



**TRUE PROGRAM  
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**'05**

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# Commonality Captured

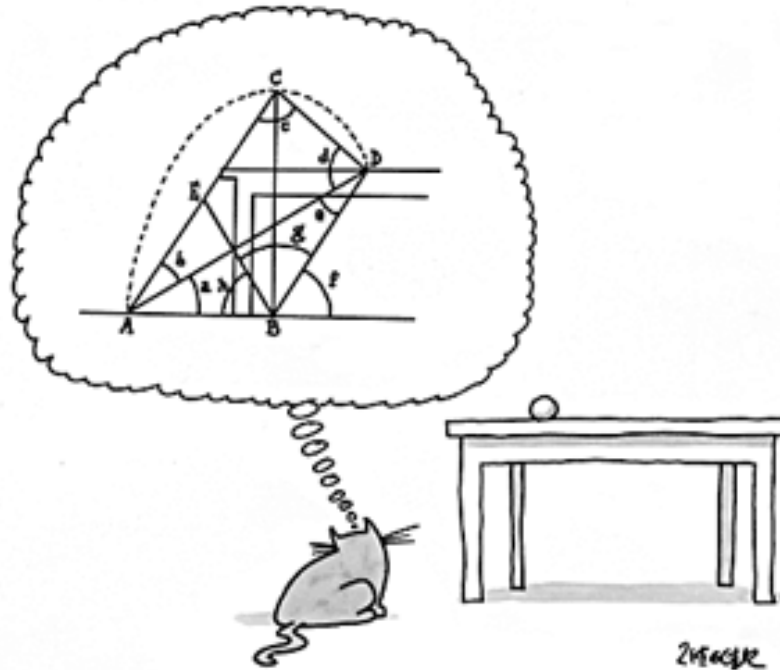
*A Simplified Approach to  
Estimating the Cost of  
Common Components  
Across Programs*

Greg Kiviat  
Sebastian W. Botta

Sikorsky Aircraft

**PRICE**

# Standard PRICE H Methodology To Estimate Common Components Across Programs Is Too Complex!



# Common Components Are Often Used Across Programs

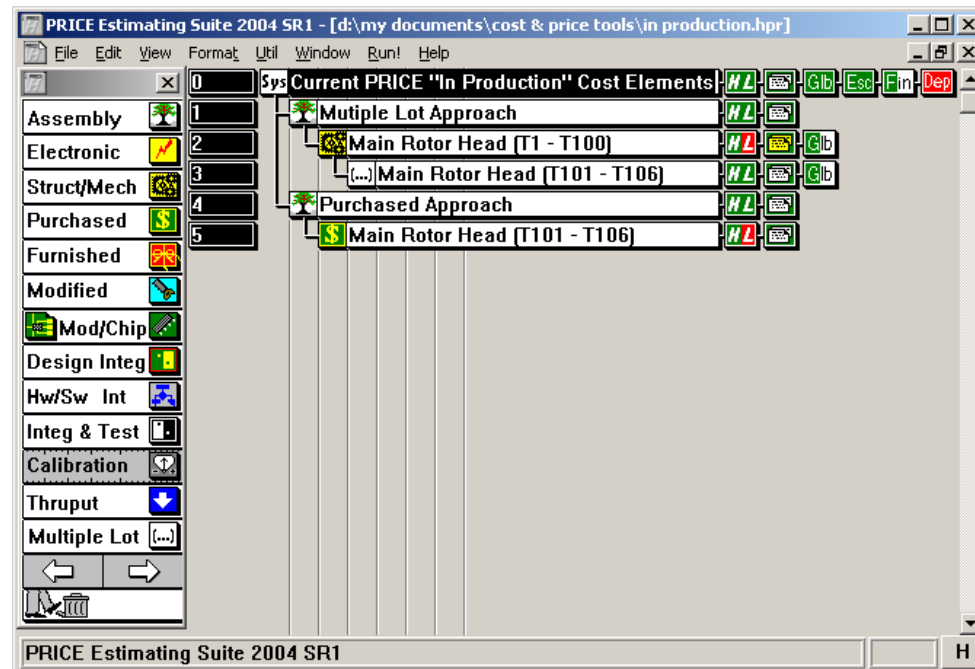


- Common components have different (lower) “T” number than new components at start of production
- Standard PRICE H methodology for common cost estimates requires complex use of “Multiple Lot” or “Purchased” EBS elements

