SCAMPI Upgrade Team: Scoping and Sampling in SCAMPI Version 1.3

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Outline Slide

Scoping to define the Organizational Unit

Sampling to establish the Organizational Scope

Sufficiency criteria for Artifacts and Affirmations

SCAMPI v1.3 Scoping – Change Package 1

Define the Organizational Unit (OU)

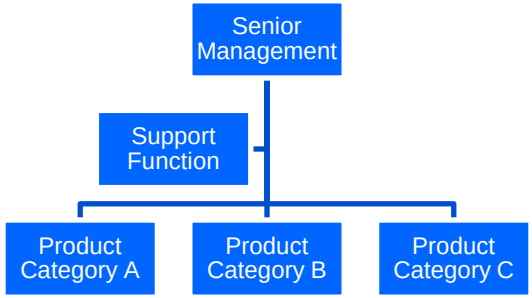
1. Identify how people are organized into basic units to do the work
2. Identify sampling factors that could affect process implementation.
3. Document the OU using the relevant sampling factors.

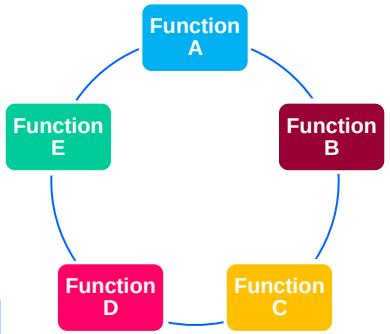
Defining the Organizational Unit – Step 1

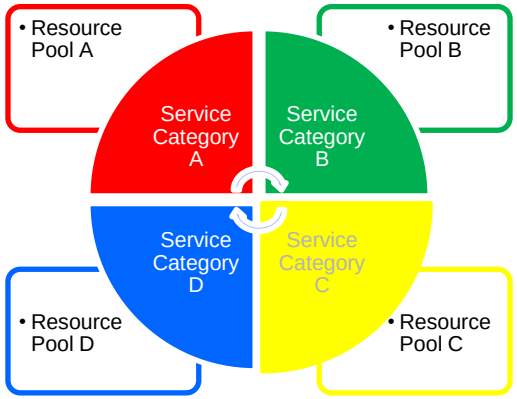
Identify how people are organized into basic units

The traditional CMMI-DEV presumption of 'project-centric structure' will not work for other constellations.

Many different types of organizations will be accommodated in v1.3



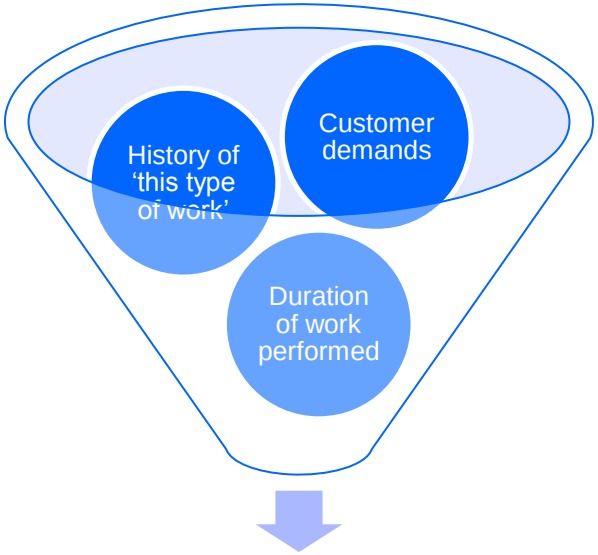




Defining the Organizational Unit – Step 2

Identify sampling factors that could affect process implementation

Differences in the way work is performed arise from the constraints of the context. A diverse organization must accommodate different sets of constraints that will lead to (purposeful) variations in the way practices are performed.



Defining the Organizational Unit – Step 3

Document the OU using the relevant sampling factors.

The range of different operating conditions under which the process is to be appraised is reflected in the documentation of the Organizational Unit.

