An Improved Method for Predicting Software Code Growth

ACEIT Users Workshop
National - Public Audience
January 31-February 2, 2011
Michael A. Ross

Approved for Public Release

Acknowledgements

- **Tony Dietl, Tecolote Research, Inc.**
- **Steve Sultzer, Galorath, Inc.**
- **Greg Hogan, USAF/AFCAA**

The author thanks these individuals for sharing their ideas and providing critical commentary in support of this work

Tecolote DSLOC Estimate Growth Model

- Based on USAF AFCAA-collected data (can be calibrated to other data)
- Requires only one parameter, Estimate Maturity, which is reasonably objective
- Produces a growth factor distribution result (embodies uncertainty)
- Provides decreasing mean growth factor as Estimate Maturity increases
- Provides decreasing growth factor uncertainty (decreasing CV) as Estimate Maturity increases
- Distinguishes between New and Pre-Existing DSLOC growth

Provides probabilistic growth adjustment to Technical Baseline Point Estimates of Software Size

Tecolote DSLOC Estimate Growth Model in a Nutshell

Basic Model

$$S_{D\_Adj\_New} \equiv S_{D\_New}\left(e^{-bt}\left(K_{GF\_New}-1\right)+1\right)$$

$S_{D\_Adj\_New}$ = Growth-adjusted New DSLOC Estimate Distribution

K_{GF_New} = Baseline New DSLOC Estimate Growth Factor Distribution (from AFCAA data)

S_{D_New} = Technical Baseline Point Estimate of New DSLOC

$$S_{D\_Adj\_PER} \equiv S_{D\_PER}\left(e^{-bt}\left(K_{GF\_PER}-1\right)+1\right)$$

$S_{D\_Adj\_PER}$ = Growth-adjusted PER DSLOC Estimate Distribution

K_{GF_PER} = Baseline Pre-Existing Reused (PER) DSLOC Estimate Growth Factor Distribution (from AFCAA data)

S_{D_PER} = Technical Baseline Point Estimate of PER DSLOC

b = Decay Constant; default is 3.466 based on Boehm's "Cone of Uncertainty" (Boehm, 1981, p. 311)

t = Estimate Maturity Parameter: (SDLCBegin=0%; SyRR=20%; SwRR=40%; SwPDR=60%; SwCDR=80%; SwAccept=100%)

for ACEIT

New DSLOC

$$K_{GF\_New} = cdf\left(AFCAA\_Data\_Growth\_Factors\_New\right)$$

Pre-Existing Reused (PER) DSLOC

$$K_{GF\_PER} = cdf\left(AFCAA\_Data\_Growth\_Factors\_PER\right)$$

for Galorath's SEER-SEM

New DSLOC

$$S_{D\_Adj\_New\_Least} = S_{D\_New}\left(-0.828071e^{-3.466t}+1\right)$$

$$S_{D\_Adj\_New\_Likely} = S_{D\_New}\left(-0.828071e^{-3.466t}+1\right)$$

$$S_{D\_Adj\_New\_Most} = S_{D\_New}\left(5.366128e^{-3.466t}+1\right)$$

Pre-Existing Reused (PER) DSLOC

$$S_{D\_Adj\_PER\_Least} = S_{D\_PER}\left(-0.687191e^{-3.466t}+1\right)$$

$$S_{D\_Adj\_PER\_Likely} = S_{D\_PER}\left(-0.687192e^{-3.466t}+1\right)$$

$$S_{D\_Adj\_PER\_Most} = S_{D\_PER}\left(3.658219e^{-3.466t}+1\right)$$

Model Details
(the rest of the story)

- Analysis of AFCAA SRDR data
- Baseline growth factor CDFs
- Estimate maturity
- Growth factor uncertainty decay
- Model equation
- Modeling growth in SEER-SEM
- Application example in ACEIT
- Application example in SEER-SEM

Filtering the AFCAA SRDR Data: First Stage

$$Candidate \equiv$$

$$Est\_New \neq 0 \ AND \ Est\_PER \neq 0$$

$$AND$$

$$GF\_New > 0 \ AND \ GF\_PER > 0$$

AFCAA SRDR data was filtered to include only those projects that experienced some measurable growth (or shrinkage)

Candidate Data Set Statistics after First Stage Filter

ACE DSLOC Baseline Growth Factor Distribution Statistics				
New DSLOC Growth Factor			Pre-Existing DSLOC Growth Factor	
Number of Data Points (N)	59		Number of Data Points (N)	59
Data Set Mean (m)	1.87		Data Set Mean (m)	2.09
%ile @ Data Set Mean (P(m))	74%		%ile @ Data Set Mean (P(m))	83%
%ile @ Point (P(pt))	31%		%ile @ Point (P(pt))	39%
Data Set Median m[~]	1.19		Data Set Median m[~]	1.02
Data Set Std Dev s	1.83		Data Set Std Dev s	3.69
Data Set CV (C[V])	0.98		Data Set CV c[V]	1.77
Multiplicitave Std Dev	0.98		Multiplicative Std Dev	0.88
One Mult Std Dev Up	3.69		One Mult Std Dev Up	3.93
One Mult Std Dev Down	0.94		One Mult Std Dev Down	1.11
Two Mult Std Dev Up	7.31		Two Mult Std Dev Up	7.40
Two Mult Std Dev Down	0.48		Two Mult Std Dev Down	0.59
Three Mult Std Dev Up	14.49		Three Mult Std Dev Up	13.93
Three Mult Std Dev Down	0.24		Three Mult Std Dev Down	0.31

Note the very large CVs

Filtering the AFCAA SRDR Data Second Stage

$$Candidate\_New \equiv$$

$$Act\_New_i / Est\_New_i = K_{GF\_New\_i} \in \left(\left(\%SEE_{GF\_New} + 1\right)^{-2} \bar{K}_{GF\_New}, \left(\%SEE_{GF\_New} + 1\right)^{2} \bar{K}_{GF\_New} \right)$$

where

$$\%SEE_{GF\_New} \equiv \sqrt{\frac{1}{(N-1)} \sum_{i=1}^{N} \left(\frac{\left(K_{GF\_New\_i} - \bar{K}_{GF\_New}\right)}{\bar{K}_{GF\_New}} \right)^2}$$

Within two multiplicative standard deviations of the data set mean

$$Candidate\_PER \equiv$$

$$Act\_PER_i / Est\_PER_i = K_{GF\_PER\_i} \in \left(\left(\%SEE_{GF\_PER} + 1\right)^{-2} \bar{K}_{GF\_PER}, \left(\%SEE_{GF\_PER} + 1\right)^{2} \bar{K}_{GF\_PER} \right)$$

where

$$\%SEE_{GF\_PER} \equiv \sqrt{\frac{1}{(N-1)} \sum_{i=1}^{N} \left(\frac{\left(K_{GF\_PER\_i} - \bar{K}_{GF\_PER}\right)}{\bar{K}_{GF\_PER}} \right)^2}$$

AFCAA SRDR data was filtered at both ends of the spectrum to reduce CV to a reasonable level while preserving the distribution's median position

Candidate Data Set Statistics after Second Stage Filter

ACE DSLOC Baseline Growth Factor Distribution Statistics				
New DSLOC Growth Factor			**Pre-Existing DSLOC Growth Factor**	
Number of Data Points (N)	56		*Number of Data Points (N)*	45
Data Set Mean (m)	1.75		*Data Set Mean (m)*	1.43
CDF Mean (m')	1.75		*CDF Mean (m')*	1.42
%ile @ Data Set Mean (P(m))	69%		*%ile @ Data Set Mean (P(m))*	71%
%ile @ CDF Mean (P(m'))	69%		*%ile @ CDF Mean (P(m'))*	71%
%ile @ Point (P(pt))	29%		*%ile @ Point (P(pt))*	29%
Data Set Median m[~]	1.20		*Data Set Median m[~]*	1.04
CDF Median m'[~] *Define a baseline growth factor distribution in ACE by using this value as the "Equation / Throughput" field entry with a custom CDF containing corresponding median-normalized growth factor values.*	was 1.19 **1.204296**		*CDF Median m'[~]* *Define a baseline growth factor distribution in ACE by using this value as the "Equation / Throughput" field entry with a custom CDF containing corresponding median-normalized growth factor values.*	was 1.02 **1.037044**
Data Set Std Dev s	1.33		*Data Set Std Dev s*	0.91
CDF Std Dev s'	1.32		*CDF Std Dev s'*	0.90
Data Set CV (C[V])	0.76		*Data Set CV c[V]*	0.64
CDF CV (C'[V])	0.75		*CDF CV (C'[V])*	0.63

Based on Software Resources Data Report (SRDR) data collected by USAF AFCAA

Baseline DSLOC Estimate Growth Factor CDFs

ACE DSLOC Baseline Growth Factor Distribution CDFs

Copy red columns into ACE Custom CDF Dialog Box

New DSLOC Growth Factor CDF

%ile	Raw Growth Factor	Median-Normalized Growth Factor
0.0	0.547902	0.4549560272208
10.0	0.676993	0.5621483902387
20.0	0.968243	0.8039911843758
30.0	1.001516	0.8316194196262
40.0	1.061531	0.8814541263447
50.0	1.204296	1.0000000000000
60.0	1.403391	1.1653207912851
70.0	1.791218	1.4873573359220
80.0	2.516756	2.0898160858878
90.0	3.710696	3.0812166786418
100.0	6.253957	5.1930414674842

Copy red columns into ACE Custom CDF Dialog Box

Pre-Existing DSLOC Growth Factor CDF

%ile	Raw Growth Factor	Median-Normalized Growth Factor
0.0	0.655131	0.6317293787416
10.0	0.725186	0.6992822451771
20.0	0.947745	0.9138907707378
30.0	1.000010	0.9642887324668
40.0	1.000096	0.9643717324103
50.0	1.037044	1.0000000000000
60.0	1.118300	1.0783540487449
70.0	1.394266	1.3444623081028
80.0	1.775599	1.7121742117209
90.0	2.571689	2.4798271957032
100.0	5.265691	5.0775979934902

CDFs above are abbreviated for this presentation; CDFs for ACEIT have 1001 elements (increments of 0.1%)

Estimate Maturity and the Software Development Life Cycle

Model — ***Software Development Life Cycle (SDLC)***

DoD 5000 Milestones → MS A; SRR; Technology Development Phase; PDR; MS B; CDR; Engineering & Manufacturing Development Phase (EMD); TRR; MS C