## Example:

Rotor Head with 100 prior production units before building 5 unit for new program

Uses “Multiple Lot” or “Purchased” element



# Multiple Lot EBS Elements Require Complex Actions To Capture Production Costs



- **Multiple Lot approach (initial production):**

- Requires a “work around” by setting initial lot “local globals” to zero in order to null costs that are not part of new program
- Creates extra records to be removed from output files
- Requires determination of “lead-in” schedule for follow on lot production

**Assumed initial lot schedule**  
**Assumed prior learning experience (100 units)**

Initial Lot PRICE H Input

**Production Globals set to zero**

Initial Lot Global

# Multiple Lot EBS Elements Require Complex Actions To Capture Production Costs (contd.)



- **Multiple Lot approach (follow-on lot):**

- Cannot translate to PRICE HL input using “Fill from H” function thus requiring manual input for Life Cycle Cost analysis
- Requires second Local Global to reset production cost from initial lot
- Complicates use of “spread” function to view costs over time

**Follow-on lot qty set to 5**

QTY	PSTART	PFAD	PEND	MPI	COST
5	409	1009	310	0.8300	0.00
Total QTY	0				
PDR CST	PDECST	PPJCST	PDACST		
0.000	0.000	0.000	0.000		
PPRCST	PTCST				
0.000	0.000				

Multiple Lot PRICE H Input

**Production Globals set to zero (except Overall Production)**

	Development	Production	Supplemental			
Overall	0.000	1.000	ECNE	1.000	ETLG1	1.000
Engineering			ECNS	1.000	ETLG2	1.000
Draft	0.000	0.000	NSHIFT	1.000	STLG1	1.000
Design	0.000	0.000	NFACS	3.000	STLG2	1.000
System	0.000	0.000	ZTECH	1.000	MSF	1.000
Proj. Mgmt.	0.000	0.000	TECDEL	0.000	SMODS	1.000
Data	0.000	0.000	LOTFAC	0.000	PSF	0.250
Manufacturing			GAPFAC	0.000		
Prototype	1.000					
Tool & Test	0.00000	0.00000				
Schedule Multipliers						
Length	0.000	1.000				
Penalty Cost	0.000	1.000				

Multiple Lot Local Global

# Multiple Lot EBS Element Results in Two Output Records



- Multiple Lot approach (initial and follow-on lot output):

Basic Estimate			
Cost Summary			
LM Totals			
LM Production			
LM Development			
Main Rotor Head (T1 - T100)			
Thu January 06 2005 7:55 AM (PRICE Estimating Suite 2004 SR1)			
Mechanical Element Costs in (\$1000 Constant 2004)			
Program Cost	Development	Production	Total Cost
Engineering			
Prel. Design	0.0	0.0	0.0
Detail Des & ME	0.0	0.0	0.0
System Engr.	0.0	-	0.0
Proj. Mgmt.	0.0	0.0	0.0
Data	0.0	0.0	0.0
<b>SubTotal(ENG)</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
Manufacturing			
Production	-	0.0	0.0
Prototype	0.0	-	0.0
Tool Test Eq.	0.0	0.0	0.0
<b>SubTotal(MFG)</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
Sik G&A / Sik CoM	0.0	0.0	0.0
SikFee / Profit	0.0	0.0	0.0
<b>Total Cost</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
Schedule Start	Feb 06 [ 5]	Jan 06 [ 4]	
First Item	Jun 06* [ 22]	Apr 08 [ 11]	
Finish	Apr 08 [ 27]	Mar 09 [ 15]	
Unit Production Cost	0.00		
Monthly Prod Rate	9.00		

Initial Lot PRICE H Output

Initial lot production costs set to zero using local globals

Basic Estimate			
Cost Summary			
LM Totals			
LM Production			
LM Development			
Main Rotor Head (T101 - T106)			
Mon January 10 2005 9:06 AM (PRICE Estimating Suite 2004 SR1)			
Multiple Lot Costs in (\$1000 Constant 2004)			
Program Cost	Production		
Engineering			
Prel. Design	0.0		
Detail Des & ME	0.0		
System Engr.	-		
Proj. Mgmt.	0.0		
Data	0.0		
<b>SubTotal(ENG)</b>	<b>0.0</b>		
Manufacturing			
Production	1010.3		
Prototype	-		
Tool Test Eq.	0.0		
<b>SubTotal(MFG)</b>	<b>1010.3</b>		
Sik G&A / Sik CoM	160.0		
SikFee / Profit	290.2		
<b>Total Cost</b>	<b>1460.5</b>		
Schedule Start	Apr 09 [ 7]		
First Item	Oct 09 [ 5]		
Finish	Mar 10 [ 12]		
Unit Production Cost	292.10		
Monthly Prod Rate	0.80		