Organizational Unit Specification

Work Type
- ☑ Traditional
- ☐ Next Generation

Customer
- ☑ Commercial
- ☑ Department of Defense

Geographic Location
- ☑ Los Angeles
- ☑ Dayton
- ☑ Other

Work Duration
- ☑ Short < 1 year
- ☑ Long > 1 year
- ☐ On-going

Work Unit Size
- ☑ Small < 15 Staff
- ☑ Large > 15 Staff

Required Practice: Identifying Sampling Factors

Standard Sampling Factors: The MDD provides a standard set of potential sampling factors to be considered. If a given factor does not apply in the organization (e.g., they don't have different product lines or locations) then this fact shall be recorded.

Other Sampling Factors: The Lead Appraiser, in collaboration with the Appraisal Sponsor, shall seek other potential sampling factors that influence process implementation.

Documenting Analysis Results: The Lead Appraiser shall document the analysis performed to identify sampling factors and their relevance to the scope of the Organizational Unit(OU) – as well as their role in sampling from the OU to define the Organizational Scope of the Appraisal.

SCAMPI v1.3 Sampling– Change Package 2

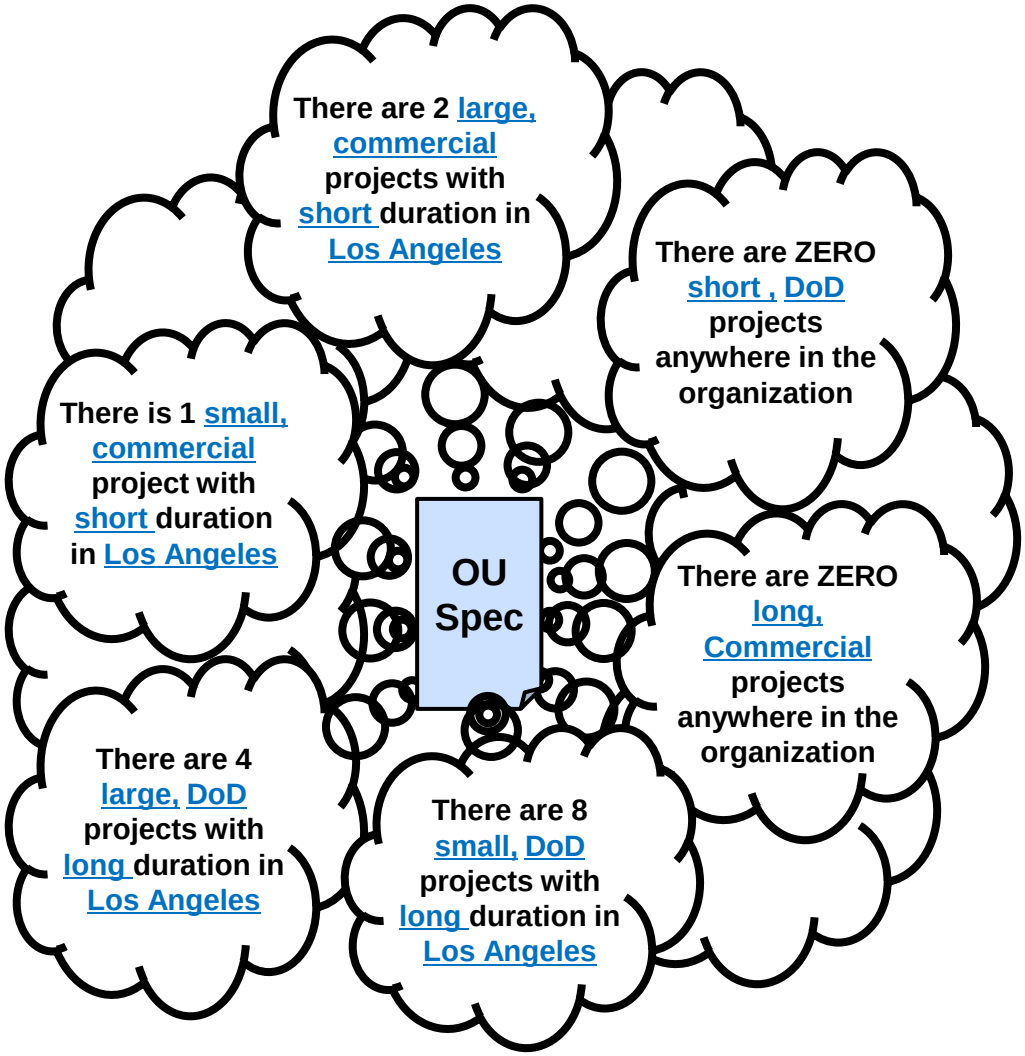
Define the Organizational Scope of the Appraisal

