

# COCOMO II Scale Factor Delphi Form

The purpose of this Delphi is to gather expert opinion on the effects of COCOMO II's scale factors on estimated effort when applied to IFPUG Function Points (FP) based on the ISO/IEC 20926 and COSMIC Function Points (CFP) based on the ISO/IEC 14143 standard. Scale drivers (parameters) in COCOMO II have a scaling or exponential influence on estimating effort, i.e., they have a small influence when the estimated software size is small and a more pronounced influence when the size is large. The detailed definitions of the scale drivers are provided at the end of this form.

This Delphi is for a small and a large nominal software project. You are asked to estimate **how many labor hours would be required** on these two projects if the ratings for a scale driver are Very Low (requiring more labor hours) or Extra High (requiring less labor hours). The number of hours for a Nominal large project are provided as a reference point.

## Small Project

The small project example is sized at 170 Function Points (approximately 9,010 Java lines of code). Using lines of code as the size, COCOMO II estimates 5,013 hours for almost 11.2 months for this development.

## Large Project

The large project example is sized at 1,000 Function Points (approximately 53,000 Java lines of code). Using lines of code as the size, COCOMO II estimates 35,187 hours for almost 20.6 months for this development.

## Reference Point Based on Lines of Code

As a reference, COCOMO II estimates the following number of labor hours using the **large** project 1,000 Function Point size and 53,000 lines of code as the size input:

Scale Driver	Very Low (VL) # Hours	Nominal (N) # Hours	Extra High (XH) # Hours
Precedentedness	38,827	35,187	30,355
Development Flexibility	38,140	35,187	31,186
Architecture & Risk Resolution	39,371	35,187	29,735
Team Cohesion	38,383	35,187	30,878
Process Maturity	39,827	35,187	29,220

## Form Instructions

Fill in your estimate of the **number of labor hours** required for a Small and Large Project based on either FP or CFP sizing. If you know both function point sizing methods, please fill in your estimate for both.

Please email your completed form to Anandi Hira: [anandihi@usc.edu](mailto:anandihi@usc.edu)

## Participant Information (Name and email for internal use only, will not be shared.)

Name: \_\_\_\_\_ Email: \_\_\_\_\_

Years of experience in:

Software Development/Engineering: \_\_\_\_\_ Software Estimating: \_\_\_\_\_

*For the following 2 questions, use this range:*

- 1: Little or none
- 2: Some
- 3: A moderate amount
- 4: An extensive amount
- 5: An extensive amount, plus experience teaching COCOMO/FSM

Expertise with using:

COCOMO® II model: \_\_\_\_\_ IFPUG FPs/COSMIC FPs: \_\_\_\_\_

### Small Project Delphi – 170 Function Points

Scale Driver	Very Low (VL) # Hours	Nominal (N) # Hours	Extra High (XH) # Hours
<b>Precedentedness</b> Very Low (VL): Thoroughly unprecedented Nominal (N): Somewhat unprecedented Extra High (XH): Thoroughly familiar	FP:	5,013	FP:
	CFP:		CFP:
<b>Development Flexibility</b> Very Low (VL): Rigorous Nominal (N): Some Relaxation Extra High (XH): General Goals	FP:	5,013	FP:
	CFP:		CFP:
<b>Architecture &amp; Risk Resolution</b> Very Low (VL): Little (20%) Nominal (N): Often (60%) Extra High (XH): Fully (100%)	FP:	5,013	FP:
	CFP:		CFP:
<b>Team Cohesion</b> Very Low (VL): Very Difficult Interaction Nominal (N): Basically Cooperative Interactions Extra High (XH): Seamless Interactions	FP:	5,013	FP:
	CFP:		CFP:
<b>Process Maturity</b> Very Low (VL): SW-CMM/CMMI Level 1 Lower Nominal (N): SW-CMM/CMMI Level 2 Extra High (XH): SW-CMM/CMMI Level 5	FP:	5,013	FP:
	CFP:		CFP:

## Large Project Delphi – 1,000 Function Points

Scale Driver	Very Low (VL) # Hours	Nominal (N) # Hours	Extra High (XH) # Hours
<b>Precedentedness</b> Very Low (VL): Thoroughly unprecedented Nominal (N): Somewhat unprecedented Extra High (XH): Thoroughly familiar	FP:	35,187	FP:
	CFP:		CFP:
<b>Development Flexibility</b> Very Low (VL): Rigorous Nominal (N): Some Relaxation Extra High (XH): General Goals	FP:	35,187	FP:
	CFP:		CFP:
<b>Architecture &amp; Risk Resolution</b> Very Low (VL): Little (20%) Nominal (N): Often (60%) Extra High (XH): Fully (100%)	FP:	35,187	FP:
	CFP:		CFP:
<b>Team Cohesion</b> Very Low (VL): Very Difficult Interaction Nominal (N): Basically Cooperative Interactions Extra High (XH): Seamless Interactions	FP:	35,187	FP:
	CFP:		CFP:
<b>Process Maturity</b> Very Low (VL): SW-CMM/CMMI Level 1 Lower Nominal (N): SW-CMM/CMMI Level 2 Extra High (XH): SW-CMM/CMMI Level 5	FP:	35,187	FP:
	CFP:		CFP:

## Scale Driver Detailed Definitions

### Precedentedness (PREC)

If a product is similar to several previously developed projects, then the precededentedness is high.

