

LIFE-CYCLE MANAGEMENT



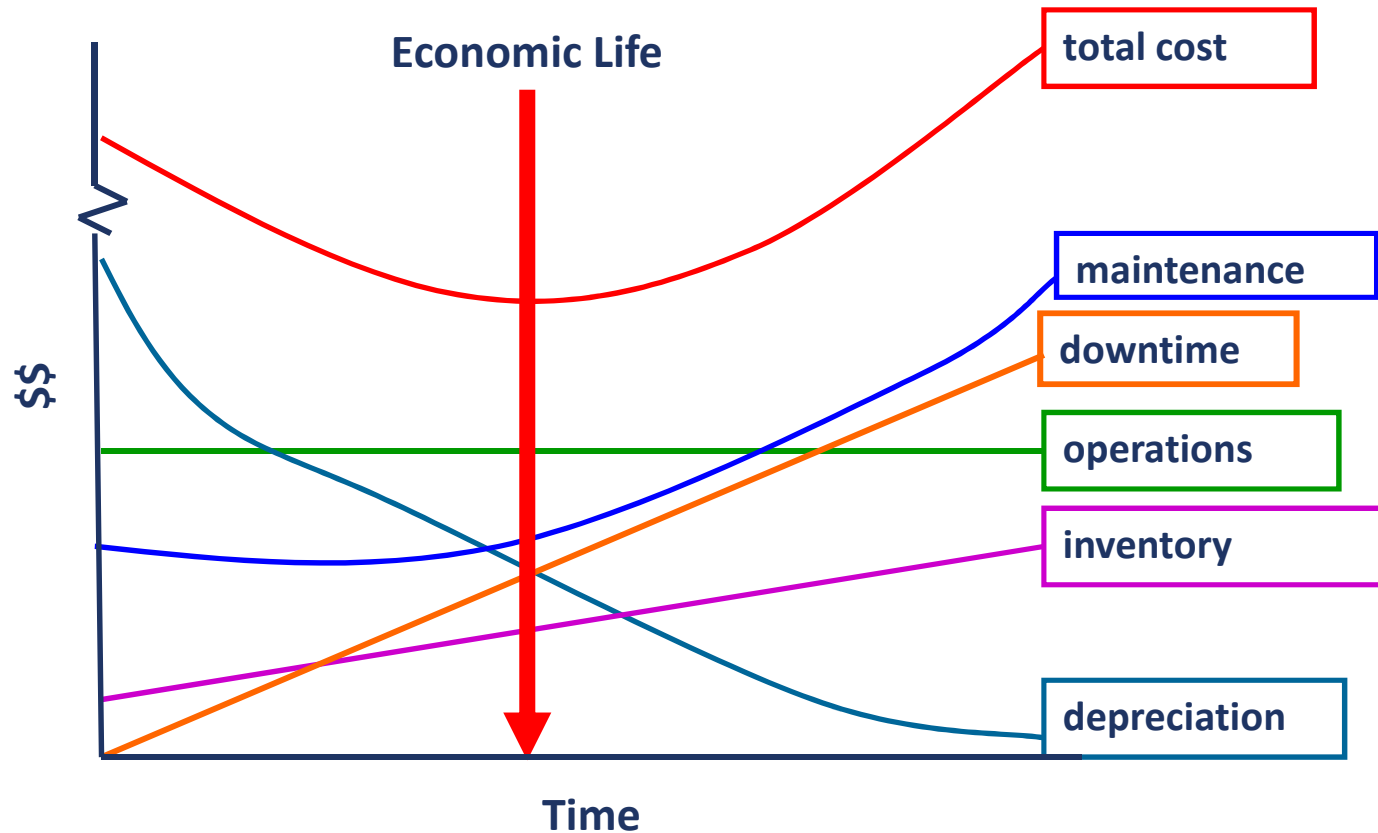
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Enviro-Fleets Workshop, London, Ontario
November 16, 2010



LIFE CYCLE MODEL



Source: H. Greene & R.E. Knorr, *Managing Public Equipment*, American Public Works Association, Kansas City, 1989.