SDLC Milestones → Begin SDLC; Sys Req Review; Sys Des Rev SW Req Rev; Software PDR; Software CDR; Software TRR; SW Accept FQT; System Acceptance

Maturity of DSLOC Estimate → 0%; 20%; 40%; 60%; 80%; 100%

Model	Sys Rqmts and Software Feasibility	Sys Design and Software Plans & Requirements	Product Design	Detailed Design	Code and Unit Test (CUT)	Integration and Test (I&T)		Implementation
COCOMO 81 / II (Boehm)	SW Feasibility	Plans & Requirements	Product Design	Detailed Design	CUT	Integration & Test		
SEER-SEM (Jensen)	Sys Rqmts Analysis	SW Requirements Analysis	Preliminary Design	Detailed Design	CUT	Component I&T	Program Test	System I&T
r2 w / Aerospace (Ross)	SEER-SEM Wrap Factor		Aerospace 2004 Software Cost and Productivity Database					SEER-SEM Wrap Factor
SLIM (Putnam)	Feasibility Study	Functional Design		Main Build				Maintenance

Yellow: *Estimated by core CDER mathematics*

Orange: *Estimated by percentage of the core*

Grey: *Not covered*

Each software estimating model has its own Software Development Life Cycle (SDLC) taxonomy and assumptions

Derivation of DSLOC Estimate Growth Factor Uncertainty Decay

Postulate some maturity-adjusted growth factor distribution $\boldsymbol{K}_{GF\_Adj}$

such that $\boldsymbol{S}_{D\_Adj} \equiv S_D \boldsymbol{K}_{GF\_Adj}$

Propose some growth distribution scale factor function $\boldsymbol{K}_U(t)$

such that $\boldsymbol{K}_{GF\_Adj} = \boldsymbol{K}_U(t)(\boldsymbol{K}_{GF} - 1) + 1$

where $\boldsymbol{K}_U(t) \in (0,1]$ and $\boldsymbol{K}_U(0) = 1$

Assume $\dfrac{d\,\boldsymbol{K}_U(t)}{dt} \propto -\boldsymbol{K}_U(t)$ or $\dfrac{d\,\boldsymbol{K}_U(t)}{dt} = -b\,\boldsymbol{K}_U(t)$

Using calculus $\displaystyle\int \frac{d\,\boldsymbol{K}_U(t)}{\boldsymbol{K}_U(t)} = \int -b\,dt \therefore \boldsymbol{K}_U(t) = e^{-bt}e^{C}$

Since $\boldsymbol{K}_U(t) = 1$ when $t = 0$, C must equal $0 \therefore \boldsymbol{K}_U(t) = e^{-bt}$

$\therefore \boldsymbol{K}_{GF\_Adj} = e^{-bt}(\boldsymbol{K}_{GF} - 1) + 1$

Uncertainty tends to decay faster during the early stages of a process when experience is low and tends to decay slower during the later stages of a process when experience is high

Applying DSLOC Estimate Growth Factor Uncertainty Decay

$$\boldsymbol{S}_{D\_Adj} = S_D \boldsymbol{K}_{GF\_Adj} \quad \text{(from previous slide)}$$

$$\boldsymbol{K}_{GF\_Adj} = e^{-3.466t}\left(\boldsymbol{K}_{GF} - 1\right) + 1 \quad \text{(from previous slide)}$$

$$\therefore \boldsymbol{S}_{D\_Adj} = S_D\left(e^{-bt}\left(\boldsymbol{K}_{GF} - 1\right) + 1\right)$$

$\boldsymbol{K}_{GF}$ = Baseline DSLOC Estimate Growth Factor Distribution
(one for each of New and Pre-Existing from AFCAA data)

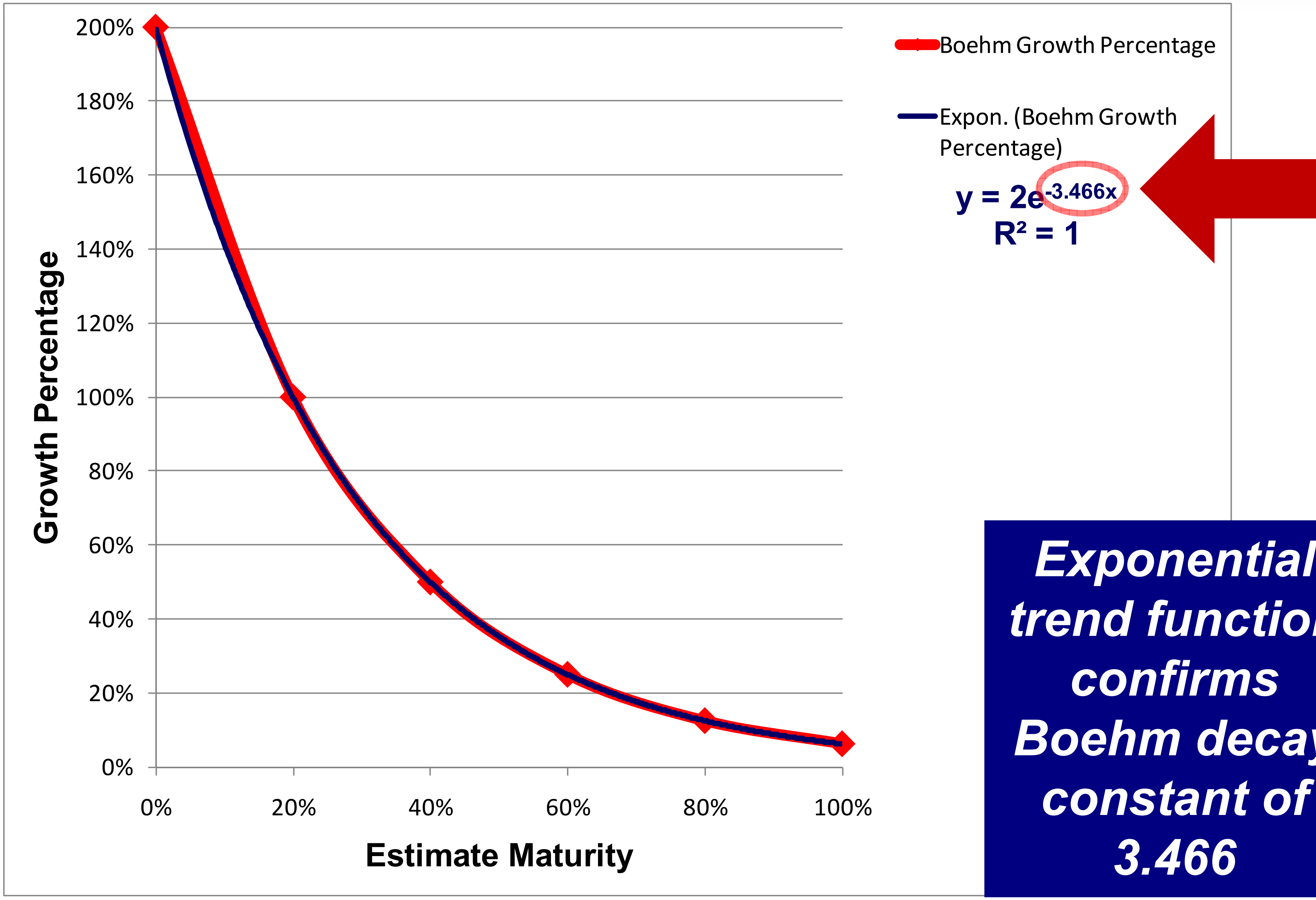
$\boldsymbol{K}_{GF\_Adj}$ = Maturity-Adjusted DSLOC Estimate Growth Factor Distribution

$b = 3.466$ based on Boehm's "Cone of Uncertainty" (Boehm, 1981, p. 311)

t = Estimate Maturity Parameter (0% to 100%)

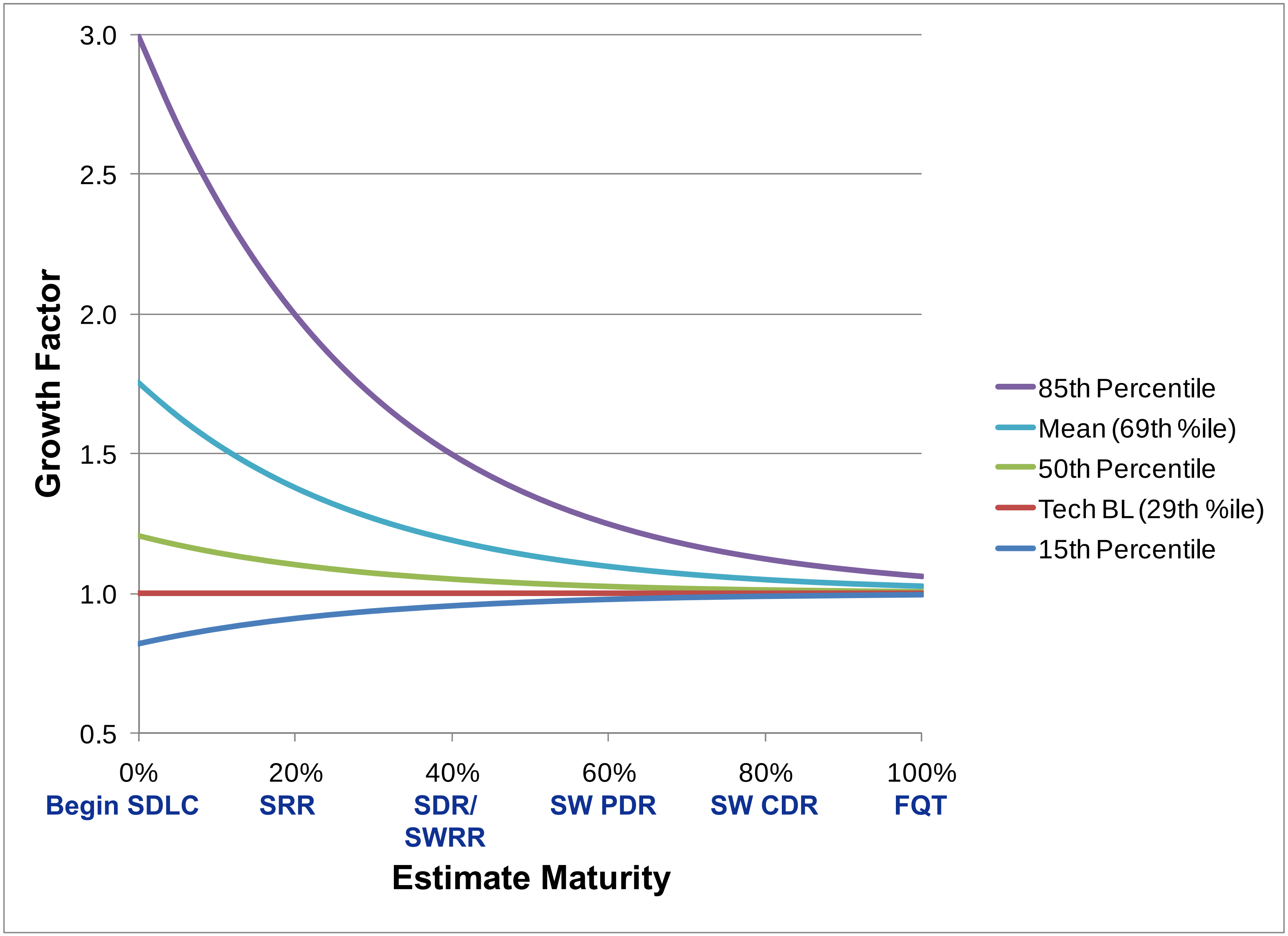
Implements time-progressive decay (narrowing) of the DSLOC estimate distribution

