

I Say Tomato... *You Say Eggplant*

Comparing process references for Systems Engineers and Project Managers in a CMMI®-compliant organization.

CMMI 9th Technology Conference and User Group

November 18, 2009

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Agenda

- Problem Statement
- Source documents
 - CMMI for Development, Ver. 1.2
 - PMBOK® Guide
 - INCOSE SE Handbook
- Discussion by CMMI® Process Area
- Conclusion & recommendations

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Problem Statement

- High-performing organizations place an emphasis on training and certification of practitioners to industry-recognized standards
- Two common training and certification standards
 - Project Managers - Project Management Institute's *Guide to the Project Management Body of Knowledge* (PMBOK® Guide)
 - Results in certification as a *Project Management Professional (PMP)*
 - Systems Engineers - International Council on Systems Engineering's (INCOSE) *Systems Engineering Handbook*
 - Results in certification as a *Certified Systems Engineering Professional (CSEP)*
- Organizations are likely to have PMs certified to the PMBOK® and SEs certified to the SE Handbook
- While these resources each recognize the existence of the other function they were developed independently as stand alone resources for their target audiences.
- Are these references consistent? Are they contradictory?
- How does the union of these references address CMMI® compliance?

PMBOK® Guide

- *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Fourth Edition, 2008
- ANSI/PMI 99-001-2008
- ISBN: 978-1-933890-51-7
- 2-dimensional view of knowledge areas intersecting with process groups



- 9 Knowledge Areas
 - Project Management Integration
 - Project Scope Mgmt
 - Project Time Mgmt
 - Project Cost Mgmt
 - Project Quality Mgmt
 - Project HR Mgmt
 - Project Communication Mgmt
 - Project Risk Mgmt
 - Project Procurement Mgmt
- 5 Process Groups
 - Initiating Process Group
 - Planning Process Group
 - Executing Process Group
 - Monitoring & Controlling Process Group
 - Closing Process Group

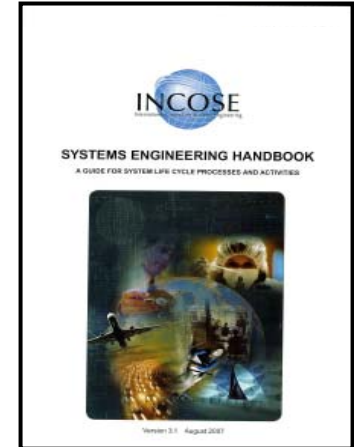
Knowledge Area	Project Management Process		
	Initiating Process Group	Planning Process Group	Executing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Execution
5. Project Scope Management		5.1 Collect Requirements 5.2 Define Scope 5.3 Create WBS	5.4 Verify Scope 5.5 Control Scope
6. Project Time Management		6.1 Define Activities 6.2 Sequence Activities 6.3 Estimate Activity Resources 6.4 Estimate Activity Durations 6.5 Develop Schedule	6.6 Control Schedule
7. Project Cost Management		7.1 Estimate Costs 7.2 Determine Budget	7.3 Control Costs
8. Project Quality Management		8.1 Plan Quality	8.2 Perform Quality Assurance 8.3 Perform Quality Control
9. Project Human Resource Management		9.1 Develop Human Resource Plan	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team
10. Project Communications Management	10.1 Identify Stakeholders	10.2 Plan Communications	10.3 Coordinate Information 10.4 Manage Stakeholder Expectations
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses	11.6 Monitor and Control Risks
12. Project Procurement Management		12.1 Plan Procurements	12.2 Conduct Procurements 12.3 Administer Procurements 12.4 Close Procurements

PMBOK® Guide

- Focus is on the *Project* and the role of the *Project Manager*
 - *A project is a temporary endeavor undertaken to create a unique product, service, or result.* (PMBok® guide, Sect 1.2)
 - Relationships between Projects, Program and Portfolios
- The enterprise's overall project management process capability is modeled separately in the *Organizational Project Management Maturity Model* (not addressed here)

