Product-Based Approach for CMMI® Appraisals

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Application Domain

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Government Communications Systems Division

· $1.1 B in Sales · 6,200 Employees · ISO 9001 · SEI CMM® Level 4

Aerospace & Ground Communication Systems

- Advanced Avionics
- Airborne Communications
- Satellite Antennas
- Satellite Electronics

- C^4I Systems
- Communications Systems (SATCOM and Terrestrial)
- Intelligence Systems
- Information Warfare and Network/Internet Security
- Commercial Systems and Products

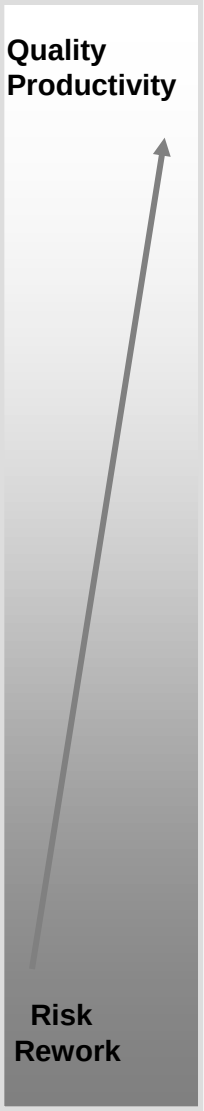
Integrated Information Communication Systems

- Computer-Controlled, Highly Distributed Communications and Control Systems to Support Air Traffic Management
- High-Reliability Satellite Communications Systems to Support Air Traffic Management
- GPS Applications for ATM—Automatic Dependent Surveillance

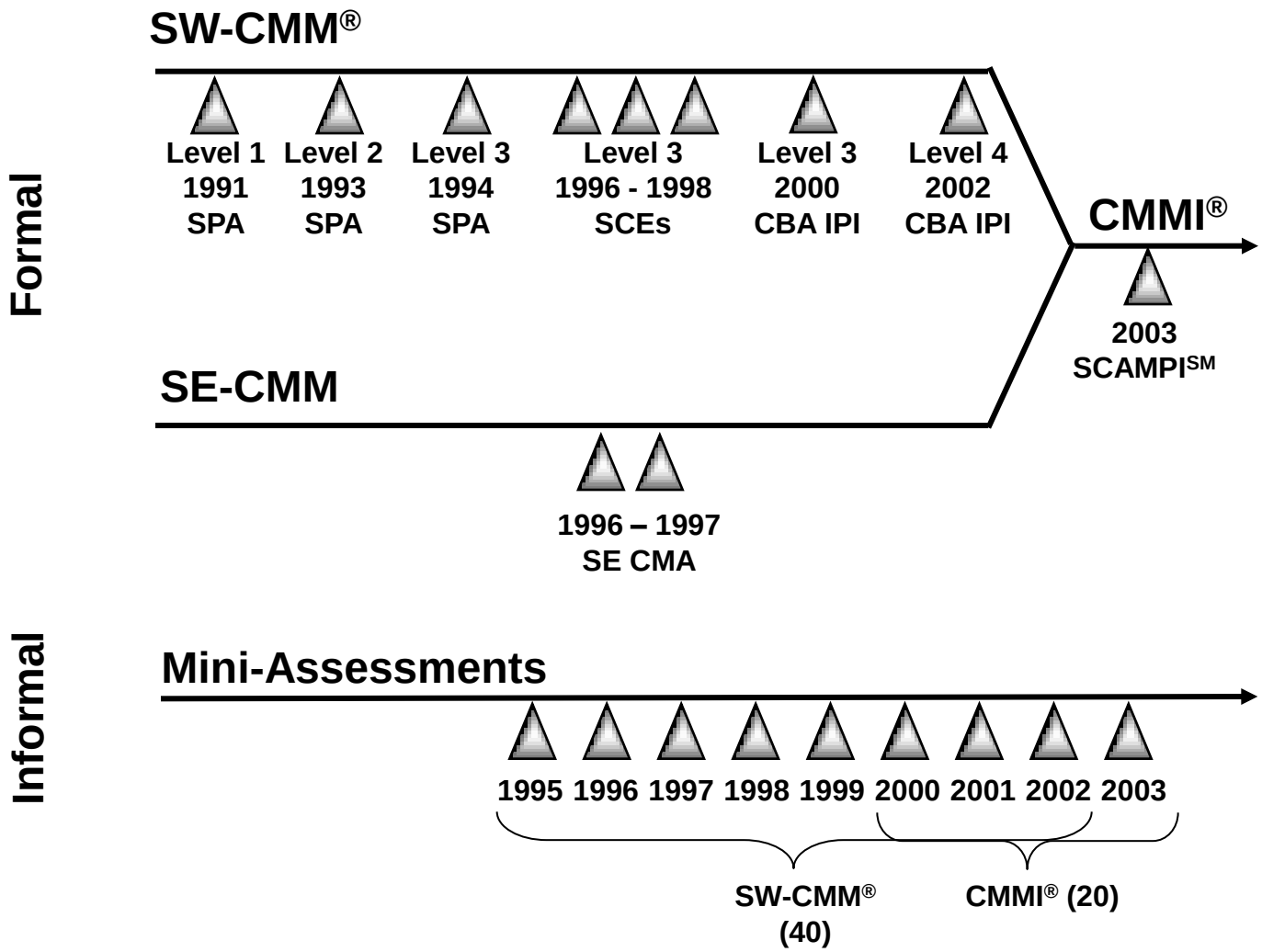
- Data Handling and Control Systems
- Image Processing
- Meteorological Processing Systems
- Range Systems
- Air Traffic Control Systems
- Transportation Communications Systems

