Applying CMMI® Generic Practices with Good Judgment

CMMI Technology Conference and User Group

17-20 November 2003

Rick Hefner, Ph.D.
Northrop Grumman

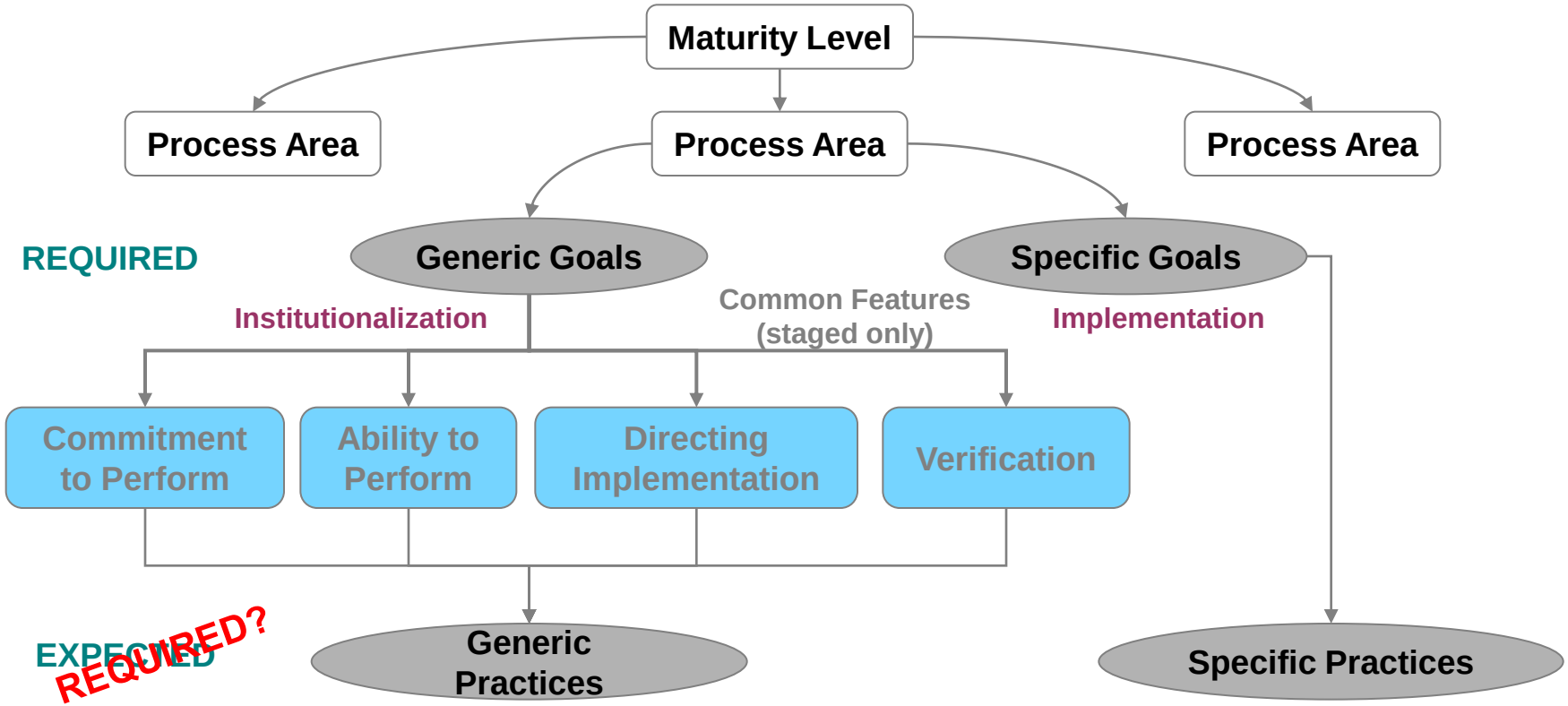
Geoff Draper
Harris Corporation

℠ CMM Integration, and SCAMPI are service marks of Carnegie Mellon University.
® Capability Maturity Model, CMM, and CMMI are registered in the U.S. Patent and Trademark Office by Carnegie Mellon University.