Multiple Lot PRICE H Output

Total Production Cost for 5 units after 100 in initial lot = \$1,460.5K

# Purchased Elements Require Only One EBS, But Must Be Pre-determined For PRICE Model Entry



- **Purchased Element approach**

- Requires pre-calculation of target lot cost using Multiple Lot, supplier input or internal bottoms up pricing then entered as a Purchased Unit (less profit)
- Does not easily support correct allocation of G&A and profit as compared to PRICE
- Supports “Fill from H to HL” function

**PURCHASED/DETAILED COST**  
Main Rotor Head (T101 - T106)

Input Form | LM Sheet | ID Sheet | Risk Input | Distributions | Worksheet

QTY	PROTOS	WT	VOL	HSINT
5	0.00	1026.300000	29.48000	0.00
Total PROTOS		Manually Allocate Design Integration Effort		DEVFRAC %
0.00				100.0
QTYNHA	INTEGE	INTEGS	PLTFM	YRTECH
1	0.0000	1.5480	1.800	2006
MCPLXE	MCPLXS	DLEVE	DLEVS	WS
0.000	6.000	0.00	0.00	1026.3000000
COST	COST TYPE	COST DESCRIPTION		
258176.00	Constant YRBASE	Purchased Cost		
DSTART	DFPRO	DLPRO	PSTART	PFAD
206	0	408	108	408
PEND	YRBASE	DMULT	PMULT	
309	2004	0.000	0.000	

**“Purchased’ qty = 5**

Purchased Element Input

**Basic Estimate**  
Cost Summary | LM Totals | LM Production | LM Development

Main Rotor Head (T101 - T106)  
Wed January 05 2005 5:12 PM (PRICE Estimating Suite 2004 SR1)  
Purchased Element Costs in (\$1000 Constant 2004)

Program Cost	Production
Purchased Item Cost	1290.9
Sik G&A / Sik CoM	0.0
SikFee / Profit	322.7
<b>Total Cost</b>	<b>1613.6</b>

Unit Production Cost 322.72

Input Cost 258176.00 (In Base Year 2004 Single Units)

Schedule Start Jan 08 [ 4]  
First Item Apr 08 [ 11]  
Finish Mar 09 [ 15]

