The Real Value of the Developmental BOM in a Gated NPD Project

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Summary

• Whether a new product meets its BOM cost target and can deliver an acceptable financial contribution is often down to chance and subject to an element of manipulation.

• To mitigate this problem we develop and demonstrate a theoretical method to notionally hedge and thereby value the stochastic price risk embedded in the cost of the materials and components specified in the Developmental BOM.

• Empirical testing would be required to verify whether its adoption leads to improved NPD outcomes reducing the number of new products with low financial contributions.

Michael Flanagan 04/09/2013
Context

• Procurement Risk Management (Nagali 2005)
  – Company value can be influenced by volatile cash flows.
  – The central importance of NPD and the Developmental BOM.

• NPD projects can in practice be like a “hot potato” game.
  – Chance often determines whether you are a “hero” or a “zero”.

• “New” components are often introduced to hit tight cost targets with only cursory regard to future performance.

• In-house/subcontracted manufacturing are left to sort out the “mess” in the exploitation phase.
Problem Formulation

• Standard TARGET COST PRICING Method (Cooper & Slagmulder 2002)
  – Deterministic
  – Helps reject potential NPD financial underperformers
  – Has no relationship to the exploitation phase (e.g. Purchasing)

• Expanded TARGET COST PRICING Method
  – Stochastic
  – Has a relationship to the exploitation phase.
  – Forces the exploitation phase to be more proactive.
Problem Solution

- The Developmental BOM as a financial asset.
  - The concept of a risk free portfolio
  - The exploitation phase writes a “notional” call option to the project.
  - The cost of the option ($C_t$) is added to the standard TCP target.
  - The value of the option changes over time as components and their “financial” characteristics change.
  - The “option writers” are in turn forced to hedge their option.
Option Price ($C_t$) Derivation

- **Asian (or average rate) Option**
  - The strike or exercise price is the average of the component estimates over the previous months.
  - Used extensively in commodity markets.

- **Derived using the Vorst (1992) Approximation.**
  - Accurate to less than a 1%
  - See paper for derivation

- **Two versions**
  - Averaging not yet started $C_{t=0}$ i.e. project has yet to start
  - Averaging started i.e. project now incorporates “learning” into $C_{t>0}$
Application (Steps)

1) Characterize the underlying volatility and price drift of the developmental BOM at \( t=0 \) (\( \sigma = 7\% \) and \( \mu = +0.4\% \)) using equations [1] and [2].
2) Set the option strike price \( S \) as \( BOM_d \).
3) Calculate the hedging premium \( C_t \) using equation [11].
4) Calculate the extrinsic (or time) value of the option premium \( C_t \).
5) Subtract the extrinsic hedging cost \( C_t \) from \( BOM_d \) to get a new target \( BOM_s \).
6) Repeat monthly using equation [12].
7) Adjust the target \( BOM_s \) on a monthly basis to take account of changes in \( BOM_d \) or \( C_t \).
8) At \( t = 5 \) the project team must make a GO/NO GO decision as to whether to proceed to the tooling and manufacturing preparation stage.
### Application (Decisions)

a) $\text{BOM} < \text{BOM}_s < \text{BOM}_d \Rightarrow$ decision is GO.

b) $\text{BOM} > \text{BOM}_d > \text{BOM}_s \Rightarrow$ decision is NO GO.

c) $\text{BOM}_d \leq \text{BOM} \leq \text{BOM}_s \Rightarrow$ decision is NO GO.

<table>
<thead>
<tr>
<th>Deterministic BOM Approach</th>
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<th>@t=0</th>
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<td>Selling Price $S$</td>
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<td>4200</td>
<td>4200</td>
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<tr>
<td>Deterministic BOM Target BOM$_d$</td>
<td>2594</td>
<td>2594</td>
<td>2594</td>
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<tr>
<td>Actual Bom Cost BOM$_a$</td>
<td>2400</td>
<td>2590</td>
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<td>Selling Price $S$</td>
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<td>Deterministic BOM Target BOM$_d$</td>
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<td>Extrinsic Asian Option Cost C$_t$</td>
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<td>54</td>
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<td>2590</td>
<td>2700</td>
</tr>
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</table>

| Actual Bom Cost BOM$_a$   | 2400 | 2590 | 2700 |
| Investment Committee Decision | GO | GO | NOGO |

$C_t$ using Equation 11 where $\text{BOM}_d = S = 2594$, BOM$_a$ as assumed, $N=48$, Averaging Period = $h = 1/12$, Period $T = 4$ years, $r = 0.4\%$, $\sigma = 7\%$, $\sigma$, $r$ estimated using Equations 1, 2 on a notional BOM (Appendix 1), an assumed Selling Price of 4200 and deterministic BOM$_d$ target of 2594.
7) Repeat the calculations 1) to 6) each month at \( t = 1, 2, 3, 4 \) and 5 as new information is collected and changes are made to the developmental BOM, volatility etc. using equation [12]. The use of this equation implies that gains or losses in previous months will be averaged out i.e. the option takes account of any project learning achieved.