Characteristic	Very Low	Nominal / High	Extra High
Organizational understanding of product objectives	General	Considerable	Thorough
Experience in working with related software systems	Moderate	Considerable	Extensive
Concurrent development of associated new hardware and operational procedures	Extensive	Moderate	Some
Need for innovative data processing architectures, algorithms	Considerable	Some	Minimal

### Development Flexibility (FLEX)

The PREC and FLEX scale factors are largely intrinsic to a project and uncontrollable. The next three factors identify management controllables by which projects can reduce diseconomies of scale by reducing sources of project turbulence, entropy, and rework.

Characteristic	Very Low	Nominal / High	Extra High
Need for software conformance with pre-established requirements	Full	Considerable	Basic
Need for software conformance with external interface specifications	Full	Considerable	Basic
Combination of inflexibilities above with premium on early completion	High	Medium	Low

### Architecture / Risk Resolution (RESL)

This factor combines two of the scale drivers in Ada COCOMO, “Design Thoroughness by Product Design Review (PDR)” and “Risk Elimination by PDR” [Boehm and Royce 1989; Figures 4 and 5]. The below table consolidates the Ada COCOMO ratings to form a more comprehensive definition for the COCOMO II RESL rating levels. It also relates the rating level to the MBASE/RUP Life Cycle Architecture (LCA) milestone as well as to the waterfall PDR milestone. The RESL rating is the subjective weighted average of the listed characteristics.

Characteristic	Very Low	Low	Nominal	High	Very High	Extra High
Risk Management Plan identifies all critical risk items, establishes milestones for resolving them by PDR or LCA.	None	Little	Some	Generally	Mostly	Fully
Schedule, budget, and internal milestones through PDR or LCA compatible with Risk Management Plan.	None	Little	Some	Generally	Mostly	Fully

<b>Characteristic</b>	<b>Very Low</b>	<b>Low</b>	<b>Nominal</b>	<b>High</b>	<b>Very High</b>	<b>Extra High</b>
Percent of development schedule devoted to establishing architecture, given general product objectives.	5	10	17	25	33	40
Percent of required top software architects available to project.	20	40	60	80	100	120
Tool support available for resolving risk items, developing and verifying architectural specs.	None	Little	Some	Good	Strong	Full
Level of uncertainty in key architecture drivers: mission, user interface, COTS, hardware, technology, performance.	Extreme	Significant	Considerable	Some	Little	Very Little
Number and criticality of risk items.	> 10 Critical	5-10 Critical	2-4 Critical	1 Critical	> 5 Non-Critical	< 5 Non-Critical

## Team Cohesion (TEAM)

The Team Cohesion scale driver accounts for the sources of project turbulence and entropy due to difficulties in synchronizing the project's stakeholders: users, customers, developers, maintainers, interfacers, others. These difficulties may arise from differences in stakeholder objectives and cultures; difficulties in reconciling objectives; and stakeholders' lack of experience and familiarity in operating as a team. The below table provides a detailed definition for the overall TEAM rating levels. The final rating is the subjective weighted average of the listed characteristics.

<b>Characteristic</b>	<b>Very Low</b>	<b>Low</b>	<b>Nominal</b>	<b>High</b>	<b>Very High</b>	<b>Extra High</b>
Consistency of stakeholder objectives and cultures	Little	Some	Basic	Considerable	Strong	Full
Ability, willingness of stakeholders to accommodate other stakeholders' objectives	Little	Some	Basic	Considerable	Strong	Full
Experience of stakeholders in operating as a team	None	Little	Little	Basic	Considerable	Extensive
Stakeholder teambuilding to achieve shared vision and commitments	None	Little	Little	Basic	Considerable	Extensive

## Process Maturity (PMAT)

### Overall Maturity Levels

The procedure for determining PMAT is organized around the Software Engineering Institute's Capability Maturity Model (CMM). The time period for rating Process Maturity is the time the project starts. There are two ways of rating Process Maturity. The first captures the result of an organized evaluation based on the CMM.

<b>PMAT Rating</b>	<b>Maturity Level</b>	<b>EPML</b>
Very Low	- CMM Level 1 (lower half)	0
Low	- CMM Level 1 (upper half)	1
Nominal	- CMM Level 2	2
High	- CMM Level 3	3
Very High	- CMM Level 4	4
Extra High	- CMM Level 5	5

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