Deriving the Decay Constant from Boehm's "Cone of Uncertainty"

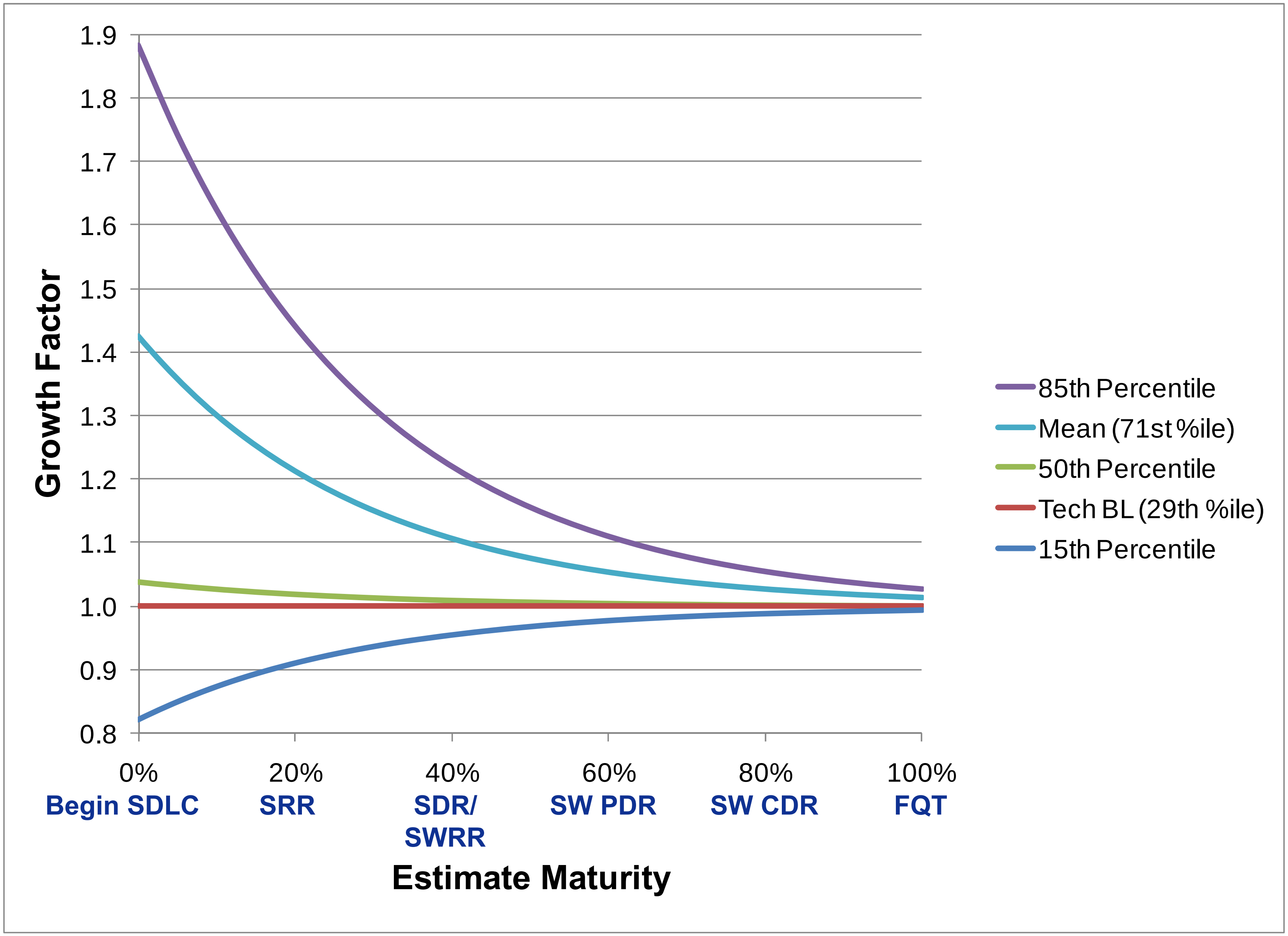


Exponential trend function confirms Boehm decay constant of 3.466

New DSLOC Growth Factor Decay



Pre-Existing Reuse DSLOC Growth Factor Decay



Least, Likely, Most Factors for SEER-SEM DSLOC Inputs

$$\boldsymbol{S_{D\_Adj}} = S_D\left(e^{-bt}\left(\boldsymbol{K_{GF}} - 1\right) + 1\right) \Rightarrow \text{ for SEER-SEM } S_{D\_Adj} = S_D\left(e^{-bt}\left(K\right) + 1\right)$$

find unique values of K

for each of Least (L), Likely (M), Most (H); for each of New, PER

New DSLOC Input Triple

$$S_{D\_Adj\_New\_L} = S_{D\_New}\left(K_{New\_L}e^{-3.466t} + 1\right)$$

$$S_{D\_Adj\_New\_M} = S_{D\_New}\left(K_{New\_M}e^{-3.466t} + 1\right)$$

$$S_{D\_Adj\_New\_H} = S_{D\_New}\left(K_{New\_H}e^{-3.466t} + 1\right)$$

Pre-Existing Reused (PER) DSLOC Input Triple

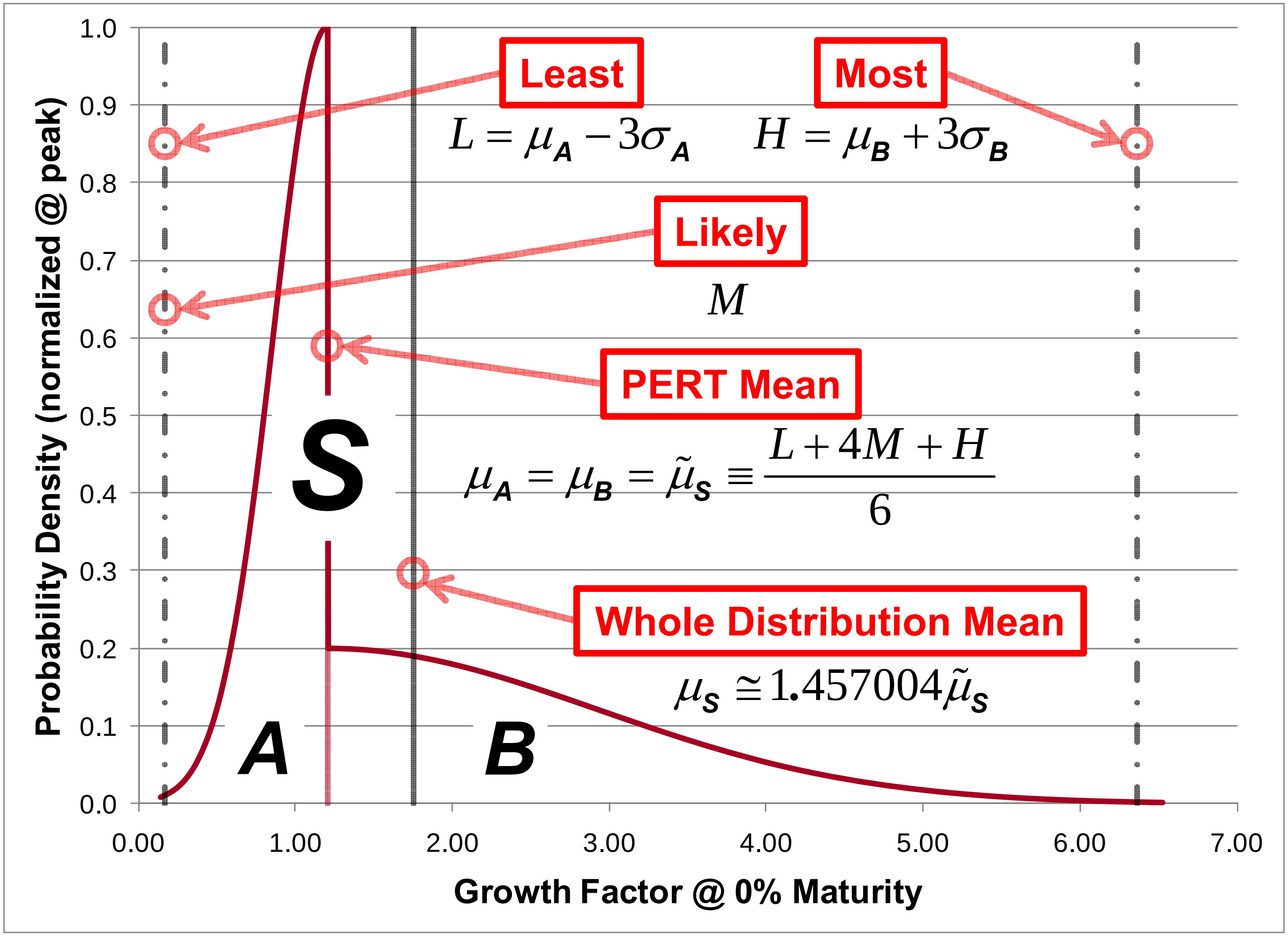
$$S_{D\_Adj\_PER\_L} = S_{D\_PER}\left(K_{PER\_L}e^{-3.466t} + 1\right)$$