1. Identify subgroups that represent differences in implementation associated with the sampling factors within the OU.
2. Identify which units within each subgroup will be selected to appropriately represent the subgroup.
3. The total of the units selected from each subgroup will be documented as the organizational scope of the appraisal.

Defining the Organizational Scope – Step 1

Identify subgroups based on sampling factors

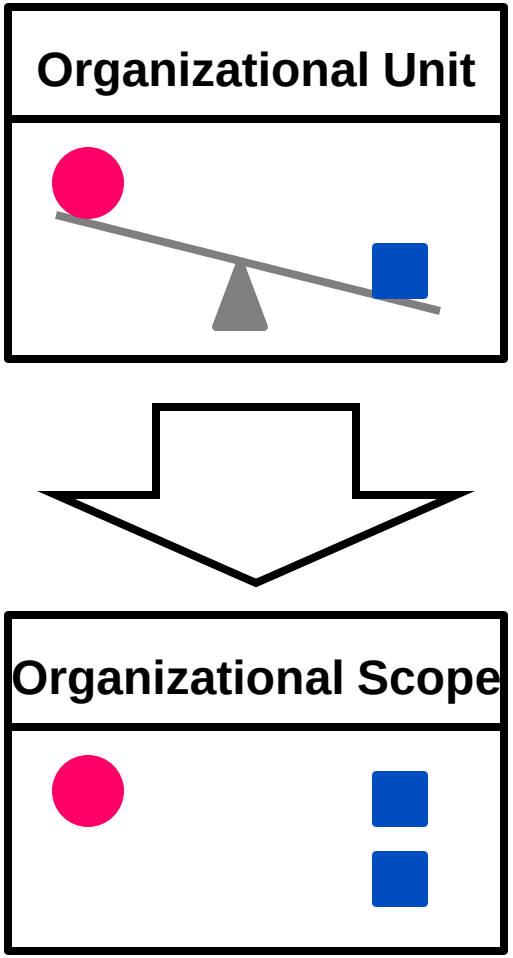
The set of units from which the sample will be drawn is partitioned using sampling factors. This identifies clusters of units that are more similar to each other. The level of diversity can then be objectively documented.



Defining the Organizational Scope – Step 2

Identify how many units within each subgroup will be sampled & choose them

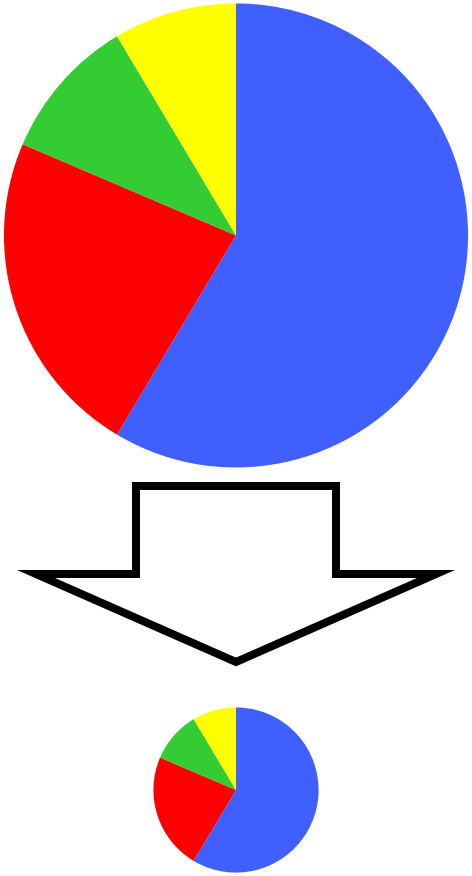
A balance of units from across the subgroups is selected in order to form a representative organizational scope. Objective analysis of the diversity in the OU supports the judgment of 'representativeness.'



