

Chapter 6

Annual Worth Analysis

Lecture slides to accompany

Engineering Economy

8th edition

Leland Blank

Anthony Tarquin



LEARNING OUTCOMES

- 1. Advantages of AW**
- 2. Capital Recovery and AW values**
- 3. AW analysis**
- 4. Perpetual life**
- 5. Life-Cycle Cost analysis**

Advantages of AW Analysis

AW calculated for only _____ life cycle

- ✦ $AW = PW(A/P, i, n) = FW(A/F, i, n)$
- ✦ It is not necessary to use the _____ of lives to satisfy the equal-Service requirement
- ✦ All cash flows *will be* _____ in every life cycle

Alternatives usually have the following cash flow estimates

- ✦ **Initial investment, P** – _____ cost of an asset
 - ✦ **Salvage value, S** – Estimated value of asset at _____ of useful life
 - ✦ **Annual amount, A** – Cash flows associated with asset, such as _____ cost (AOC), etc.
-

Relationship between AW, PW and FW

$$AW = PW(A/P, i\%, n) = FW(A/F, i\%, n)$$

n is years for equal-service comparison (value of LCM or specified study period)

Calculation of Annual Worth

AW for one life cycle is the _____ life cycles!!

An asset has a first cost of \$20,000, an annual operating cost of \$8000 and a salvage value of \$5000 after 3 years. Calculate the AW for one and two life cycles at $i = 10\%$

$$\begin{aligned} AW_{\text{one}} &= -20,000(A/P, 10\%, 3) - 8000 + 5000(A/F, 10\%, 3) \\ &= \text{\$-14,532} \end{aligned}$$

$$\begin{aligned} AW_{\text{two}} &= -20,000(A/P, 10\%, 6) - 8000 - 15,000(P/F, 10\%, 3)(A/P, 10\%, 6) \\ &\quad + 5000(A/F, 10\%, 6) \\ &= \text{\$-14,532} \end{aligned}$$

Capital Recovery and AW

Capital recovery (CR) is the _____ amount that an asset, process, or system must earn each year to just recover the _____ cost and a stated rate of return over its expected life. Salvage value is considered when calculating CR.

$$\mathbf{CR = -P(A/P, i\%, n) + S(A/F, i\%, n)}$$

Use previous example: (note: _____ not included in CR)

$$\mathbf{CR = -20,000(A/P, 10\%, 3) + 5000(A/F, 10\%, 3) = \$ - 6532 \text{ per year}}$$

Now $\mathbf{AW = CR + \underline{\hspace{2cm}}}$

$$\mathbf{AW = - 6532 - 8000 = \$ - 14,532}$$

Selection Guidelines for AW Analysis

One alternative: If $AW \geq 0$, the requested MARR is met or exceeded and the alternative is economically justified.

Two or more alternatives: Select the alternative with the AW that is **numerically largest**, that is, less negative or more positive. This indicates a lower AW of cost for cost alternatives or a larger AW of net cash flows for revenue alternatives.

ME Alternative Evaluation by AW

Not necessary to use LCM for different life alternatives

A company is considering two machines. Machine X has a first cost of \$30,000, AOC of \$18,000, and S of \$7000 after 4 years. Machine Y will cost \$50,000 with an AOC of \$16,000 and S of \$9000 after 6 years. Which machine should the company select at an interest rate of 12% per year?

Solution: $AW_X = -30,000(A/P, 12\%, 4) - 18,000 + 7,000(A/F, 12\%, 4)$
 $= \$-26,412$

$$AW_Y = -50,000(A/P, 12\%, 6) - 16,000 + 9,000(A/F, 12\%, 6)$$
$$= \$-27,052$$

Select Machine ____; it has the numerically _____ AW value

AW of Permanent Investment

Use $A = Pi$ for AW of _____ life alternatives
Find AW over _____ *life cycle* for *finite* life alternatives

Compare the alternatives below using AW and $i = 10\%$ per year

	C	D
First Cost, \$	-50,000	-250,000
Annual operating cost, \$/year	-20,000	-9,000
Salvage value, \$	5,000	75,000
Life, years	5	∞