Agenda

- Understanding Generic Practices
  - Treating Generic Practices as Expected
- Challenges in Implementation
  - Process Architecture versus Model Architecture
- Challenges in Appraisal
  - Effort Required
  - Understanding PA / GP Relationships
  - Reaching Appraiser Consensus
- Generic Practice Breakdown
  - Implementation Guidance
  - Appraisal Guidance

CMMI Model Structure



- 2.1 Policies
- 2.2 Plans
- 2.3 Resources
- 2.4 Responsibilities
- 2.5 Training
- 2.6 Configuration mgmt
- 2.7 Stakeholders
- 2.8 Monitoring/control
- 2.9 Objective evaluation
- 2.10 Mgmt oversight

- 3.1 Defined Process
- 3.2 Collect Improvement Information

EXPECTED?

Informative material:
- Subpractices
- Notes
- References
- Typical work products
- Elaborations
- Amplifications

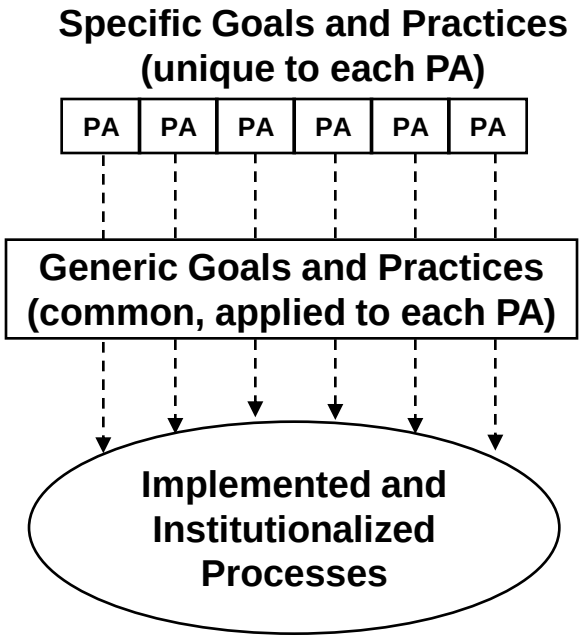
CMMI Generic Practices (GPs)

Institutionalization of each Process Area

NORTHROP GRUMMAN
HARRIS

GP1.1 Perform Base Practices
GP2.1 Establish an Organizational Policy
GP2.2 Plan the Process
GP2.3 Provide Resources
GP2.4 Assign Responsibility
GP2.5 Train People
GP2.6 Manage Configurations
GP2.7 Identify and Involve Relevant Stakeholders
GP2.8 Monitor and Control the Process
GP2.9 Objectively Evaluate Adherence
GP2.10 Review Status with Higher Level Management
GP3.1 Establish a Defined Process
GP3.2 Collect Improvement Information
GP4.1 Establish Quantitative Objectives for the Process
GP4.2 Stabilize Subprocess Performance
GP5.1 Ensure Continuous Process Improvement

Continuous representation only



What really needs to be institutionalized are the organizational processes – not the CMMI process areas

Agenda

- Understanding Generic Practices
  - Treating Generic Practices as Expected
- Challenges in Implementation
  - Process Architecture versus Model Architecture
- Challenges in Appraisal
  - Effort Required
  - Understanding PA / GP Relationships
  - Reaching Appraiser Consensus
- Generic Practice Breakdown
  - Implementation Guidance
  - Appraisal Guidance

Implementing the CMMI Model
Process Architecture - 1

NORTHROP GRUMMAN
HARRIS

REQM	REQM Policy	REQM Process
PP	PP Policy	PP Process
PMC	PMC Policy	PMC Process
SAM	SAM Policy	SAM Process
MA	MA Policy	MA Process
PPQA	PPQA Policy	PPQA Process
CM	CM Policy	CM Process
RD	RD Policy	RD Process
TS	TS Policy	TS Process
PI	PI Policy	PI Process
VER	VER Policy	VER Process
VAL	VAL Policy	VAL Process
OPF	OPF Policy	OPF Process
OPD	OPD Policy	OPD Process
OT	OT Policy	OT Process
IPM	IPM Policy	IPM Process
RSKM	RSKM Policy	RSKM Process
DAR	DAR Policy	DAR Process