CMMI®-SE/SW (Staged Representation)

Maturity Level	Focus	Process Areas
5 Optimizing	*Continuous Process Improvement*	Organizational Innovation and Deployment Causal Analysis and Resolution
4 Quantitatively Managed	*Quantitative Management*	Organizational Process Performance Quantitative Project Management
3 Defined	*Process Standardization*	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Risk Management Decision Analysis and Resolution
2 Managed	*Basic Project Management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Initial		

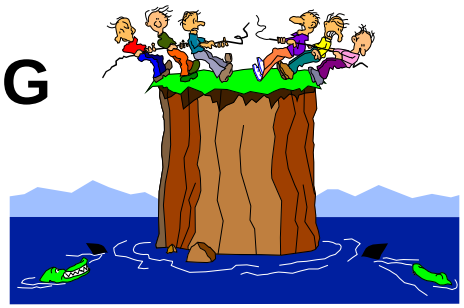


Appraisal History



Mini-Assessment Method

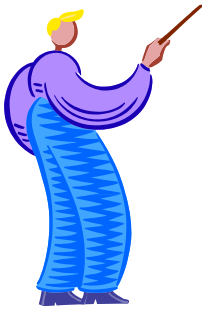
- **Project selection by Management**
- **Participant preparation led by EPG**
  - Program Management, Systems Engineering, Software Engineering and Quality Assurance
  - PA worksheets completed (scores and artifact notes)
  - Inputs consolidated
- **Delphi group meeting conducted by EPG**
  - Lowest score if consensus cannot be reached
  - No examination of data



- **Results presented to project by EPG**
  - CMMI®-SE/SW summary
  - PA strengths/weaknesses
- **Action Plan developed and tracked by project**
- **Organizational improvements facilitated by EPG**

Mini-Assessment Guidelines

- **Scoring matrix is applied to all the PA practices (specific & generic) to ensure the CMMI® goals are addressed**
- **Each PA practice is scored:**



  - 5 : Exemplary Best Practice (Outstanding)
  - 4 : Fully Implemented (Strong)
  - 3 : Largely Implemented (Marginal)
  - 2 : Partially Implemented (Weak)
  - 1 : Not Implemented (Poor)
- **Evidence is noted in the worksheet to include:**
  - Direct Artifacts: tangible resulting directly from implementation of a specific or generic practice
  - Indirect Artifacts: a consequence of performing a specific or generic practice or that substantiates its implementation

