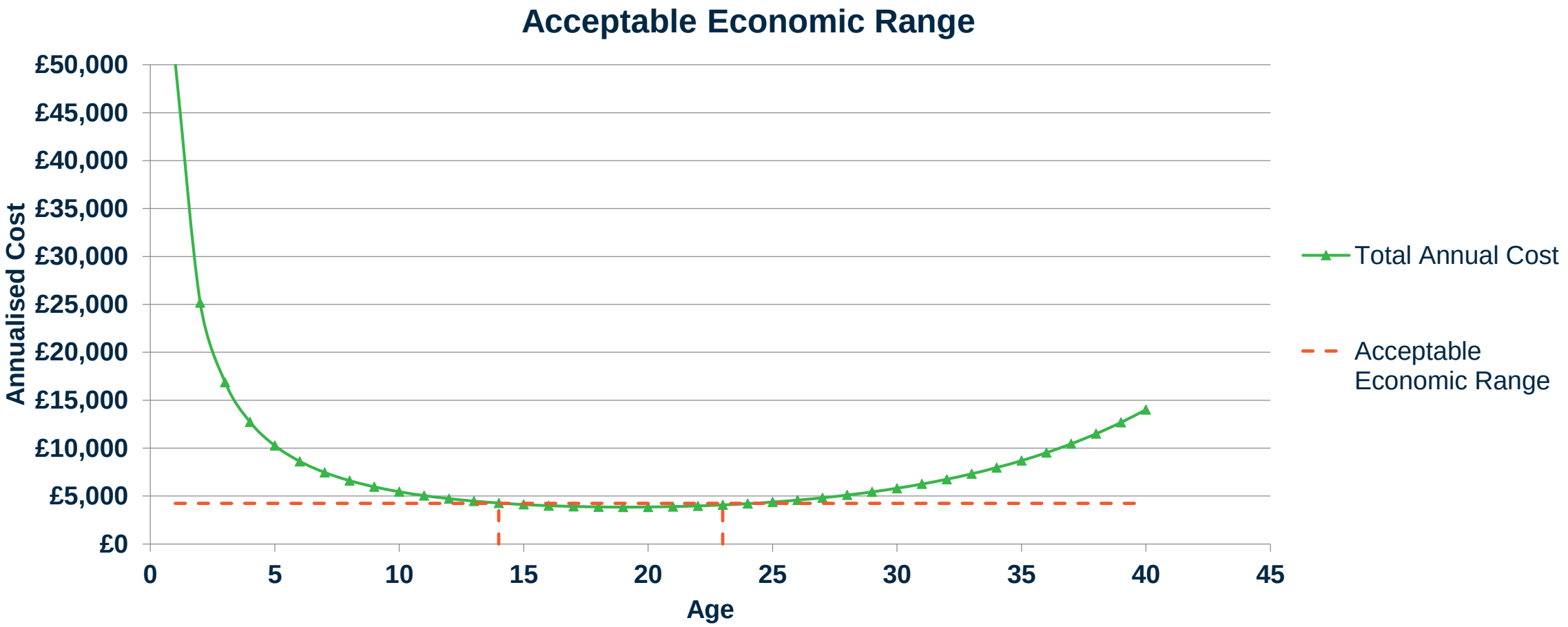


Reliability Calculations

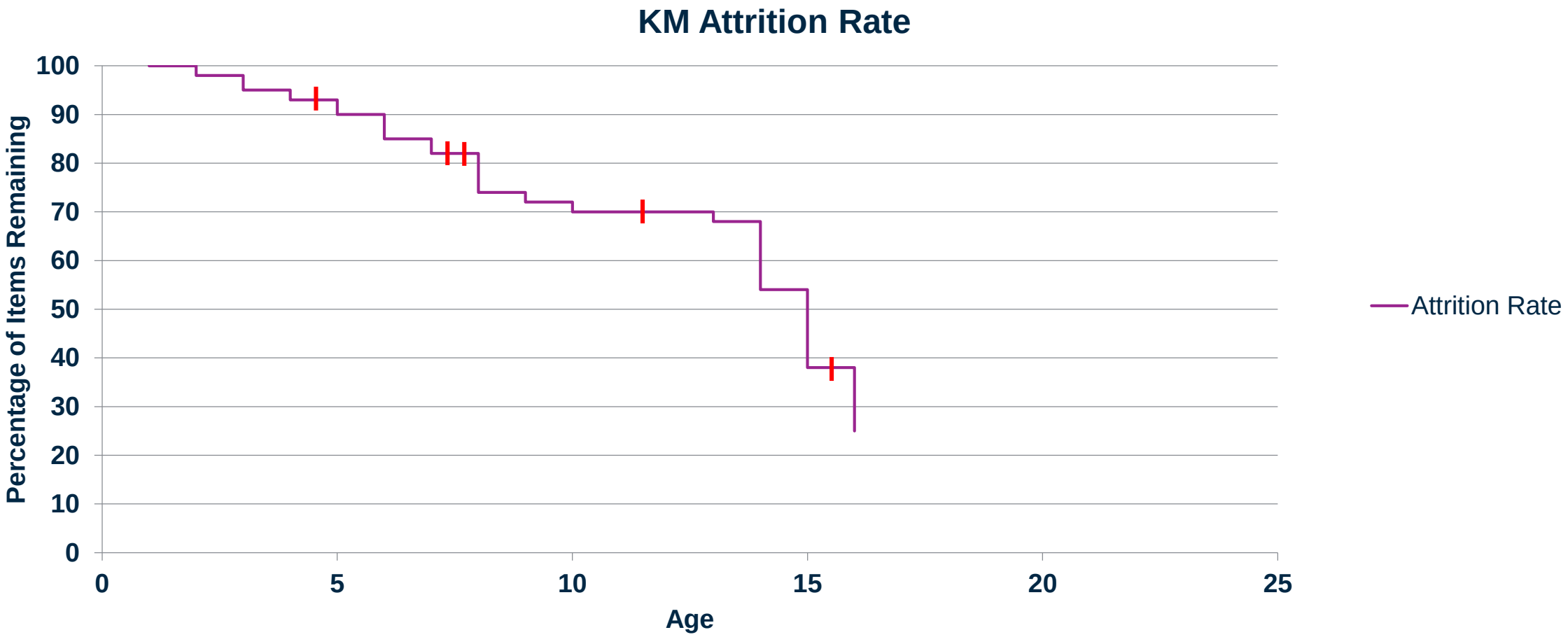
Maintenance Events per item per year

Year	Item 1	Item 2	Item 3
2010	-	1	-
2011	-	2	-
2012	1	0	-
2013	2	0	-
2014	**Failed**	2	1
2015	-	1	0
2016	-	**Failed**	1
2017	-	-	2

Maintenance Events per item per age

Age	Item 1	Item 2	Item 3
1	1	1	1
2	2	2	0
3	**Failed**	0	1
4		0	2
5		2	Unknown
6		1	-
7		**Failed**	-
8			-

