



Measurement and the CMMI^(SM): an Impact Analysis



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Overview

- What is the CMMI?
- Australian DoD Appraisal Background
- Impact of Measurement on the CMMI
- Aggregated Appraisal Results
- Lessons Learnt
- Summary

What is the CMMI?

- The Capability Maturity Model Integrated (CMMI) is a model of world's best practice covering:
 - Process Management
 - Project Management
 - Systems Engineering
 - Software Engineering, and
 - Support Functions including QA, CM, Measurement & Analysis, and Decision Making

CMMI - Process Areas

Category	Process Areas
Process Management	Organizational Process Focus (SE/SW) Organizational Process Definition (SE/SW) Organizational Training (SE/SW) Organizational Process Performance (SE/SW) Organizational Innovation and Deployment (SE/SW)
Project Management	Project Planning (SE/SW) Project Monitoring and Control (SE/SW) Supplier Agreement Management (SE/SW) Integrated Project Management (SE/SW/IPPD*) Risk Management (SE/SW) Integrated Teaming (SE/SW/IPPD) Integrated Supplier Management (SE/SW/IPPD/SS) Quantitative Process Management (SE/SW)
Engineering	Requirements Management (SE/SW) Requirements Development (SE/SW) Technical Solution (SE/SW) Product Integration (SE/SW) Verification (SE/SW) Validation (SE/SW)
Support	Configuration Management (SE/SW) Process and Product Quality Assurance (SE/SW) Measurement and Analysis (SE/SW) Decision Analysis and Resolution (SE/SW) Organizational Environment for Integration (SE/SW/IPPD) Causal Analysis and Resolution (SE/SW)
Safety*	Safety Management (+SAFE) Safety Engineering (+SAFE)

CMMI - DMO Model Choice

- CMMI was selected for the following reasons:
 - Defence acquires total system capabilities - not just software
 - Able to perform concurrent or separate appraisals
 - Can tailor to focus on specific process areas
 - Can produce a capability profile as well as an organisational maturity level
- CMMI sources:
 - EIA/IS 731, SW-CMM, IPD-CMM, SA-CMM
 - PDT (Industry, Academia, Government)

CMMI Trials - Objectives

- Evaluate the model
- Understand the appraisal methodology & resources required.
- Encourage (SE/SW) PI in Australian Defence industry.
- Establish appraisal expertise.
- Map CMMI to ISO/IEC 15504 - correspondence & translation.

CMMI Trials - Status

- 15 appraisals completed to date (6 SCAMPI A^(SM), 9 SCAMPI B^(SM))
- As a result of Trials Program, DSWE has a team of highly experienced appraisers
- CMMI to ISO 15504 mapping completed
- Development of safety process extension (+SAFE)
- Generated interest from Defence, Defence industry, non-Defence industry and other Australian government departments

Appraisal Outputs

- Observations for each practice - 300 to 500 + (dependent on scope of appraisal)
- Findings (global and per Process Area) - strengths and improvement opportunities
- Ratings against goals
- Capability Profile
- Non-CMMI findings

Example Capability Profile

Goal/P	Process Management			Project Management					Engineering					Support						
CL3/GG3	[Red]																			
GG3-GP2	[Red]																			
GG3-GP1	[Red]																			
CL2/GG2	[Red]																			
GG2-GP10	[Green]	[Red]	[Red]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Red]	[Red]	[Red]	[Red]	
GG2-GP9	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	
GG2-GP8	[Yellow]	[Red]	[Red]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Red]	[Red]	[Red]	[Red]	
GG2-GP7	[Green]	[Yellow]	[Yellow]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	
GG2-GP6	[Yellow]	[Red]	[Red]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Red]	[Red]	[Red]	[Red]	
GG2-GP5	[Green]	[Green]	[Green]	[Yellow]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Red]	[Red]	[Red]	[Red]	
GG2-GP4	[Green]	[Red]	[Red]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Red]	[Red]	[Red]	[Red]	
GG2-GP3	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	
GG2-GP2	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	[Red]	
GG2-GP1	[Green]	[Yellow]	[Yellow]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Red]	[Red]	[Red]	[Red]	
CL1/GG1	[Green]																			
GG1-GP2	[Green]	[Red]	[Yellow]	[Red]	[Yellow]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Red]	[Red]	[Red]	[Red]		
GG1-GP1	[Green]	[Red]	[Red]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Red]	[Red]	[Red]	[Red]		
SG4	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]		
SG3	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]		
SG2	[Green]	[Red]	[Red]	[Green]	[Yellow]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Red]	[Red]	[Red]	[Red]		
SG1	[Green]	[Red]	[Red]	[Red]	[Yellow]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Green]	[Red]	[Red]	[Red]	[Red]		
PA=>	OT	OPF	OPD	IPM	PPlan	PMC	SAM	RiskM	RqMgt	RD	PI	Ver	Val	TS	PPQA	DAR	M&A	CM		
	PA - Process Area					NA - Not Applicable					[Green]	Satisfied								
	CL - Capability Level											[Yellow]	Partially Satisfied							
	GG - Generic Goal					NR - Not Rated					[Red]	Not Satisfied								
	GP - Generic Practice																			
	SG - Specific Goal (achieved through Specific Practices in the PA)																			