OPTIMIZING FLEET REPLACEMENT DECISIONS

- Constant Annual Utilization



- Varying Annual Utilization



- Technological Improvement



- Tracking Individual Units



- Repair versus Replace



FLEET STATISTICS

Utilization: 110,000 km/year per tractor

Fleet size: 17

Tractor weight: 23,000

Current policy: 5 year replacement cycle



THE DATA

Title: BEST ESTIMATE RESALE VALUES

Number of Years: 5

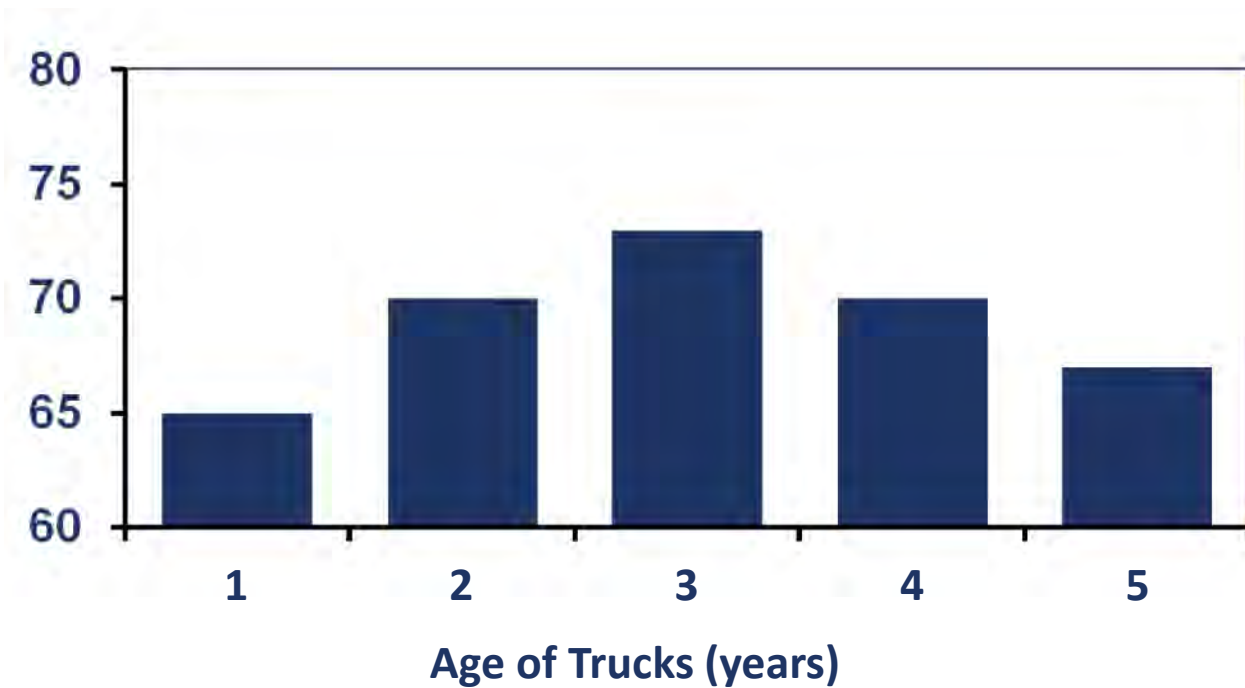
Acquisition Cost: 85000

Age of Vehicle	O&M Cost (In Today's Dollars)	Rate for Cash Flow Discounting	Trade-in Value	EAC Best Year Highlighted
1 Year Old	29352	10%	60000	
2 Year Old	45246	10%	40000	
3 Year Old	52626	10%	25000	
4 Year Old	53324	10%	20000	
5 Year Old	42363	10%	15000	



DATA ANALYSIS: EQUIVALENT ANNUAL COST VS AGE OF TRUCKS

EAC - \$ (Thousands)