Reliability Calculations



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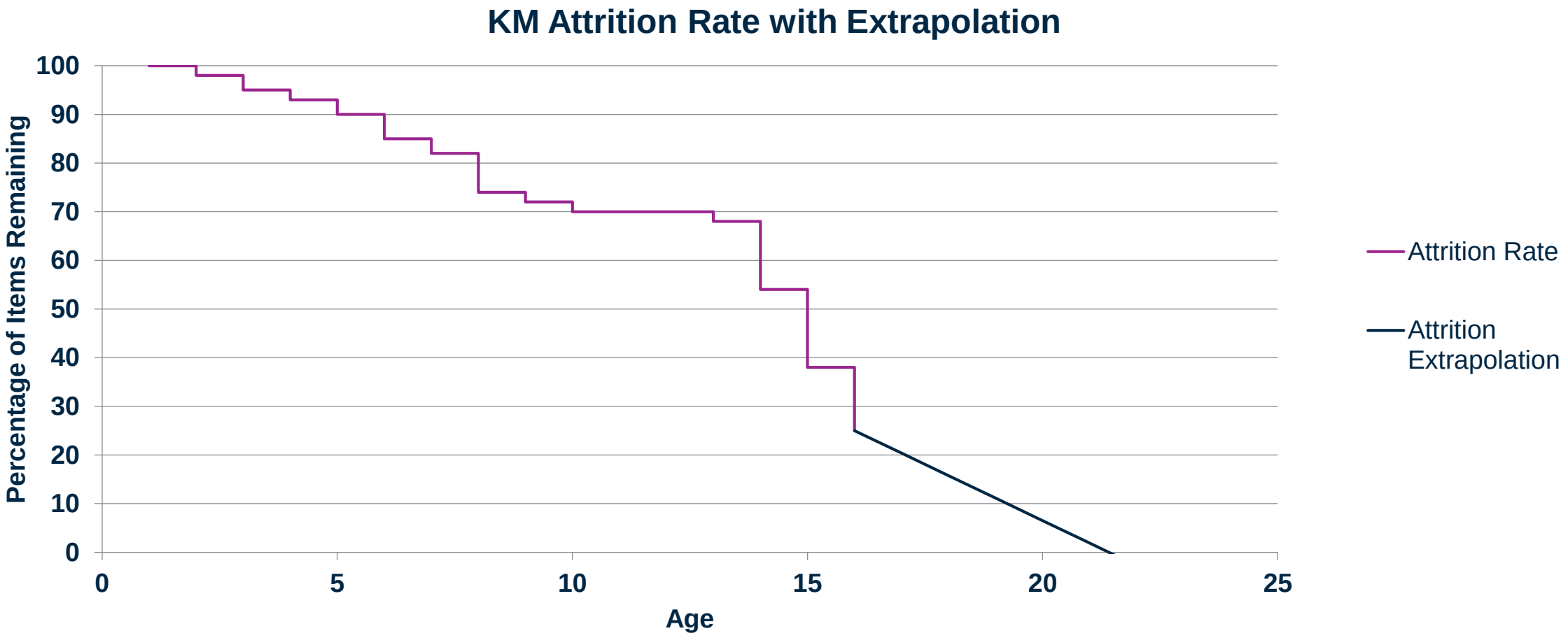