$$S_{D\_Adj\_PER\_M} = S_{D\_PER}\left(K_{PER\_M}e^{-3.466t} + 1\right)$$

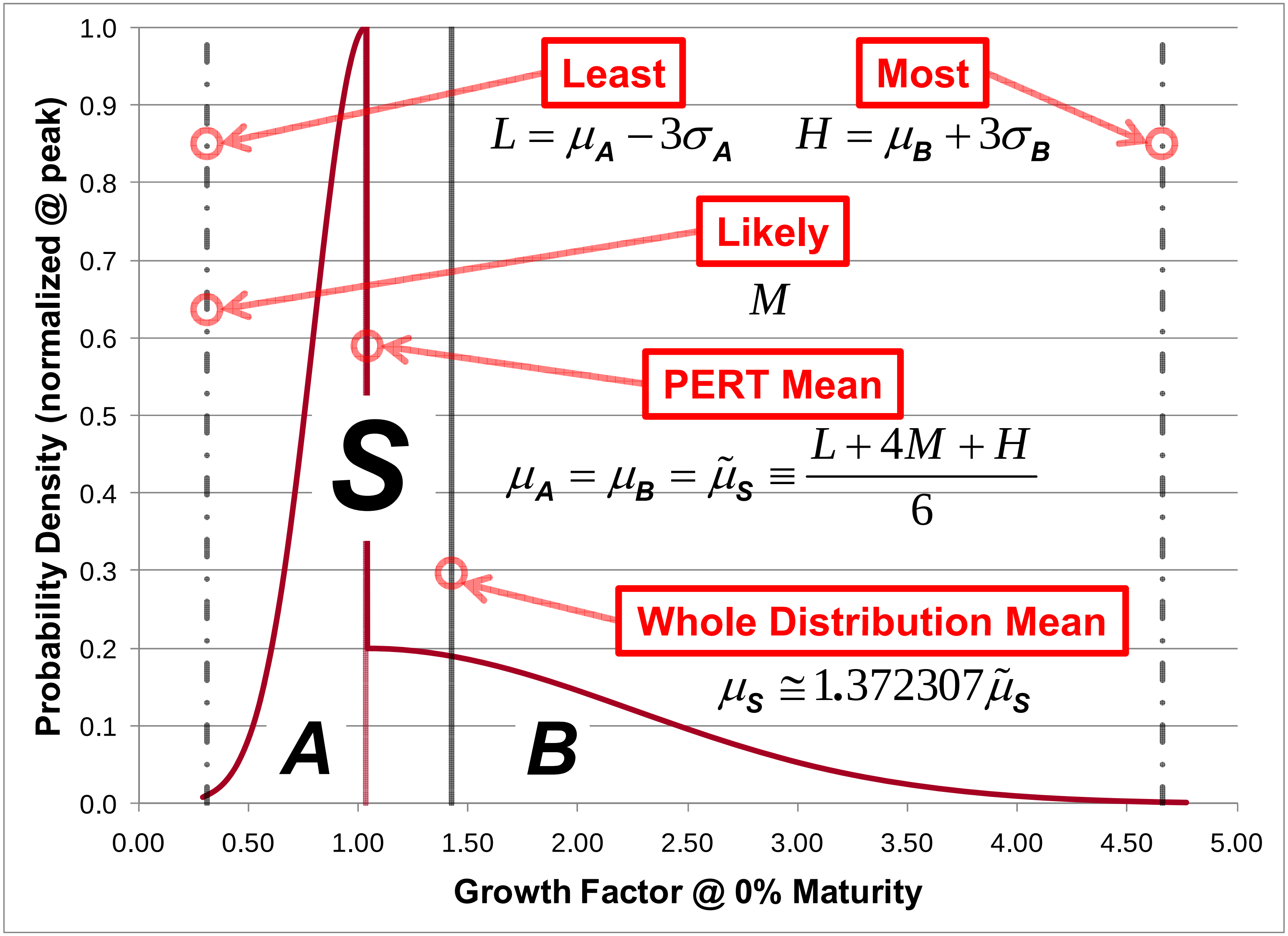
$$S_{D\_Adj\_PER\_H} = S_{D\_PER}\left(K_{PER\_H}e^{-3.466t} + 1\right)$$

SEER-SEM DSLOC input uncertainty must be characterized using Least (L), Likely (M), and Most (H) inputs

SEER-PERT Distribution Math: New Growth Factor PDF



SEER-PERT Distribution Math: PER Growth Factor PDF



Determining Least, Likely, Most Factors for SEER-SEM DSLOC Inputs

	OptimizeTriple Macro					
	Solver Change Values (Results)		Solver Target (Objective)	SEER-SEM Multiplier Expression Scale Factors		
DSLOC Type	σ[A]	σ[B]	|μ[ACE]-μ[SEER]|	K[L]	K[M]	K[H]
New	0.344122	1.720611	0.017010	-0.828071	-0.828071	5.366128
Pre-Existing	0.241411	1.207058	0.014898	-0.687191	-0.687192	3.658219

Excel Solver was used to find the optimum scale factor values for use in the SEER-SEM DSLOC growth equations

Applying Least, Likely, Most Factors to SEER-SEM DSLOC Inputs

New DSLOC Input Triple

$$S_{D\_Adj\_New\_L} = S_{D\_New}\left(-0.828071e^{-3.466t} + 1\right)$$

$$S_{D\_Adj\_New\_M} = S_{D\_New}\left(-0.828071e^{-3.466t} + 1\right)$$

$$S_{D\_Adj\_New\_H} = S_{D\_New}\left(5.366128e^{-3.466t} + 1\right)$$

Pre-Existing Reused (PER) DSLOC Input Triple

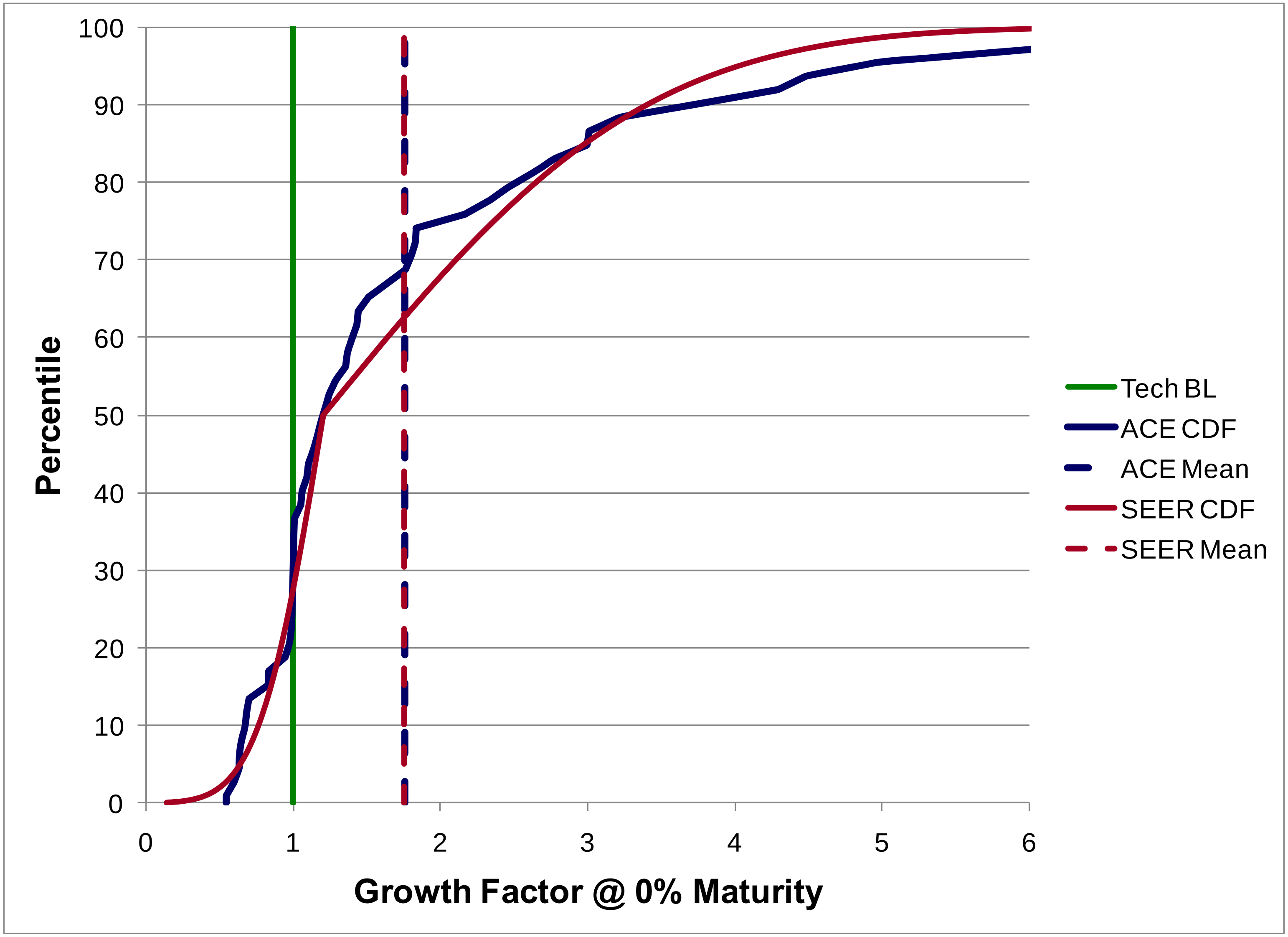
$$S_{D\_Adj\_PER\_L} = S_{D\_PER}\left(-0.687191e^{-3.466t} + 1\right)$$

