Enhancing Preventive Maintenance Policy and Performing Asset Failure Analysis

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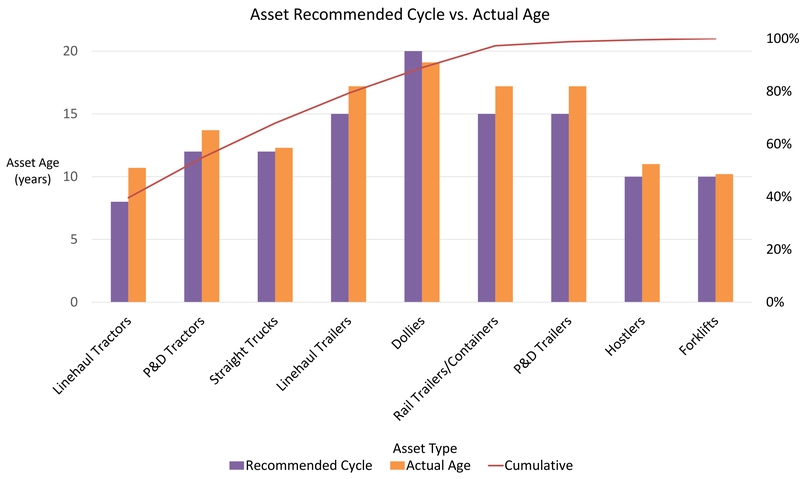
Introduction

Vision Statement:

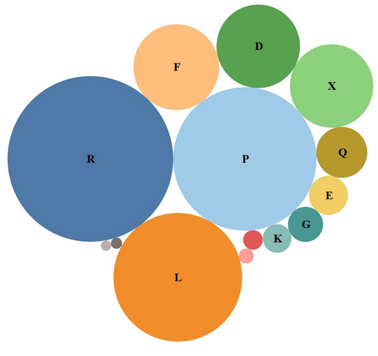
"Analyze FedEx Freight's equipment fleet to mathematically model asset failure and enhance preventive maintenance policy, proactively supporting the identification of potential issues while maximizing fleet availability."



- An asset is considered out-of-cycle when the actual age exceeds the prescribed life cycle. The figure above depicts the recommended retirement age (purple bars) and the average actual age (orange bars).
- Establishing and maintaining in-cycle fleets minimizes the cost of maintenance as assets approach its recommended useful life. 89% of FedEx Freight's material handling fleet is currently operating beyond its retirement benchmark.

Asset Group	Assets	Percentage
Linehaul Tractors	R, Q	32%
Linehaul Trailers	H, P	22%
P&D Tractors	L	18%
P&D Trailers	G, K, X	10%

- As a result of 82% of the material handling fleet consisting of tractors & trailers, the team scoped the analysis to the asset types shown in the table above.



R = Linehaul Tractors
P = Linehaul Trailers
L = P&D Tractors
F = Forklifts
D = Dollies
X = P&D Trailers
Q = Linehaul Tractors
E = Yard Mules
G =P&D Trailers
K =P&D Trailers

Analysis

Policy Adherence:

- It was important to examine how effectively FedEx is following the current PM policy.
- FedEx provided the team with a set of benchmarks for different PM operations allowing us to construct an Excel-based VBA model to analyze maintenance records and their compliance with each.
- It is unrealistic to expect FedEx to precisely meet their PM benchmarks encouraging the team to develop a tolerance window.
- The percentages shown in the table below represent the proportion of records where maintenance on the asset was within the acceptable tolerance window. This comparison emphasizes the need for a more strictly enforced set of PM rules.

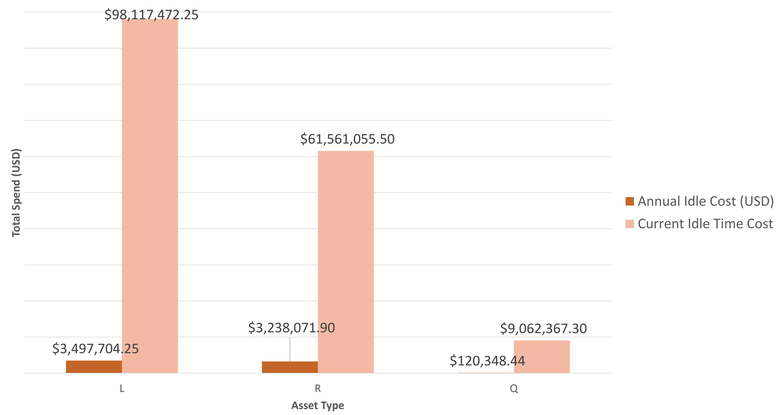
Tolerance Window:	Policy Adherence Level:
10%	2%
25%	5%
50%	9%
75%	21%
100%	59%

Cost Analysis:

- Because FedEx Freight has seen significant company growth through recent years, they have seen an increasing trend in cost for labor and parts in both inventory and non-inventory maintenance scenarios.
- The most significant increase occurred between FY12 and FY13, but each of the four asset groups displayed have shown overall increases over the five fiscal years shown.
- This increase in cost can be attributed to both an increase in fleet size and an increase in the number of out-of-cycle assets in the fleet.

Analysis (cont.)

Opportunity Cost Analysis:



- The idle time opportunity cost analysis shows the potential revenue increase attainable through reducing the time assets spend idle in the shop receiving maintenance.
- FedEx is currently seeing a large idle time cost. However, an increase in the proportion of PMs performed relative to all other maintenances would result in a reduction of this opportunity cost.
- The ideal idle time cost shows a 94% reduction from current levels.
- We recognize this is not feasible, so we performed sensitivity analysis showing the incremental cost reduction from increasing the proportion of PMs by increments of 10%.

Percentage of PM	50%	60%	70%	80%	90%	100%
Opportunity Cost	$16,041,809	$14,204,672	$12,367,535	$10,530,398	$8,693,261	$6,856,125
% Cost Reduction	0%	11%	23%	34%	46%	57%

Risk Analysis:

- Risk analysis was performed on maintenance data from the past five years. These records were analyzed in Weibull++ to determine important fleet life expectancy characteristics.
- Simulation modeling techniques were employed to characterize the PM policy and its effects on the fleet's performance. The video demonstration details the methodologies used and our findings.

Conclusions

- Increase the level of adherence to current PM policies
- Implement means to track incremental performance factors to collect data to evaluate component PM benchmarks for further revision of the PM policy
- FedEx is performing some level of Imperfect maintenance on their fleet. There is significant room for improvement to the PM policy