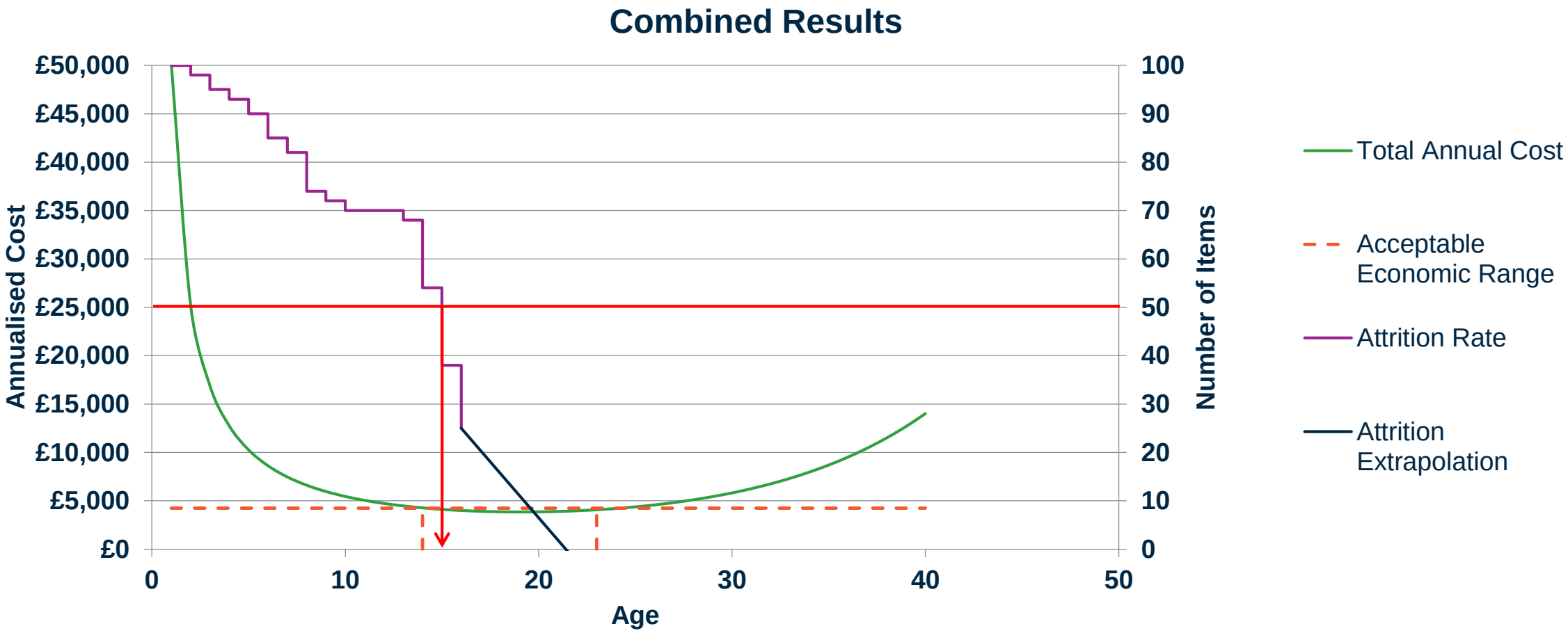
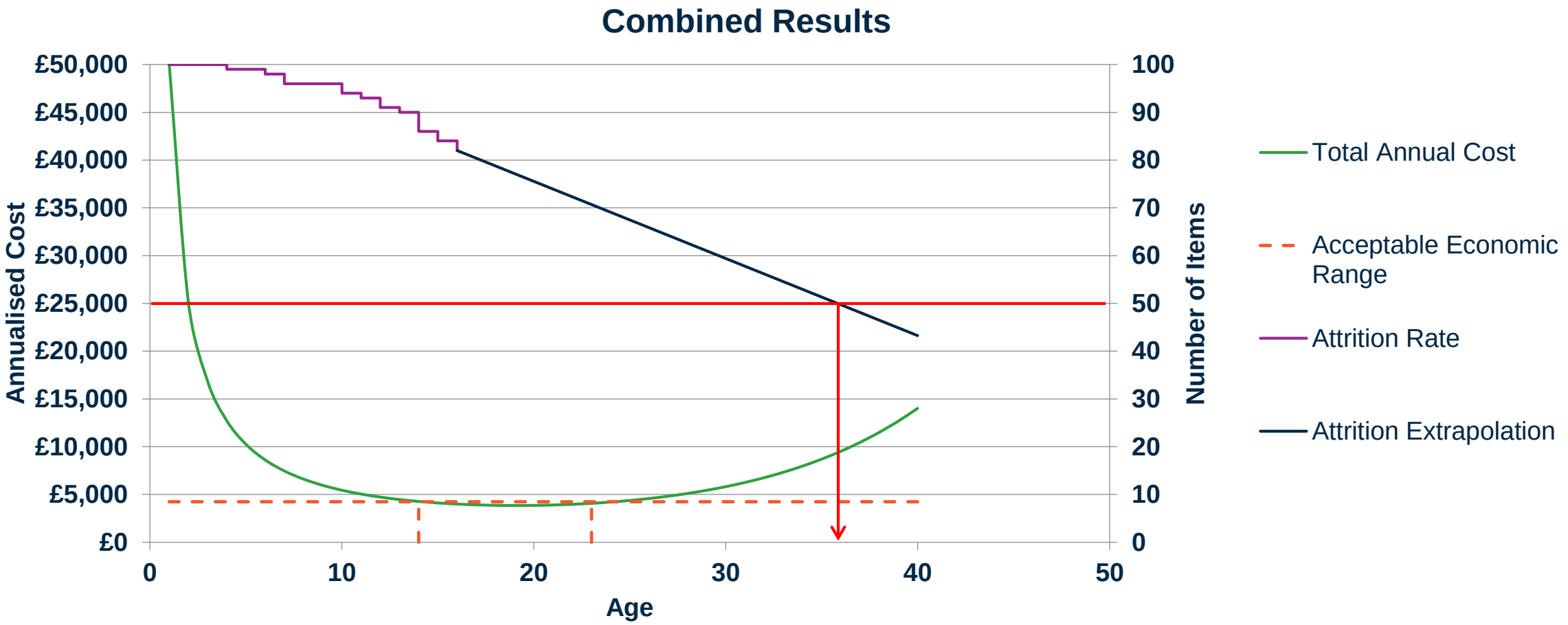
Reliability Calculations