$$S_{D\_Adj\_PER\_M} = S_{D\_PER}\left(-0.687192e^{-3.466t} + 1\right)$$

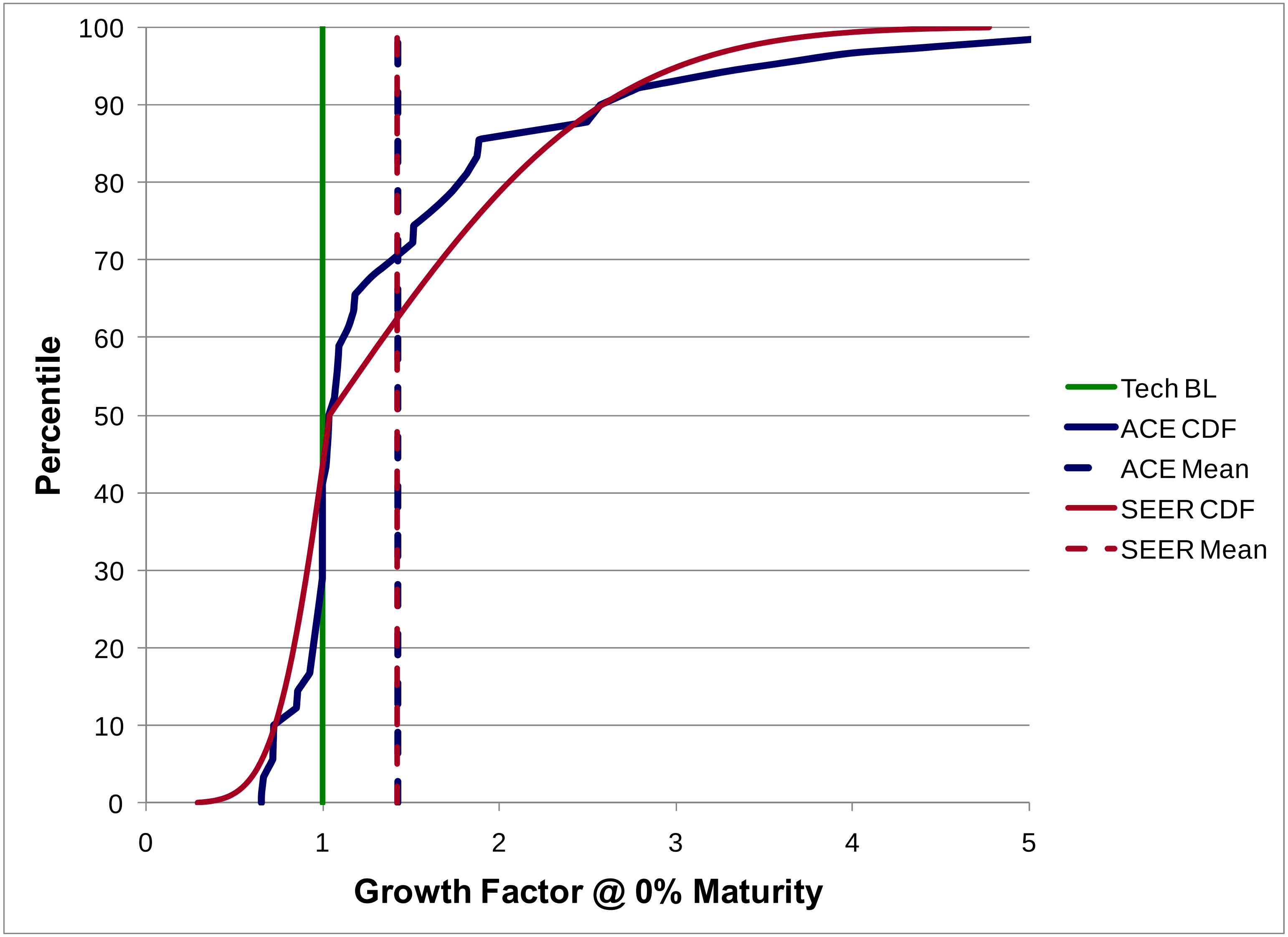
$$S_{D\_Adj\_PER\_H} = S_{D\_PER}\left(3.658219e^{-3.466t} + 1\right)$$

Tecolote DSLOC Estimate Growth Model can be successfully implemented with Galorath's SEER-SEM

Comparing ACE to SEER-SEM: New Growth Factor Theoretical CDFs



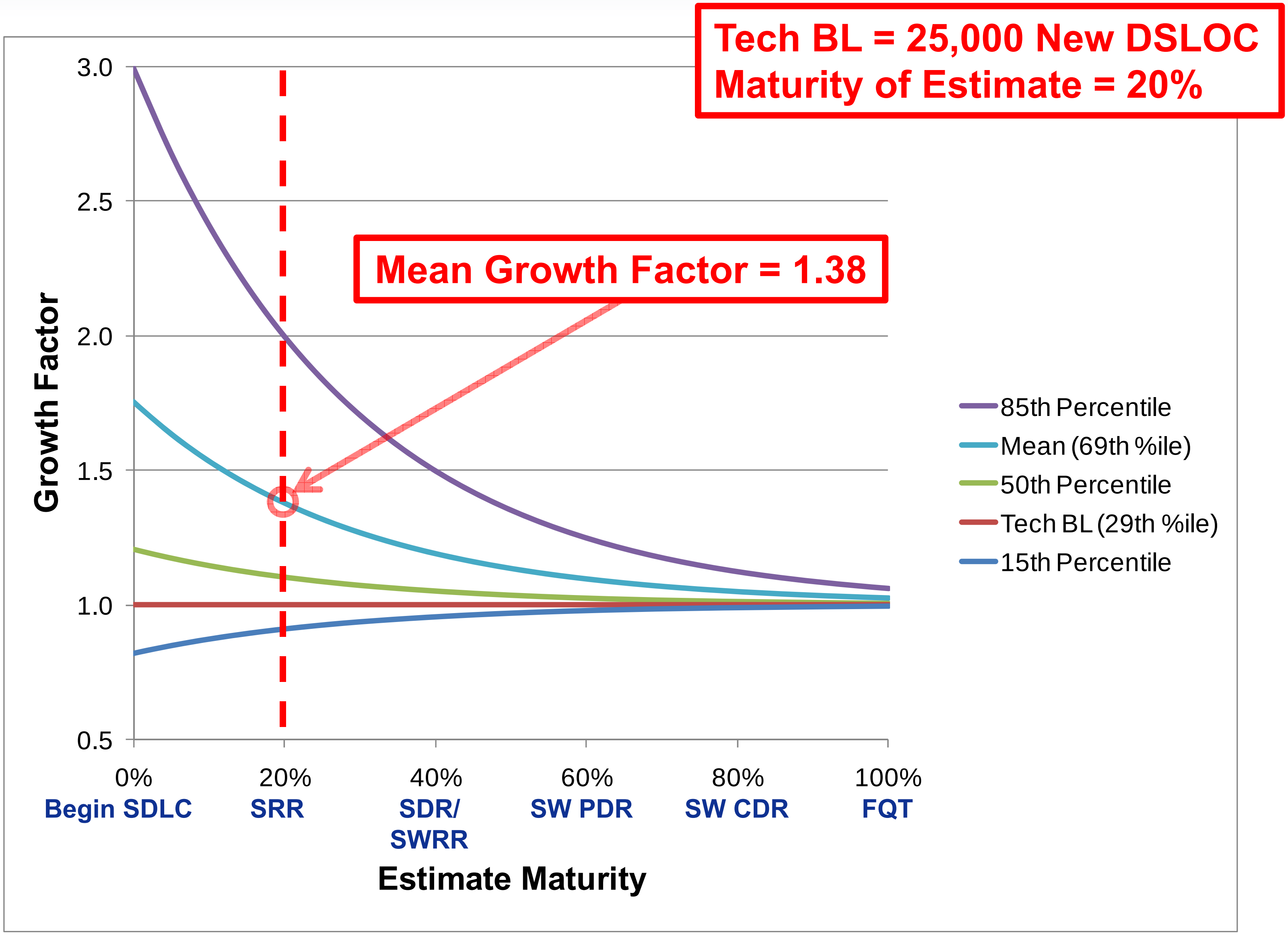
Comparing ACE to SEER-SEM: PER Growth Factor Theoretical CDFs



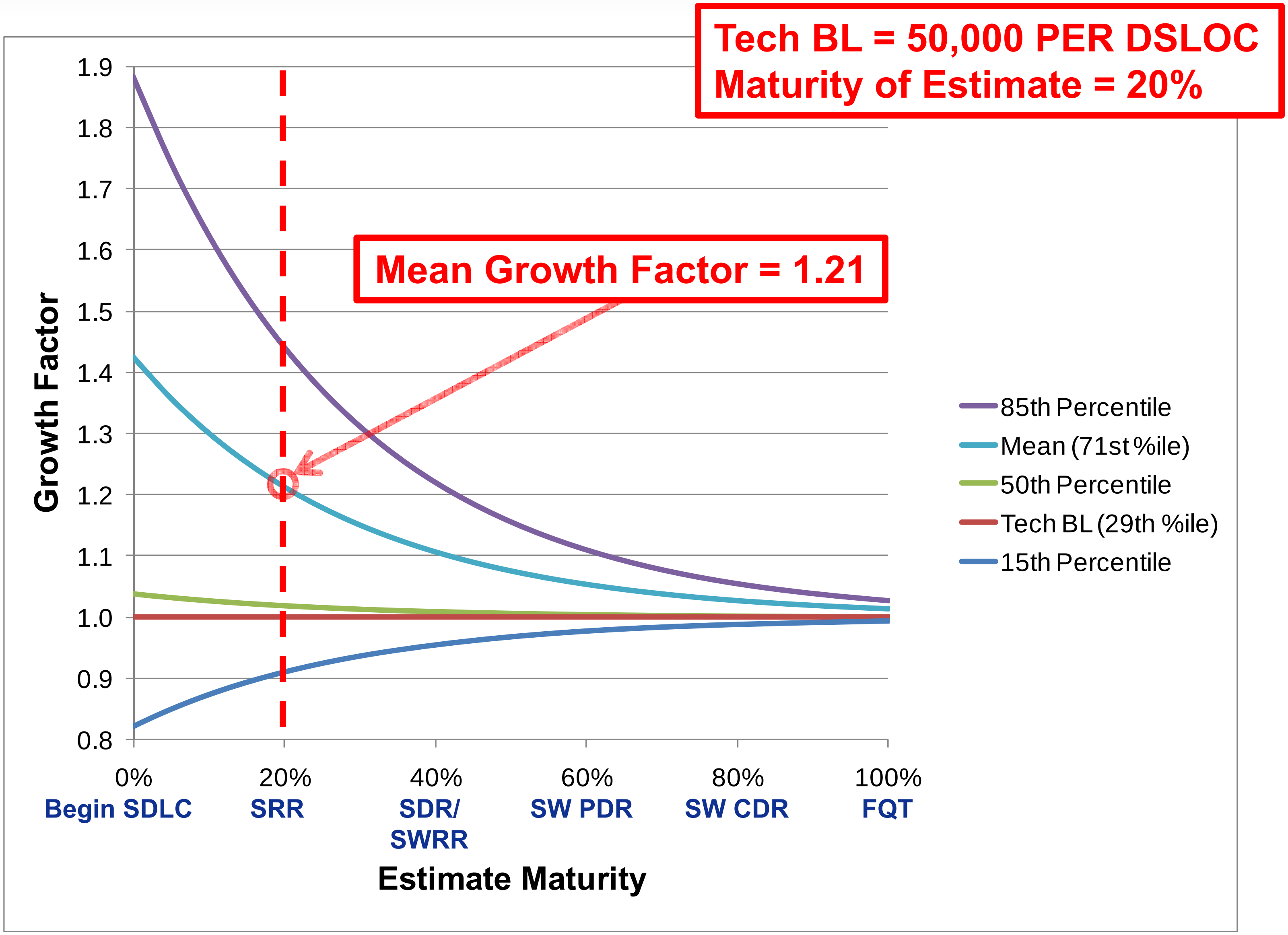
Tecolote DSLOC Estimate Growth Model: Example w/ ACEIT & w/ SEER-SEM