Mini-Assessment Evaluation Matrix

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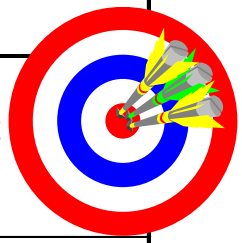
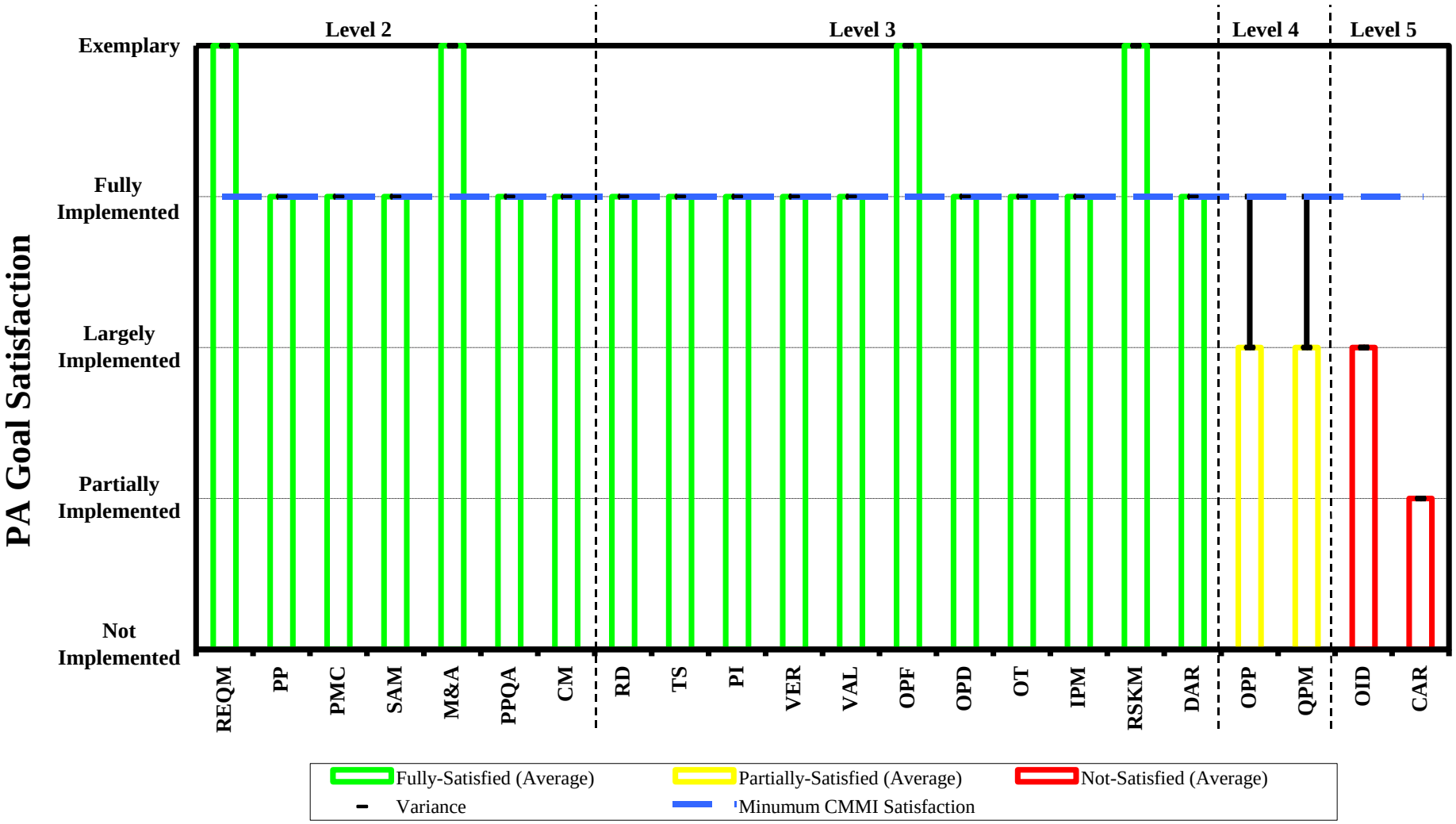


Score	Practice Characterization	Deployment
5 Outstanding	Exemplary Best Practice (FI+)	• Above expectations, organizational best practice • Zealous leadership and management commitment to ensure consistent deployment • World class results sought by others
4 Strong	Fully Implemented (FI)	• Process documented, consistently deployed, effective • Strong infrastructure and management commitment to reinforce process implementation • Appropriate evidence exists to verify implementation (direct and indirect artifacts)
3 Marginal	Largely Implemented (LI)	• Process documented, with mostly consistent deployment and positive results • Some support provided by infrastructure/management • Appropriate evidence exists to verify implementation • One or more weaknesses are noted
2 Weak	Partially Implemented (PI)	• Some process documentation may exist • Inconsistent deployment with spotty results • Some evidence exists to substantiate partial deployment • Significant weaknesses are noted
1 Poor	Not Implemented (NI)	• Documentation, deployment, and infrastructure are poor • Little support, commitment, or recognition of the need • Limited/no evidence to substantiate implementation

Mini-Assessment Results



Why Product-Based Approach?