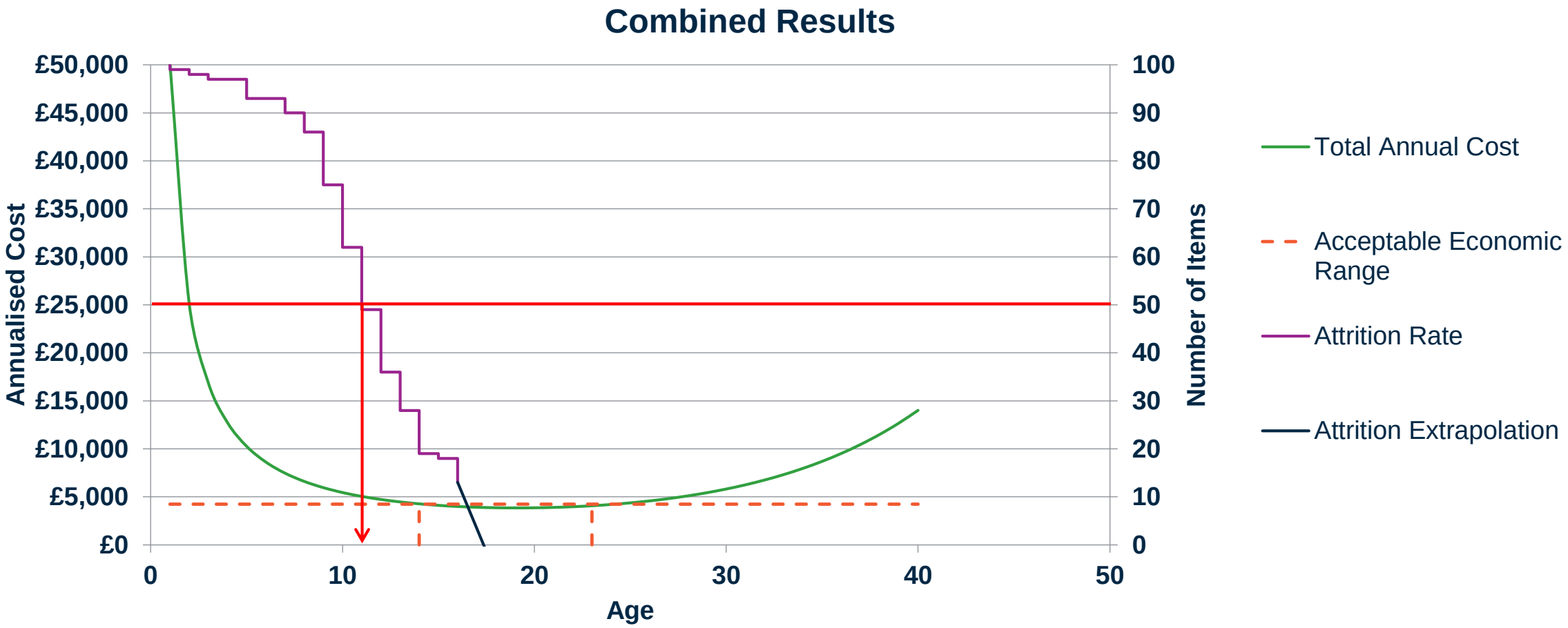
Combining the Results



Combining the Results – Slow Attrition Rate



Combining the Results – Fast Attrition Rate



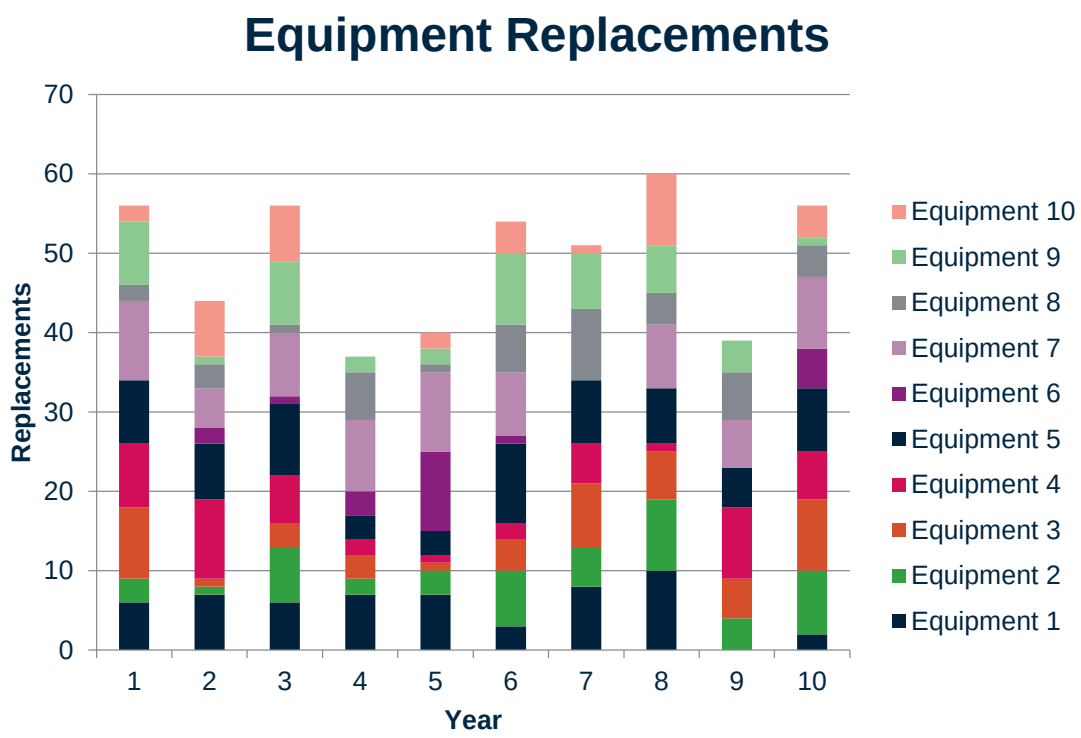