Impact Analysis of Measurement

- Measurement and Analysis mapped onto the rest of the CMMI in one of three categories:
 - Explicit dependency
 - Enabler (including implicit dependency)
 - No explicit dependency
- Method Used:
 - Review of CMMI (Normative and Informative sections of the model)
 - Appraisal experience

Measurement Mapping

Generic Goals / Practices																										
GG 5																									GG 5	
GP 5.2																										GP 5.2
GP 5.1																										GP 5.1
GG 4																										GG 4
GP 4.2																										GP 4.2
GP 4.1																										GP 4.1
GG 3																										GG 3
GP 3.2																										GP 3.2
GP 3.1																										GP 3.1
GG 2																										GG 2
GP 2.10																										GP 2.10
GP 2.9																										GP 2.9
GP 2.8																										GP 2.8
GP 2.7																										GP 2.7
GP 2.6																										GP 2.6
GP 2.5																										GP 2.5
GP 2.4																										GP 2.4
GP 2.3																										GP 2.3
GP 2.2																										GP 2.2
GP 2.1																										GP 2.1
GG 1																										GG 1
GP 1.1																										GP 1.1

Specific Goals / Practices																										
SG 4																										SG 4
SP 4.3.4																										SP 4.3.4
SP 4.2.4																										SP 4.2.4
SP 4.1.4																										SP 4.1.4
SG 3																										SG 3
SP 3.5.2																										SP 3.5.2
SP 3.5.1																										SP 3.5.1
SP 3.4.3																										SP 3.4.3
SP 3.4.1																										SP 3.4.1
SP 3.3.4																										SP 3.3.4
SP 3.2.2																										SP 3.2.2
SP 3.2.1																										SP 3.2.1
SP 3.1.1																										SP 3.1.1
SG 2																										SG 2
SP 2.7.1																										SP 2.7.1
SP 2.6.1																										SP 2.6.1
SP 2.5.1																										SP 2.5.1
SP 2.4.3																										SP 2.4.3
SP 2.4.1																										SP 2.4.1
SP 2.3.3																										SP 2.3.3
SP 2.3.2																										SP 2.3.2
SP 2.3.1																										SP 2.3.1
SP 2.2.3																										SP 2.2.3
SP 2.2.1																										SP 2.2.1
SP 2.1.4																										SP 2.1.4
SG 1																										SG 1
SP 1.7.1																										SP 1.7.1
SP 1.6.1																										SP 1.6.1
SP 1.5.1																										SP 1.5.1
SP 1.4.2																										SP 1.4.2
SP 1.4.1																										SP 1.4.1
SP 1.3.3																										SP 1.3.3
SP 1.3.1																										SP 1.3.1
SP 1.2.2																										SP 1.2.2
SP 1.2.1																										SP 1.2.1
SP 1.1.2																										SP 1.1.2
SP 1.1.1																										SP 1.1.1

Organisational Environment	Goals/Practices	Measurement and Analysis Dependency
SE/SW	Generic Goal	Explicit Dependency
SE/SW/PPD	Generic Practice	Enabler
SE/SW/PPD/SS	Specific Goal	No Explicit Dependency
Common Process Area	Specific Practice	Not Applicable

