CORADMO and COSSEMO Driver Value Determination Worksheet

1. COCOMO Stage Schedule and Effort MODEL (COSSEMO)

COSSEMO is based on the lifecycle anchoring concepts discussed by Boehm[3]. The anchor points are defined as Life Cycle Objectives (LCO), Life Cycle Architecture (LCA), and Initial Operational Capability (IOC). An enhanced version of an illustration from Rational Corporation[4] showing the stages around the anchor points is shown below.

[1] **Co**nstructive **RAD** schedule and effort **Mo**del

[2] **CO**COMO-II **S**taged **S**chedule and **E**ffort **Mo**del

[3] Barry W. Boehm, "Anchoring the Software Process," *IEEE Software*, 13, 4, July 1996, pp. 73-82

[4] Rational Corp., "Rational Objectory Process 4.1 – Your UML Process", available at http://www.rational.com/support/techpapers/toratobjprcs/.

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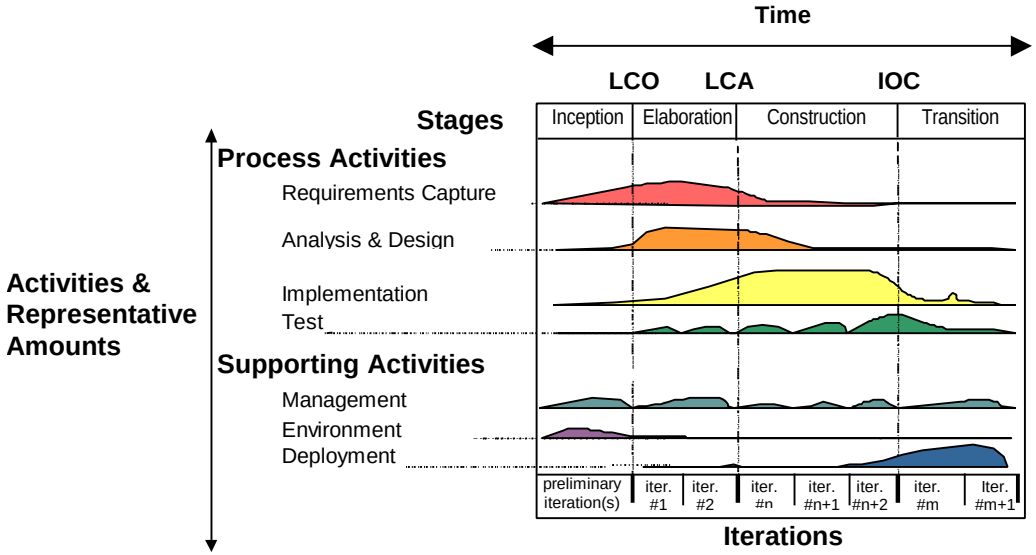

The correspondence between COSSEMO's & CORADMO's "Stages"[5], COCOMOII's submodels and the life cycle anchor points is shown in the following table along with an indication of the relative amounts of the different activities.

COCOMO II Submodel Usage	**Early Design**		**Post-Architecture**	**Maintenance**
	LCO		**LCA**	**IOC**
Activities \ Stage	**Inception**	**Elaboration**	**Construction**	**Transition**
Requirements Capture	Some usually	Most, peaks here	Minor	None

[5] COSSEMO & CORADMO use the word "stage" so it is not confused with the classic waterfall phases: Requirements, Analysis, Design, Code, Test and Maintenance.

Analysis & Design	A little	Majority, mostly constant effort	Some	Some, for repair during ODT&E
Implementation	Practically none	Some, usually for risk reduction	Bulk; mostly constant effort	Some, for repair during ODT&E
Test	None	Some, for prototypes	Most for unit, integration and qualification test.	Some, for repaired code.