Portfolio Level Management with Linear Programming

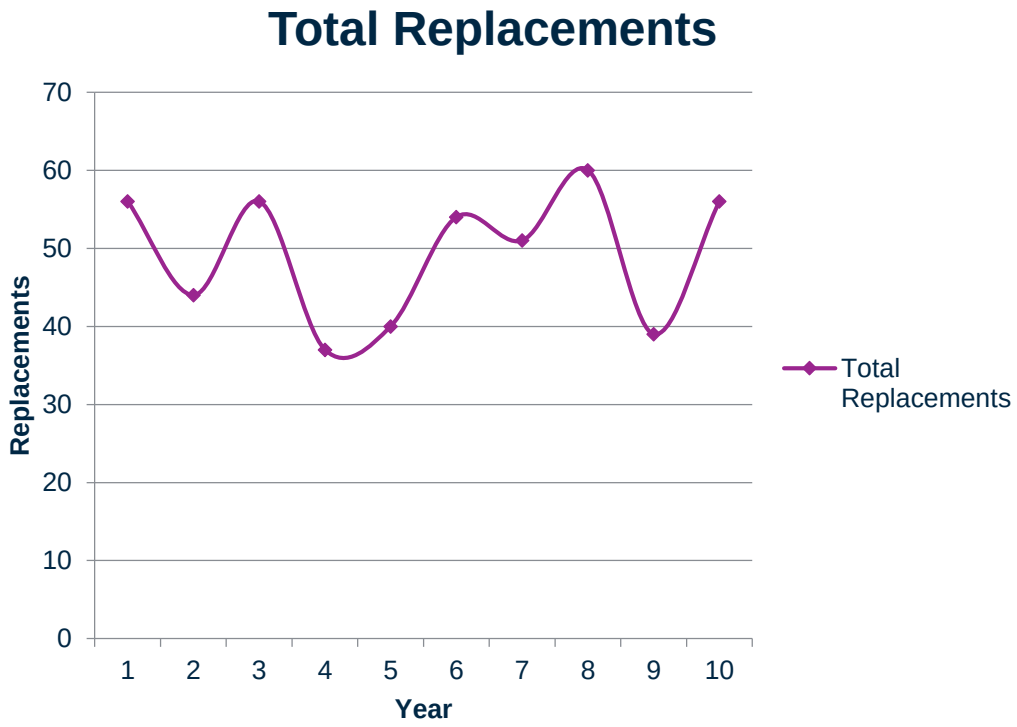
- When working with a portfolio of equipment or fleet of fleets it is important that replacement activity remains under a capital expenditure budget.