INCOSE Handbook

- *Systems Engineering Handbook*
A Guide for System Life Cycle Processes and Activities
Version 3.1, August 2007
- INCOSE-TP-2003-002-03.1
 - 11 **Technical** Processes
 - Stakeholder requirements definition
 - Requirements Analysis
 - Architectural design
 - Implementation
 - Integration
 - Verification
 - Transition
 - Validation
 - Operation
 - Maintenance
 - Disposal
 - 7 **Project** Processes
 - Project Planning
 - Project Assessment
 - Project Control
 - Decision-Making
 - Risk & Opportunity Mgmt
 - Configuration Mgmt
 - Information Mgmt
 - 7 **Enterprise & Agreement** Processes
 - Enterprise Environment Management
 - Investment Management
 - System Life Cycle Process Management
 - Resource Management
 - Quality Management
 - Acquisition
 - Supply



INCOSE Handbook

- Focus is on the *System* and the role of the *Systems Engineer*
 - *A system is a combination of interacting elements organized to achieve one or more stated purposes.* (INCOSE Handbook, Sect 1.5)
- Addresses *Operation*, *Maintenance* and *Disposal* in addition to the processes employed to develop the system

CMMI® Process Management Processes

	CMMI® Process Area	PMBOK® Knowledge Area	INCOSE Handbook
Process Management	OPF - Organizational Process Focus	--	Enterprise Environment Management Process
	OPD - Organizational Process Definition	--	System Life Cycle Processes Management Process
	OPP - Organizational Process Performance	--	
	OID - Organizational Innovation & Deployment	--	--
	OT - Organizational Training	Human Resources Management	Resource Management Process

- PMI uses the *Organizational Project Management Maturity Model* to address organizational process areas
 - Not required for PMP certification
- INCOSE indirectly addresses OID with Enterprise Environment Management Process
 - Focus is on incremental improvement of System Life Cycle

CMMI[®] Process Management Processes

- PMBOK[®]
 - Due to its project focus, organizational functions such as organizational process development, process deployment, and training of the organization at large are not covered in the PMBoK
 - Improving the competencies of the assembled project team is addressed within the PMBoK within *9.3 Develop Project Team* of the Project Human Resource Management knowledge area
 - Organizational processes and human resource skills, disciplines & knowledge are grouped with other internal and external factors that surround and influence a project into *Enterprise Environmental Factors*
- INCOSE Handbook
 - Organizational process areas are addressed in the INCOSE Handbook
 - *Enterprise Environment Management* Process addresses policies and procedures at the enterprise level
 - *System Life Cycle Processes Management* Process establishes a set of life cycle processes for the enterprise
 - Training of the organization is discussed within the *Resource Management* Process, although not to the level of detail provided within the CMMI[®] Guidelines

CMMI® Project Management Processes

CMMI® Process Area		PMBOK® Knowledge Area	INCOSE Handbook
Project Management	PP - Project Planning	(All Areas - Planning Process Group)	Project Planning Process
	PMC - Project Monitoring & Control	(All Areas - Monitoring & Controlling PG)	Project Assessment Process
			Project Control Process
	SAM - Supplier Agreement Management	Project Procurement Management	Acquisition Process
	IPM - Integrated Project Management & IPPD	Project Integration Management	--
	RSKM - Risk Management	Project Risk Management	Risk & Opportunity Management Process
QPM - Quantitative Project Management	Project Scope Management	--	
	Project Time Management		
	Project Cost Management		

Project Planning Processes

- PMBOK®: “The project management plan (is) the primary source of information for how the project will be planned, executed, monitored and controlled, and closed.”
- INCOSE Handbook: “The Systems Engineering Plan (SEP)...defines how the project will be organized, structured, and conducted and how the total engineering process will be controlled to provide a product that satisfies customer requirements.”

