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The Application of IEEE Software and System Engineering Standards in Support of Software Process Improvement

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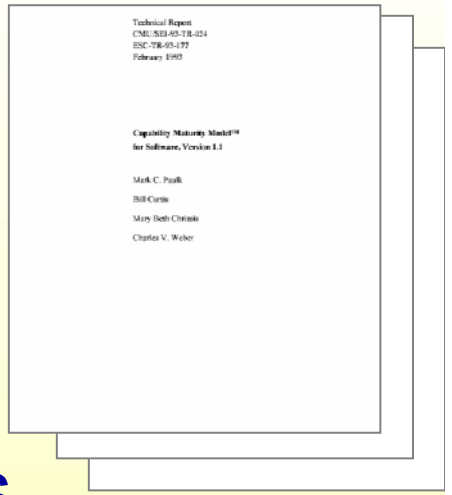
In Other Words…

Using IEEE Software Engineering Standards to:

- Define software engineering (SE) processes.
- Ensure CMMI-SW Level 2 compliance.
- Perform software engineering gap analyses.
- Improve existing SE processes.



Why Process Improvement?

- All those practicing as software engineers should desire to evolve out of the chaotic activities and heroic efforts of a Level 1 organization.
  - *Because no one likes a 'painful' work environment -*
- Good software can be developed by a Level 1 organization, but often at the expense of the developers.
  - *People get tired of being the hero -*
- At the repeatable level, Level 2, software engineering processes are under basic management control and there is a management discipline.
  - *Even the most die-hard techie needs time away from work -*

Who Cares?

The Organization

- *Interested in defining sound software engineering practices.*
- *Would like to perform a Gap analysis on existing processes.*
- *Would like to demonstrate CMMI Level 2 capability*.

The Individual

- *Tasked to implement CMMI compliant processes.*
- *Would like to improve existing software engineering capabilities.*
- *Would like to demonstrate CMMI Level 2 capability*.

Why IEEE Standards?

- IEEE Standards can be used as tools to help in the painful process of *'self-documentation'*.
- Many of the *standards provide detailed procedure explanations*, they offer section by section guidance on building the necessary documentation.
- Most importantly, they *provide the best practice* as defined by those from the software development industry who sit on the panels of reviewers.

The CMMI and SWE Standards

The ***CMMI*** is a compendium of software engineering practices, which act as ***the motivator for the continuous evolution*** of improved software engineering processes.

IEEE Standards can be used to ***provide the basic beginning framework*** for software process improvement.

IEEE and Standards Development

Software and Systems Engineering Standards Committee (S2ESC)

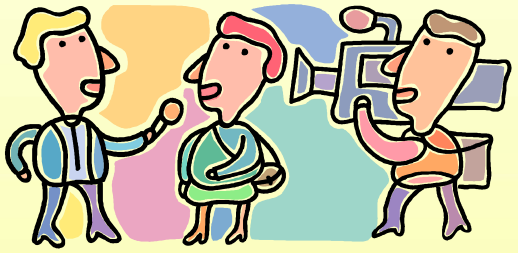
"To provide a family of products and services based on software engineering standards for use by practitioners, organizations, and educators to *improve the effectiveness and efficiency of their software engineering processes, to improve communications between acquirers and suppliers, and to improve the quality of delivered software and systems containing software."*

In 1996 and 1998 S2ESC conducted two web-based software engineering users surveys, the results of these surveys indicated that users perceived the standards provided the most value when applied as guidance in support of software process improvement efforts.

http://standards.computer.org/sesc/

User Feedback/Summary

- Users view ***IEEE software engineering standards*** primarily as reference material to develop their own internal plans.
- ***IEEE SE standards*** are tailored and used to develop internal documentation for compliance measures, namely ***CMMI***.
- There is ***value added*** in the use of the IEEE software engineering standards set in support of process improvement activities.

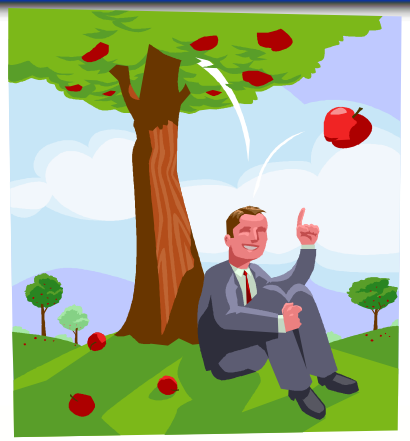


My Personal Goals

- Show how the IEEE set of software engineering standards may be applied to facilitate CMM/CMMI Level 2.
- Examine Strengths and weaknesses of each standard in support of CMM Level 2 requirements.