- By understanding the optimum economic range and expected failure rate of every fleet a replacement plan can be designed.

- This process can be automated with a linear program using the following hierarchy of rules:
  1. All replacement activity must fall under a specified annual capital expenditure budget;
  2. All replacement must occur before the threshold frequency requirement is expected to be reached;
  3. All replacement activity must occur in the expected optimum economic range.

Portfolio Level Management with Linear Programming





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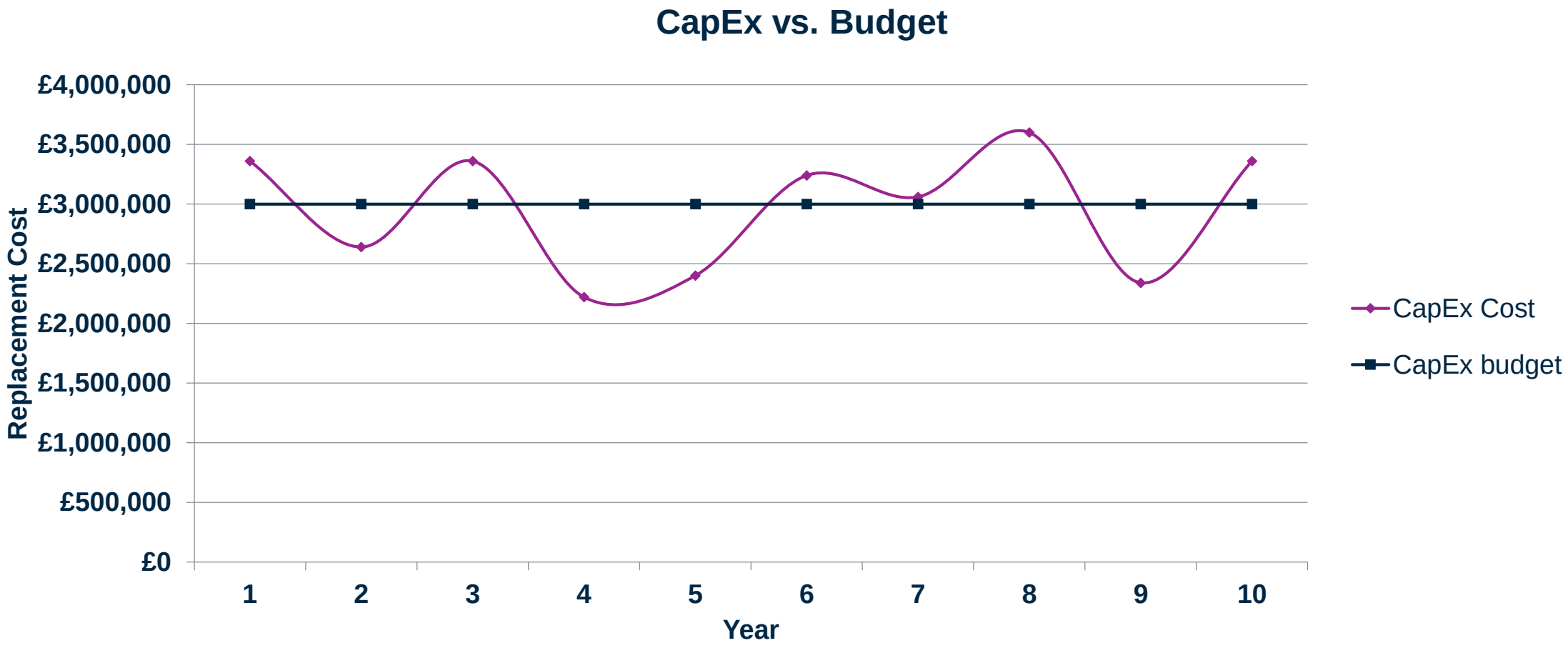

