**PSM measurement process**

How measurement helps: ● objective insight into project performance ●objective information to identify and manage risk ● early detection and resolution of problems ● objective team and organizational communications ● ability to assess organizational performance ● ability to defend and justify decisions.

PSM project-level objectives: ● help project and technical mangers meet cost, schedule, and technical objectives ● provide a basis for objective communication and informed decision making ● establish a foundation for organizational and executive-level performance measurement.

PSM key concepts: ● measurement is a process - not a pre-defined list of graphs or report ● both data collection and analysis must be planned ● PSM is flexible – adapted to meet specific project information needs ● PSM supports the integrated information needs of both acquirer and supplier organizations ● PSM addresses the relationships and trade-offs between project objectives.

Measurement principles: ● use information needs and objectives to drive the measurement requirements ● define and collect measures based on the technical and management process ● collect and analyse data at a level of detail sufficient to identify and isolate problems ● implement an independent analysis capability ● use a systematic analysis process to trace the measures to the decisions ● interpret the measurement results in the context of other project information ● integrate measurement into the project management process throughout the life cycle ● use the measurement process as a basis for objective communications ● focus initially on project-level analysis.

An effective measurement approach must: ● help project and technical managers anticipate what could go wrong ● objectively support trade-off decisions if problems Arise ● help evaluate and communicate actual performance results.

Quantitative management disciplines: ● risk management – helps to recognize potential problems and prevent or minimize their impact on project objectives ● measurement – provides the information required to identify, correlate, and manage issues ● financial management – establishes budgets and tracks project performance against associated cost and schedule baselines ● the output of assess risks is risk management plan, the output of plan measurement is measurement plan and the output of establish budget and schedule is financial performance plan.

Integrated process: ● risk management, measurement, and financial management may be treated as independent quantitative process ● but the processes must work together to: - define consistent plans and baselines – provide consistent analysis results ● the processes are continuous, and they are more effective when implemented on a day-to-day basis.

**Concept of information Need**

Plan measurement key concepts: ● each project is described by a unique set of information needs ● unique project information needs usually can be grouped into “seven common information categories” ● the project information needs drive the selection of measures ● the measurement definitions and methods are determined by the project process.

Information needs: ● objective – a project goal or requirement ● issues – an area of concern that could impact the achievement of an objective: 1) risk –concern the way occur 2) problem –concern that has occurred 3) lack of information –inadequate data.

Identify and prioritize information needs: ● identify information needs ● map information needs ● prioritize information needs ● output is prioritized information needs.

Integrate risk into the planning process: ● risk identification elicits candidate cost, schedule, technical and quality information needs ● risk estimation quantifies the project’s exposure to risks ● risk evaluation ranks risks in terms of the project’s need for information ● information needs defined without a formal risk management process also need to be prioritized.

Source for defining and prioritizing project information needs: ● risk analysis results ● project constrains and objectives ● leveraged technologies ● product acceptance criteria ● external requirements ● experience ● planned-decision points.

PSM measurement hierarchy: ● project information need ● information categories ● measurable concepts ● measurement constructs (measures).

Information categories: ● schedule and progress ● resources and cost ● product size and stability ● product quality ● process performance ● technology effectiveness ● customer satisfaction.

Prioritize information needs: ● rank information needs based on priority at the current time ● ranking may be set through a measurement planning workshop with participant consensus ● priorities may change in each phase different issues Arise. (two ways: 1) rank by expert 2) rank by comparing them based on matrix)

Select and specify measures: ● characterize project context ● define measurable concepts ● select the applicable measures ● specify measurement constructs.

Characterize Project Context: ● application domain ● life-cycle model or activities structure ● product structure ● current measurement activities ● system and software processes and technology ● planned sources of components ● process maturity.

Measurable concept: ● an idea about how information need can be satisfied: 1) possible entities and attributes to be measured 2) potential use of results in decision making ●may be implemented in many different ways ● each measurable concept involves a different question ● PSM-defined measurable concepts are widely used.