Option #1: Brute Force

- Processes directly derived from CMMI model

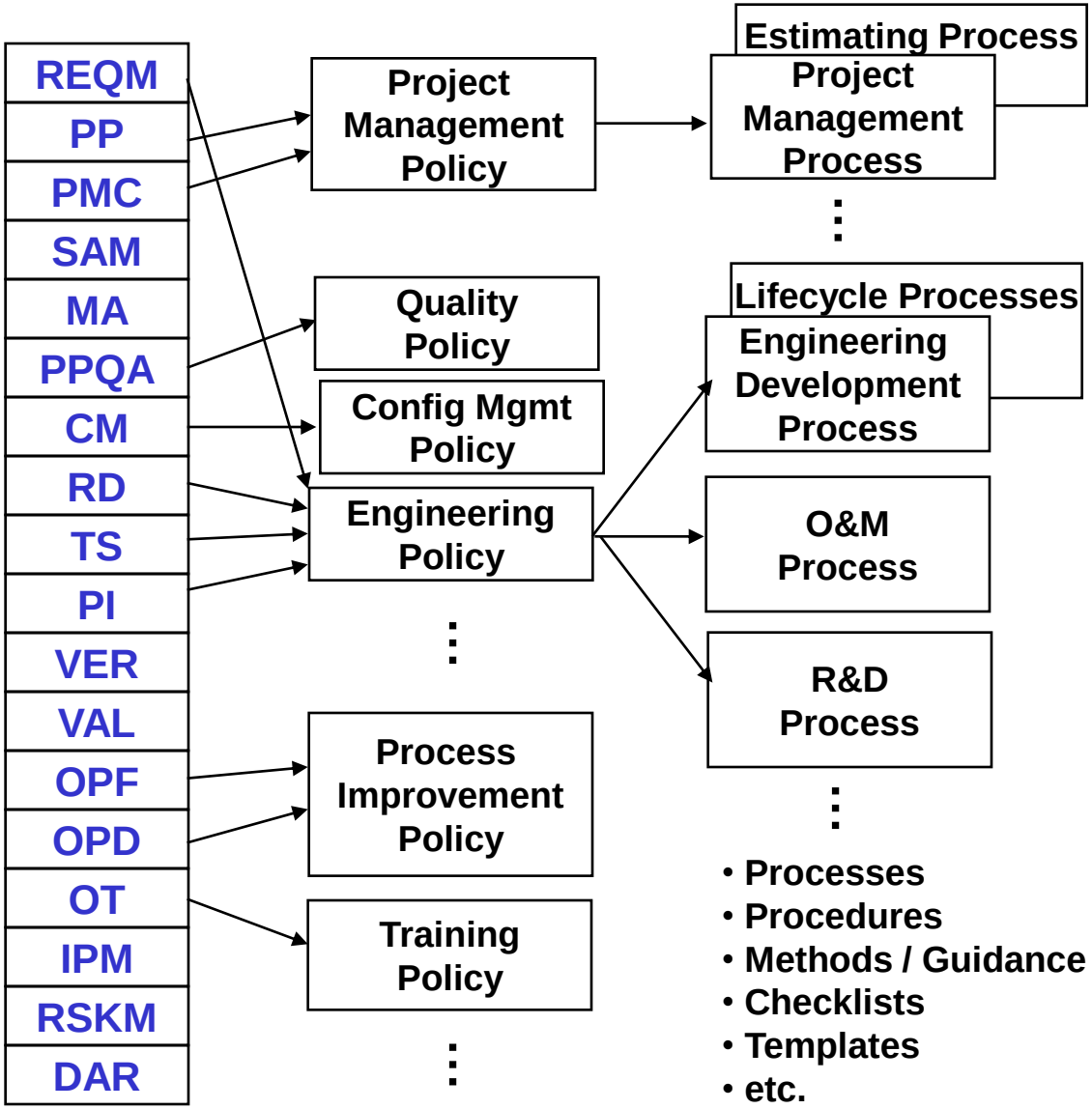
Advantages:

- "Idiot-proof" linkage for CMMI appraisals
- Supports explicit implementations of specific/generic practices (PIIs)

Disadvantages:

- Unlikely to fit the real business processes
- Lost opportunities for process efficiency

Implementing the CMMI Model
Process Architecture - 2



Option #2: Thought and Judgment

- Processes organized to fit the business and culture

Advantages:

- Model tailoring based on business value
- Emphasize key subprocesses
- Processes more intuitive to implement and institutionalize

Disadvantages:

- Indirect mapping and CMMI tailoring could complicate appraisal risk
- Reduced visibility of PA-based generic practices for objective evidence

Implementing the Generic Practices

NORTHROP GRUMMAN HARRIS

For the Project Mgmt, Engineering, and Support process areas, the generic practice may be implemented by:

- **Projects**
- **Organization**
- **Either**
- **Both**

(details in later charts)

For organizational implementations, how will you count "instantiations" in an appraisal?