- **Technical Baseline Point Estimate of *New* DSLOC = 25,000**
- **Technical Baseline Point Estimate of *Pre-Existing Reused* DSLOC = 50,000**
- **Estimate Maturity = 20% (successful completion of System Requirements Review)**

Growth Example: New DSLOC Growth Factor



Growth Example: Pre-Existing DSLOC Growth Factor



Approved for Public Release

Modeling the Example in ACEIT: ACE Line Item Entries for an SI

WBS/CES Description	Unique ID	Point Estimate	Equation / Throughput	RI$K Specification	Grouping	Group Strength
- Total Growth-Adjusted DSLOC		**78,480 (50%) ***	SI010101_New_Adj_SD+SI010101_PER_Adj_SD			
- New Growth-Adjusted DSLOC	SI010101_New_Adj_Sd	**27,554 (50%) ***	SI010101_New_Adj_GUF*SI010101_New_Sd			
- Technical Baseline DSLOC Point Estimate	SI010101_New_Sd	**25,000 ***	25000 [Given]			
- Maturity at DSLOC Estimate	SI010101_New_Sd_Est_Mat	**0.200 ***	0.20 [SSR Complete = 20% Estimate Maturity]			
- Baseline Growth Factor	SI010101_New_BL_GF	**1.204 (50%) ***	1.204296 [Tecolote DSLOC Estimate Growth Model v05 Median of AFCAA New DSLOC Data Set]	Form=CDF, PE=Undefined, Ref=New_GF_CDF, GrpID=SI010101_Sd_Group, GrpStr=D, Seed=1352163	SI010101_SD_Group	D
- Decay Constant	SI010101_New_GF_Decay	**3.466 ***	3.466 [Tecolote DSLOC Estimate Growth Model v05 Default]			
- Adjusted Growth Factor	SI010101_New_Adj_GUF	**1.102 (50%) ***	exp(-SI010101_New_GF_Decay*SI010101_New_Sd_Est_Mat)*(SI010101_New_BL_GF-1)+1 [Tecolote DSLOC Estimate Growth Model v05]			
- PreExisting: Reuse Growth-Adjusted DSLOC	SI010101_PER_Adj_Sd	**50,926 (50%) ***	SI010101_PER_Adj_GUF*SI010101_PER_Sd			
- Technical Baseline DSLOC Point Estimate	SI010101_PER_Sd	**50,000 ***	50000 [Given]			
- Maturity at DSLOC Estimate	SI010101_PER_Sd_Est_Mat	**0.200 ***	0.20 [PDR Complete = 20% Estimate Maturity]			
- Baseline Growth Factor	SI010101_PER_BL_GF	**1.037 (50%) ***	1.037044 [Tecolote DSLOC Estimate Growth Model v05 Median of AFCAA Pre-Existing DSLOC Data Set]	Form=CDF, PE=Undefined, Ref=PER_GF_CDF, GrpID=SI010101_Sd_Group, GrpStr=1, Seed=2069408	SI010101_SD_Group	1
- Decay Constant	SI010101_PER_GF_Decay	**3.466 ***	3.466 [Tecolote DSLOC Estimate Growth Model v05 Default]			
- Adjusted Growth Factor	SI010101_PER_Adj_GUF	**1.019 (50%) ***	exp(-SI010101_PER_GF_Decay*SI010101_PER_Sd_Est_Mat)*(SI010101_PER_BL_GF-1)+1 [Tecolote DSLOC Estimate Growth Model v05]			

Modeling the Example in ACEIT: Zooming in on Key ACE Entries

WBS/CES Description	Unique ID	Equation / Throughput
- New Growth-Adjusted DSLOC	SI010101_New_Adj_Sd	SI010101_New_Adj_GUF*SI010101_New_Sd
- Technical Baseline DSLOC Point Estimate	SI010101_New_Sd	25000 [Given]
- Maturity at DSLOC Estimate	SI010101_New_Sd_Est_Mat	0.20 [Sys Req Rev Complete = 20% Estimate Maturity]
- Baseline Growth Factor	SI010101_New_BL_GF	1.204296 [Tecolote DSLOC Estimate Growth Model v05 Median of AFCAA New DSLOC Data Set]
- Decay Constant	SI010101_New_GF_Decay	3.466 [Tecolote DSLOC Estimate Growth Model v05 Default]
- Adjusted Growth Factor	SI010101_New_Adj_GUF	exp(-SI010101_New_GF_Decay*SI010101_New_Sd_Est_Mat)*(SI010101_New_BL_GF-1)+1 [Tecolote DSLOC Estimate Growth Model v05]

Modeling the Example in ACEIT: Specifying the Distributions

WBS/CES Description	Equation / Throughput	RI$K Specification
New - Baseline Growth Factor	1.204296 [Tecolote DSLOC Estimate Growth Model v05 Median of AFCAA New DSLOC Data Set]	Form=CDF, PE=Undefined, Ref=New_GF_CDF, GrpID=SI010101_Sd_Group, GrpStr=D, Seed=1352163

Pre-Existing - Baseline Growth Factor	1.037044 [Tecolote DSLOC Estimate Growth Model v05 Median of AFCAA Pre-Existing DSLOC Data Set]	Form=CDF, PE=Undefined, Ref=PER_GF_CDF, GrpID=SI010101_Sd_Group, GrpStr=1, Seed=2069408

Modeling the Example in ACEIT: Custom CDFs

New_GF_CDF		
	Confidence (%)	Multiplier
1	0.00000000000	0.4549560272208
2	10.00000000000	0.5621483902387
3	20.00000000000	0.8039911843758
4	30.00000000000	0.8316194196262
5	40.00000000000	0.8814541263447
6	50.00000000000	1.0000000000000
7	60.00000000000	1.1653207912851
8	70.00000000000	1.4873573359220
9	80.00000000000	2.0898160858878
10	90.00000000000	3.0812166786418
11	100.00000000000	5.1930414674842

PER_GF_CDF		
	Confidence (%)	Multiplier
1	0.00000000000	0.6317293787416
2	10.00000000000	0.6992822451771
3	20.00000000000	0.9138907707378
4	30.00000000000	0.9642887324668
5	40.00000000000	0.964371732410З
6	50.00000000000	1.0000000000000
7	60.00000000000	1.0783540487449
8	70.00000000000	1.3444623081028
9	80.00000000000	1.7121742117209
10	90.00000000000	2.4798271957032
11	100.00000000000	5.0775979934902

CDFs above are abbreviated for this presentation; actual CDFs have 1001 elements (increments of 0.1%)

Modeling the Example in ACEIT: Abbreviated RI$K Results

WBS/CES Description	Mean	Std Dev	CV	15%	50%	85%
- Total Growth-Adjusted DSLOC	94,952	38,836	0.41	69,692	78,480	122,047
- New Growth-Adjusted DSLOC	34,412	16,497	0.48	22,754	27,552	49,967
- Technical Baseline DSLOC Point Estimate	25,000			25,000	25,000	25,000
- Maturity at DSLOC Estimate	0.2			0.2	0.2	0.2
- Baseline Growth Factor	1.753	1.32	0.75	0.82	1.204	2.998
- Decay Constant	3.466			3.466	3.466	3.466
- Adjusted Growth Factor	1.376	0.66	0.48	0.91	1.102	1.999
- PreExisting: Reuse Growth-Adjusted DSLOC	60,540	22,474	0.37	46,938	50,928	72,079
- Technical Baseline DSLOC Point Estimate	50,000			50,000	50,000	50,000
- Maturity at DSLOC Estimate	0.2			0.2	0.2	0.2
- Baseline Growth Factor	1.422	0.899	0.63	0.878	1.037	1.883
- Decay Constant	3.466			3.466	3.466	3.466
- Adjusted Growth Factor	1.211	0.449	0.37	0.939	1.019	1.442

This report was generated with ACEIT's Inputs/Results Viewer set to "BY Risk Statistics"

Modeling the Example in SEER-SEM: Input Parameters for an SI

Tech BL = 25,000 New DSLOC
Maturity of Estimate = 20%
Tech BL = 50,000 Pre-Existing DSLOC
Maturity of Estimate = 20%

DSLOC Type	SEER Least DSLOC	SEER Likely DSLOC	SEER Most DSLOC
New	14,650	14,650	92,073
Pre-Existing	32,821	32,821	141,451

Wide ranges due to the way SEER-SEM models the DSLOC distribution and interprets the Least and Most percentiles

Modeling the Example in SEER-SEM: Risk Report – New DSLOC

SEER-SEM (TM) Software Schedule, Cost & Risk Estimation Version 8.0.6

Project : Tecolote DSLOC Estimate Growth Model Analysis 12/01/2010

Program : 1.2: New DSLOC 8:26:30 AM

Risk-Adjusted Metrics

Probability	Effective Size	Effective Technology	Productivity
----------	-------------	-------------------	-----------
1%	17,548	3,522.23	130.54
10%	22,042	3,522.23	124.72
20%	23,934	3,522.23	122.69
30%	25,298	3,522.23	121.33
40%	26,464	3,522.23	120.24
50%	27,554	3,522.23	119.28
60%	33,002	3,522.23	115.05
70%	38,832	3,522.23	111.37
80%	45,654	3,522.23	107.82
90%	55,115	3,522.23	103.84
99%	77,585	3,522.23	96.97