Defining the Organizational Scope – Step 3

Document organizational scope of appraisal

Diversity found in the organizational unit drives the size and diversity of the organizational scope. All other things being equal, a more diverse OU will increase the sample size more than a larger OU will increase the sample size.



Required Practice: Sampling from Subgroups

The number of entities selected from each subgroup shall be proportional to the representation of that subgroup in the organizational unit. Specifically, the Lead Appraiser will compute this number by multiplying the number of entities in the subgroup by the number of subgroups, then dividing that product by the total number of entities in the organizational unit. Fractional values resulting form this computation will be rounded up or down according to standard mathematical rules (except where the number is less than 1, in which case the result is rounded up to 1).

By this method, the organizational scope of the appraisal will be comprised of a proportionally representative sample of entities distributed across the subgroups.

This computation will be illustrated with an example

Iteration: OU and Organization Scope Definition

Specification of the Organizational Scope may cause the sponsor to reconsider the definition of the Organizational Unit.

- A very diverse Organizational Unit will warrant a relatively larger Organizational Scope. Limiting the diversity of the Organizational Unit enables appraisal of a smaller Organizational Scope.
- What-if analysis can be performed to consider whether or not to include another division, or another product line in the Organizational Unit – and the effect that has on the size of the Organizational Scope

The Lead Appraiser, working in collaboration with the Appraisal Sponsor will explore alternative scenarios as appraisal constraints dictate. This iteration is permitted, so long as the objective characterization of Sampling Factors is documented and clearly explained in the Appraisal Plan.

SCAMPI V1.3 Data Sufficiency – Change Package 2

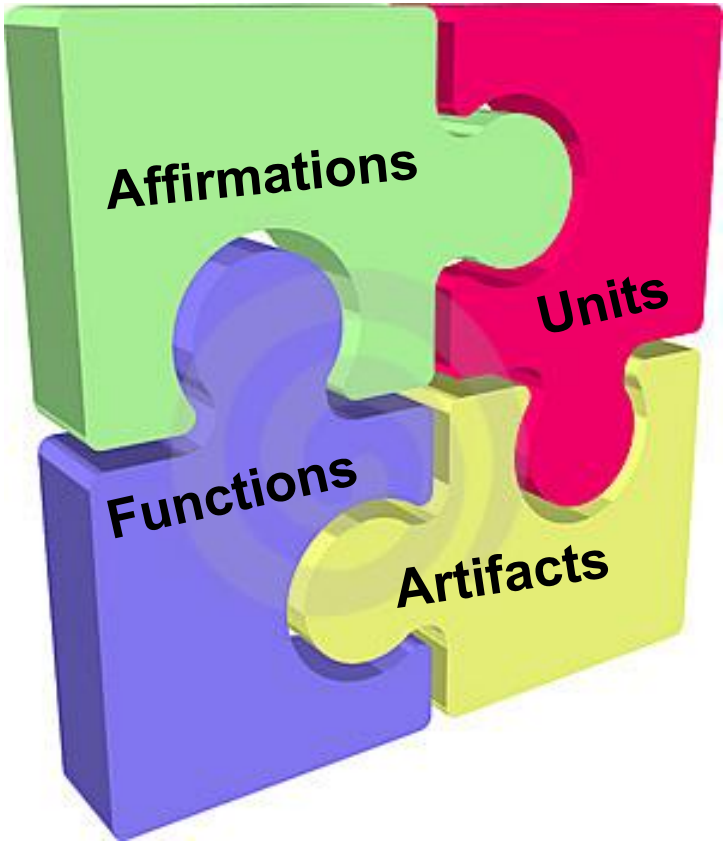
Plan Data Collection to Meet Sufficiency Requirements

1. Specify Data Sources
2. Identify Sources of Artifacts
3. Identify Interviewees
4. Document the Data Collection Plan

Specify Data Sources

Balanced participation of all sampled units and functions (providing affirmations & artifacts) must be specified

The purpose is to assure sufficient corroboration and to limit redundant data which increases cost without increasing the appraisal team's insight. Selection criteria and minimum standards are provided.