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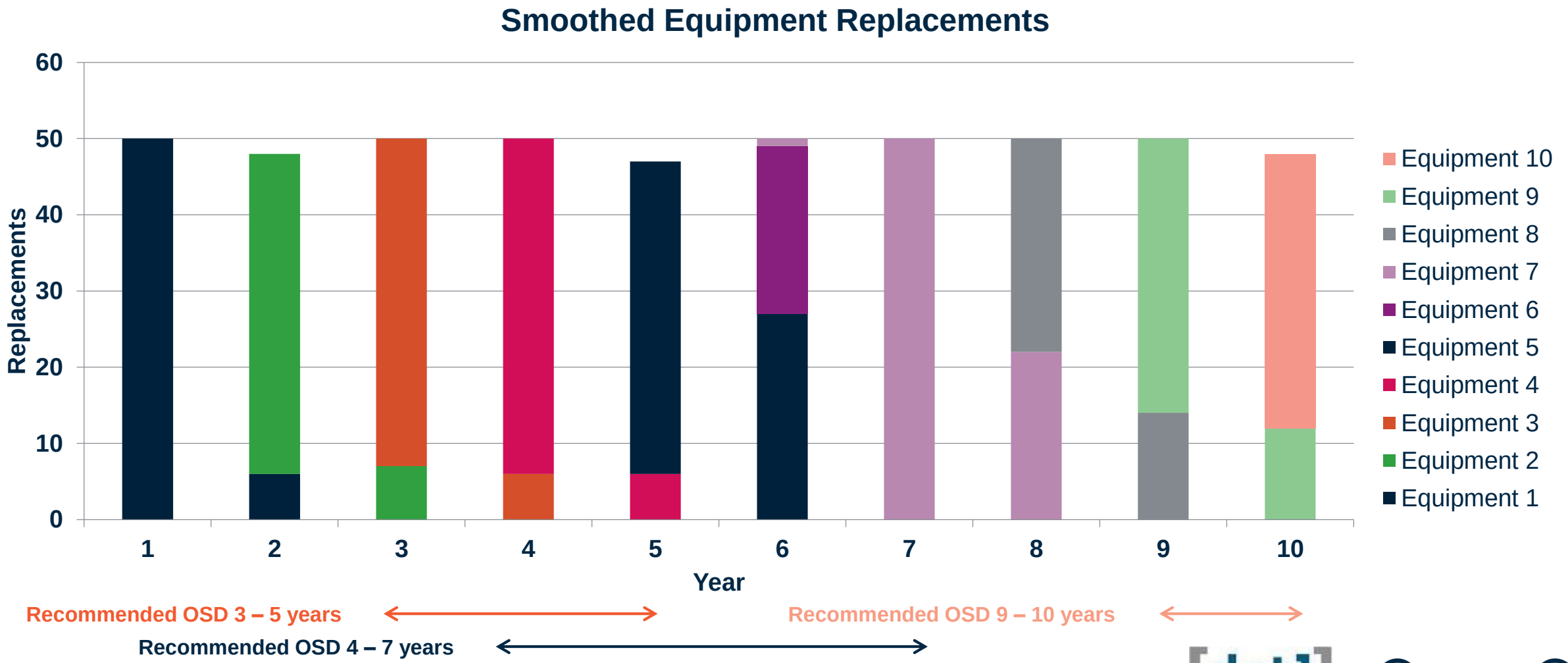