Make recommendations: ●the measurement results must be clearly understood by the decision maker’s ●results should be available throughout the organization ●action must be taken to realize any benefit from measurement ●desired actions may not be possible –may have to optimize within project constraints.

**PSM analysis activities**

Perform measurement key-concepts: ●this activity provides a systematic method for converting data into usable information ●like planning, performing must be flexible to adapt to changing information needs ●analysis is the primary task of this activity –it includes estimating, assessing feasibility of plans, and tracking performance against plans.

Collection and process data: ●collect values for both planned and actual base measures ●collect data at a level appropriate to localize problems ●question unusual trends and inconsistencies in the data ●develop clear and concise definitions to guide data collection –know what the data means ●expect the data to be noisy.

Analyse data: ●indicators are systematically generated, analysed, interpreted, and reported to: -produce an assessment relative to know information needs –identify new information needs.

Generate indicators: ●”standard” indicators: -pre-defined in measurement plan –produced regularly –may be organized into “sets” ●“special” indicators: -usually created as needed –may be decompositions of indicators to localize problems –may be new indicators that respond to new questions.

Generating useful indicators: ●use consistent conventions ●keep it simple; keep the message clear ●unique titles should reflect scope ●include an as of line or data ● label each axis and provide scale markers ● annotate with milestones and significant events ●use same axes and scales if indicators will be compared.

Estimation analysis: ●conducted to establish target values or numerical expectations for subsequent activities and parameters, based on currently available data ●employ special types of indicator (estimators), adjusted by performance factors ●predicts values such as: -product size –effort –schedule –quality.

Software and system project estimation: ●total system cost is the sum of all individual cost elements ●hardware and software use the same basic estimation techniques with different models based on physical and technical characteristics.

System engineering estimation: ●system engineering estimates may include requirements development, design, integration, testing, development, and maintenance and operations activities ●system engineering activities are sometimes estimated simply as a factor of hardware and software costs ●a model developed for systems engineering activities provides better estimates.

Estimation: ●select approach: -parametric model –activity-based model –analogy –simple estimating relationship ●calibrate the model based on: -project processes, including activities and labour categories -historical data -early project data ● compute estimates: -end produces size –effort required for the product, as defined by the end product size and development environment –cost, schedule, and quality ●evaluate estimates: -quality of estimates –satisfaction of constraints –documentation –multiple approaches used.

Feasibility analysis: ●conducted to determine whether plans and targets are realistic and achievable ●conduct during the initial planning activity and at all subsequent replans ●looks at: -basis for estimate –realism of adjustments –confidence in process –changes in assumptions or environment –comparisons of project parameters.

Performance analysis: conduct to determine whether development is meeting the plans, assumptions, and targets ●conducted periodically once a project has committed to a plan ●looks at: -leading indicators –critical path items –inconsistent trends.

PSM analysis model: ●technology effectiveness: -technology suitability –technology volatility ●process performance: -process compliance –process efficiency –process effectiveness ●product size and stability: -functional size and stability –physical size and stability. ●resource and cost: -personal effort –financial performance –environment and support resources ●customer satisfaction: -customer support –customer feedback ●schedule and progress: -milestone performance –work unit progress –incremental capability ●product quality: -efficiency –reliability –usability –portability –functional correctness –maintainability.

Using the PSM analysis model for performance analysis: ●relates information categories in terms of causes and effect ●helps address the difficult management questions: -is there really a problem –what is causing the risk –what re the related information needs? –what corrective action should be taken? ●requires multiple measures –indicators.

Establish and sustain commitment key concepts: ● properly implemented, measurement becomes part of the way an organization does business ●the most effective measurement process is one that is used and understood at all levels within the organization ●measurement must reflect existing management and engineering capabilities.

Obtain organizational support: ●ensure that all levels of the organization understand how measurement results will be used ●show how measurement benefits each level of the organization ●directly address the “cultural” impacts of implementing measurement.

Define responsibilities: ●executive: -establishes high level performance objectives –use measurement results to make organizational and enterprise level decisions ●project manager: -identifies and manages project information needs –uses measurement results to make program decisions ●measurement analyst: -develops measurement plan to address program information needs –collects and analyse measurement data and reports results –evaluate measurement program ●project team: -uses measurement results –provides measurement data.