CMMI® Project Management Processes

- PMBOK®
 - Emphasizes planning across the project and across all knowledge areas through the **Planning** Process Group rather than confining planning to a discrete process step at the beginning of the project
 - Similarly, most Knowledge Areas include processes to monitor and control the activities through the **Monitoring and Controlling** Process Group.
 - Quantitative techniques are included within **Project Cost, Time** and **Scope Management** Knowledge areas, although not discussed to the level of detail in the CMMI Guide
- INCOSE Handbook
 - Most CMMI Project Management Process areas have a parallel within the INCOSE Handbook, except for **Integrated Project Management**
 - TPMs are mentioned as a partner to cost and schedule status, but **Quantitative Management** is not otherwise discussed in detail

CMMI® Engineering Processes

	CMMI® Process Area	PMBOK® Knowledge Area	INCOSE Handbook
Engineering	REQM - Requirements Management	5. Project Scope Management	Requirements Management: Enabling Process Activity
	RD - Requirements Development	5.1 Collect (Product) Requirements	Stakeholder Requirements Definition
		5.2 Define (Product) Scope	Requirements Analysis Architectural Design Process
	TS - Technical Solution	--	Implementation Process
	PI - Product Integration	--	Integration Process
	VER - Verification	5.4 Verify (Product) Scope	Verification Process
	VAL - Validation	--	Validation Process

CMMI[®] Engineering Processes

- PMBOK[®]
 - The PMBoK treats **Requirements Development** and **Requirements Management** activities largely as management of the scope of the project
 - Similarly, **Verification** is focused on the customer's formal acceptance of the project deliverables. Requirements conformance is considered to be within **Quality Control**.
 - **Validation** is treated as a stakeholder management topic
- INCOSE Handbook
 - Largely parallel with the scope of the CMMI Guide
 - **Requirements Management** is an “**Enabling SE Process Activity**”
 - Supports Requirements Analysis Process
 - Managed throughout system life cycle

CMMI® Support Processes

	CMMI® Process Area	PMBOK® Knowledge Area	INCOSE Handbook
Support	CM - Configuration Management	4.5 Integrated Change Control	Configuration Management Process
	PPQA - Process & Product Quality Assurance	8. Project Quality Management	Quality Management Process
	MA - Measurement & Analysis	5. Project Scope Management	Project Assessment Process
		6. Project Time Management	
		7. Project Cost Management	Project Control Process
	DAR - Decision Analysis & Resolution	--	Decision-Making Process
CAR - Causal Analysis & Resolution	--	--	

CMMI® Support Processes

- PMBOK®
 - Lacks a strong discussion of decision making techniques and processes
 - Quantitative Analysis is discussed in the context of risk analysis
 - Causal Analysis techniques are presented within the Quality Control process
 - Fishbone Diagrams, Control Charts, etc.
 - Less emphasis on product configuration management; CM processes are discussed within the context of scope management and integrated change control
- INCOSE Handbook
 - Largely parallels CMMI processes
 - CMMI Measurement & Analysis is addressed via [Project Assessment](#) and [Project Control](#) processes
 - No treatment of [Root Cause](#) or [Causal Analysis](#) techniques

Other Processes

CMMI® Process Area		PMBOK® Knowledge Area	INCOSE Handbook
	--	10. Project Communications Management	Information Management Process
	--	4.6 Close Project	Transition Process
	--	4. Project Integration Management	Supply Process
	--	--	Investment Management Process
	--	--	Operation Process
	--	--	Maintenance Process
	--	--	Disposal Process
	--	--	

