- So far we learned *PW* and *FW* as comparison tools
- *AW* analysis is said to be the best comparison tool.
- *AW* value is the equivalent uniform annual worth of all estimated receipts and disbursements during the life cycle of the project or alternative
- *AW* value is equivalent to the *PW* and *FW* values at the MARR for *n* years
  - $AW = PW(A/P, i, n) = FW(A/F, i, n)$

  where *n* is the number of years for equal-service comparison.
- When all cash flow estimates are converted to an *AW* value, this value applies for:
  - every year of the life cycle
  - for each additional life cycle
- The prime advantage of *AW* analysis is:
  1. *AW* value has to be calculated for only one life cycle
  2. not necessary to use the LCM of lives as it is for *PW* and *FW*.

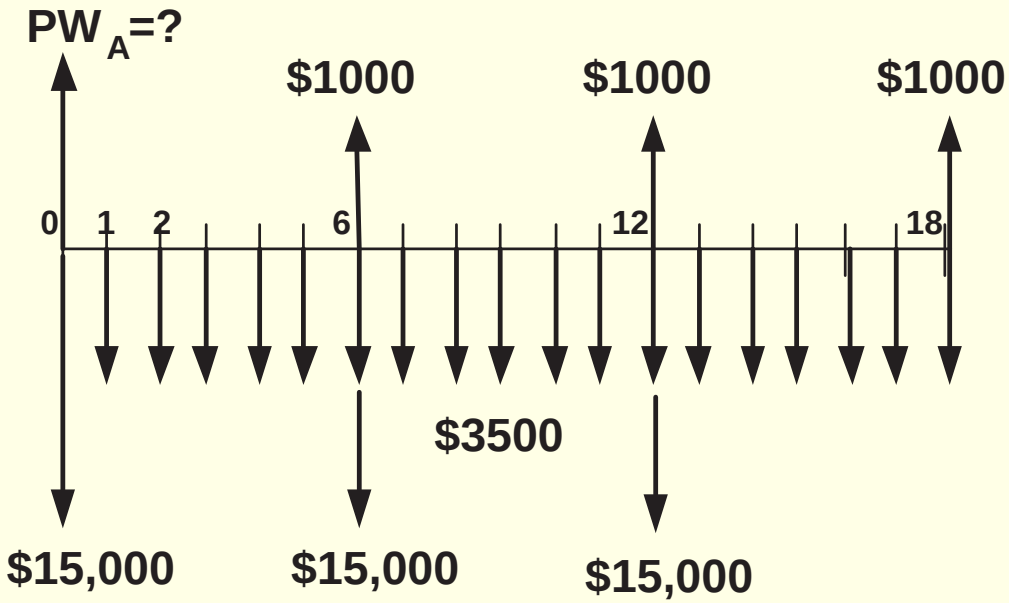
- When alternatives being compared have different lives, the *AW* method makes the assumption that:
  1. The service provided by alternatives will be needed for at least the LCM of years or more
  2. The selected alternative will be repeated over each life cycle of the LCM in exactly the same manner
  3. The cash flow estimates will be the same in every life cycle

Example

Eric Forman, a project engineer is assigned to start up a new office in Wisconsin. Two lease options are available:

	Location A	Location B
First cost, $	$-15,000	$-18,000
Annual lease cost, $ per year	-3,500	-3,100
Deposit return, $	1,000	2,000
Lease term, years	6	9

For Location A, demonstrate the the equivalence at $i = 10\%$ of *PW* ($-55,888.4) over three life cycles and *AW* over one cycle.



1. From $PW = \$-55,888.4$ over 18 years

$$AW = PW(A/P, 10\%, 18) = -55,888.4(0.12193) = -6,814.47$$

2. Directly from AW over 6 years

$$\begin{aligned} AW &= -15,000(A/P, 10\%, 6) - 3500 + 1,000(A/F, 10\%, 6) \\ &= -15,000(0.22961) - 3500 + 1,000(0.12961) \\ &= \$-6,814.54 \end{aligned}$$

- Selection guidelines are the same as for the *PW* method
- For Mutually Exclusive Alternatives:
  1. One Alternative: Calculate *AW* at MARR. If $AW \geq 0$, the requested MARR is met or exceeded and the alternative is financially viable.
  2. Two or more Alternatives: Calculate *AW* of each alternative at MARR. Select the alternative with the *AW* value that is numerically largest.
- For independent projects:
  - All projects with $AW \geq 0$ calculated at MARR are acceptable.
- If a study period is specified, the cash flows over the study period are converted to *AW*.

In Class Work 8

Southern Cement plans to open a new rock mining site. Two plans are suggested. Plan A requires the purchase of two earth movers and an unloading pad at the plant. Plan B calls for the construction of a conveyor from mining site to the plant. MARR is effective 15% per year compounded monthly, and costs are given:

	Plan A		Plan B
	Mover	Pad	Conveyor
First cost,$	$-45,000	$-28,000	-175,000
Annual Operating cost, $	-6,000	-300	-2,500
Salvage value, $	5,000	2000	10,000
Life, years	8	12	24

1. Compare the two plans using *AW* method
2. Compare the two plans using *AW* method over a study period of 6 years. The market value of each mover after 6 years is $20,000 and trade-in value of the conveyor after 6 years is $25,000. The pad can be salvaged for $2,000.

1. The LCM of lives is 24 years.

$$
\begin{aligned}
AW_A &= -12,000 - 90,000(A/P,15\%,8) + 10,000(A/F,15\%,8) \\
&- 300 - 28,000(A/P,15\%,12) + 2,000(A/F,15\%,12) \\
&= -12,000 - 90,000(0.22285) + 10,000(0.07285) \\
&- 300 - 28,000(0.18448) + 2,000(0.03448) \\
&= \$ - 36,724 \\
AW_B &= -175,000(A/P,15\%,24) + 10,000(A/F,15\%,24) \\
&- 2,500 \\
&= -175,000(0.15543) - 2,500 + 10,000(0.00543) \\
&= \$ - 29,646
\end{aligned}
$$

Plan B is selected

1. **Plan B is selected**
2. Over a study period of 6 years

$$
\begin{aligned}
AW_A &= -12,000 - 90,000(A/P, 15\%, 6) + 40,000(A/F, 15\%, 6) \\
&- 300 - 28,000(A/P, 15\%, 6) + 2,000(A/F, 15\%, 6) \\
&= -12,000 - 90,000(0.26424) + 40,000(0.11424) \\
&- 300 - 28,000(0.26424) + 2,000(0.11424) \\
&= \$ - 38,682 \\
AW_B &= -175,000(A/P, 15\%, 6) + 25,000(A/F, 15\%, 6) \\
&- 2,500 \\
&= -175,000(0.26424) - 2,500 + 25,000(0.11424) \\
&= \$ - 45,886
\end{aligned}
$$

Plan A is selected

- Same concept in Capitalized Cost, projects that have long lives that can be considered infinite in economic analysis
- Annual worth of an initial investment is $A = Pi$
- Cash flows recurring regular or irregular intervals handled by:
  - converting them to equivalent uniform annual amounts A for one cycle

Example

An engineer received a bonus of \$10,000. If he deposits it now at an interest rate of 8% per year, how many years must the money accumulate before she can withdraw \$2,000 per year forever?

$$P_n = \frac{A}{i} = \frac{2,000}{0.08} = \$25,000$$
$$10,000(1+0.08)^n = 25,000 \rightarrow n = 12$$