Identify Sources of Artifacts

Artifacts are selected to provide needed insight – not to meet 'inventory standards'

The previous focus on "Direct" and "Indirect" distracted people.

Specified requirements and guidance drives an improved focus.

Identify Interviewees

Interviews not conducted for the sole purpose of corroborating data from artifacts.

Data collection planning involves devising a strategy for complementing data from artifacts using interviews. Some things are more efficiently learned through interviews, others through document review.

Document the Data Collection Plan

The data collection plan is an important asset which is established and maintained

There are many different sources of strategic and tactical insight that drives planning and re-planning data collection throughout appraisal conduct.

The data collection plan is submitted with the appraisal artifacts to the CMMI Steward

Required Practices: Data Sufficiency Rules – 1

Involvement: Every sampled unit included within the Organizational Scope of the appraisal shall provide data (either artifacts or affirmations) for at least one process area that is applicable to that unit.

Corroboration – 1: At least 50% of the sampled units within an identified subgroup shall provide both artifacts and affirmations for at least one process area that is applicable to those units.

Corroboration – 2: At least one of the sampled units within an identified subgroup shall provide both artifacts and affirmations for any and all process areas that are applicable to units within that subgroup. *This is subject to override as defined on the next slide.*

Corroboration – 3: All other sampled units (not included in 1 or 2 above) shall provide either artifacts or affirmations for at least one process area applicable to units in the subgroup to which they belong (this is essentially a repeat of the "involvement" requirement above).

if a subgroup consists of only one unit, then only "corroboration – 2" applies

Required Practices: Data Sufficiency Rules – 2

Support Functions and Process Areas: It is expected that some organizations implement practices in a centralized manner, such that they are not observable in a distributed fashion on sampled units from subgroups. A common example of this is seen in the implementation of Organizational Process Focus. Therefore, in the case of process areas implemented by one or more centralized functions, the Lead Appraiser shall plan for collection of artifacts and affirmations (both) from only those centralized functions (e.g., there may be more than one EPG).

Corroboration Override: Some process areas implemented by units within or across subgroups may be implemented with common templates and staffed by people who play roles that span those units. A common example of this is seen in the way Process and Product Quality Assurance or Configuration Management is implemented. An additional example includes ‘project managers’ overseeing multiple units and using common process assets across all of those units. In such cases, the second corroboration rule on the previous slide may be overridden – and data collection shall include each unique implementation (which may be 1).

Required Practice: Appropriate Artifacts

Process Documentation: A description of how a practice is intended to be performed shall not be accepted as evidence that the practice was performed – though it should provide evidence for OPD or contribute to understanding the context of implementation level documents.

Command Media or Policies: Existence of policies or work instructions shall not be accepted as evidence that they guide the work performed. Corroboration through tracing other artifacts to these documents or verbal descriptions of their role must be observed by the team.

Implementation Level Documents: Documents produced as the intended output of a practice, or an incidental side effect shall be examined in order to substantiate that the practice was performed.

Conformance to Organizational Standards: Non-conformance to organizational standards (by itself) shall not be interpreted to negate implementation of a CMMI practice – though this may warrant a finding.

Required Practices: Appropriate Affirmations

No Hearsay: Affirmations of 'what other people do' shall not be accepted. The team must speak with people who implement practices.

No Vocabulary Quiz: The appraisal team shall take responsibility to understand what interviewees are saying. Acceptance of affirmations shall not be contingent on use of CMMI terminology, nor shall it be contingent on internal consistency in the terminology used across the organizational unit. Findings may point out that terminology is a barrier, but this shall not negate the perception that practices are implemented.

Reasonable Inferences: Interviewees may describe what they do without use of specialized terms, and casual mention of jargon shall not be over-interpreted. For example, if a person says "we implement everything in this process area" this shall not be accepted as such. In contrast, a thorough description of a Work Breakdown Structure without using that term shall be considered acceptable evidence.

