Chapter 11 – Replacement and Retention Decisions

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Need for Replacement Study

- Reduced Performance:
  - Reduction in quality, reliability and productivity due to wear and tear
- Altered Requirements:
  - New production needs, accuracy, speed, etc.
- Obsolescence:
  - Not competitive

Terminology

- Defender Asset:
  - Currently installed asset
- Challenger Asset:
  - Potential replacement, to the current defender (possibly “best” among many challengers)
- AW values are used, often referred to as EUAC (equivalent uniform annual cost)
  - EUAC would be the negative of AW, as it treats costs as positive and revenues/salvage as negative

The Proper Viewpoint

- Consultant’s viewpoint
  - The analyst assumes that he/she is an outsider (a consultant)
  - Thus, the analyst owns neither asset and must assign reasonable value to the defender and challenger

First Costs of Defender/Challenger

- Viewpoint taken for a replacement analysis dictates that the first costs are estimated as follows:
  1. The proper first cost to apply to keeping the defender in service for it’s remaining life- is its current Market Value
  2. The proper first cost to apply to a challenger asset that might replace the current defender asset – is its investment cost P, which may be reduced if defender could actually be traded-in for value higher than its estimated market value, in this case it is \( P - (TIV - MV)_{defender} \)

First costs - continued

- Defender First Cost
  - \( MV_{defender} \)
- Challenger first cost
  - Amount of capital used to replace the defender with the challenger
  - Usually equals challenger initial investment, P
  - Sometimes equal to \( P - (TIV - MV)_{defender} \)
Two Approaches

- **ECONOMIC SERVICE LIFE (ESL)**
  - Used when year-by-year market values are provided for D & C
  - ESL of D & C are identified and AW of D & C at ESL are identified, decision to replace or retain is then made

- **STUDY PERIOD ANALYSIS**
  - Succession options for D & C are listed where each such option lasts for the given study period, and these options are compared to select the best

**Economic Service Life (ESL)**

- ESL of an alternative: Year at which the AW is maximized i.e. EUAC is minimized

- Given interest rate \( i \) and cash flow estimates for years \( 0, \ldots, n (=\text{life}) \) AW up to year \( k \) (denoted by \( AW_k \)) is a function of \( k \)

- Find the \( k \) that maximizes \( AW_k \) (numerically, or it is the smallest of \( EUAC_k = -AW_k \) over all \( k=1,2,\ldots,n \))

**ESL – continued**

\[ AW_k = -P(A/P,i,k) + S_k(A/F,i,k) - \sum_{x=1}^{k} A_x(P/F,i,x) \]

Where
- \( P = \) initial investment (chall.) or current market value (def.)
- \( S_k = \) salvage/market value after \( k \) years
- \( A_x = \) operating cost for year \( x \) in \( \{1\ldots\text{life}\} \)

**Example 11.4**

(a) Perform the replacement study now.

- **Challenger**: First cost $50,000
  - Future market values decreasing by 20% per year
  - Estimated retention period: no more than 3 years
  - AOC estimate $5,000 in year 1 with increases of $2,000 per year thereafter

- **Defender**: Current international market value: $15,000
  - Future market values decreasing by 20% per year
  - Estimated retention period: no more than 3 more years
  - AOC estimate $4,000 next year, increasing by $4,000 per year thereafter, plus the $15,000 team in next year

**Conclusion**

- **Defender**: ESL = 3, \( AW_D = -17,307 \)
  - **Challenger**: ESL = 4, \( AW_C = -19,123 \)

  - \( AW_C < AW_D \)
  - Use Defender for 3 more years and repeat analysis then

  - **Note**: This conclusion assumes costs are not going to change and the estimates are perfect!
New Replacement Study

- Given: (C) and (D) find ESL (n_C, n_D), and the corresponding AW at ESL (AW_C, AW_D)

- AW_D vs. AW_C
  - Select the better alternative
  - Stay with the Defender for n_D years or,
  - Go with the challenger for n_C years.