Example Implementation

Generic Practice	Project	Organization
GP2.1 Policy	X ← BOTH →	X
GP2.2 Plan	X	
GP2.3 Resources	X	
GP2.4 Responsibility	X	
GP2.5 Training	X ← BOTH →	X
GP2.6 Manage Configurations	X	
GP2.7 Stakeholders	X	
GP2.8 Monitor & Control	X	
GP2.9 Objective Evaluation	X	
GP2.10 Management Review		X
GP3.1 Defined Process	X ← BOTH →	X
GP3.2 Improvement Info		X

Agenda

- Understanding Generic Practices
  - Treating Generic Practices as Expected
- Challenges in Implementation
  - Process Architecture versus Model Architecture
- Challenges in Appraisal
  - Effort Required
  - Understanding PA / GP Relationships
  - Reaching Appraiser Consensus
- Generic Practice Breakdown
  - Implementation Guidance
  - Appraisal Guidance

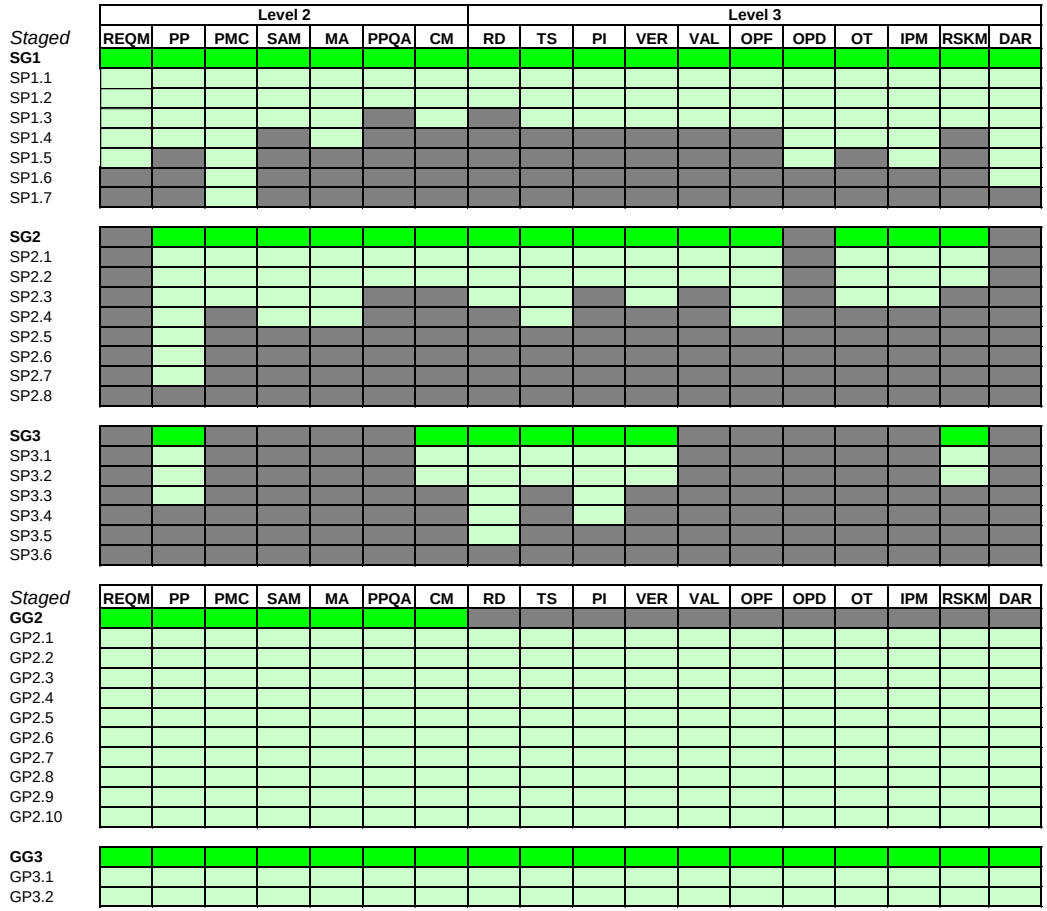
Quantifying Appraisal Effort

Evidence needed for GPs exceeds SPs by >50%

NORTHROP GRUMMAN
HARRIS

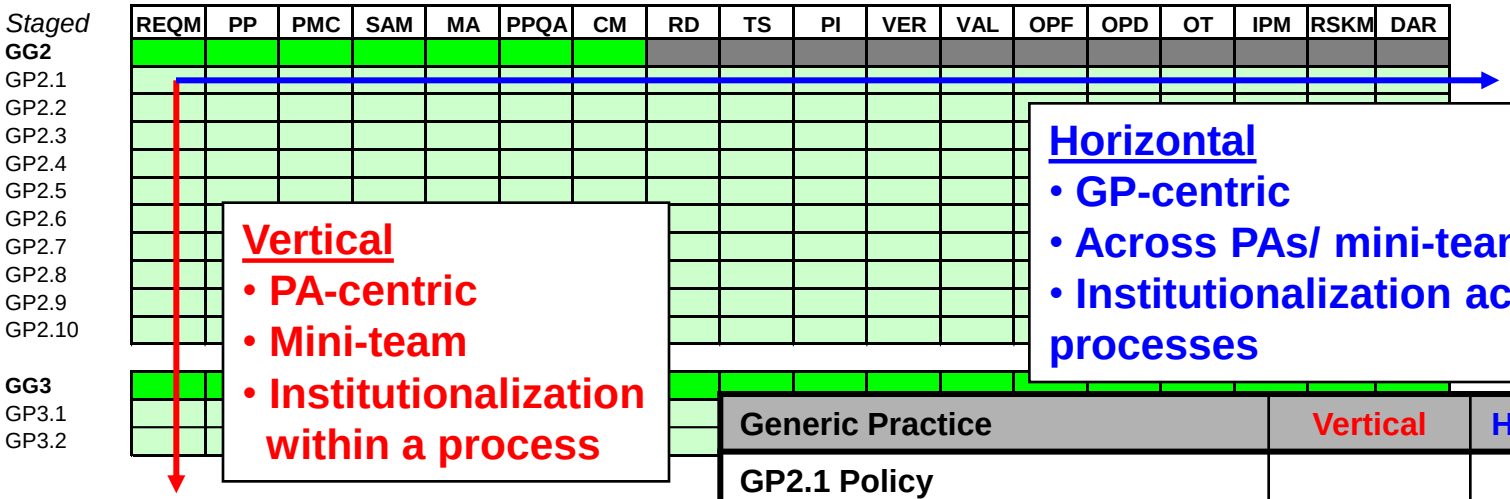
Example scope:
- CMMI-SE/SW (staged)
- ML3 model scope
- 4 projects

	Projects (4)	Org Unit (1)	Total
PAs	15	3 OPF,OPD,OT	18
SPs	117	19	136
GPs	180	36	216
PII Direct Artifacts	SP: 468 GP: 720	SP: 19 GP: 36	SP: 487 GP: 756
PII Indirect /Affirmation	SP: 468 GP: 720	SP: 19 GP: 36	SP: 487 GP: 756
Total PIIs (min.)	SP: 936 GP: 1,440 = 2,376	SP: 38 GP: 72 = 110	SP: 974 GP: 1,512 = 2,486



*SCAMPI requirements for Practice Implementation Indicators (PIIs):
-direct artifact for each specific and generic practice, for each instance (project or OU level)
-corroborated by an indirect artifact or affirmation

Generic Practice Appraisal Approaches



Horizontal
- GP-centric
- Across PAs/ mini-teams
- Institutionalization across processes

Vertical
- PA-centric
- Mini-team
- Institutionalization within a process

Hybrid
- Approach varies by GP
- Vertical (mini-team): GPs that tend to be uniquely implemented by PA
- Horizontal (across mini-teams): GPs more effectively considered together across multiple PAs