Required Practices: Data Collection Plan

Baseline at Readiness Review: The initial draft of the data collection plan shall be baselined (documented and reviewed by the appraisal team) prior to the conclusion of the first Readiness Review.

Required Contents: The plan shall include, at a minimum:

- Organizational and Model Scope of the Appraisal
- List of planned data collection, including document reviews & interviews
- Specification of contingency plans to address potential shortfalls in data
- Risk identification and mitigation strategies

Established and Maintained: Baselines of the plan shall be reviewed and discussed by the appraisal team prior to the start of phase 2 of the appraisal, and at other milestones designated by the Team Leader.

Submission with Appraisal Data Package: The data collection plan shall be submitted with the data package supplied to the CMMI steward.

A Worked Example

Organizational Demographics

The Lead Appraiser has started to work with a large aerospace and defense corporation to perform a Maturity Level 2 appraisal. The organization has been implementing and improving process for over 10 years. Based on conversations with the Sponsor the Lead Appraiser initially determines the appropriate Organizational Unit should be the Blue Business Unit. The Blue Business Unit is comprised of 30 projects. The documented analysis resulted in the following sampling factors with their values being relevant:

- Customer (DOD, Commercial)
- Geography (Los Angeles, Dayton, Other)
- Project Duration (Long > 1yr, Short <1yr)
- Project Size (Large >15 people, Small <15 people)

From this the Lead Appraiser now determines the number of subgroups by applying the sampling factors to the projects in the OU. This documented analysis results in the table on the next slide

Subgroups Defined by Sampling Factors

Subgroup	Relevant Sampling Factors	Size of Subgroup
G1	Com/Geo LA/Short/Large	2
G2	Com/Geo LA/Short/Small	1
G3	DOD/Geo LA/Long/Large	4
G4	DOD/Geo LA/Long/Small	8
G5	DOD/Geo Dayton/Long/Large	2
G6	DOD/Geo Dayton/Long/Small	6
G7	DOD/Geo Other/Long/Large	3
G8	DOD/Geo Other/Long/Small	4
TOTALS	**8 subgroups**	**30**

Note: not all possible combinations of the sampling factors are relevant, because projects like that don't exist (e.g., no short DoD projects here)

Applying the Sampling Computation…

Full Organizational Unit

Subgroup	Relevant Sampling Factors	Size of Subgroup	Subgroup Size x Number of Subgroups	… Divided by Total Number of Entities	Number Sampled
G1	Com/Geo LA/Short/Large	2	16	0.53	1
G2	Com/Geo LA/Short/Small	1	8	0.27	1
G3	DOD/Geo LA/Long/Large	4	32	1.07	1
G4	DOD/Geo LA/Long/Small	8	64	2.13	2
G5	DOD/Geo Dayton/Long/Large	2	16	0.53	1
G6	DOD/Geo Dayton/Long/Small	6	48	1.60	2
G7	DOD/Geo Other/Long/Large	3	24	0.80	1
G8	DOD/Geo Other/Long/Small	4	32	1.07	1
TOTALS	**8 subgroups**	**30**			**10**

Limiting Organizational Unit to 2 Locations

Omitting the "Other Location" from OU

Subgroup	Relevant Sampling Factors	Size of Subgroup	Subgroup Size *x* Number of Subgroups	… Divided by Total Number of Entities	Number Sampled
G1	Com/Geo LA/Short/Large	2	12	0.52	1
G2	Com/Geo LA/Short/Small	1	6	0.26	1
G3	DOD/Geo LA/Long/Large	4	24	1.04	1
G4	DOD/Geo LA/Long/Small	8	48	2.09	2
G5	DOD/Geo Dayton/Long/Large	2	12	0.52	1
G6	DOD/Geo Dayton/Long/Small	6	36	1.57	2
~~G7~~	~~DOD/Geo Other/Long/Large~~				
~~G8~~	~~DOD/Geo Other/Long/Small~~				
TOTALS	**6 subgroups**	**23**			**8**