PARKS & RECREATION DEPARTMENT: DUMP TRUCKS

DETERMINING OPTIMAL REPLACEMENT AGE FOR MUNICIPAL DUMP TRUCKS



AGE/CON - Main

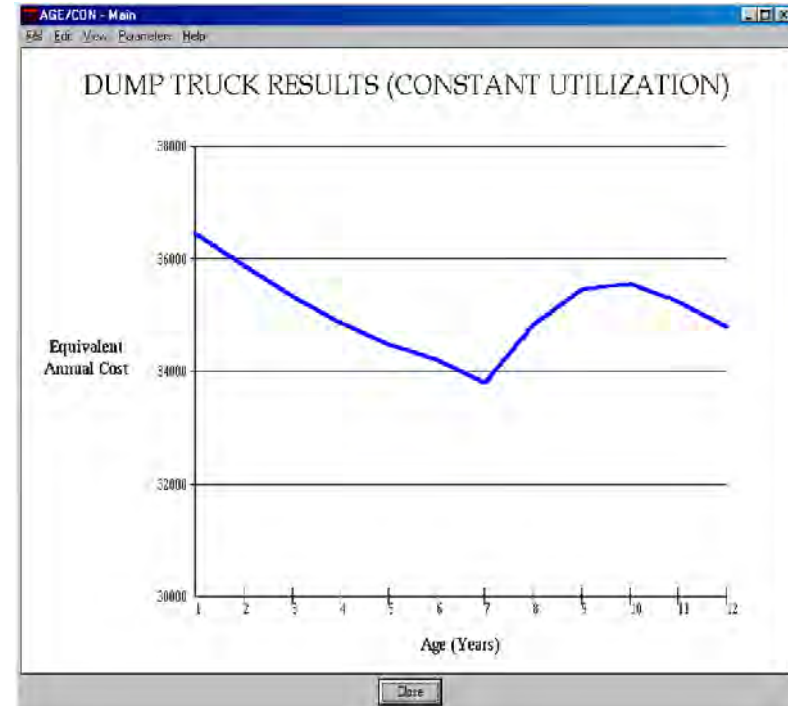
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Description: DUMP TRUCK RESULTS (CONSTANT UTILIZATION)

Number of Years: 12 Acquisition Cost: 120,000 Best Year: 7

Parameters

Age of Vehicle(s)	O&M Cost	Resale Value	Resale Rate (%)	EAC
1 Year Old	13,500	110,400	92.0000	36,450
2 Years Old	14,000	101,568	84.6400	35,889
3 Years Old	14,385	93,443	77.8692	35,350
4 Years Old	14,824	85,967	71.6392	34,871
5 Years Old	15,462	79,090	65.9083	34,480
6 Years Old	16,632	72,763	60.6358	34,227
7 Years Old	15,656	66,942	55.7850	33,815
8 Years Old	30,411	61,586	51.3217	34,837
9 Years Old	29,463	56,659	47.2158	35,475
10 Years Old	24,174	52,127	43.4392	35,557
11 Years Old	18,481	47,956	39.9633	35,242
12 Years Old	15,737	44,120	36.7667	34,807



In this case, optimal replacement age is after 7 years of operation



A FURTHER EXAMPLE: PICK – UP TRUCK

DETERMINING OPTIMAL REPLACEMENT AGE FOR 4X4 PICK-UP TRUCKS



AGE/CON - Main

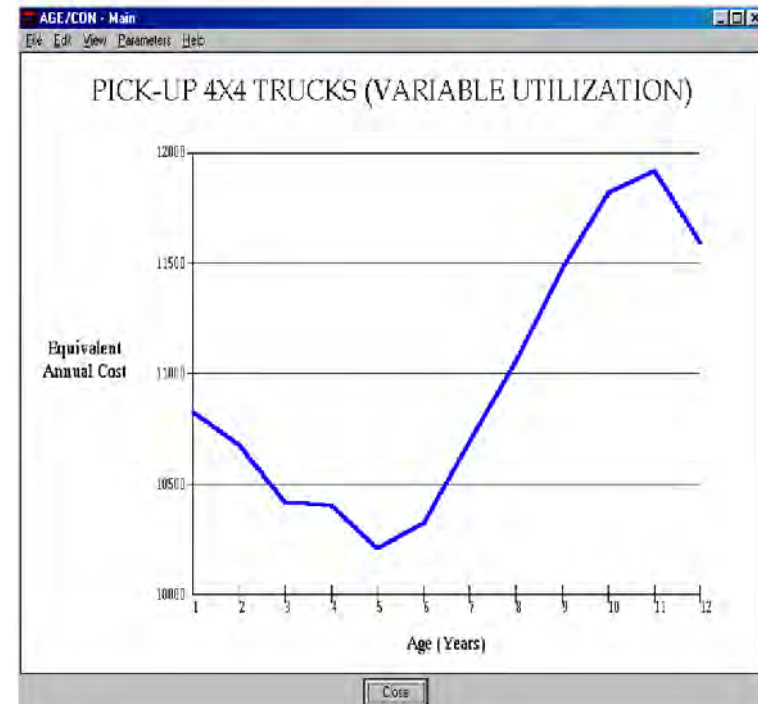
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Description: PICK-UP 4X4 TRUCKS (VARIABLE UTILIZATION)