Review implementation: ●review measurement implementation to ensure timely and effective deployment ●if implemented incrementally, review each increment ●focus on data quality early in the implementation.

Evaluate measurement key concepts: ●both the measures and the measurement process should be regularly evaluated ●planning the evaluation process in advance helps to ensure that it occurs ●a good evaluation process may enhance an already adequate measurement process.

Evaluate the measures: the effectiveness of the measures, indicators, and analysis results should be evaluated regularly using pre-defined criteria including: ●measurement products use ●confidence in measurement results ●measurement results fitness for purpose ●understand ability of measurement results ●satisfaction of the assumptions of an indicator model ●measurement accuracy ●measurement reliability.

Evaluate the measurement process: ●consider three perspectives: -performance: how effective and efficient is the measurement process? –conformance: is the defined measurement process being followed? –capability: how good is the measurement process, compared to an external standard? ●the process should be evaluated regularly, such as semi-annually.

Performance evaluation: ●address the information needs of those who perform and manage the measurement process ●the information may also be used to help plan future measurement processes ●criteria that may be used include: -timeliness –efficiency –defect containment –customer satisfaction.

Conformance evaluation: ●verify that the measurement plan was followed ●evaluate the plan measurement, perform measurement, and establish and sustain commitment activities ●compliance is normally determined by an independent audit.

Capability evaluation: ●compare the measurement process to an external benchmark of process maturity ●the results of an evaluation against a reference model may be used to: -monitor improvement progress –select among alternative measurement process –identify potential improvements to the measurement process.

**Update the experience base**: ●lessons learned should be stored in an experience base, along with artefacts and observations from the measurement process ●potential artefacts includes: -measurement plan, policies, and procedures –definitions of measurements –data verification techniques –measurement customer satisfaction surveys –measurement performance analysis reports –measurement process audit reports –measurement process capability assessment result ●types of potential observations include: -patterns symptomatic of specific problems –successful and unsuccessful corrective actions –implementation problems and results –tool evaluation ●planned an actual project data is normally stored separately from the experience base.

Identify and implement improvements: ●lessons learned may be implemented as improvements to the current project’s measurement process or for future projects ●changes may affects: -definitions of measures –analysis techniques –data collection and processing procedures –staffing and tool support –reporting and communicating ●changes should be tracked to determine effectiveness.

**PSM Analysis Model with scenario in which analyse set of measurement indicators**

Entity –Attribute: entities and attributes are the basic elements of a measure. ● an entity is the object that is measured – entities includes processes, products, projects, and resources ● a measurable attribute is a distinguishable property or characteristic of the entity –Attributes are either quantitative or qualitative –examples include hours, problems, source lines of code, and design units.

Criteria for selecting prospective measures: ● match with information need ● measurement effectiveness ● nature of the entities to be measured ● cost and availability of data ● life-cycle coverage ● external data requirements.

Measurement construct: ● a specification of a prospective measure ● a specific method for implementing a measurable concept: -specific entities and attributes –pre-planned analyses ● consist of base measures, derived measures, and indicators ● the information product is comprised of a collection of measurement constructs with interpretations ● multiple constructs may be specified for a single concept and information need.

Specify measurement constructs: ● information need ● information categories ● indicator: -analysis model –decision criteria –base/derived measures ●for each derived measure: -measurement function –base measures ● for each base measurement: -measurement method –type of method –scale –type of scale –unit of measurement – relevant entity –attribute.

Integrate into the project processes: ●identify measurement opportunities ● develop measurement procedures ● document measurement plan.

Integrate into the project process: ● as effective measurement process should reflect the: - project’s information needs –characteristics of the project process –maturity of the organization ● the measurement plan defines how the measurement process is implemented for a particular project.

Identify measurement opportunities: ● take advantage of existing tools and measurement activities: -problem report database –configuration management systems –project cost and schedule control systems –design tools ● consider three types of data: -historical results (previous projects) –planning information –actual performance.