Limiting Organizational Unit Further

Also Omitting "small projects" from OU

Subgroup	Relevant Sampling Factors	Size of Subgroup	Subgroup Size x Number of Subgroups	… Divided by Total Number of Entities	Number Sampled
G1	Com/Geo LA/Short/Large	2	6	0.75	1
G2	~~Com/Geo LA/Short/Small~~				
G3	DOD/Geo LA/Long/Large	4	12	1.50	2
G4	~~DOD/Geo LA/Long/Small~~				
G5	DOD/Geo Dayton/Long/Large	2	6	0.75	1
G6	~~DOD/Geo Dayton/Long/Small~~				
~~G7~~	~~DOD/Geo Other/Long/Large~~				
~~G8~~	~~DOD/Geo Other/Long/Small~~				
TOTALS	**3 subgroups**	**8**			**4**

Evaluating the Tradeoffs

The Appraisal Sponsor and Lead Appraiser can work with the alternative scenarios above (and others as they wish) to evaluate the tradeoff between the *scope of generalizability* and the *magnitude of the appraisal event*.

Each Organizational Unit definition, and accompanying Organizational Scope would present a different scenario in planning data collection for the appraisal event.

Applying the Data Sufficiency Requirements to the Scenarios…

Scenario One: The 'Full OU' As Described

- Number of Subgroups = 8
- Number of Total Units = 30
- Organizational Scope = 10 Units

Further assumptions made based on looking at the organization:

- Centralized QA function operates at each location, sharing staff and using location-specific infrastructure and personnel
- A Project Management Office was established to manage all DoD projects, and the management structure overseeing those projects operates as a cross-site function. Standard planning and monitoring processes are implemented, and personnel who perform that work have responsibility for multiple DoD projects
- Small projects share a common infrastructure for configuration management, including CM tools and personnel – who are assigned from a larger pool. For large projects, project-specific infrastructure and staffing are established
- DoD projects do not use suppliers – as a matter of policy

Scenario One: Robust Data for a Diverse OU

The Data Collection Plan depicted below conforms to the rules, with:

- One unit providing PP & PMC data from DoD programs
- One unit each providing PPQA data from the LA and Dayton locations

		REQM		PP		PMC		MA		CM		PPQA		SAM	
Relevant Sampling Factors	**Sample**	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff
Com/Geo LA/Short/Large	1	1	1	1	1	1	1	1	1	1	1			1	1
Com/Geo LA/Short/Small	1	1	1	1	1	1	1	1	1	1	1			1	1
DOD/Geo LA/Long/Large	1	1	1					1	1	1	1	1	1		
DOD/Geo LA/Long/Small	2	1	1					1	1						
		1							1		1				
DOD/Geo Dayton/Long/Large	1	1	1	1	1	1	1	1	1	1	1				
DOD/Geo Dayton/Long/Small	2	1	1					1				1	1		
			1					1	1	1					
DOD/Geo Other/Long/Large	1	1	1					1	1	1	1	1	1		
DOD/Geo Other/Long/Small	1	1	1					1	1			1	1		
8 subgroups	**10**	9	9	3	3	3	3	9	9	6	6	4	4	2	2

Scenario Two: Omitting the "Other Sites"

- Number of Subgroups = 6
- Number of Total Units = 23
- Organizational Scope = 8 Units

The further assumptions described above are retained for this scenario as well.

Only major difference is the omission of "other sites" from the scope of the Organizational Unit. The appraisal results would apply to only the LA and Dayton locations.

The projects from the "other sites" do not differ substantially in other respects from the projects in LA and Dayton, so the decrease in organizational scope is not very substantial.

Scenario Two: Scaled Down a Little Bit

The Data Collection Plan depicted below conforms to the rules, with:

- One unit providing PP & PMC data from DoD programs
- One unit providing PPQA data from the LA location

		REQM		PP		PMC		MA		CM		PPQA		SAM	
Relevant Sampling Factors	**Sample**	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff
Com/Geo LA/Short/Large	1	1	1	1	1	1	1	1	1	1	1			1	1
Com/Geo LA/Short/Small	1	1	1	1	1	1	1	1	1	1	1			1	1
DOD/Geo LA/Long/Large	1	1	1					1	1	1	1	1	1		
DOD/Geo LA/Long/Small	2	1	1					1	1						
		1							1		1				
DOD/Geo Dayton/Long/Large	1	1	1	1	1	1	1	1	1	1	1				
DOD/Geo Dayton/Long/Small	2	1	1					1				1	1		
			1					1	1	1					
6 subgroups	**8**	7	7	3	3	3	3	7	7	5	5	2	2	2	2

