TEXAS TECH UNIVERSITY™

SEER-SEM to COCOMO II Factor Convertor

Anthony L Peterson
Mechanical Engineering

8 June 2011

SEER-SEM to COCOMO II Factor Convertor

The Software Parametric Models

- COCOMO II – public domain model which continues to be updated at USC
- SEER-SEM – proprietary commercial model from Galorath Inc. that shares a number of characteristics with COCOMO II

Estimate Software Effort Using Multiple Models

- A "Rosetta Stone" provides a mapping from the cost factors of one parametric model to corresponding cost factors of another
- Madachy and Boehm (2006, 2008) defined transformations between different models by the use of Rosetta Stones
  - *Top-level maps the cost factors between models*
  - *Detailed-level maps individual ratings between analogous cost factors*

Automating Production of Second Estimate

- Automation of second estimate facilitates multiple cost rounds
- Tool for SEER-SEM estimate ⇨ COCOMO II estimate
  - *Top-level Rosetta Stone maps between COCOMO II Effort Multiplier (EM) factors and SEER-SEM cost factors*
  - *Detailed-level Rosetta Stone maps individual ratings from analogous SEER-SEM cost factors to COCOMO II EM factors*
  - *Compute composite COCOMO II EM via Rosetta Stone transformation*
  - *Using that composite EM generate a COCOMO II estimate*

Top-Level Rosetta Stone Mapping

- Identified correspondence between SEER-SEM cost factors and thirteen COCOMO II EM factors
- Two COCOMO II EM ⇨ multiple SEER-SEM cost factors
  - *Platform Volatility* ⇔ *Volatility of Host & Target Systems*
  - *Platform Experience* ⇔ *Experience with Development & Target Systems*
- Three COCOMO II EM factors have no equivalent
  - *Data Base Size*
  - *Documentation*
  - *Personnel Continuity*

Top-Level Rosetta Stone

COCOMO II Effort Multiplier	ID	SEER−SEM Cost Factor
PRODUCT ATTRIBUTES		
Required Software Reliability	RELY	Specification Level - Reliability
Data Base Size	DATA	No Equivalent
Product Complexity	CPLX	Complexity (Staffing)
Required Reusability	RUSE	Reusability Level Required
Documentation	DOCU	No Equivalent
PLATFORM ATTRIBUTES		
Execution Time Constraint	TIME	Time Constraints
Main Storage Constraint	STOR	Memory Constraints
Platform Volatility	PVOL	Host System Volatility
		Target System Volatility

Top-Level Rosetta Stone

COCOMO II Effort Multiplier	ID	SEER−SEM Cost Factor
PERSONNEL ATTRIBUTES		
Analyst Team Capabilities	ACAP	Analyst Capabilities
Programmer Team Capabilities	PCAP	Programmer Capabilities
Personnel Continuity	PCON	No Equivalent
Applications Experience	APEX	Analyst Application Experience
Platform Experience	PLEX	Development System Experience
		Target System Experience
Language and Tools Experience	LTEX	Programmer's Language Experience
PROJECT ATTRIBUTES		
Use of Software Tools	TOOL	Automated Tools Use
Multi-Site Development	SITE	Multiple Site Development

Rosetta Stone Transformation

- Map SEER-SEM cost factors to analogous COCOMO II EM
  - *Refinement of method described in an unpublished Galorath document*
  - *Note that SEER-SEM has many factors not found in COCOMO II*
- Account for higher fidelity of SEER-SEM cost factor
  - *SEER-SEM values Extra High, Very High, High, Nominal, Low, and Very Low flanked by two "between" settings*
  - *Higher fidelity facilitates mapping disproportionate factor definitions*
  - *Remaining mapped via linear interpolation of COCOMO II EM values*
- Clip mapping whenever factor range differs

Example: Application Experience Mapping

SEER−SEM Cost Factor Definitions	SEER−SEM Rating	COCOMO II Effort Multiplier (EM) Definitions	EM Rating	
Analyst's Application Experience		**Applications Experience (APEX)**		
> 10 years	VHi		VH	0.81
	VHi−		VH	0.81
	Hi+		VH	0.81
6 years	Hi	6 years	VH	0.81
	Hi−		VH−	0.83
	Nom+		H+	0.86
3 years	Nom	3 years	H	0.88
	Nom−		H−	0.92
	Low+		N+	0.96
1 year	Low	1 year	N	1.00
	Low−		N−L	1.05
	VLo+	6 months	L	1.10
< 4 months	VLo	2 months	VL	1.22