Generic Practice	Vertical	Horizontal
GP2.1 Policy		X
GP2.2 Plan	X	
GP2.3 Resources	X	
GP2.4 Responsibility	X	
GP2.5 Training		X
GP2.6 Manage Configurations	X	
GP2.7 Stakeholders	X	
GP2.8 Monitor & Control	X	
GP2.9 Objective Evaluation	X	
GP2.10 Management Review		X
GP3.1 Defined Process	X	
GP3.2 Improvement Info		X

Understanding PA / GP Relationships

NORTHROP GRUMMAN HARRIS

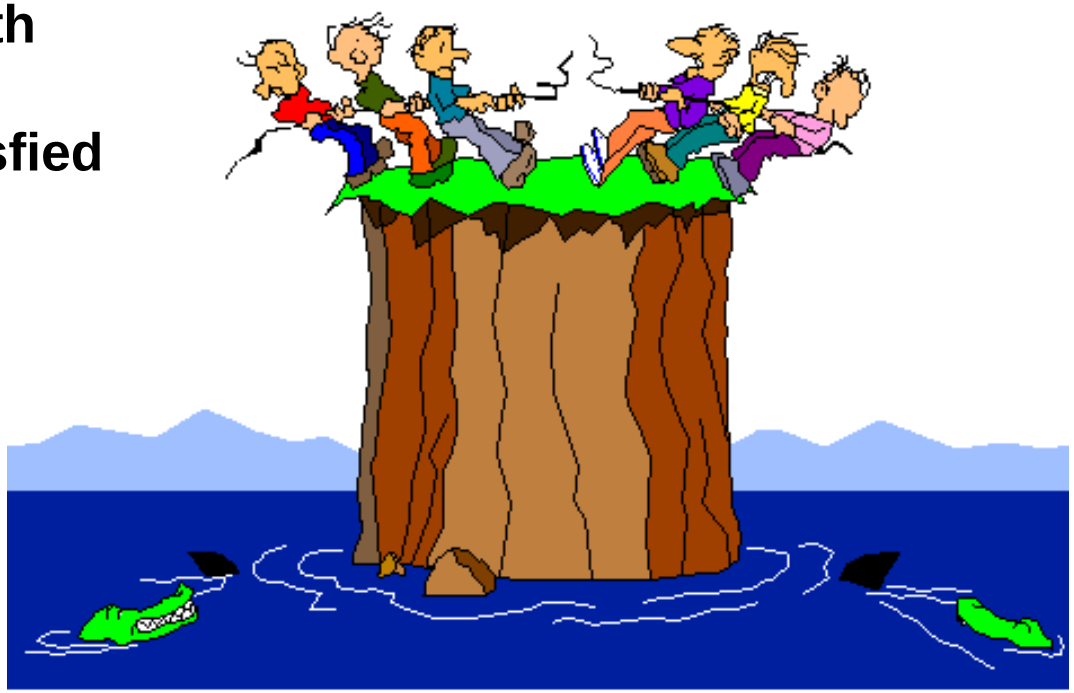
- **Linkages among PAs and GPs must be well understood for effective model implementation and appraisal**
  - **PAs that enable GPs**
    - E.g., CM capability ⇒ GP2.6
  - **"Pitch/catch" relationships**
    - E.g., IPM assets ⇒ GP3.2
  - **"Recursive" relationships**
    - E.g., PP GP 2.2: "plan for the plan"
    - Do project plans discuss how and when planning (and re-planning) is done?

Example PA/GP Relationship Issues

Generic Practice	Process Area
GP 2.1 Policy	Org. Process Definition
GP 2.2 Plan	Project Planning
GP 2.3 Resources	Project Planning
GP 2.4 Responsibility	Project Planning
GP 2.5 Training	Organizational Training
GP 2.6 Manage Configurations	Configuration Mgmt.
GP 2.7 Stakeholders	Integrated Project Mgmt.
GP 2.8 Monitor & Control	Project Monitoring & Control
GP 2.9 Objective Evaluation	Product & Process Quality Assurance
GP 2.10 Management Review	
GP 3.1 Defined Process	Integrated Project Mgmt.; Org, Process Definition
GP 3.2 Improvement Info	Integrated Project Mgmt.; Org, Process Definition