- Provide recommendations on how the IEEE software engineering standards set may most effectively be utilized to establish software process controls.

The Logic



Assumption 1

The CMMI-SW Staged is an upgrade of the CMM.

Assumption 2

IEEE Standards proved to be an effective support for the implementation of CMM-based process improvement.

Therefore

IEEE Standards provide effective support for the implementation of CMM and CMMISW-based process improvement.

The Basics – CMM/CMMI

- A process is a leverage point for an organization's *sustained improvement*.
- The purpose of the CMMI is to *provide guidance for improving processes* within an organization.
- CMM v1.1 being phased out, CMMI-SW builds on CMM v1.1 and *supports integrated enterprise-wide process improvement*.

Overview Comparison

Maturity Level	SW-CMM	CMMI-SW (Staged)
5	Optimizing	Optimizing
4	Managed	Quantitatively Managed
3	Defined	Defined
2	Repeatable	Managed

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CMMI-SW (Staged) Level 2 PAs

Maturity Level	Process Area (PA) Name	# of Key Practices
5 Optimizing	Organizational Innovation and Deployment Causal Analysis and Resolution	19 17
4 Quant.Managed	Organizational Process Performance Quantitative Project Management	17 20
3 Defined	Requirements Development Technical Solution Product Integration Verification/Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Risk Management	20 21 21 20 19 17 19 20 19
2 Managed	Requirements Management Project Planning Project Monitoring and Control Process and Product Quality Assurance Configuration Management Supplier Agreement Management Measurement and Analysis	15 24 20 14 17 17 18

Level 2 organizations must demonstrate 125 key practices!

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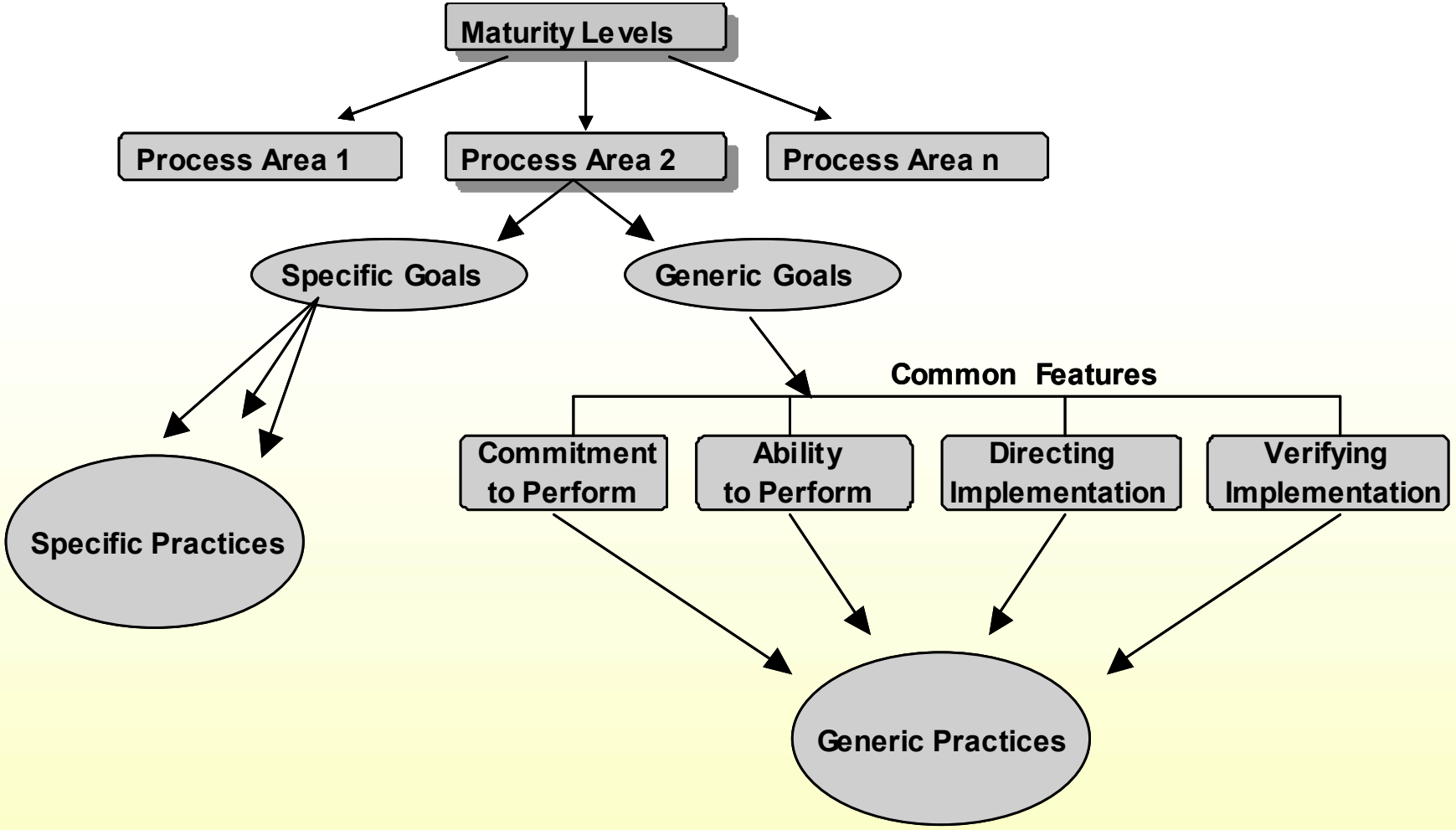
CMMI – Structural Overview