Develop measurement procedures: ●define the specific operations, tools, and responsibilities for measurement activities ●address both: 1) data collection and storage 2) data analysis and reporting ●further considerations are discussed in the perform measurement section.

Data collection procedure contents: ● base measures to collect ● sources of data ● date collection tools ● database and retrieval tools ● base and derived measures to store ● verification activities ● collection frequency ● applicable phases and activities ● responsibility.

Data analysis procedure contents: ● base and derived measures to analyse ● databases to access ● data analysis tools ● indicators to produce ● activities to review results ● analysis and reporting frequencies ● applicable phases and activities ● responsibility.

Document measurement plan: ● purposes of plan include: -integrate analysis and reporting into decision-making processes –integrate data collection into data-generating processes –provide a central source for definitions of measures and analyses ● establish a concise working document subject to change.

Measurement plan context: ● introduction ● project description ●measurement roles, responsibilities, and communications ●description of project information needs ●definition of measurement constructs ● project aggregation (roll-up) structures ● data collection and analysis procedures ● measurement evaluation criteria.

Multi-level measurement considerations: ● higher-levels of management may have information needs that require project data ●these information needs should be integrated into the project-level measurement program ● wherever possible; use the same base measurement to address both project and high-level information needs.

Measurable concept: ● an idea about how information need can be satisfied: -possible entities and attributes to be measured –potential use of results in decision making ● may be implemented with many different measurement constructs ●each measurable concept responds to a different question.

Measurement construct: ● specific method for implementing a measurable concept: -specific entities and attributes –pre-planned analysis ●consists of base measures, derived measures, and indicators ●an information product is comprised of a collection of measurement constructs with interpretations.

Base measure definition: ● a measure of a single attribute ●a base measure includes: -a measurable attribute of an entity –a method for quantifying the attribute –a value resulting from applying the method ●related concepts include: ●measurement scale (use by method) ●unit of measure (used by scale) ●observation (act of assigning a value) ●unit of observation (i.e. type of entity).

Derived measure definition: ●a measure that incorporates information about two or more attributes or multiple observations of the same attribute ●a derived measure includes: -two or more values of base and/or derived measures –a mathematical function combining the values –a value resulting from applying the function.

Indicator definition: ●a measure that provides an estimate or evaluation of specified attributes with respect to an information need ●an indicator includes: -one or more values of base end/or derived measures –an analysis model combining the values –a value resulting from applying the model –decision criteria used to assess the indicator value.

Indicator baselines: ●many indicators incorporate a measurement baseline against which actual values can be compared ●the baseline is a set of values of a base and/or derived measure ●baselines may be derived from: -plans –rules of thumb –totals or goals –threshold values –completion criteria –typical values –statistical models –simple averages.

Levels of data aggregation: ●aggregation structures describe the relationships among measured entities ●detailed data should be stored at the level at which it is measured ● the data should be aggregated, or summarized, to higher-level components or organizations for analysis and reporting ● PSM defines three general types of measurement aggregation structures components, functions and activities.

**Structure of CMMI**

Process: ●a set of practices performed to achieve a given purpose (including tools, methods and materials) ●while process is often described as a leg of the process-people-technology triad; it may also be considered the “glue” that unifies the others.

The CMMI: ●an internationally recognised best practice process reference model: -integration of multiple process models that have been used and proven world-wide since the early 1990s –proven use and benefits in multiple organisations ●developed by an international team: -lead by Carnegie Mellon University –representation from industry, academia and government organisation.

The CMMI process coverage: ●the CMMI covers: -process management: process definition, improvement and training –project management: -planning, monitoring and control, risk management, supplier management ●systems, software and hardware engineering ●support activities: -quality assurance, measurement and analysis, decision making.

The benefits of CMMI: ●better control of requirements changes ●earlier identification and removal of defects ●improved employee morale ●less staff turnover ●improved communication ●decreased risk exposure ●increased customer satisfaction ●less ‘fire fighting’ ●less last minute changes ●less overtime ●more certainty and stability.