Number of Years: 12 Acquisition Cost: 35,000 Best Year: 5

Parameters

Age of Vehicle(s)	O&M Cost	Resale Value	Resale Rate (%)	EAC
1 Year Old	2,833	30,789	87.9686	10,827
2 Years Old	4,783	28,624	81.7829	10,674
3 Years Old	5,085	27,254	77.8686	10,418
4 Years Old	4,952	25,074	71.6400	10,404
5 Years Old	5,195	24,068	68.7657	10,211
6 Years Old	6,230	22,222	63.4914	10,327
7 Years Old	8,075	19,525	55.7857	10,693
8 Years Old	10,348	17,963	51.3229	11,061
9 Years Old	12,271	16,526	47.2171	11,478
10 Years Old	12,668	15,204	43.4400	11,819
11 Years Old	9,965	13,987	39.9629	11,921
12 Years Old	2,190	12,868	36.7657	11,594



In this case, optimal replacement age is after 5 years of operation



MUNICIPAL BUS FLEET

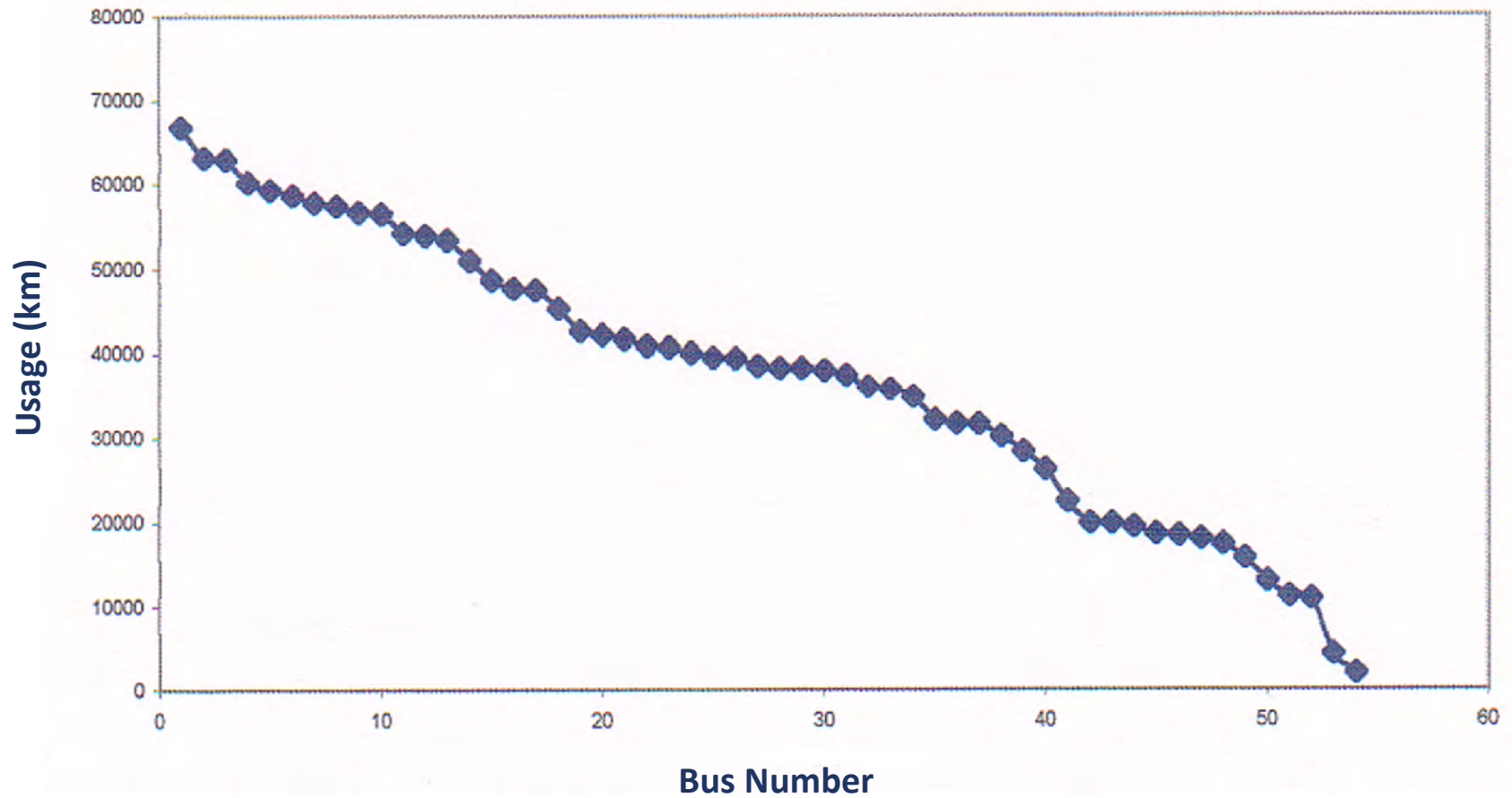
Optimizing Economic Life Decisions for a Bus Fleet