CMMI-SW Level 2 / The Specifics

Requirements Management. Manage requirements associated with a project and identify inconsistencies between the requirements and the project plan and associated work products.

Project Planning. Planning in support of project activities.

Project Monitoring and Control. Processes supporting the effective management of a software project.

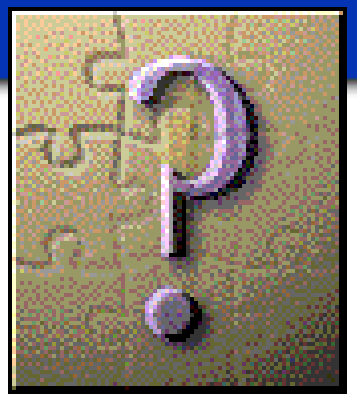
Process and Product Quality Assurance. Activities associated with software project oversight.

Configuration Management. Processes in support of the definition, control, review, and reporting of the work products associated with a software project.

Supplier Agreement Management. Processes supporting the acquisition of products from suppliers for which there exists a formal agreement.

Measurement and Analysis. Processes supporting the development, maintenance, and implementation of software project measurement activities.

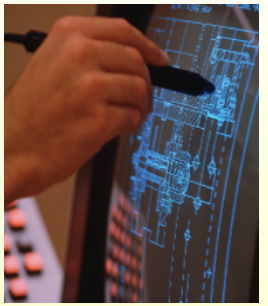
CMMI & IEEE Standards



- **CMMI – Prescriptive *(What)***
  - ✓ Provide guidance for improving the processes within an Organization
- **IEEE – Descriptive *(How)***
  - ✓ To provide a family of products and services based on software engineering standards …

IEEE Standards Structure

- The standards *specify format and content* with no recommendation of the exact techniques to be used.
- The standards *represent industry best practices* having been developed by domain experts with broad expert consensus.