Process appraisal versus audit: ●appraisal: -purpose: to identify current project practices and compare them to an accepted standard or model –goal: to support continuous improvement ●audit: -purpose: to determine adherence to organisational processes and standards –goal: to determine degree of compliance.

Benefits of appraisal: ●helps to understand current processes: -compare organisational practices to best practice reference models ●provides catalyst for change and risk mitigation: -focus stakeholder commitment –obtain buy-in for improvement ●identifies opportunities for: -training &resource allocation –improvement opportunities.

**Appraisal principles**: ●conducted against an appraisal process framework –SCAMPI: -developed to be used in conjunction with the process reference models such as the CMMI ●SCAMPI principles: -strict confidentiality and non-attribution observed throughout the appraisal process –senior management involved as appraisal sponsors ●appraisals approached collaboratively ●focus is on processes not people’s performance.

Appraisal process: ●appraisal process includes: -preparation and training –review of documentation –conduct of interviews –corroboration of data –development of findings –validation of findings –determination of process capability/maturity ●consensus must be reached for major stages.

Interview process: ●interviewed in functional groups ●non-attribution of information ●focus on process not people ●CMMI related questions ●2 or 3 non-CMMI questions depending on the type of appraisal: -initial benchmarking appraisal –follow-up appraisal.

Appraisal outputs: ●observations for each practice ●findings for each process area –strengths and improvement opportunities ●rating against goals ●process capability profile/maturity level ●non-CMMI findings ●appraisal summary report.

Role of findings: ●identify process issues currently facing the organisation ●identify highest priority issues facing the organisation ●basis for formulating action plans and recommendations.

**Process architecture**: ●a process architecture describes the ordering, interfaces, interdependencies, and other relationships: -among the process elements in a standard process –between process elements and external process.

The importance of architecture: ●leads to a well-designed process environment: -results in a consistent process ‘look and feel’ –assists process uptake and institutionalisation –more readily adaptable to changes in strategic focus ●enables consistency in process design: -assists with process coverage and optimisation ●facilitates improvement activities: -improvement/modification of existing processes –training and deployment.

Important factor in process definition: ●traceability and flow-down among: -strategic goals and objectives –process needs –policies –procedures, instructions and guidelines –templates –tools –process assets –repositories –training and deployment assets.

Major causes for failed improvement: ●no management sponsorship ●no organisational version, mission or goals ●lack of resources ●incomplete delegation ●responsibility/authority imbalance ●threatened middle-managers ●no plan ●wrong people.

The critical success factor: ●the major key to seeing it through is senior management commitment: -senior management sponsorship ●management steering group owns the improvement program: -results are measured and reported to the MSG as part of a planned and managed project ●MSG provides the vision and end-state goal ●MSG provides the compelling need and states expectations.

Major improvement activities: ●establish a management steering group ●establish a process enhancement group ●identify processes action team member’s ●involve the organisation in process improvement education ●develop an action plan and allocate resources ●priorities needed improvements ●institutionalise practices across organisation.

The key to continuous improvement: ●the continuous improvement journey is one which by definition never ends ●process baseline affected by: -change in organisational context –changes in business environment ●alignment of improvement to organisational goals and objectives are the key to ensuring effectiveness.

**Context of CMMI**

CMMI content: ●the CMMI contains three parts ●Part 1 introduces the CMMI: -structure of the model and relationships between components -using the CMMI ●Part 2 contains the generic goals and practices, and the process areas ●Part 3 contains the appendices and glossary.

The process areas: ●CMMI for development contains 22 process areas which are listed in alphabetical order: -causal analysis and resolution –configuration management –decision analysis and resolution –integrated project management –measurement and analysis –organisational performance management –organisational process definition -Organisation process focus –organisational processes performance –organisational training –product integration –project monitoring and control –project planning –process and product quality assurance –quantitative project management –requirements development –requirements management –risk management –supplier agreement management –technical solution –validation –verification.

Process area contents: each process area contains ●purpose statement ●introductory notes ●process area relationships ●summary of specify goals and practices ●specific practices by goal: specific goals and specific practices ●generic practices by goal: generic goals and generic practices.