8) Adjust the target BOM\(_s\) on a monthly basis to take account of changes in BOM\(_d\) or C\(_t\).

9) At \( t = 5 \) the project team must make a GO/NOGO decision as to whether to proceed to the tooling and manufacturing preparation stage.

   a) The current and expected developmental BOM cost is below the stochastic BOM target BOM\(_s\) in which case the decision is GO.

   b) The current and expected developmental BOM cost is above the deterministic BOM target BOM\(_d\) in which case the decision is NOGO.

   • The current and expected developmental BOM cost is between the stochastic BOM target BOM\(_s\) and the deterministic BOM target BOM\(_d\) in which case the decision (either GO/NOGO) should strictly speaking be NOGO.
Conclusions

• The expanded stochastic TCP method should in theory
  – Reject those NPD projects which are expensive to hedge.
  – Involve the exploitation phase at an earlier stage in the project.
  – Force the exploitation phase to value and reinsure the hedging option.

• The theoretical support for this method are based on well accepted approaches in both the NPD and Financial Markets.

• Empirical application over time would be needed to demonstrate whether it reduces the number of exploited NPD products that deliver sub optimal financial contributions.

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References


Appendix 1: A Stylised NPD Project

- We assume a total product life cycle N of 48 months consisting of:
  - a) 1 month Feasibility Stage (t=0)
  - b) 4 months Design Stage (t=1…4)
  - c) 7 Months Tooling and Manufacturing Preparation Stage (t=5…11)
  - d) 36 months Manufacturing Stage (t= 12…48)

- Expected selling price of $4200,

- Constant phased sales projection over 36 months and a minimum expected net margin of 5%.

- Minimum required target cost price (TCP) is therefore $3990.

- Assuming direct labour costs, indirect overheads and investment costs of 35% this implies

- A maximum allowable developmental BOM$_d$ cost of $2594.
Appendix 2: Characterising the BOM

- Price series 1) to 4) were taken monthly from January 2000 to August 2007 (92 observations)
- We calculate the continuously compounded returns \((\ln[\pi_{i,t}] - \ln[\pi_{i,t-1}])\) of the relevant \(P\) series for \(i = 1...4\), and their sample drift \(\mu\) and variance \(\sigma\) are then estimated below.

### Summary Table of BOM Component Characteristics

<table>
<thead>
<tr>
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<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
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<tbody>
<tr>
<td><strong>Sample (\mu)</strong></td>
<td>-0.0064</td>
<td>0.0098</td>
<td>0.0001</td>
<td>0.0045</td>
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<tr>
<td><strong>Std. Dev.</strong></td>
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<td><strong>Skewness</strong></td>
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<td><strong>Kurtosis</strong></td>
<td>4.0018</td>
<td>2.8567</td>
<td>3.9020</td>
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### Calculation of BOM value \(B_{A,0,t=0}\) and \(\sigma\) using Equations (1) and (2)

#### Using Equation (1)

<table>
<thead>
<tr>
<th>Electronics</th>
<th>Metal</th>
<th>Packaging</th>
<th>Plastics</th>
<th>Total</th>
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<td>1</td>
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<tr>
<td>Cost/Amount (P)</td>
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<td>242</td>
<td>141</td>
<td>212</td>
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<tr>
<td>Initial Cost (A*P)</td>
<td>673</td>
<td>1212</td>
<td>141</td>
<td>955</td>
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<tr>
<td>% Weighting</td>
<td>23%</td>
<td>41%</td>
<td>5%</td>
<td>32%</td>
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<tr>
<td>Sample (\mu)</td>
<td>-0.00064</td>
<td>0.0098</td>
<td>0.0001</td>
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#### Using Equation (2)

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<td>0.000803</td>
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**Variance**: 0.00463941

**Volatility \(\sigma\)**: 7%