COCOMOII's effort and schedule estimates are focused on Elaboration and Construction (the stages between LCO and IOC. Inception corresponds to the COCOMO's "Requirements" activity in a waterfall process model. COCOMO's effort for the "Requirements" activity is an additional, fixed percentage of the effort calculated by COCOMO for the development activities. The table also indicates the areas in which the COCOMO II Early Design and Post-Architecture submodels are normally used.

Allocations

1.A.1. Percentage Effort per Stage. Allocate the effort (person months) used in each of the stages as a percentage of the total effort during Elaboration and Construction. The sum of the percentages of Elaboration and Construction should be 100%. The effort during Inception (as a percentage of total Elaboration and Construction) is added to get the Total IE&C which should be greater than 100%.

	LCO	**LCA**	**IOC**		
Stage	**Inception**	**Elaboration**	**Construction**	**Total E & C**	**Total I E & C**
%Effort				**100%**	

1.A.2. Percentage Schedule per Stage. Allocate the schedule (calendar months) for each of the stages as a percentage of the total schedule during Elaboration and Construction. The sum of Elaboration and Construction should be 100%. The schedule during Inception (as a percentage of total Elaboration and Construction) is added to get the Total IE&C which should be greater than 100%.

	LCO	**LCA**	**IOC**

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Stage	Inception	Elaboration	Construction	Total E & C	Total I E & C
%Schedule				**100%**	

1.A.3. Person-Power per Stage. Indicate the average number of people actually working during this period of each of the stages. If the loading was not approximately constant during the period except for typical, limited ramp-ups, please indicate the degree of variation by providing the Persons-Max and Persons-Min, and the number of months with that number of people (max and min, respectively). NOTE: summing persons across stages is illogical and incorrect.

	LCO		**LCA**		**IOC**			
Stage	**Inception**		**Elaboration**		**Construction**		**Total E & C**	**Total I E & C**
Persons, Average							**X**	**X**
	Heads	Months	Heads	Months	Heads	Months	**X**	**X**
Persons, Maximum							**X**	**X**
Persons, Minimum							**X**	**X**

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2. COCOMO RAD MODEL (CORADMO)

The intent of the COCOMO II RAD model is to calculate/predict the schedule (months, M), personnel (P), and adjusted effort (person-months, PM) based on the distribution of effort and schedule to the various stages, and impacts of the selected schedule driver ratings on the M, P, and PM of each stage.

2.A.1. Reuse and VHLL's (RVHL) The degree to which re-use of other than code and/or very high level languages are utilized. This driver reflects schedule compression in Inception and Elaboration stages due to faster prototyping or option exploration. The rating for this driver depends on the amount of Rapid Prototyping Experience the development team has had in the domain of the project being evaluated. Since the rating applies to the team, it must include the experience of the managers and team leaders and their experience takes precedence over the average of the rest of the team working in the Inception and Elaboration phases.

RVHL		Very Low	Low	Nominal	High	Very High
Don't Know	**N/A - Not Applicable**	none	On average, personnel have experience on less than one recent project using Rapid Prototyping	most personnel have worked on more than one project using Rapid Prototyping	on average, personnel have worked on more than two projects using Rapid Prototyping	all personnel have worked on at least three projects using Rapid Prototyping

N/A
rationale:_____
_____

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2.A.2. Development Process Reengineering and Streamlining (DPRS) The degree to which the project and organization allow and encourage streamlined or re-engineered development processes: the current level of bureaucracy is a clear indicator. The schedule compression or expansion, because of this driver, doesn't alter staff level (P). The following table can be used to make a subjective average to determine the level of bureaucracy.