Process area: ●a process area is defined as: -a cluster of related practices in an area that, when implemented collectively, satisfy a set of goals considered important for making improvement in that area ●all 22 PAs are common to both the continuous and staged representations of the CMMI: model representations will be covered in Par2.

Introductory material: ●purpose: describes the purpose of the PA ●introductory notes: describes the major concepts the PA covers ●Related PAs: provides a high-level relationship between the PA and other PAs ●specific goal and practice summary: lists the titles of the specific goals and practices.

Specific goals and practices: ●specific goals: -apply to a specific PA ●describe the unique characteristics that are required to satisfy a PA ●they are numbered starting with the prefix SG ●Specific practices: -describe the activities that are expected to results in achieving the SGs of a PA –they are numbers SP x.y where x is the number of the SG and y the sequence number of the SP.

Generic goals and practices: ●generically goals: -apply to all 22 PAs –describe the characteristics that are required to institutionalise the processes that implement a PA –they are numbered starting with the prefix GG ●generic practices: -activities that ensure the processes associated with the PA will be effective, repeatable and lasting ●they are numbered GP x.y where x is the number of the GG and y the sequence number of the GP.

Typical work product, subpractices and generic practice elaborations: ●example work product: -typical outputs and product resulting from the implementation of a SP and used to evaluate the degree of practice implementation ●subpractices: -details and guidance for interpreting and implementing SPs and GPs ●generic practice elaborations: -provide guidance on how GPs may be applied in the context of each PA.

Supporting information: ●examples provide clarification to a concept ●amplifications provide information relevant to one of three disciplines covered by the CMMI: -system engineering –software engineering –hardware engineering ●references are pointers to more information in related PAs ●notes are nearly any other model component.

Required, expected an informative model components: process area components are categories as either: -required which are the SGs and GGs describing what an organisation must achieve to satisfy a PA –Expected which are the SPs and GPs describing what an organisation will typically implement to achieve a required component –informative which provide guidance, details and examples on how the required and expected components could be approached.

The CMMI constellations: ●feedback from acquirers and service providers indicated significant interpretation needed to use earlier versions of the CMMI ●the CMMI architecture was used to enable 3 constellations to be developed to meet the needs of the 3 main user groups: -CMMI for development for product developers –CMMI for acquisition for acquisition organisations –CMMI for services for service providers.

Constellation structures: ●3 CMMI version for 3 main user groups ●commonality among the constellations: -core process areas –core definitions –core informative material –all generic goals and practices ●constellation specific material: -discipline specific process areas –discipline specific guidance and definitions.

Model representations: ●there are two recognised and generally accepted representations of the CMMI: -continuous -staged ●the representations each provide a way of implementing process improvement for the achievement of business goals ●both representations provide the same content of the model but are organised in different ways.

Process area organisation: ●the PAs are organised into four categories in continuous representation: -process management –project management –engineering -support ●the PAs are organised by maturity levels in the staged representation.

Understanding the levels: ●levels are used in the CMMI to describe the incremental paths to improving organisational processes ●continuous representation allows an organisation to select and focus its improvement on individual PAs ● the staged representation allows an organisation to improve predefined sets of PAs.

Capability and maturity levels: ●improvement paths follow well defined improvement levels ● for the continuous representation, the term capability level or process area capability is used ● for the staged representation, the term maturity level or organisational maturity level is used ● regardless of the representation, the concept of levels is the same: -the levels characterise the improvement path an organisation takes from an ill-defined and often chaotic state of operation to a state of continuously optimised processes that are quantitatively management to meet business objectives ● to reach a level, the organisation must satisfy all the goals of the PA in question up to and including the level in question.

Capability levels: ●a capability level is a well-defined evolutionary plateau describing the capability of a process area ● there are four capability levels in the CMMI ● each level is a layer in the foundation for continuous improvement ● capability levels are cumulative: -a higher capability level includes the practices of the lower levels ● an organisation’s process capabilities may be represented by a set of points in two dimensions: -process dimension shows what is done –capability dimension shows how well it is done ● 0 incomplete, 1 performed, 2 managed, 3 defined.