Reaching Appraiser Consensus

- Many parts of the CMMI can be interpreted in multiple ways
  - Generic practices are especially difficult
- Must reach consensus on how the organization and projects will implement the generic practices
  - E.g., split of responsibilities between organization and projects
- Must reach consensus with the appraisers on how the generic practices are satisfied
  - Must be done long in advance of the actual appraisal
  - Following charts suggest a starting point for the discussion



Agenda

- Understanding Generic Practices
  - Treating Generic Practices as Expected
- Challenges in Implementation
  - Process Architecture versus Model Architecture
- Challenges in Appraisal
  - Effort Required
  - Understanding PA / GP Relationships
  - Reaching Appraiser Consensus
- Generic Practice Breakdown
  - Implementation Guidance
  - Appraisal Guidance

GP 2.1 – Establish an Organizational Policy

NORTHROP GRUMMAN HARRIS

Establish and maintain an organizational policy for planning and performing the process.

Implementation Guidance

- **Policies provide clear senior management direction**
- **Must be implemented by the organization, but at any level or multiple levels of the organization**
  - **E.g., policies at both the Corporate and Division level**

Appraisal Guidance

- **"Establish and maintain" implies creation, maintenance, and usage (see CMMI Chapter 3)**
- **Appraisers must see evidence of the policy being used**
  - **E.g., audits, mapping policies to processes used**

GP 2.2 – Plan the Process

NORTHROP GRUMMAN HARRIS

Establish and maintain the plan for performing the process.

Implementation Guidance

- **Plan = description of activities + budget + schedule**
  - **Includes other generic practices (e.g., process descriptions, resources, responsibilities, CM)**
- **Must distinguish between plans (GP 2.2) and process descriptions (GP 3.1)**
  - **Much of the plan is replaced by the process description**

Appraisal Guidance

- **Schedules may be tied to program events as opposed to shown on a Gantt chart**
  - **E.g., DAR events**
  - **Plans should make clear the conditions under which a DAR is to be conducted**

GP 2.3 – Provide Resources

NORTHROP GRUMMAN HARRIS

Provide adequate resources for performing the process, developing the work products, and providing the services of the processes.

Implementation Guidance

- **Resources = budget + facilities + tools + skilled people**
- **All activities should be budgeted, but budget categories may be organized around the organization's process architecture, not CMMI process areas**

Appraisal Guidance

- **"Adequate" must be interpreted as sufficient to execute the plan and schedule**
  - **Not based on asking performers whether they have adequate resources (everybody wants more time to do their work)**

GP 2.4 – Assign Responsibility

NORTHROP GRUMMAN
HARRIS

Assign responsibility and authority for performing the process, developing the work products, and providing the services of the process.

Implementation Guidance

- **Responsibility assigned in various ways**
  - **E.g., project plans, process descriptions, job descriptions, work authorizations, stakeholder matrix, team charter**
- **May have multiple roles assigned for portions of a PA**
- **Must have authority to take appropriate action**

Appraisal Guidance

- **Job assignments may be to functions (e.g., systems engineering)**
  - **Can judge "reasonableness" of the approach by whether performers must understand who is responsible to perform each task**

GP 2.5 – Provide Training

NORTHROP GRUMMAN HARRIS

Train the people performing or supporting the process as needed.

Implementation Guidance

- **Training <u>proactively</u> ensures that individuals possess the minimum skills and knowledge to perform their job competently**
  - **The organization should address training for all process areas and job functions**
  - **Projects are responsible for project-specific training, if needed**

Appraisal Guidance

- **Must establish appraiser consensus on how this practice is interpreted**
  - **Also on how to judge partial satisfaction, e.g., if XX% of the people are trained**
- **Need to determine how "instantiations" will be counted**
  - **E.g., in a particular process area, there may be organizational and some project-specific training**

GP 2.6 – Manage Configurations

NORTHROP GRUMMAN HARRIS

Place designated work products of the process under appropriate levels of configuration management.

Implementation Guidance

- **Must identify which work products are to be controlled and how they will be controlled (level of formality)**
  - **It is NOT necessary to designate and control every work product; omission implies "not controlled"**

Appraisal Guidance

- **A list of what is being controlled (e.g., a DM master document list) is not sufficient**
  - **Must understand what is <u>planned</u> to be controlled**

GP 2.7 – Identify and Involve Relevant Stakeholders

NORTHROP GRUMMAN
HARRIS

Identify and involve relevant stakeholders of the process as planned.