- **How can intensive data collection for CMMI® appraisals be enacted efficiently?**
  - Direct/indirect artifacts required for each process instantiation
- **What level of CMMI® model expertise should we expect from project practitioners?**
  - Experts in model implementation and interpretation?
  - Experts in organizational process implementation, mapped to the CMMI® model?
- **How can the data collection effort be balanced among an internal appraisal team and project staff?**

The Problem - 1

- **Model coverage**
  - SCAMPI^{SM} Class A requires at least 1 direct + 1 indirect artifact/affirmation
  - Projects must furnish Practice Implementation Indicators (PIIs) for each CMMI® specific/generic practice within scope
  - Example: CMMI®-SE/SW Level 3 (staged representation) for 4 projects:
    - **15 project-level PAs: 297 practices * 2 artifacts * 4 projects = 2,376 artifacts**
    - **3 organizational PAs: 55 practices * 2 artifacts * 1 OU = 110 artifacts**
    - **Total: 2,486 artifacts (minimum)**

The Problem - 2

- **Organizational issues**
  - Organizational/project process architecture relative to CMMI®
  - Natural frame of reference is the organizational processes, not CMMI®
  - Detailed model expertise
  - Terminology
  - Cost and schedule to collect project evidence
  - Labor-intensive mapping

An Approach

- **Specify required data collection needs as project or data-centric**
  - Derived from standard organizational processes, terminology, and assets
  - Typical evidence pre-mapped to candidate associated CMMI® practices
- **Leverage and cross-correlate model built-in dependencies for improved appraisal data management**
  - Relationships (threads) among Goals, PAs and practices (GPs, SPs)
    - **PP, PMC, IPM**
    - **CM, GP2.5**
  - Single work products / indicators that satisfy multiple practices

Correlating Indicators (example)

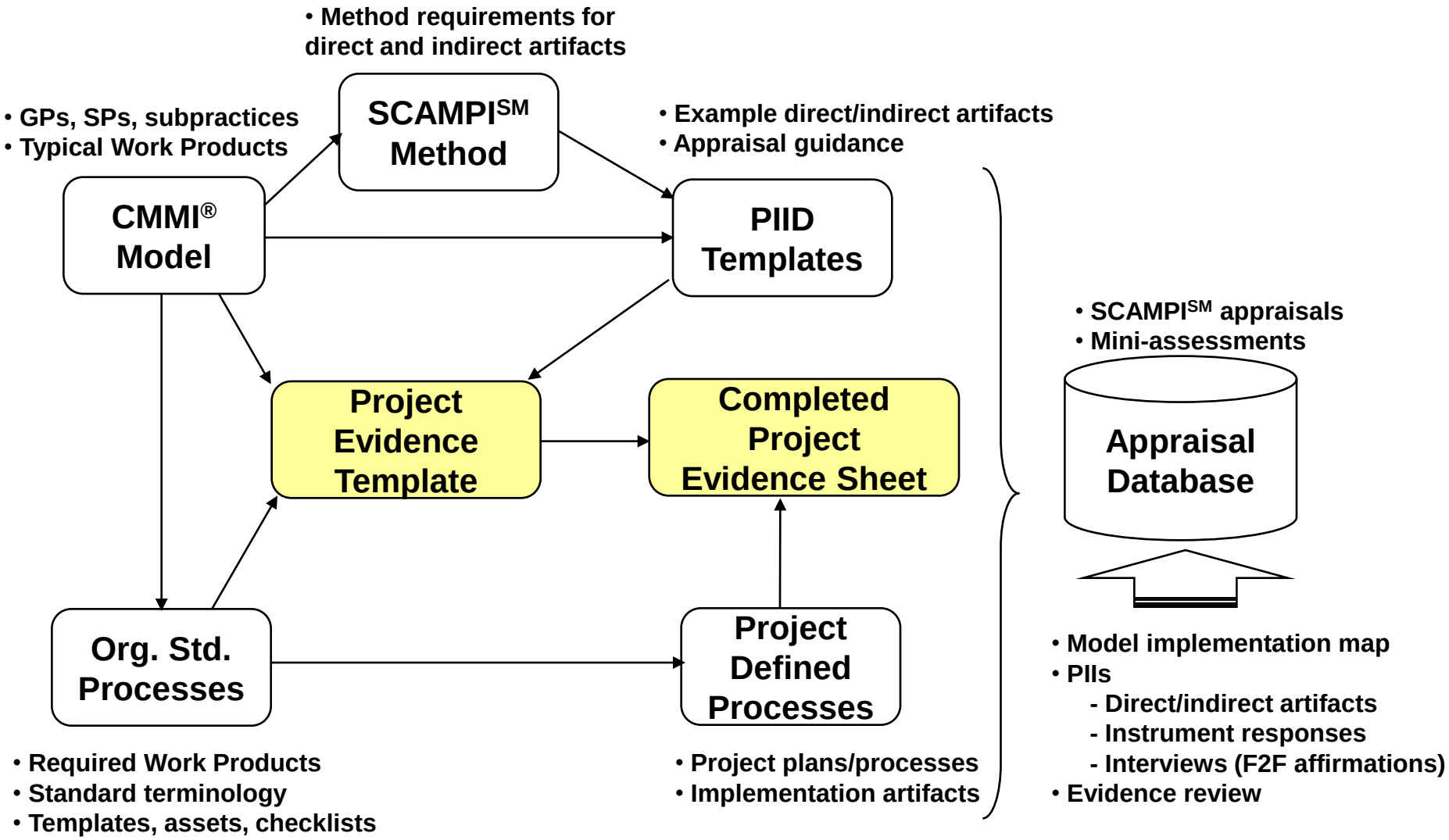
SP/GP	Summary	Project Plan	Commit-ments	…
PP.SP2.7	Establish the project plan	✓		
PP.SP3.3	Obtain plan commitment	✓	✓	
…				
PMC.SP1.1	Monitor project planning parameters	✓		
PMC.SP1.2	Monitor commitments		✓	
PMC.GP2.2*	Plan the process	✓		
…				
IPM.SP1.4	Integrate plans	✓		
IPM.SP1.4	Manage project using integrated plans	✓		
…				
DAR.GP2.2*	Plan the process	✓		
…				