Level of Bureaucracy Indicators	**Very Low**	**Low**	**Nominal**	**High**	**Very High**
Number of approvals required per task	Excessive	Occasionally Reduced	Mature	Actively Reduced	Actively Minimized
Time taken per approval	Excessive	Occasionally Reduced	Mature	Actively Reduced	Actively Minimized
Reduced task dependencies, critical path tasks	None	Little	Mature Tech. Adopted	Advanced Tech. Adopted	Pioneering
Follow-up to expedite task completion	None	Little	Encouraged	Emphasized	Strongly Emphasized
Process measurement & streamlining	None	Little	Mature Tech. Adopted	Advanced Tech. Adopted	Pioneering
Level of Bureaucracy	Heavily Bureaucratic	Bureaucratic	Basic good business practices	Partly streamlined	Fully streamlined

DPRS		**Very Low**	**Low**	**Nominal**	**High**	**Very High**
Don't Know	**N/A - Not Applicable**	Heavily Bureaucratic	Bureaucratic	Basic good business practices	Partly streamlined	Fully streamlined

N/A rationale:_____
_____

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2.A.3. Collaboration Efficiency (CLAB) Teams and team members who can collaborate effectively can reduce both effort and schedule; those that don't collaborate effectively have increased schedule and effort (due to wasted time). With this multiplier, staff level does not change based on collaboration efficiency.

Collaboration efficiency is clearly impacted by TEAM and SITE ratings. Collaboration efficiency is impacted by TOOL, but only for tools that support or enable collaboration. However, the tool technology impact is lessened in the case of a co-located team with high experience ratings (PREX, the combination of application, platform, language and tool experience taken from the early design ratings).

2.A.3.1. Team Cohesion (TEAM). The Team Cohesion cost driver accounts for the sources of project turbulence and extra effort due to difficulties in synchronizing the project's stakeholders: users, customers, developers, maintainers, interfacers, others. See the Model Definition Manual for more details.

Team		**Very Low**	**Low**	**Nominal**	**High**	**Very High**	**Extra High**
Don't Know	**N/A - Not Applicable**	Very difficult interactions	some difficult interactions	basically cooperative interactions	largely cooperative	highly cooperative	seamless interactions

N/A
rationale:_____
_____

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2.A.3.2. Multisite Development (SITE). Given the increasing frequency of multisite developments, and indications that multisite development effects are significant, the SITE cost driver has been added in COCOMO II. Determining its cost driver rating involves the assessment and averaging of two factors: site collocation (from fully collocated to international distribution) and communication support (from surface mail and some phone access to full interactive multimedia). See the COCOMO-II User's Manual. We recommend a 70% and 30% weightings for Collocation and Communications, respectively, when making your subjective average of these two components of SITE.

	Very Low	**Low**	**Nominal**	**High**	**Very High**	**Extra High**
SITE: Collocation	Inter-national	Multi-city and Multi-company	Multi-city or Multi-company	Same city or metro area	Same building or complex	Fully collocated
SITE: Communications	Some phone, mail	Individual phone, FAX	Narrowband email	Wideband electronic communication	Wideband elect. comm., occasional video conf.	Interactive multimedia

Don't Know	**N/A**	**Very Low**	**Low**	**Nominal**	**High**	**Very High**	**Extra High**

N/A rationale:_____

_____

2.A.3.3. Applications Experience (AEXP). This rating is dependent on the level of applications experience of the project team developing the software system or subsystem. The ratings are defined in terms of the project team's equivalent level of experience with this type of application. See the COCOMO-II User's Manual.

AEXP		**Very Low**	**Low**	**Nominal**	**High**	**Very High**
Don't Know	**N/A - Not Applicable**	≤ 2 months	6 months	1 year	3 years	≥6 years

N/A rationale:_____

_____

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2.A.3.4. Platform Experience (PEXP). The Post-Architecture model broadens the productivity influence of PEXP, recognizing the importance of understanding the use of more powerful platforms, including more graphic user interface, database, networking, and distributed middleware capabilities. See the COCOMO-II User's Manual.

PEXP		Very Low	Low	Nominal	High	Very High
Don't Know	**N/A - Not Applicable**	≤ 2 months	6 months	1 year	3 years	≥6 years

N/A
rationale:_____
_____

2.A.3.5. Language and Tool Experience (LTEX). This is a measure of the level of programming language and software tool experience of the project team developing the software system or subsystem. See the COCOMO-II User's Manual.

