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.

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.

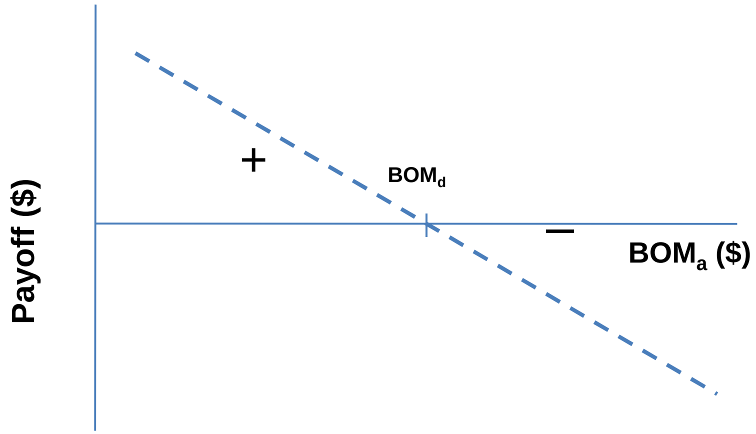
- In-house/subcontracted manufacturing are left to sort out the “mess” in the exploitation phase.

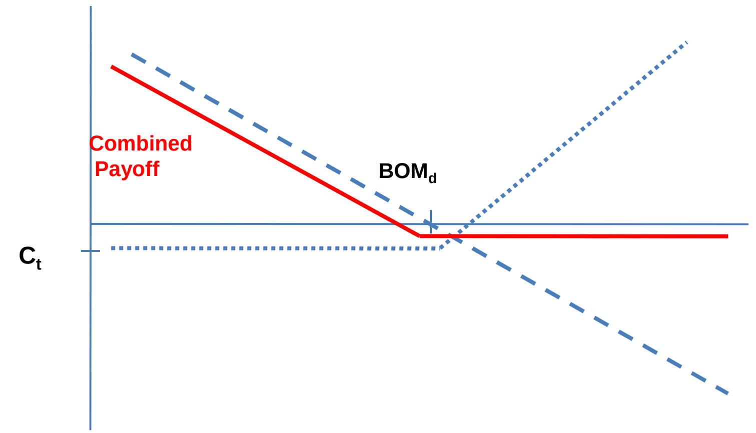
Problem Formulation

- 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 (σ = 7% and μ=+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) $BOM < BOM_s < BOM_d$ => decision is GO.

b) $BOM > BOM_d > BOM_s$ => decision is NO GO.

c) $BOM_d \leq BOM \leq BOM_s$ => decision is NO GO.

Deterministic BOM Approach	@t=0	@t=0	@t=0
Selling Price $	4200	4200	4200
Deterministic BOM Target BOM_d	2594	2594	2594
Actual Bom Cost BOM_a	2400	2590	2700
	@t=5	@t=5	@t=5
Actual Bom Cost BOM_a	2400	2590	2700
Investment Committee Decision	GO	GO	NOGO

Stochastic BOM Approach	@t=0	@t=0	@t=0
Selling Price $	4200	4200	4200
Deterministic BOM Target BOM_d	2594	2594	2594
Extrinsic Asian Option Cost C_t	20	90	54
Stochastic BOM Target BOM_s	2574	2504	2540
Actual Bom Cost BOM_a	2400	2590	2700
	@t=5	@t=5	@t=5
Actual Bom Cost BOM_a	2400	2590	2700
Investment Committee Decision	GO	NOGO	NOGO

C_t using Equation 11 where $BOM_d = S = 2594$, BOM_a as assumed, N=48, Averaging Period = h = 1/12, Period T = 4 years, $r=\mu=0.4\%$, $\sigma=7\%$,

σ, μ estimated using Equations 1, 2 on a notional BOM (Appendix 1), an assumed Selling Price of 4200 and deterministic BOM_d target of 2594

Application (3)

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

- Cooper, R. & Slagmulder, R. (2002), Target Costing for New Product Development: Component Level Target Costing, *Cost Management* Sep/Oct 2002. Vol. 16, Iss. 5, 36-43.
- Vorst, T. (1992), Prices and Hedge Ratios of Average Exchange Rate Options, International Review of Financial Analysis 1, 179-193.
- Nagali, V. (2005) Procurement Risk Management (PRM) at Hewlett Packard Company, from http://cscmp.org/downloads/public/resources/HPProcurement.pdf

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

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- Price series 1) to 4) were taken monthly from January 2000 to August 2007 (92 observations)
- Dow Jones US Semiconductor Index/S&P 500 Metals & Mining Index/S&P 500 Paper & Forest Index/Taiwan SE Plastics and Chemicals Index
- We calculate the continuously compounded returns ($Ln[P_{i,t}] - Ln[P_{i,t-1}]$) of the relevant P series for i =1…4, and their sample drift μ and variance σ are then estimated below.

Summary Table of BOM Component Characteristics

	(1) Elec.	(2) Metal	(3) Pack.	(4) Plastics
Sample μ	-0.0064	0.0098	0.0001	0.0045
Std. Dev.	0.1280	0.0760	0.0735	0.0889
Skewness	-0.5600	-0.3250	-0.3013	-0.3286
Kurtosis	4.0018	2.8567	3.9020	4.9641

Calculation of BOM value $B_{A.0,t=0}$ and σ using Equations (1) and (2)

	Electronics	Metal	Packaging	Plastics	Total
Using Equation(1)					
Amount (A)	0.5	5	1	4.5	
Cost/Amount (P)	1347	242	141	212	
Initial Cost (A*P)	673	1212	141	955	2982
% Weighting	23%	41%	5%	32%	
Sample μ	-0.0064	0.0098	0.0001	0.0045	0.40%
Using Equation (2)					
Electronics	0.000826	0.000424	0.000036	0.000212	0.001498
Metal	0.000424	0.000945	0.000069	0.000260	0.001698
Packaging	0.000036	0.000069	0.000012	0.000026	0.000143
Plastics	0.000212	0.000260	0.000026	0.000803	0.001300
				Variance	0.00463941
				Volatility σ	7%