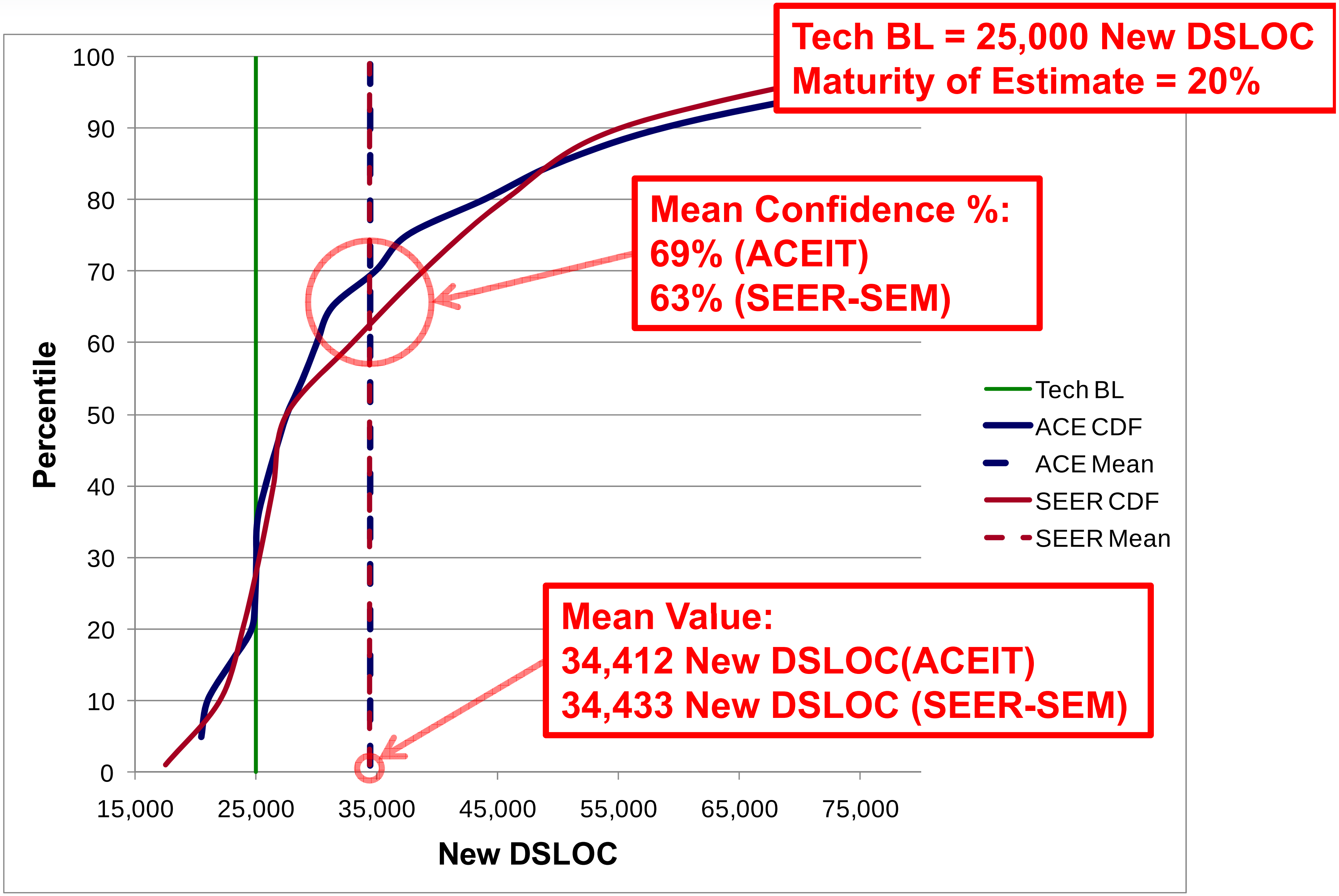
Modeling the Example in SEER-SEM: Risk Report – Pre-Existing DSLOC

SEER-SEM (TM) Software Schedule, Cost & Risk Estimation Version 8.0.6			
Project : Tecolote DSLOC Estimate Growth Model Analysis			12/01/2010
Program : 1.3: Pre-Existing DSLOC			8:26:55 AM
Risk-Adjusted Metrics			
Probability	Effective Size	Effective Technology	Productivity
----------	-------------	-------------------	-----------
1%	36,887	3,522.23	112.52
10%	43,192	3,522.23	109.02
20%	45,847	3,522.23	107.73
30%	47,761	3,522.23	106.85
40%	49,397	3,522.23	106.13
50%	50,926	3,522.23	105.49
60%	58,571	3,522.23	102.58
70%	66,750	3,522.23	99.93
80%	76,322	3,522.23	97.29
90%	89,597	3,522.23	94.22
99%	121,123	3,522.23	88.71

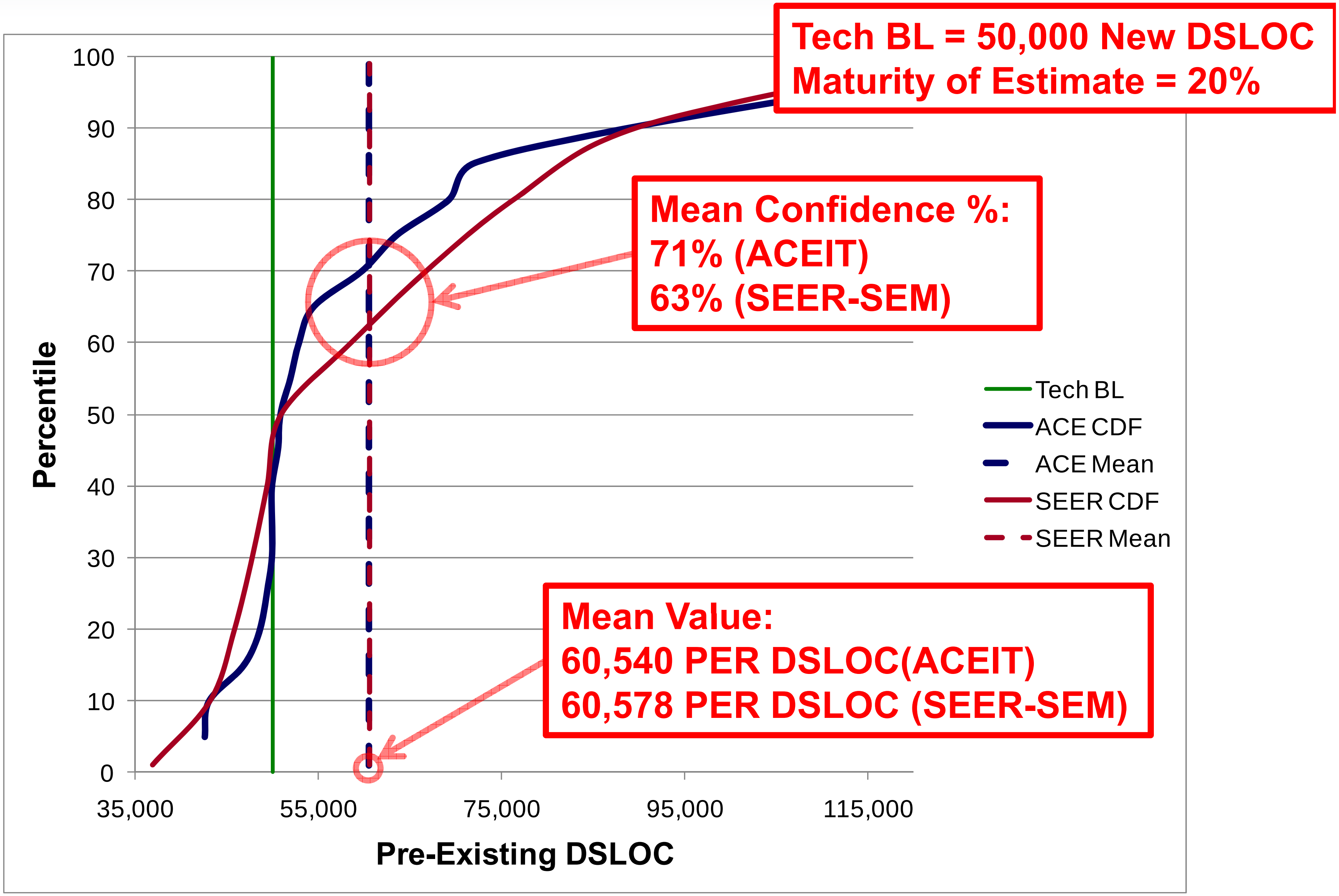
Modeling the Example in SEER-SEM: Risk Report – Total DSLOC

SEER-SEM (TM) Software Schedule, Cost & Risk Estimation Version 8.0.6			
Project : Tecolote DSLOC Estimate Growth Model Analysis			12/01/2010
Program : 1.1: Total DSLOC			8:25:54 AM
Risk-Adjusted Metrics			
Probability	Effective Size	Effective Technology	Productivity
----------	-------------	-------------------	-----------
1%	54,434	3,522.23	104.09
10%	65,233	3,522.23	100.39
20%	69,781	3,522.23	99.05
30%	73,059	3,522.23	98.14
40%	75,861	3,522.23	97.41
50%	78,480	3,522.23	96.75
60%	91,573	3,522.23	93.81
70%	105,582	3,522.23	91.18
80%	121,976	3,522.23	88.58
90%	144,712	3,522.23	85.60
99%	198,708	3,522.23	80.34