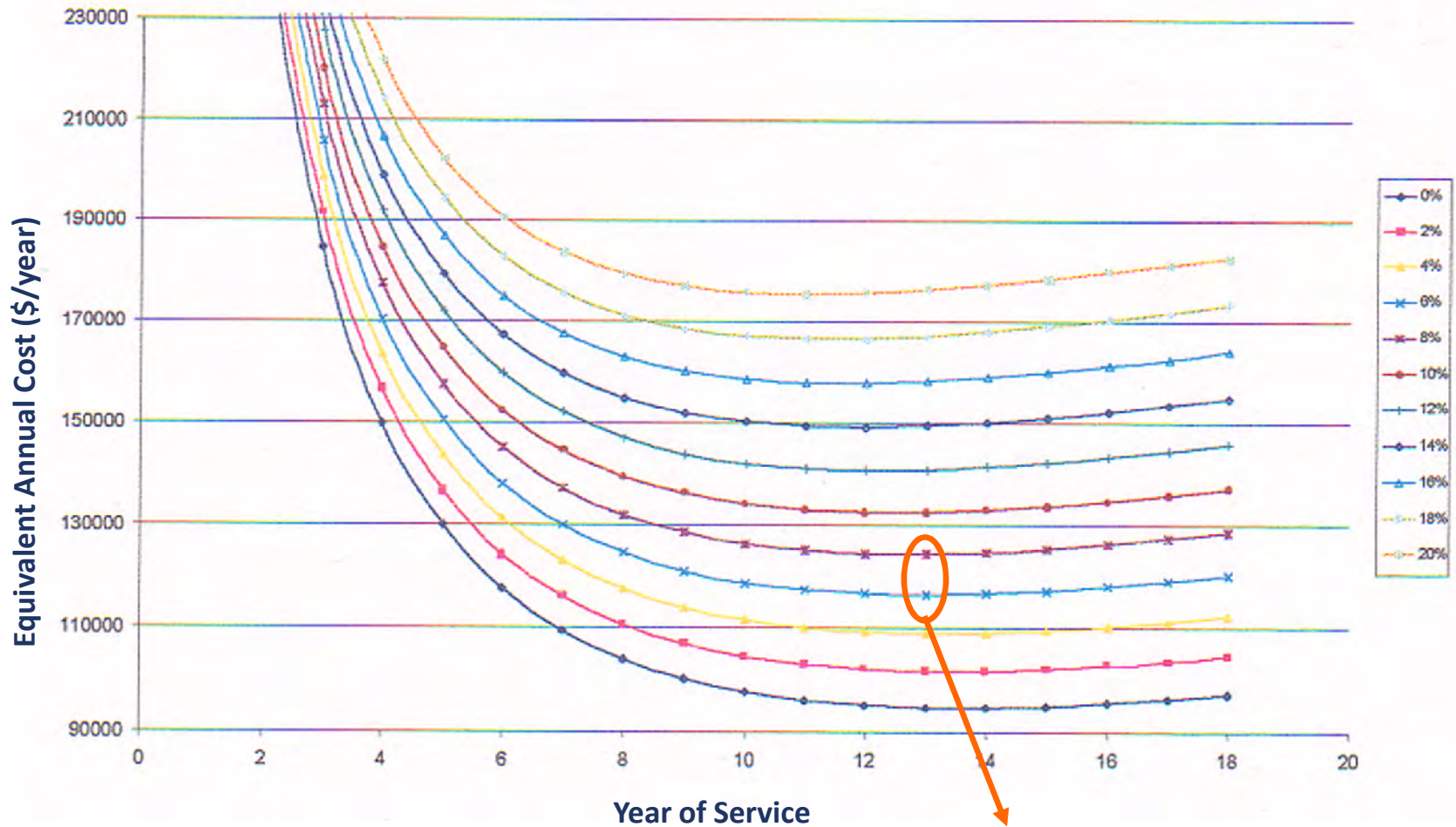
By: Cheung- Ki Derek Siu Monique Ka Yee Ho