LTEX		Very Low	Low	Nominal	High	Very High
Don't Know	**N/A - Not Applicable**	≤ 2 months	6 months	1 year	3 years	≥6 years

N/A
rationale:_____
_____

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2.A.3.6. Personnel Experience (PREX) This Early Design cost driver combines the three Post-Architecture cost drivers application experience (AEXP), platform experience (PEXP), and language and tool experience (LTEX). While these three Post-Architecture ratings normally apply to a module, for CoRADMo they are applied across the entire project. Their individual rating information is given above.

The approach for mapping the Post-Architecture cost drivers and rating scales onto their Early Design model counterparts involves the use and combination of numerical equivalents of the rating levels. Specifically, a Very Low Post-Architecture cost driver rating corresponds to a numerical rating of 1, Low is 2, Nominal is 3, High is 4, Very High is 5, and Extra High is 6. For the combined Early Design cost drivers, the numerical values of the contributing Post-Architecture cost drivers are summed, and the resulting totals are allocated to an expanded Early Design model rating scale going from Extra Low to Extra High. The Early Design model rating scales always have a Nominal total equal to the sum of the Nominal ratings of its contributing Post-Architecture elements.

The table below assigns PREX ratings across this range, and associates appropriate effort multipliers and rating scales to each of the rating levels.

PREX	Extra Low	Very Low	Low	Nominal	High	Very High	Extra High
Sum of AEXP, PEXP, and LTEX ratings	3, 4	5, 6	7, 8	9	10, 11	12, 13	14, 15
Applications, Platform, Language and Tool Experience	≤ 3 mo.	5 months	9 months	1 year	2 years	4 years	≥ 6 years

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Don't Know	N/A - Not Applicable							

To determine the CLAB rating, take the subjective/fuzzy average of TEAM and SITE ratings from COCOMO II's post-architecture definitions and the PREX ratings using COCOMO II's Early Design definitions.

	Very Low	Low	Nominal	High	Very High	Extra High
SITE	<== COCOMO II Post-Arch. Ratings ==>				High plus negotiation/tradeoff tools basic | advanced	
TEAM	←= ←= ←= COCOMO II Scale Factor Ratings =→ =→ =→					
PREX	(EL & VL) <=== <=== <=== COCOMO II Early Design Ratings ===> ===> ===>					
Fuzzy Average						

CLAB		Very Low	Low	Nominal	High	Very High	Extra High
Don't Know	**N/A - Not Applicable**	← Pick most appropriate rating level based on fuzzy average →					

N/A rationale:_____

_____

2.A.4. Architecture & Risk Resolution (RESL) This rating is exactly the same as the COCOMO II RESL rating. The architecture portion enables parallel construction, thus reducing schedule during the construction phase assuming that staff level

increases during construction while applying the same effort. Good risk resolution in a schedule driven development effort applying RAD strategies increases the probability of the strategies success.

RESL		Very Low	Low	Nominal	High	Very High	Extra High
Don't Know	N/A - Not Applicable	<== Use COCOMO II's RESL Rating Level ==>					

N/A
rationale:_____
_____

2.A.5. Prepositioning Assets (PPOS) This driver assesses the degree to which assets are pre-tailored to a project and furnished to the project for use on demand. This clearly has impacts from people skills and team building. The assets that are being pre-positioned include processes and tools, and architecture and componentry.

In order to take advantage of PPOS, the organization must either be taking a product-line approach or have made a 3, 6 or 10% pre-Inception effort investment!

PPOS		Nominal	High	Very High	Extra High
Don't Know	N/A - Not Applicable	Basic project legacy, no tailoring	Some prepositioning and tailoring	Key items prepositioned and tailored	All items prepositioned & tailored

N/A
rationale:_____
_____