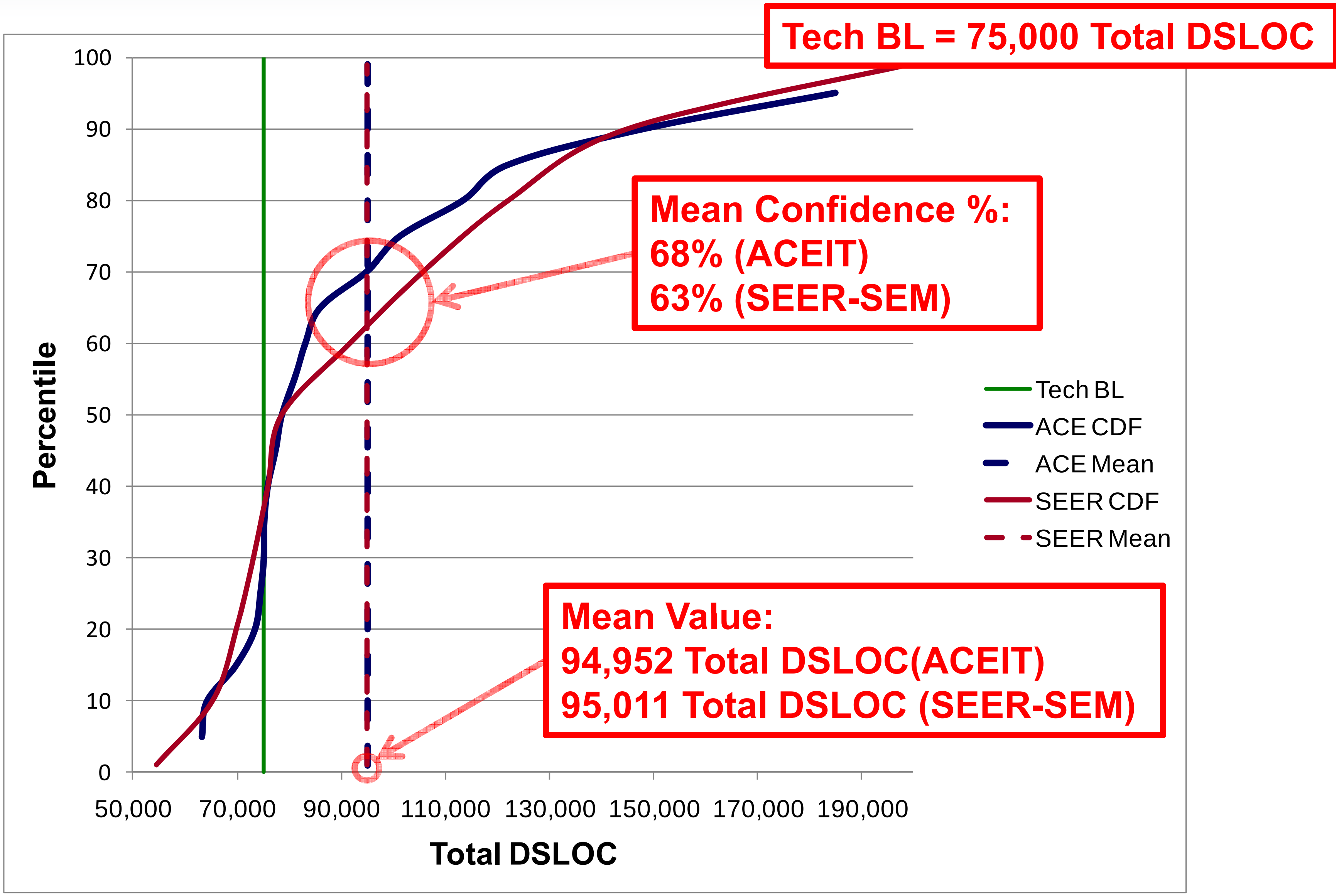
ACEIT vs. SEER-SEM: Growth-Adjusted New DSLOC



ACEIT vs. SEER-SEM: Growth-Adjusted PER DSLOC

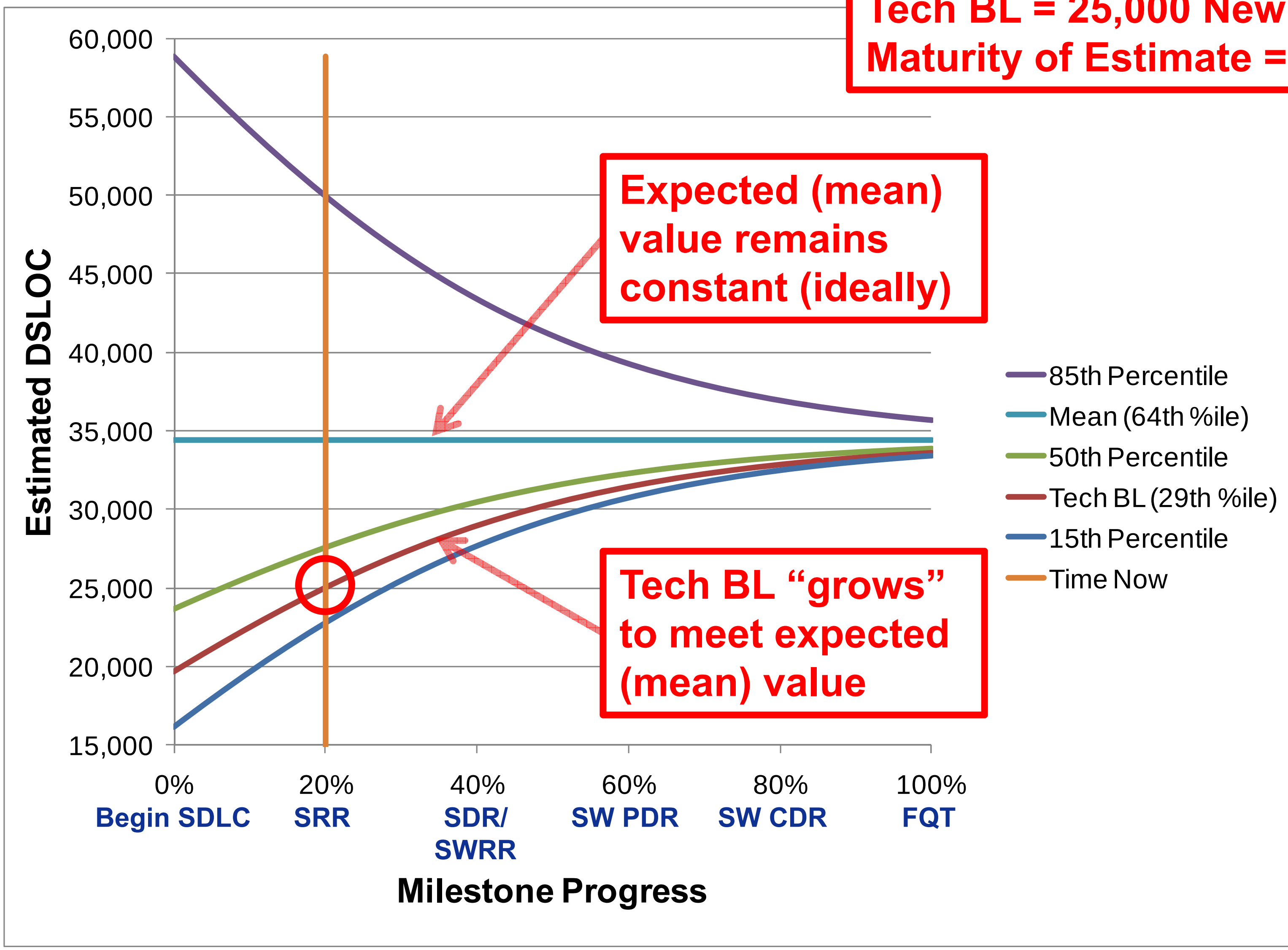


ACEIT vs. SEER-SEM: Growth-Adjusted Total DSLOC



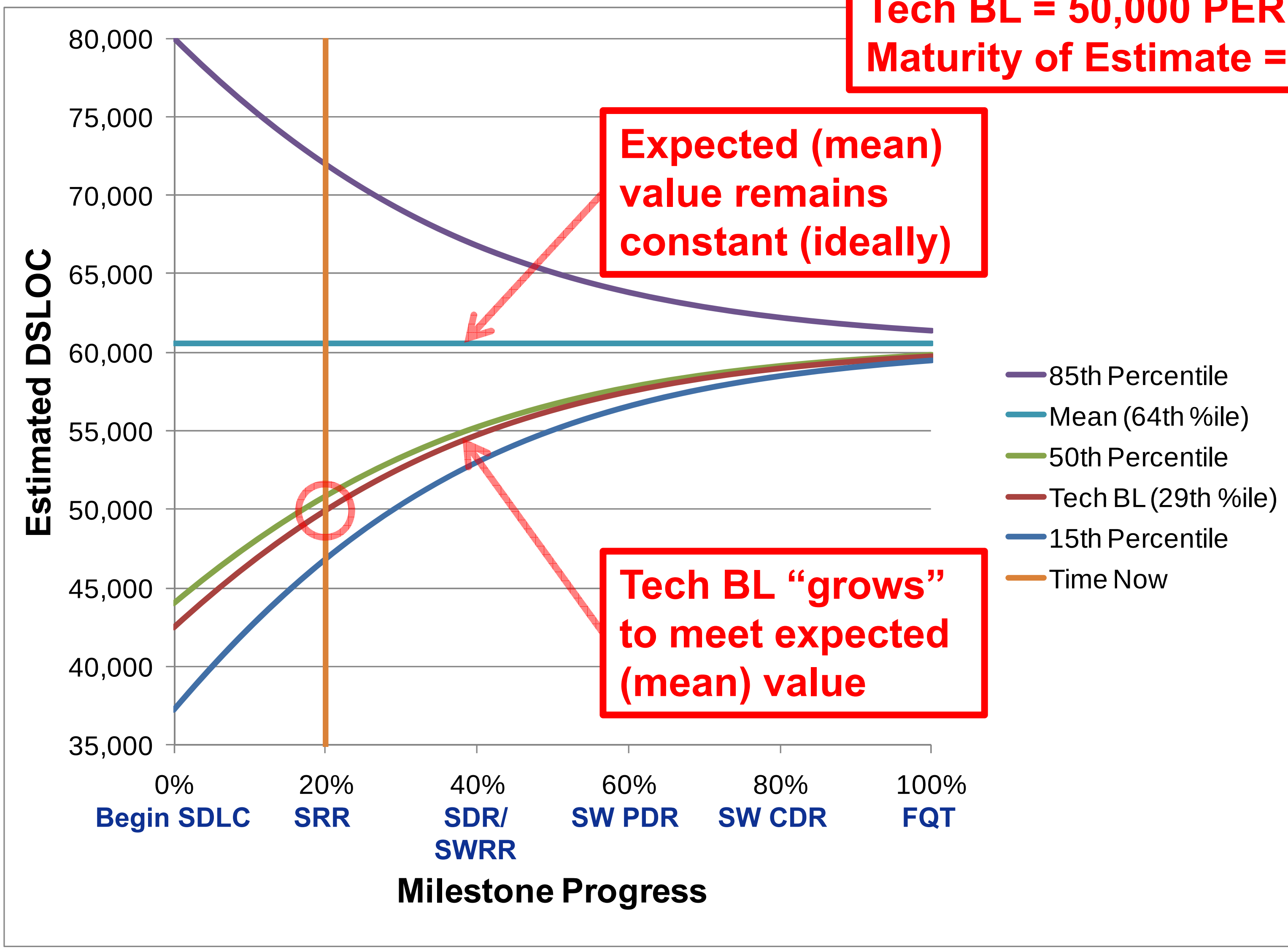
Growth Example: New DSLOC

Tech BL = 25,000 New DSLOC
Maturity of Estimate = 20%



Growth Example: Pre-Existing DSLOC

Tech BL = 50,000 PER DSLOC
Maturity of Estimate = 20%



Future Research and Analysis

- AFCAA SRDR data update from Wilson Rosa
- Investigate correlation between New and Pre-Existing DSLOC growth
- Collect and analyze time-phased DSLOC estimate data to refine decay