The maturity levels: ●maturity level 1 –initial: -processes are incompletely performed or not at all –process performance is unpredictable and dependent on individual staff members’ performance ● maturity level 2 –managed: -processes are characterised at the project level –each project can manage its processes differently -process are often reactive ● maturity level 3 –defined: -processes are characterised at the organisational level –process performance objectives are typically qualitative –projects are permitted to tailor processes ensuring consistent process performance ● maturity level 4 –quantitatively managed: -quantitative process performance targets are established for meeting business goals –process performance is measured and controlled ● maturity level 5 –optimising: -processes are continuously optimised based on a quantitative understanding of process performance.

Important model terminology: ● establish and maintain: -means to create, document, use and revise ● project: -a managed set of interrelated resources which delivers one or more products to a customer or end user. A project has a definite beginning and end and typically operates according to a plan ●peer review: the review of work products performed by peers during development of the work products to identify defect for removal ●work product: a useful result of a process. A key distinction between a work product and product component is that a work product is not necessarily part of the product ● operational concept: a general description of the way in which an entity is used or operates ● operational scenario: a description of an imagined sequence of events that includes the interaction of the product with its environment and among tis product components ● requirement: a condition of capability needed by a user to solve a problem or achieve an objective.

**SCAMPI A and interpretation of the CMMI**

SCAMP appraisal methods: ● class A: the most rigorous and is the only method that can result in ratings ● class B: provides options in model scope and organisational scope, but characterisation of practices is fixed to one scale and is performed on implemented practices ● class C: provides a wide range of options, including characterisation of planned approaches to process implementation according to a scale defined by the user.

Object evidence in SCAMPI: ● all SCAMPI methods require that appraisal findings are based on a review of objective evidence: ● SCAMPI methods defined two types of objective evidence that can be used when characterising practices: -artifacts –affirmations ●artifacts: -tangible forms of objective evidence indicative of work being performed; the primary output of a practice; or a consequence of implementing a practice -examples: example work products listed in model practices –target products of ‘establish and maintain’ –documents, deliverables, meeting minutes, ect ● affirmations: -oral or written statement confirming or supporting implementation of a specific or generic practice ● usually provided by the implementers of the practice and/or internal or external customers, but may also include other stakeholders –examples: interviews, presentations, demonstrations.

**Context of CMMI specifically verification and validation**

Verification: ● the purpose of verification is to ensure that selected work products meet their specified requirement ● VER involves: -evaluating work products against specifications ● conducting product quality evaluations compared with quality assurance evaluations ● verification is ensuring “the product is built right” ● SG1 prepare for verification –preparation for verification is conducted: 1) select work products for verification 2) establish the verification 3)establish verification procedures and criteria ● SG2 perform peer reviews –peer reviews are performed on selected work product: 1) prepare for the peer reviews 2) conduct peer reviews 3) analyse peer review data ● verify selected work products –selected work products are verified against their specified requirement: 1) perform verification 2) analyse verification results ● output: verified product, verification again specification.

Validation: ● the purpose of validation is to demonstrate that a product or product component fulfils its intended use when placed in its intended environment ● VAL involves: -evaluating work products against operational concepts and use scenarios –determining the fitness for use of work products ● validation is ensuring the right product is built ● (missing)