One-Year Later Analysis

- Validate all cost and market value estimates;
- If estimates are still good, is the current year n_D?
  - If “YES”, replace (D) with (C);
  - If “NO”, retain defender for one more year and re-evaluate then.
- If cost estimates have changed then:
  - Update all estimates
  - Calculate AW_C and AW_D
  - Initiate a new replacement study.
  - See Examples 11.2 and 11.4

Market Value of Defender

- What minimum market value of the defender will make the current challenger economically attractive?
- If a high enough market value (trade-in) is possible for the defender asset, one should take it and go with the challenger immediately!
- Break-even or replacement value (RV)
- See the example pg. 402

If the actual market value (trade-in) exceed the break-even replacement value, the challenger is the better alternative. If this is the case, replace now with the challenger!

Specified Study Period

- At times, a fixed study period will apply to both the challenger and defender.
- Determine AW for both C and D over the prescribed study period for all succession options
- Assumption is that the services of C and D are not needed beyond the study period.
- Use the AW relations over the study period to select C or D

EXAMPLE 11.2

Assume Canada has all the equipment placed into service 3 years ago for which a replacement study has been requested. Due to its special purpose, it has been decided that the current equipment will have to serve for either 2, 3, or 4 more years before replacement. The equipment has a current market value of $100,000, which is expected to decrease by $25,000 per year. The O&A is constant now, and is expected to remain so, at $25,000 per year. The replacement challenger is a fixed-price contract to provide the same services at $60,000 per year for a minimum of 2 years, and a maximum of 5 years. Use MARR of 12% per year to perform a replacement study over a 4-year permit to determine which will be the lowest cost and purchase the contract services.

<table>
<thead>
<tr>
<th>Option</th>
<th>Years</th>
<th>NCF</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
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<tr>
<td>X</td>
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<td>-100K</td>
<td>-25K</td>
<td>-25K+50K</td>
<td>-60K</td>
</tr>
<tr>
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<td>3</td>
<td>-100K</td>
<td>-25K</td>
<td>-25K</td>
<td>-60K</td>
</tr>
<tr>
<td>Z</td>
<td>4</td>
<td>-100K</td>
<td>-25K</td>
<td>-25K</td>
<td>-60K</td>
</tr>
</tbody>
</table>

Solution

Since the defender will be retained for 2, 3, or 4 years, three alternative options (X, Y, and Z) are:

- NCF in years {0,1,2,3,4,5,6}
- X = {2D, 4C}
- AW_0 = [-100K-25K(P/A,12%,2)+50K(P/F,12%,2)]/(A/P,12%,6) - 60K(A/F,12%,6) = -60.24K
\( X = \{2D, 4C\} \)
- \( AW_X = -60.24K \)

\( Y = \{3D, 3C\} \)
- \( \{-100K, -25K, -25K, -25K, +25K, -60K, -60K, -60K\} \)
- \( AW_Y = [-100K-25K(P/A, 12\%, 2)][(A/P, 12\%, 6) - 60k(F/A, 12\%, 3)(A/F, 12\%, 6)] = -59.55K \)

\( Z = \{4D, 2C\} \)
- \( \{-100K, -25K, -25K, -25K, 25K, -60K, -60K, -60K\} \)
- \( AW_Z = [-100K-25K(P/A, 12\%, 4)][(A/P, 12\%, 6) - 60k(F/A, 12\%, 2)(A/F, 12\%, 6)] = -58.47K \)

So select option Z

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**Performing a Replacement Study**

Two approaches:
1. ESL
2. Study period

See Figure 11-4

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**Chapter Summary**

- Compare the best challenger to the current defender
- “Best” is defined as the option with the lowest EUAC over the specified period of time among all challengers
- Apply the ESL method to find the economic life of the defender and challenger
- For ESL, need estimates of future market values and annual operating costs for both C and D
- \( AW_C \) is compared to \( AW_D \) and decision to replace or retain is made
- For a fixed study period, apply the traditional AW method for comparing D and C with sound estimates of “missing” cash flows