UTILIZATION TREND CURVE



EQUIVALENT ANNUAL COST (EAC)



Minimum EAC in year 13



INTERPRETATION OF RESULTS

- The optimal solution's (13 years) corresponding EAC is between \$116,000 and \$125,000
- The current replacement policy (18 years) has a corresponding EAC between \$120,000 and \$129,000
- Therefore, the potential cost savings are about \$216,000/year (= \$4,000 × 54 vehicles)

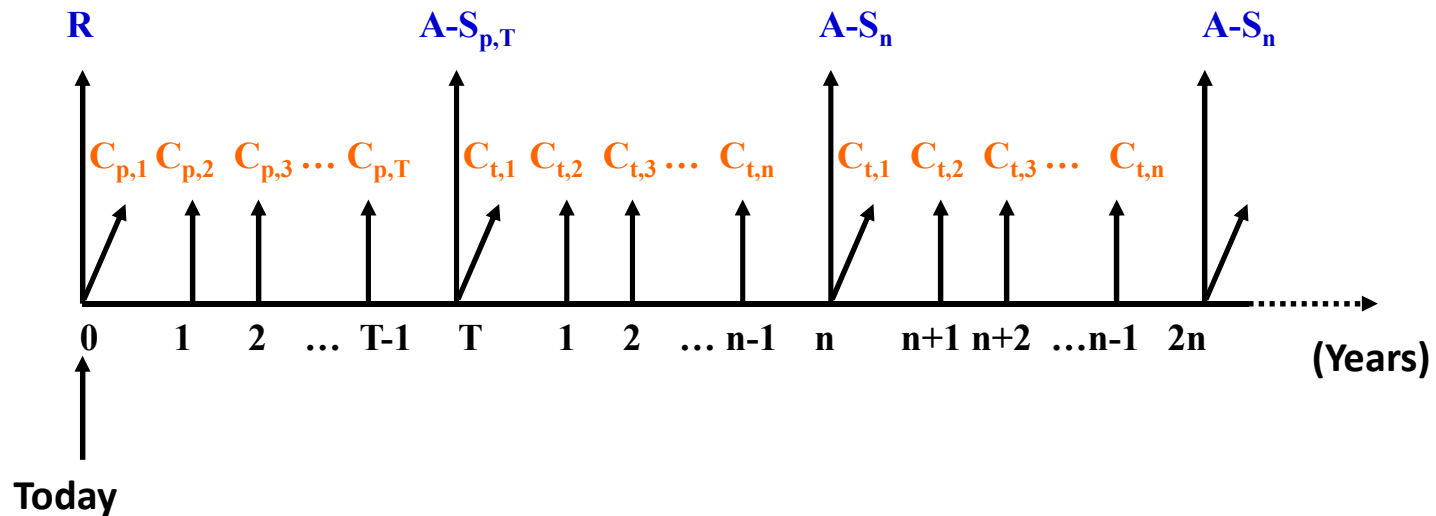


CATERPILLAR 992D WHEEL LOADER



REPAIR VS. REPLACE

Cash Flows Associated with Acquiring New Equipment at Time 'T'