**Overview:**

1. Why measurement is important: ● can use experience ●reduce cost ● easy to set target.
2. Software is intangible product.
3. PSM is: ● an issue-driven, flexible measurement approach for system and software measurement. ● based on actual DoD and industry measurement.
4. Benefits of PSM: ● compile best measurement practices from government and industry ● develop a cohesive approach based on these practices ● develop products and services that support the approach ● transition the approach to government and industry ●continually improve the approach, product, and services.
5. PSM Project Objectives: ● developing effective measurement practices that address software and systems technical and management information needs. ● transitioning into general use and integrated measurement approach that result in performance improvements.
6. Keep the historical data to make you success next time.
7. Some PM only react their mistake, like “add more people”, “build components in parallel”, “ignore development dependencies”, and “reduce requirement”.
8. 1) plan measurement 2) perform measurement 3) evaluate measurement and 3) technical and management processes 4) establish and sustain commitment. This is not in the scope of PSM.
9. PSM approach summary: ● measurement must address the specific information needs of each unique project ● the PSM principles define an effective measurement process ●PSM can be applied to all projects ● PSM is based on actual experience from DoD, Government, and industry programs.
10. ICM table
11. Multi-project parameters can from 1) enterprise and organization parameters 2) project A parameter 3) common project parameter.
12. Plan measurement summary: ● the planning activity is dynamic –project information needs and processes are always changing ● success depends on the integration of the measurement process into the project processes ● an effective measurement process is designed to meet the information needs of both supplier and acquirer organizations ●PSM provides a systematic approach for planning a measurement process.
13. Information model summary: ●the measurement information model provides a mechanism for systematically defining measures and analyse ● aggregation structures describe the relationships among the measured entities ● measurement constructs are defined during the plan measurement activities ●measurement construct are applied during the perform measurement activity.
14. Perform measurement has three steps: ●collect and process data ●analyse data ●make recommendations.
15. For the measurement analysis, there are three ways to analyses data to get information: ●estimation (for project data and historical data) ●feasibility analysis (for plan) ●performance analysis (for status problems).
16. Chechlist
17. Performance analysis summary: ●problems detected using measurement (low productivity) ●underlying causes localized (requirements growth, low staffing, and code source) ●alternative replan strategies evaluated ●measurement supported an informed decision.
18. Perform measurement summary: ●analysis is dynamic –analysis must respond to new and changing questions ●the PSM analysis model links information needs and measurement results ●both quantitative and qualitative data should be used ●measurement results are the basis for risk resolution, financial performance analysis, and performance assessment.
19. Establish and sustain commitment summary: ●measurement requires management involvement to succeed ●measurement data must support users at all levels of the organization ●information needs and data management responsibilities of all users must be coordinated and prioritized to minimize impact on the project.
20. Evaluate measurement summary: ●both the measures and the measurement process should be regularly evaluated ●evaluation of a measurement process should be based on objective data and specific criteria to measure performance, conformance, and capability ●lessons learned in the evaluation should be stored in an experience base ●evaluation results should be used to improve the existing measurement process.
21. Summary: PSM is an effective measurement approach that includes: ●measurement based on information needs ●a systematic method of defining measures through the information model ●a defined process for planning, performing, evaluating, and establishing a measurement program.
22. The CMMI is an internationally recognised reference model describing world’s best practice ●the CMMI is used worldwide by organisations to assist in: -process evaluations –source selection –improvement activities ●organizations have demonstrated quantitative and qualitative benefits in using the CMMI.
23. ●CMMI appraisals are not process audits: -looking for intent of best practice compared with process compliance ●selection of appropriate appraisal class is dependent on the organisation’s information requirements: -drives appraisal resource requirements ●appraisal results assist in prioritising improvement initiatives.
24. ●Optimised process baseline dependent on two key inputs: -the organisation’s goals and objectives –the standard process architecture ●senior management sponsorship is the main success factor for any improvement initiative ●continuous improvement is just that-continuous: affected by internal and external factors.
25. **Copy generic goals and practices**.
26. Evolution of GGs: ● a manage processes is a performed process that is planned and managed in accordance with an organisational policy ● a defined process is a managed process that is tailored from a standard process and contributes information to support future improvement.
27. ● institutionalised processes are ingrained in the corporate culture and define how an organisation does business ● when a process is ingrained in the organisation, it is more likely to be retained during times of stress ● the degree to which a process is institutionalised is embodied in the GGs and described in the GPs.
28. ● the three SCAMP appraisal classes provide a comprehensive family of appraisal methods that can be used to appraise processes depending on the information needs: -demonstrating process institutionalisation –measuring process deployment –evaluating approach or return on investment ● the collection and evaluation of objective evidence is a central concept to all three classes of appraisal method.