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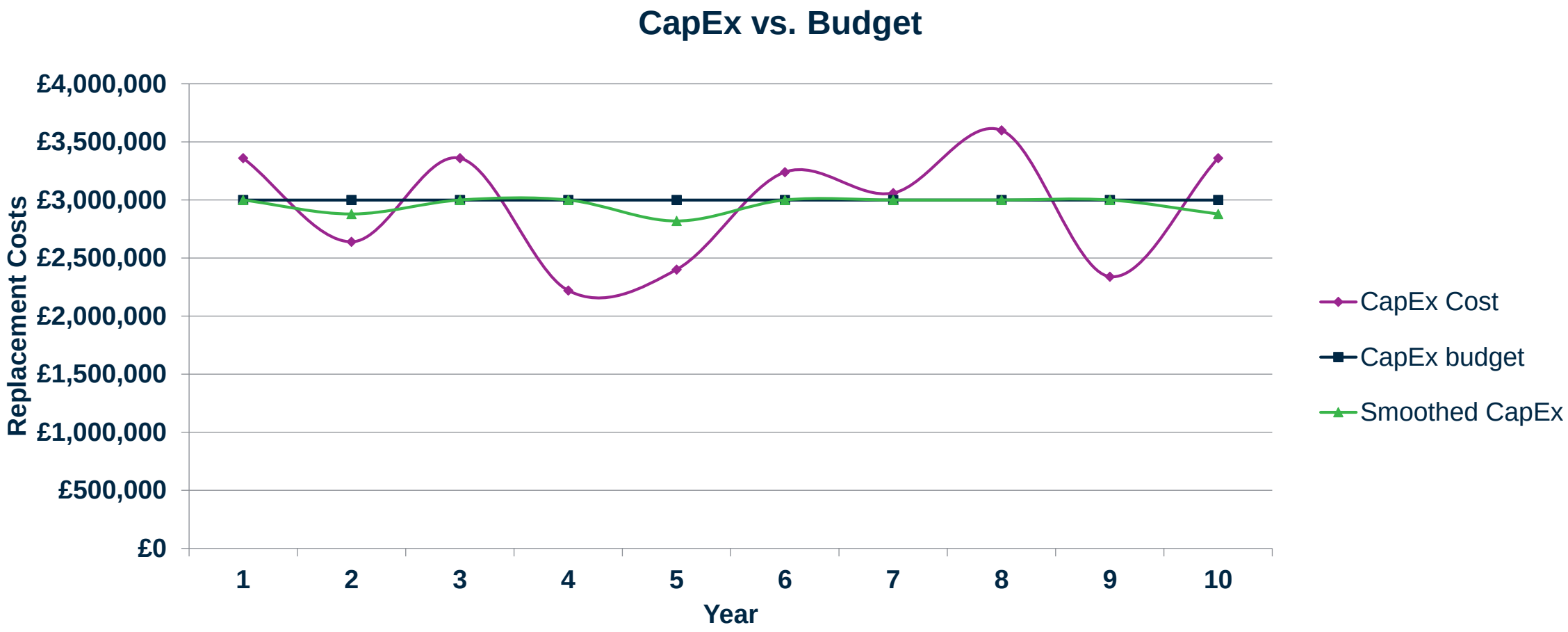
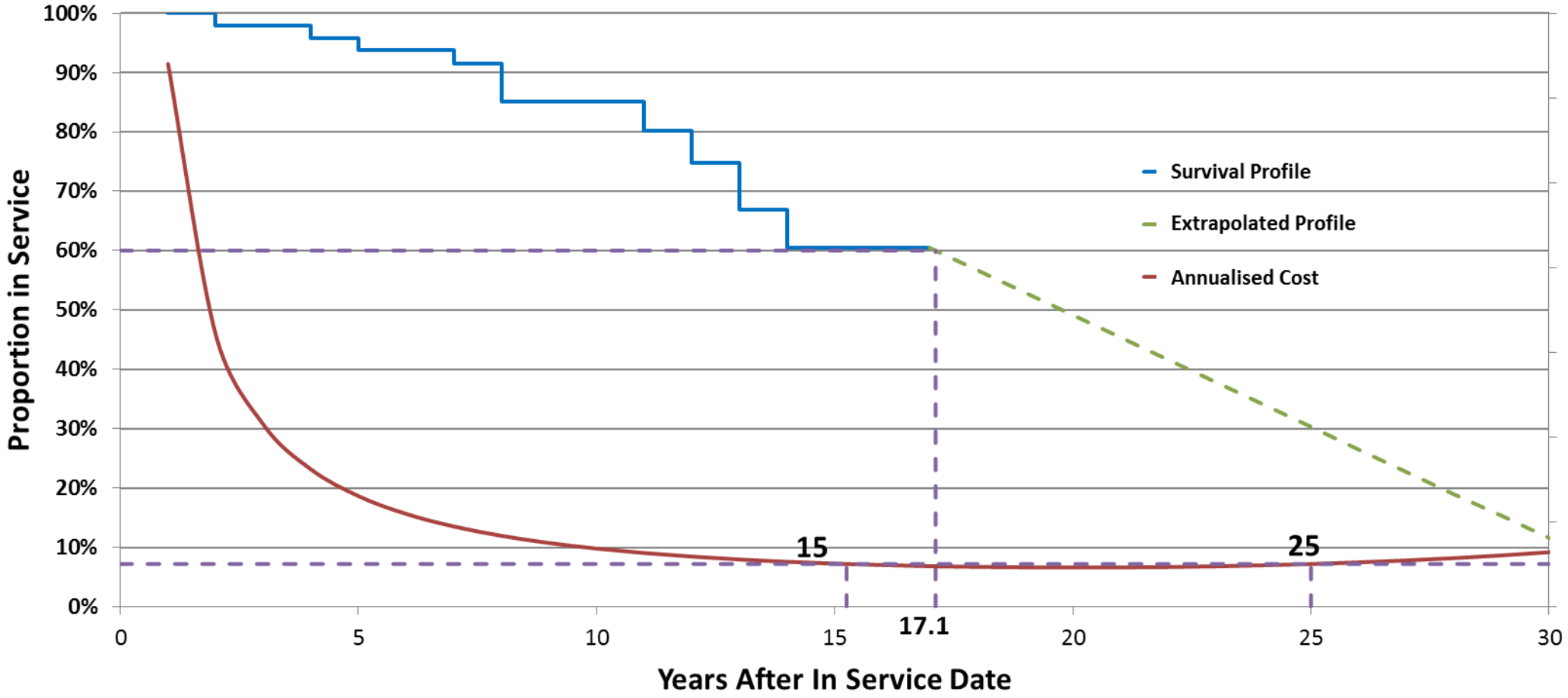


Early Results with Real Data



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Summary

- Annualised cost is a suitable consideration when planning replacement of equipment on a one-to-one basis.

- Combining this analysis with reliability data for a fleet of equipment allows the user to effectively plan replacement on a fleet-by-fleet basis.

- By considering the recommended out of service date ranges for a fleet of fleets a linear program can be used to help smooth capital expenditure profile.

- The Cost Effective Replacement Management method has the potential to deliver significant cost savings without sacrificing any operational effectiveness.


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