Implementation Guidance

- **Relevant stakeholders must be <u>identified</u>, along with their planned <u>involvement</u>**
  - **Typically done as a stakeholder plan or matrix**
  - **Might also be used to document responsibilities (GP 2.4)**

Appraisal Guidance

- **Evidence of "involvement" could easily get overwhelming (e.g., attendance at meetings, review signoffs)**
  - **Must establish appraiser consensus on what constitutes a reasonable sampling**

GP 2.8 – Monitor and Control the Process

NORTHROP GRUMMAN HARRIS

Monitor and control the process against the plan for performing the process and take appropriate corrective action.

Implementation Guidance

- **Activities must be reviewed against plan, budget, and schedule**
  - **Typically performed in staff meetings, cost/schedule reviews, variance reports**
  - **Detailed review of the process performed against the process description is performed in the QA audits**

Appraisal Guidance

- **Must establish appraiser consensus**
  - **Frequency, formality of review**
  - **Budgets need not be tracked to individual process areas, but each process area must be covered in some budget**
- **Often difficult to find direct evidence that something is tracked**
  - **E.g., tracking of Project Management PAs**

GP 2.9 – Objectively Evaluate Adherence

NORTHROP GRUMMAN HARRIS

Objectively evaluate adherence of the process and the work products and services of the process to the applicable requirements, objectives, and standards, and address noncompliance

Implementation Guidance

- **Process audits determine whether the project performs each process, as documented in the plans or tailoring report**
  - **Not just audits against policy**
  - **Also against the appropriate procedure and work product standards, if they exists**
- **Must be objective, but not necessarily QA**

Appraisal Guidance

- **Must establish appraiser consensus on how to handle work products for which no standard exists, procedures used as "guidance"**

GP 2.10 – Review Status with Higher Level Management

NORTHROP GRUMMAN
HARRIS

Objectively evaluate adherence of the process and the work products and services of the process to the applicable requirements, objectives, and standards, and address noncompliance

Implementation Guidance

- **Must decide who is designated as the "senior management" reviewer**
  - **Must be above the project level**
  - **Concern should be long term heath of the organization; sometimes in conflict with short-term project goals**
- **Reviews are not necessarily face-to-face (e.g., status reports)**

Appraisal Guidance

- **Must establish appraiser consensus on:**
  - **Who acts as "senior management"**
  - **Depth of review**
- **Evidence must show review of each process area**
  - **Not every PA will be covered at every review**
  - **May review by business process, not by PA**

GP 3.1 – Establish a Defined Process

NORTHROP GRUMMAN
HARRIS

Establish and maintain the description of a defined process.

Implementation Guidance

- Includes organizational standard process + tailoring by project or organization (tailoring report)
- May establish a family of process descriptions
- The enterprise should also consider tailoring for their organizational processes (OPF, OPD, OT, OPP, OID)
  - Organizational processes may be implemented differently at multiple levels of the enterprise

Appraisal Guidance

- Standard process may be organized by business process, not by PA
- Must establish appraiser consensus on what constitutes tailoring

GP 3.2 – Collect Improvement Information

NORTHROP GRUMMAN HARRIS

Collect work products, measures, measurement results, and improvement information derived from planning and performing the process to support the future use and improvement of the organization's processes and process assets.

Implementation Guidance

- **Includes**
  - **Process Asset Library (work products)**
  - **Measurement repository (measures, results)**
  - **Improvement information database or feedback**
- **Connected to**
  - **IPM SP 1.5 Contribute to the Organizational Process Assets**
  - **OPD SP 1.4 (Measurement repository) and SP 1.5 (PAL)**

Appraisal Guidance

- **"Collect" implies an organizational responsibility (not "submit", which is a project responsibility)**
  - **Organization must collect in all PAs, bur projects are not expected to submit in all PAs**
  - **Not all items submitted must be made available to all projects**

Contact Information

Dr. Rick Hefner, Ph.D.
Northrop Grumman
Mission Systems
One Space Park - R2/2144
Redondo Beach, CA 90278
310.812.7290
rick.hefner@ngc.com

Geoff Draper
Harris Corporation
Government Communications Systems Division
P.O. Box 37
Melbourne, Florida 32902
321.727.5617
gdraper@harris.com