Other Processes, not explicitly covered in CMMI®

- Communications/Information Management
 - Storage, maintenance, security and accessibility of project-related data
 - Defined within [Information Management](#) Process in INCOSE Handbook
 - Implied within [Project Communications Management](#) Knowledge Area within PMBOK®
 - CMMI® - SP1.4 Monitor Data Management
 - Measurement and Analysis
 - Project Monitoring and Control
 - Requirements Management
- Transition
 - Transfer of custody from one organizational entity to another
 - [Transition](#) Process within INCOSE Handbook
 - [Scope Verification](#) and [Project Closeout](#) within the PMBOK®
 - CMMI® - SP2.5 Transition Products
 - Supplier Agreement Management
- Supply
 - The larger context in which the other processes are applied in a contract, in response to a request from an acquirer
 - CMMI® has acquisition perspective with supplier agreements

Processes Presented only in the INCOSE Handbook

- Investment Management Process
 - Initiation and sustainment of investment in projects meeting the objectives of the organization
- Operation Process
 - Use of the system to deliver its services
 - Training, tracking/managing system performance and malfunctions
- Maintenance Process
 - Sustainment of the system through its useful life
 - Provide operations support, logistics, material management
- Disposal Process
 - Permanent removal of a system element from its operational environment
 - Disposal of any hazardous or toxic materials in accordance with guidance, policy regulations and statutes

Summary

	CMMI® Process Area	PMBok Knowledge Area	INCOSE Handbook
Process Management	OPF - Organizational Process Focus	--	Enterprise Environment Management Process
	OPD - Organizational Process Definition	--	System Life Cycle Processes Management Process
	OPP - Organizational Process Performance	--	
	OID - Organizational Innovation & Deployment	--	--
	OT - Organizational Training	9. Human Resources Management	Resource Management Process
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	IPM - Integrated Project Management & IPPD	4. Project Integration Management	--
	RSKM - Risk Management	11. Project Risk Management	Risk & Opportunity Management Process
	QPM - Quantitative Project Management	5. Project Scope Management	--
6. Project Time Management			
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		5.2 Define (Product) Scope	Requirements Analysis
	TS - Technical Solution	--	Architectural Design Process
	PI - Product Integration	--	Implementation Process
	VER - Verification	5.4 Verify (Product) Scope	Integration Process
VAL - Validation	Part of 10.4 - Manage Stakeholder Expectations	Verification Process	
Support	CM - Configuration Management	4.5 Integrated Change Control	Validation Process
	PPQA - Process & Product Quality Assurance	8. Project Quality Management	Configuration Management Process
	MA - Measurement & Analysis	5. Project Scope Management	Quality Management Process
		6. Project Time Management	Project Assessment Process
		7. Project Cost Management	Project Control Process
	DAR - Decision Analysis & Resolution	--	Project Assessment Process
CAR - Causal Analysis & Resolution	--	Decision-Making Process	
	--	10. Project Communications Management	--
	--	4.6 Close Project	Information Management Process
	--	4. Project Integration Management	Transition Process
	--	--	Supply Process
	--	--	Investment Management Process
	--	--	Operation Process
	--	--	Maintenance Process
--	--	Disposal Process	

Conclusion

- PMBOK® has little emphasis on Organizational functions
 - Process development and deployment
 - Organizational training
- PMBOK® has little or no emphasis on Engineering processes
 - Technical Solution
 - Product Integration
 - Requirements Development and Management are considered synonymous with project scope control
- INCOSE Handbook has less emphasis on Project Management
 - Earned Value Techniques
 - Causal/Root Cause Analysis

Recommendations

- The PMBOK® and the INCOSE Handbook can be used as primary training and certification references for Project Managers and Systems Engineers, respectively
- Organizational process definition and training is required to tie the standards together into a cohesive process for the enterprise
- The organizational process framework should show
 - The relationship between Project Management and Systems Engineering
 - The work products of each part of the organization
- Necessary topics not fully covered in the Guides should be addressed through additional training topics:
 - Project Managers
 - Quantitative decision techniques
 - Decision documentation
 - Organizational process development and deployment
 - Systems Engineers
 - Project Time and Cost Management (including earned value)
 - Root cause analysis techniques