Impact of Measurement on the CMMI

Measurement Mapping	Explicit Dependency	Enabler	No Explicit Dependency	Totals	Percentages *
Process Areas	6	-	19	25	24%
Generic Goals	0	125	0	125	100%
Generic Practices	25	200	200	425	53%
Specific Goals	3	43	9	55	84%
Specific Practices	26	89	74	189	61%

* Percentages calculated as: $(\text{Explicit Dependency} + \text{Enabler}) / \text{Totals}$

Explicit Dependency Example

- Goal:
 - Verification Specific Goal 2: Perform Peer Review
- Description:
 - Peer reviews are performed on selected work products
- Practice implementation indicators:
 - Peer review records
 - Data from peer reviews
 - Results from analysis conducted on peer review data

Implicit Dependency Example







- Goal:
 - Project Planning Specific Goal 1: Establish Estimates
- Description:
 - Estimates of project planning parameters are established and maintained
- Practice implementation indicators:
 - Use of estimation parameters
 - Estimation rationale
 - Use of historical data

Enabler Example

- Goal:
 - Decision Analysis and Resolution Specific Goal 1: Evaluate Alternatives
- Description:
 - Decisions are based on an evaluation of alternatives using established criteria
- Practice implementation indicators:
 - Trigger points for formal decision making process (based on thresholds)
 - Trade studies (eg make, buy or reuse)

Aggregated Appraisal Results*

	Process Management			Project Management					Engineering					Support					
	OT	OPF	OPD	IPM	PP	PMC	SAM	RISK	RM	RD	TS	PI	VER	VAL	PPQA	CM	DAR	M&A	
GG3	0%	0%	0%	0%	0%	10%	13%	0%	0%	0%	0%	0%	0%	10%	0%	0%	0%	GG3	
GG2	0%	0%	0%	0%	23%	46%	29%	17%	38%	50%	33%	50%	36%	36%	36%	43%	0%	GG2	
GG1	60%	11%	22%	0%	33%	57%	89%	43%	43%	64%	67%	71%	50%	46%	36%	57%	0%	GG1	
SG3					79%				50%		64%	100%	79%	85%		64%		SG3	
SG2	50%	22%		89%	29%	64%	90%	71%		85%	92%	86%	50%	54%	71%	64%		29%	SG2
SG1	50%	33%	22%	0%	50%	64%	100%	29%	43%	64%	58%	86%	93%	57%	50%	71%	8%	0%	SG1

Goals		Measurement and Analysis Dependency	
	Generic Goal		Explicit Dependency
	Specific Goal		Enabler
			No Explicit Dependency
			Not Applicable

* Results from 15 Appraisals Conducted over the period May 2001 - February 2002

Summary from Aggregated Results

Specific Goals	Explicit Dependency	Enabler	No Explicit Dependency	Totals	Percentages
Majority Satisfied ¹	0	19	4	23	58%
Majority Not Satisfied ²	3	12	2	17	42%
Totals	3	31	6	40	100%

Generic Goals	Goal 1	Goal 2	Goal 3	Totals	Percentages
Majority Satisfied ¹	7	0	0	7	13%
Majority Not Satisfied ²	11	18	18	47	87%
Totals	18	18	18	54	100%

- 1: Majority of organisations appraised (ie 51% or greater) achieved Goal Satisfaction**
2: Majority of organisations appraised (ie 51% or greater) did not achieve Goal Satisfaction

Some Lessons Learnt from the CMMI Based Appraisal Program

- Measurement is currently being done poorly and/or incompletely
- Capability appraisals catalyse adoption of reform initiatives such as measurement
- Pre-conceived notion that you should only worry about measurement for Maturity Level 2 and above
- Resistance to transition from SW-CMM to CMMI significantly reduced after organisations realise the impact measurement has on the model

Summary

- Measurement although not explicitly required for a large part of the model is still an effective enabler for many practices
- Measurement is key to an effective process improvement program
- Measurement is an enabler for all Process Areas at Capability Levels 1 - 5
- Measurement dependency illustrates the highly integrated nature of the CMMI

Questions?



(SM): CMMI, SCAMPI A and SCAMPI B are service marks of Carnegie Mellon University