Scenario Three: Omitting "Small" Projects

- Number of Subgroups = 3
- Number of Total Units = 8
- Organizational Scope = 4 Units

This case has the potential to reduce the sufficiency requirements below what we currently see in SCAMPI V1.2 – because the diversity of the organizational unit, as well as the size, have been reduced.

In addition, the elimination of "Direct vs. Indirect Artifact" and other new features (to be described elsewhere) makes the conduct of the appraisal event even more efficient than a SCAMPI V1.2 appraisal would be.

Scenario Three: The Smallest Scope

The Data Collection Plan depicted below conforms to the rules, with:

- One unit providing PP & PMC data from DoD programs
- One unit providing PPQA data from the LA location

		REQM		PP		PMC		MA		CM		PPQA		SAM	
Relevant Sampling Factors	**Sample**	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff	Doc	Aff
Com/Geo LA/Short/Large	1	1	1	1	1	1	1	1	1	1	1			1	1
DOD/Geo LA/Long/Large	2	1	1					1	1	1	1	1	1		
			1	1	1	1	1	1	1	1	1				
DOD/Geo Dayton/Long/Large	1	1	1					1	1	1	1	1	1		
3 subgroups	**4**	3	4	2	2	2	2	4	4	4	4	2	2	1	1

Scenario Summary

Many different permutations are supported by SCAMPI V1.3.

The analysis of sampling factors, and trade-studies done on their basis, helps the Lead Appraiser to work with the Appraisal Sponsor to seek the most efficient appraisal for a given scope of the Organizational Unit. If the magnitude of the Organizational Scope of the appraisal exceeds the constraints of the sponsor, then eliminating one or another source of diversity in the Organizational Unit can provide needed de-scoping.

These decisions are not driven by arbitrary minimums, or unsupported claims – they all derive from meaningful differences that exist in the context of the organization.

Backup Slides

Published References

A good online reference (that is, a reference that is easily obtained) may be found at http://stattrek.com/Lesson6/STR.aspx. (This is an online statistics tutorial.)

A more complete, albeit more abstract, discussion with respect to partitioning and minimal sufficient statistics may be found on pages 399-402 of Rohatgi, V. K., An Introduction to Probability Theory and Mathematical Statistics, New York: John Wiley and Sons, 1976. (This is discussion is not for the layperson.)

Reference Formula for Computing Sample Size

$$M = \sum_{i=1}^{j} \frac{m * N_i}{N}$$

Where
i = an identifier for a specific subgroup
j = the total number of subgroups in the organizational unit
N_i = the number of entities in a specific subgroup
N = the total number of entities in the organizational unit. The sum of all subgroup sizes N_i equals N.
m = an initial guess at the sample size used in calculating the actual minimum sample size.
For our purposes, this number will be equal to the number of subgroups determined from the analysis of the sampling factors
M = the minimum number of entities to be sampled

"Other New Features" Referenced on Slide 38

While the SCAMPI Upgrade Team has not yet established the final form of these features and what they are to be called, we are discussing:

- The concept of "Managed Discovery" to reset expectations regarding the distinction between "verification" and "discovery" appraisals
- A concept of "Phased Data Collection" in which a sequence of 'data calls' is used to progressively elaborate the data needs of the appraisal (this may be an aspect of managed discovery)
- Operational benefits that may derive from "Product-Centric PIIDS" – whereby an 'artifact-to-CMMI-mapping' is utilized along with a 'CMMI-to-artifacts-mapping'
- More details about the form and function of the "Data Collection Plan" – which we see as a high-leverage focus for planning efficient appraisals and managing risk
- Implications for other changes facing the CMMI user community, such as:
  - Use of virtual technology, and/or virtual teams
  - Organizations implementing multiple-constellations