Solution: Find AW of C over 5 years and AW of D using relation $A = Pi$

$$AW_C = -50,000(A/P, 10\%, 5) - 20,000 + 5,000(A/F, 10\%, 5)$$

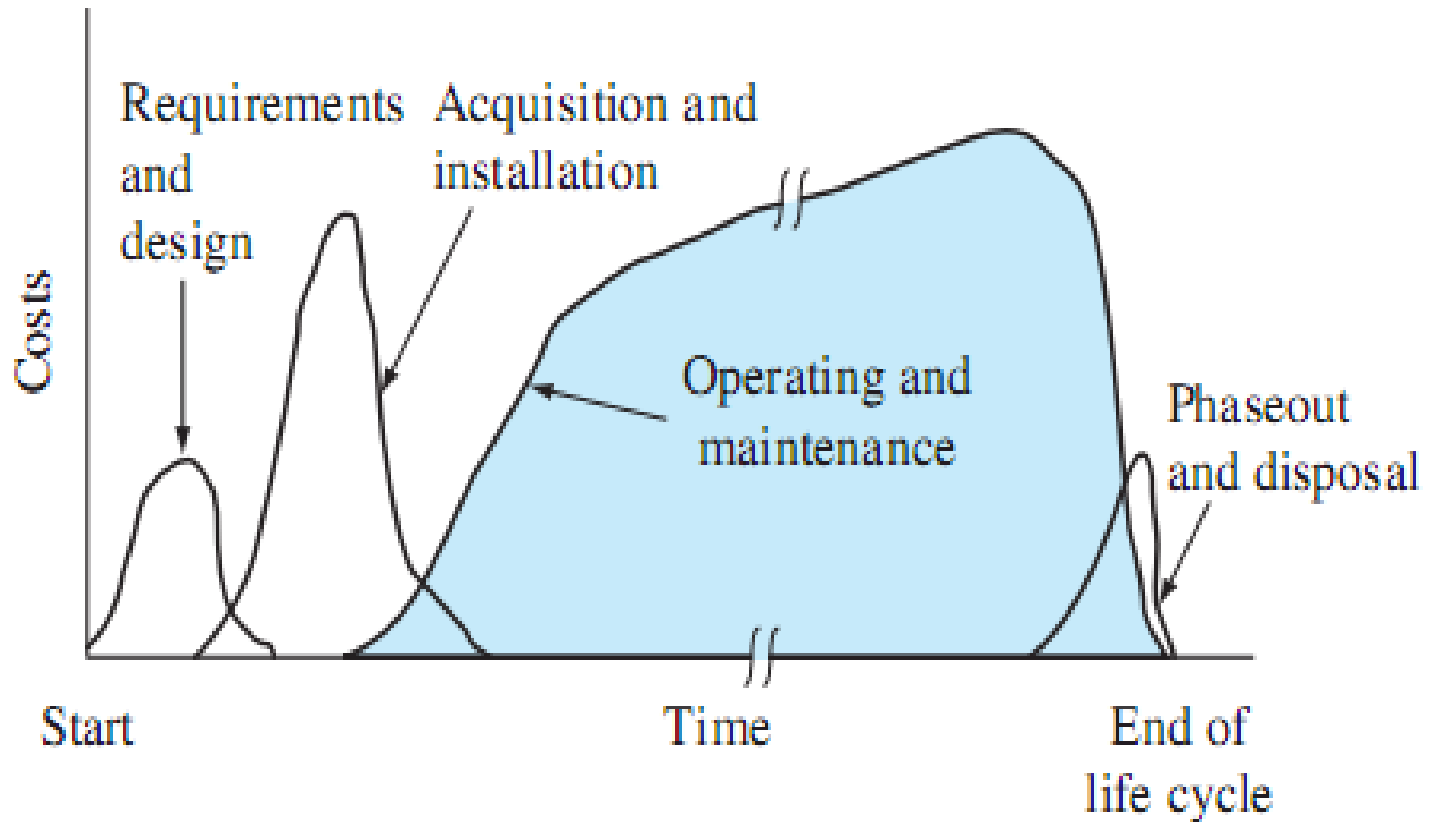
$$= \$-32,371$$

$$AW_D = Pi + AOC = -250,000(0.10) - 9,000$$

$$= \$-34,000$$

Select alternative C

Typical Life-Cycle Cost Distribution by Phase



Life-Cycle Cost Analysis

LCC analysis includes ____ costs for ____ life span,
from concept to disposal

Best when large percentage of costs are ____

Includes phases of ____, ____, & ____

- ✓ Apply the AW method for LCC analysis of 1 or more cost alternatives
- ✓ Use PW analysis if there are revenues and other benefits considered

Summary of Important Points

- ★ AW method converts all cash flows to _____ *value at* _____
- ★ Alternatives can be *mutually exclusive, independent, revenue, or cost*
- ★ AW comparison is *only* _____ *life cycle* of each alternative
- ★ For infinite life alternatives, annualize *initial cost as A =* _____
- ★ Life-cycle cost analysis includes _____ *costs* over a project's life span

HOMEWORK

1. Please solve every Examples in your textbook. You do not have to submit your works.
2. Please upload following “PROBLEMS” solution file on “Assignment” menu in e-Class.
 - ① 6.7
 - ② 6.16
 - ③ 6.31
 - ④ 6.36
 - ⑤ 6.49