THE RESULT

Purchase price: \$ = \$ 1,083,233 (Unit operational)
Rebuild Cost = \$ 489,970

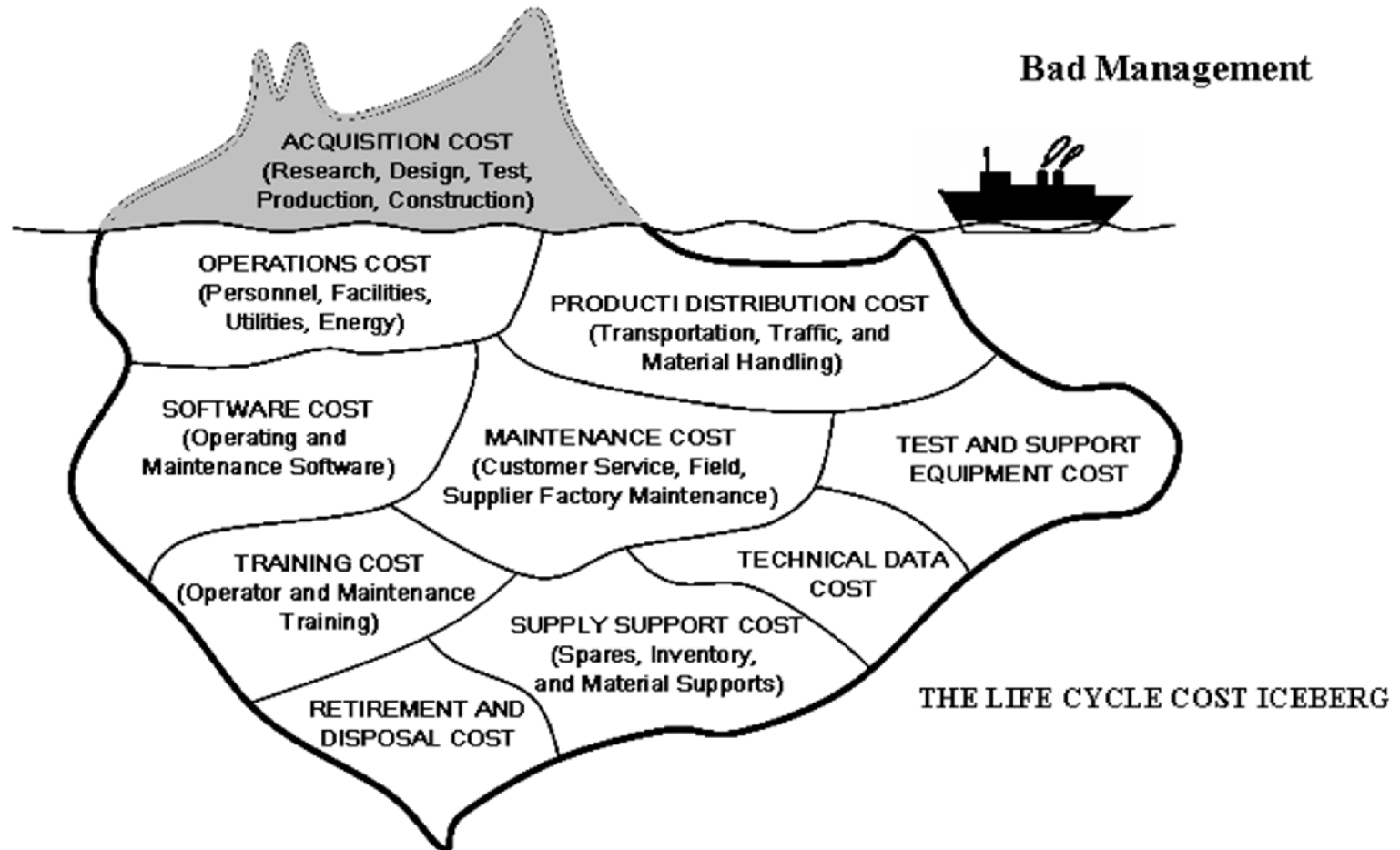
Change-over time to new loader, T				
	T = 0	T = 1	T = 2	T = 3
Overall EAC (\$)	449,074	471,725	459,319	450,217

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Minimum



THE LIFE CYCLE COST ICEBERG



Source: B.S. Blanchard and W.J. Fabrycky, *Systems Engineering and Analysis*, Prentice Hall, 1990



THANK YOU

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