Other potential PII threads spanning PAs:
- Interfaces
- Scenarios
- Stakeholders
- Training
- Metrics
- Reviews
- etc.

*GP2.2 elaborations for many PAs: "This plan for performing the … process is typically a part of the project plan, as described in the Project Planning process area."

Reference: CMMI Appraisal Approaches, G. Draper and D. Kitson, CMMI Technology Conference, November 2001, © Carnegie Mellon University.

Identifying Appraisal Artifacts



Project Evidence Sheet (example)

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Evidence Number	Evidence Description (SE + SW)	Examples / Notes for Clarification	Keyword	CMMI	Project Evidence Name
4	IMP/IMS	Integrated Master Plan / Integrated Master Schedule (or equivalent indicating integration of plans/schedules across disciplines)	Project Mgmt	PP.SP2.1; 2.6; 2.7; 3.1 IPM.SP1.3; 1.4; 2.1; 2.2	http://somehyperlink.html
5	Work Breakdown Structure (WBS)	Used to decompose work for estimating, and identify cost account responsibility.	Project Mgmt	PP.SP1.1; 2.4	\\device\pathname\file.doc
6	Project estimates / PWAs	Size, effort, cost, budget, staffing. BOEs, LOC estimates, rationale, SLIM models, etc. Project Work Authorizations (PWAs/H-1000s).	Project Mgmt	PP.SP1.2, 1.3, 1.4	
7	Proposal Cost Review (PCR) packages (aka Engineering Review)	Management review of engineering proposals and estimates	Project Mgmt	PP.SP3.3 PP.GP2.10	
8	Project organization chart	Roles, responsibilities, reporting relationships	Project Mgmt	PP.SP2.4, 2.6, 2.7 *.GP2.3, 2.4, 2.7	
9	Project schedules	Program master schedule, and lower level detailed schedules as appropriate	Project Mgmt	PP.SP2.1	
10	Planning records	Records or minutes of planning, rolling wave, or replanning cycles. Incremental planning or corrective action replans/adjustments.	Project Mgmt	PP.SP2.7; 3.2; 3.3 PM	
11	Project financial reports (PCS)	Monthly cost/schedule starus reports fr l, SPI, variance			

Typical project work products or assets commonly available as a result of implementing standard processes. Project products and terminology may vary.

Categories of evidence, for convenience in grouping related pieces of evidence.

Potential areas in CMMI® model that may be satisfied (all or in part) by the identified project evidence.

Path(s) or hyperlink(s) to example artifacts or repository where the evidence can be found.

Lessons Learned

- **Establish an implementation guide for how the CMMI® is implemented in organizational/project processes**
  - Internal users (projects, managers, EPG)
  - External users (customers, appraisal teams)
- **References to evidence must be very specific**
  - Concise list of implementation artifacts covering the practice
  - Paragraph numbers within a document
  - Hyperlinked files/directories
  - Facilitate efficient on-line access and review
- **Trade-off how much projects must understand CMMI® details**
  - Organization/project process knowledge vs. model knowledge
- **Facilitate or review the entry of project evidence**
  - Ensure artifacts are appropriate, relevant, complete

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