**Total Cost for 5 units after  
100 in initial lot = \$1,613.6K**

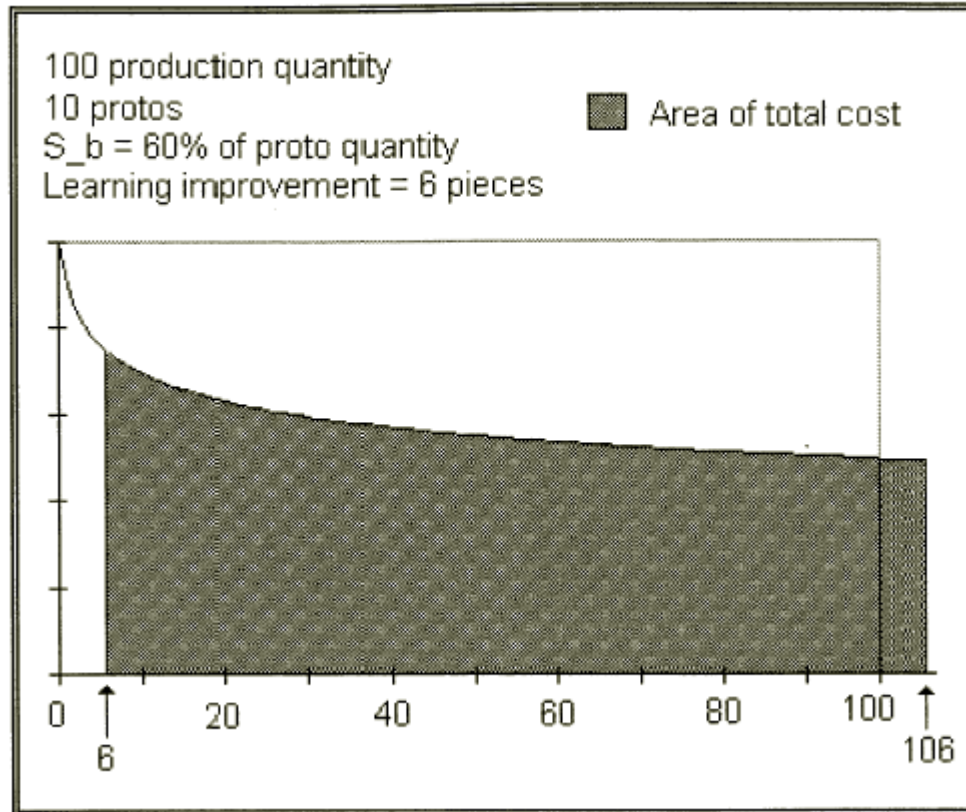
Purchased Element Output

# Alternate Concept – The Stanford-B Methodology



*I like the concept, but does it work?*

# What Is The Stanford-B Factor?



When Stanford-b is greater than zero in the first lot, the block quantities of each subsequent lot are shifted by the number of prototypes influencing the first lot. Using our example with Lot 1 consisting of 100 units with 10 prototypes and Stanford-b of 60%, the first production lot runs from unit 7 through unit 106.

# Benefits – The “B” Factor Approach



- The “B” factor process can substitute for the Multiple Lot element that generates later lot costs
  - The “B” Factor may be any value from 0 (no learning transfer) to 100 (100% prototype learning transfer), but is preset to 0
- “B” Factor results production costs that are virtually the same as Multiple Lot for a defined production lot (“T” value)
- Only one EBS is needed for each common cost element, simplifying PRICE Output including extracts to Clipboard, Excel Solutions or spread
- PRICE HL “Fill from H” is enabled



# Input Form and LM Sheet using “B” Factor



- The PRICE “B Factor” was intended to transfer cost improvement experience from prototype to production manufacturing
- The B Factor can also be used to simulate prior production experience using a single “make” (structural/mechanical or electronic) EBS element

**PROTOS = 100 (proxy for prior production)**  
**QTY = 5 (new program quantity)**

Structural/Mechanical Input Form

B Factor on LM sheet

# Output to HL Using “B” Factor Method



- “Fill From H” function is operational using B Factor approach

**Life Cycle Input**

Main Rotor Head (T101 - T106)

OK  
Cancel

**Input Form** | Worksheet

Validate | Notepad | Lock | Override | Reset | **Fill From H** | Help

MTBF	TF	TI	TD	TMO	TMI	TMD	EE	FN
4663	1.36	1.36	1.36	2.76	2.76	2.76	1.0	0.0
CEND	CPE	CUR		CMR	TRE			
72292553.46		0.00		11688.85	15341.62	1.00		
P	PP	FNSP		CPPE				
10.000		265.397		0.50	1609.93	Select All		
CFIM	CFIP	FTSQF		FTSQP				
430097.43		500113.29		1.674	1.946	Select None		
TC	CCOU	FTSQC						
0.910		172036.97		0.669	Concept Detail			
DSTART	307	Prod Cost	233777.09	MODULE	43833.20	PART	1609.93	
DEND	309	LCurve	0.877		0.939		0.969	
PSTART	409	Ref Qty	5		5		5	
PEND	310	Weight	1000.000000		71.428571		0.170218	
YRBASE	2004	Volume	24.00000		1.71429		0.00409	

Calculate support costs

Concepts

01	02	03
04	05	06
07	08	09
10	11	12
13	14	15
16	17	18
19	20	21
22	23	24
25	26	27
28		

# Results – The “B” Factor Approach



- Results show very close correlation to Manufacturing/Production costs (within 1% of Multiple Lot)
- Note:
  - Cost for Sustaining Engineering and Tooling did not track closely with B Factor method
  - However most program and tooling costs for common components are borne by the “parent” program and can be “zeroed” out using the local globals (Draft, Design, Proj Mgmt, Data and Tooling)

## Production Only

Multiple Lot		Input Parameters				Sustaining Engineering					Manufacturing			Production Total
Title	Mode	QTY	PROTO S	WT	WS	Drafting	Design	Prog Mgmt	Data	Engineering Total	Production	Tool Test	Manufacturing Total	Production Total
Main Rotor Head (T1 - T100)	STRUCTURAL	100	1	1000	1000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Main Rotor Head (T101 - T106)	MULTIPLE LO	5	0	0	0	\$0	\$0	\$0	\$0	\$0	\$1,187,004	\$0	\$1,187,004	\$1,187,004