Determine Analogous COCOMO II EM

- Import SEER-SEM cost factors
- Tool automatically applies Rosetta Stone
- Review converted ratings, adjusting as required
- Input the three unmapped EM factors
- Rating triplet values evaluated via center-weighted PERT
  - $(\text{Lowest} + 4 \cdot \text{Most Likely} + \text{Highest}) / 6$
- Composite analogous EM is product of sixteen EM ratings

Compute COCOMO II Estimate

- Input the five COCOMO II Scale Factors (SF)
- Enter COCOMO II ESLOC (different algorithm from SEER)
- Compute COCOMO II effort estimate for nominal schedule
  - *Calibration constants should be adjusted based on local experience*
- Revise effort estimate if project has compressed schedule
  - *COCOMO II time to develop for nominal schedule calculated*
  - *Required Schedule EM (SCHD) established via 4th degree polynomial*
- Effort adjustment required before comparison to SEER-SEM
  - *Scope of COCOMO II effort estimated differs from SEER-SEM*

Compute Effort for Nominal Schedule

$$PM_{NS} = A \cdot Size^{E} \cdot \prod_{i=1}^{16} EM_i \quad where\ E = B + 0.01 \sum_{j=1}^{5} SF_j$$

- PM_{NS} – *Effort in person-months for nominal schedule*
- *SIZE* – *Equivalent source lines of code*
- *A* – *Effort (productivity) coefficient constant* – 2.94 (COCOMO II.2000)
- *B* – *Scaling effort exponent base constant* – 0.91 (COCOMO II.2000)
- *E* – *Scaling exponent expressing diseconomy of scale*
- *EMi* – *Effort Multipliers specific to Project estimated*
- SF_j – *Scale Factors specific to Project estimated*

Compute Time to Develop for Nominal Schedule

$$TDEV_{NS} = C \cdot (PM_{NS})^{F} \quad where\ F = D + 0.2 \cdot 0.01 \sum_{j=1}^{5} SF_j = D + 0.2(E - B)$$

- *TDEV – Time to develop in calendar months*
- *B – Scaling effort exponent base constant* – 0.91 (COCOMO II.2000)
- *C – Time to develop calibration constant* – 3.67 (COCOMO II.2000)
- *D – Schedule compression exponent base scaling constant* – 0.28 (COCOMO II.2000)
- *E – Scaling exponent expressing diseconomy of scale*
- *F – Schedule compression adjusted scaling exponent*

Adjust Effort if Compressed Schedule

$$SP = \frac{TDEV_{NS}}{SDEV} = \frac{C \cdot (PM_{NS})^F}{SDEV}$$

$$SCED \cong \begin{cases} 1.00 & SP \geq 1 \\ 16.444 \cdot SP^4 - 65.778 \cdot SP^3 + 104.52 \cdot SP^2 - 77.482 \cdot SP + 23.297 & 0.75 < SP < 1 \\ 1.43 & SP \leq 0.75 \end{cases}$$

$$PM_{CS} = SCED \cdot A \cdot Size^E \cdot \prod_{i=1}^{16} EM_i = SCED \cdot PM_{NS}$$

- *SDEV* – *Required development schedule in calendar months*
- *SP* – *Schedule percentage of acceleration or stretch-out with respect to a nominal schedule*
- *SCHD* – *Required Schedule EM* (*new technique*)
- PM_{CS} – *Adjusted effort in person-months* (*raised if compressed schedule*)

DEMO

Conclusions

- Rosetta Stone defined for mapping SEER-SEM cost factors to thirteen COCOMO II Effort Multipliers (EM) factors
- Presented SEER-SEM estimate to COCOMO II estimate tool
  - *Compute composite COCOMO II EM via Rosetta Stone transformation*
  - *Produce COCOMO II estimate using composite EM*
  - *Revise effort estimate if project has compressed schedule*
    - New technique for computing Required Schedule EM (SCHD)
- Effort adjustment required before comparison to SEER-SEM
  - *Scope of COCOMO II effort estimated differs from SEER-SEM*

TEXAS TECH UNIVERSITY