B- Factor		Input Parameters				Sustaining Engineering					Manufacturing			Production Total
Title	Mode	QTY	PROTO S	WT	WS	Drafting	Design	Prog Mgmt	Data	Engineering Total	Production	Tool Test	Manufacturing Total	Production Total
Main Rotor Head (T101 - T106)	STRUCTURAL	5	100	1000	1000	\$0	\$0	\$0	\$0	\$0	\$1,175,799	\$0	\$1,175,799	\$1,175,799

Delta Cost	Drafting	Design	Prog Mgmt	Data	Engineering Total	Production	Tool Test	Manufacturing Total	Production Total
Percent Different	\$0	\$0	\$0	\$0	\$0	-\$11,205 -1.0%	\$0	-\$11,205 -1.0%	-\$11,205 -1.0%

Production cost for B Factor within 1% of Multiple Lot

# Methodology



- **PROTO count is used as ‘proxy’ for prior production experience**
- **Development manufacturing costs for “in-production” components can be captured with Development Global adjustment**
  - Enter the ratio of “actual” Prototypes needed for test to the number of Protos entered for “prior learning” (actual protos / entered protos)
- **Preliminary Steps include:**
  - 1) **Identify EBS elements that require no new design and are in production at start of new program**
    - **Electronic or Struct/Mech Items only**
  - 2) **Determine units of production credit (prior learning) to be taken for identified EBS elements prior to start of new production**
  - 3) **Determine number of prototypes needed for the development program**
  - 4) **Determine if additional tooling is needed to support production**



# Process Details



## For each identified EBS element:

- Set the B Factor on the LM sheet to 100 indicating 100% unit learning transfer from prototype count
- Determine the number of prior learning units to be credited before production of new system begins from program schedules
- Determine the number of manufactured prototypes required for new system test
- Enter the number of production units for the new system in the QTY field
- Enter the number of prior learning units to be credited before production in the PROTOS field
- Calculate the ratio of the “number of prototypes required for new system test” to the “prototypes entered in the PROTOS field” (required PROTOS/entered PROTOS)
- Create a “local” Global and enter the calculated ratio (required PROTOS/entered PROTOS) in the “Overall Development” multiplier

# Process Details (contd.)



## For each identified EBS element:

- Set all Engineering and Manufacturing globals (except Prototype if development cost needed) to zero
- Leave Overall Development and Production Globals at 1.000 or calibrated value
- Set DTGLTS or PTGLTS to zero to remove tooling costs
- Adjust Overall Production cost globals if NSHIFT or NFACS > 1
  - If NSHIFT or NFACS = 2 enter 1.153
  - If NSHIFT or NFACS = 3 enter 1.249

# PRICE Example



The screenshot displays the PRICE Estimating Suite 2004 SR1 software interface. The title bar reads "PRICE Estimating Suite 2004 SR1 - [d:\my documents\ch-53x\avs compliance\in production 2.hpr]". The menu bar includes File, Edit, View, Format, Util, Window, Run!, and Help. The main window shows a hierarchical tree structure of cost elements. On the left, a vertical toolbar contains icons for various cost estimation methods: Assembly, Electronic, Struct/Mech, Purchased, Furnished, Modified, Mod/Chip, Design Integ, Hw/Sw Int, Integ & Test, Calibration, Thruput, and Multiple Lot. The tree structure is as follows:

- 0 Sys Current PRICE "In Production" Cost Elements
  - 1 Multiple Lot Approach
    - 2 Main Rotor Head (T1 - T100)
      - (...) Main Rotor Head (T101 - T106)
  - 4 Purchased Approach
    - 5 Main Rotor Head (T101 - T106)
  - 6 B - Factor Method
    - 7 Main Rotor Head (T101 - T106)

The status bar at the bottom of the window displays "PRICE Estimating Suite 2004 SR1" and a cursor icon.

# Questions/Contacts



**Greg Kiviat:** [gkiviat@sikorsky.com](mailto:gkiviat@sikorsky.com)  
(203) 386-7274

**Sebastian Botta:** [sbotta@sikorsky.com](mailto:sbotta@sikorsky.com)  
(203) 386-6935