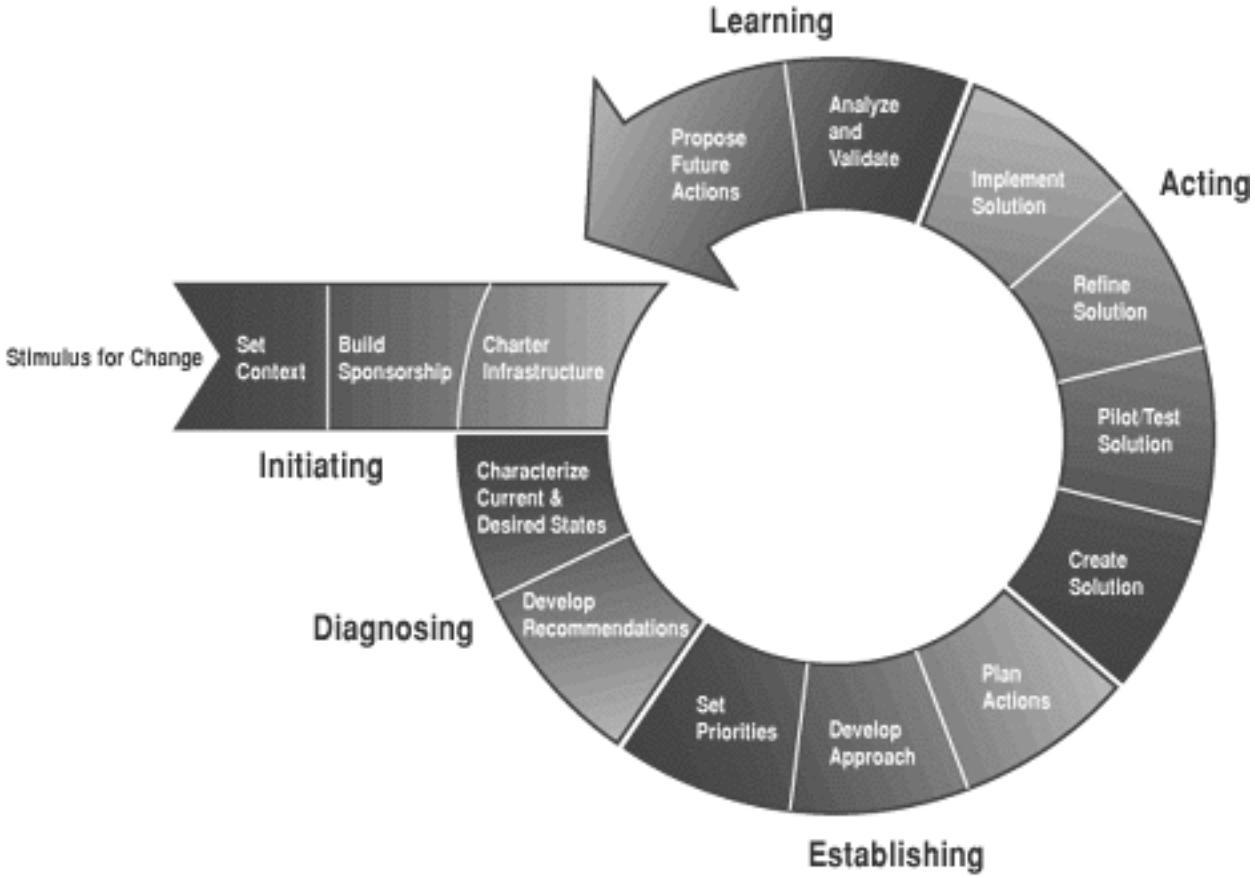


- The standards *specify the minimum required contents for each CMMI support document.*

Implementation Recommendations…

The IDEAL® Approach

Initiate
Diagnose
Establish
Act
Learn



- Developed to support the CMM/CMMI
- Serves a road map to software process implementation and improvement

Define and Train the Process Team (Initiate)

Identify a group of people who are given responsibility and authority for improving organizational processes:

- Implementing process improvement can be very time-consuming, depending upon the scope and complexity of the effort.
- Expectations for each team member's time commitments and job responsibilities must be modified accordingly to reflect the new responsibilities.
- This commitment should reflect time budgeted for process definition and improvement and any required refresher training.

IEEE software engineering standards provide valuable support to the process team. The standards should be used to help define and document the initial baseline of recommended processes and practices.

Set Realistic Goals (Diagnose)

- The leap from chaos (Level 1) to Level 2 is often the hardest step for many organizations.
- Defining the initial process baseline is key, in order to understand where the organization needs to be; it must first understand where it is.
- Use the CMMI®-SW Level 2 and Level 3 goals to identify areas of weakness or bottlenecks in existing processes. Then refer to each of the appropriate IEEE Software Engineering standards using them as planning tools and as checklists to be considered when determining how to accomplish process completeness.
- It is important to identify which organizational process plans will be developed and the sequence of their development.

Fix Timelines (Establish)

Goal driven process improvement is the most effective. Identify short and long term goals and time periods; associate these goals as schedule milestones.

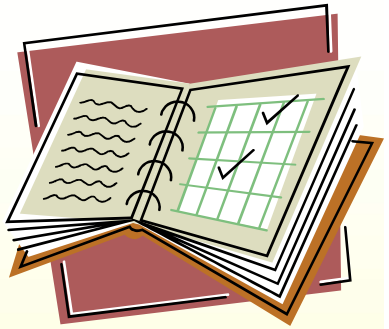
(0-3 months)

- Identify responsible individuals.
- Identify participating project managers.
- Identify candidate projects.
- Solidify backing of Senior Management.
- Look at existing processes.
- Define the formats for your process plans using IEEE Software Engineering Standards and measure them against the CMMI® requirements.
- Get project members to provide feedback on process plans, review and incorporate feedback.
- Conduct ARC Class C Gap Analysis.

Fix Timelines (Establish)

(3-6 months)

- Create process document templates (e.g., Software Development Plan, Software Requirements Specification.)
- Conduct weekly/monthly status reviews.



(6-9 months)

- Conduct CMMI®-based reviews of the projects.
- Provide feedback regarding project reviews.

(9-12 months)

- Conduct Internal Assessments, with reporting to senior management.
- Provide feedback regarding project review providing requirements for improvement to the projects.

Baseline and Implement Processes (Act)

Use IEEE standards to develop your baseline process documentation.

- Once a process baseline has been established formulate an action plan.
- It is also important to evaluate and identify any potential tools that may be used in support of process automation:
  - A tool is not a substitute for a process.
  - An ideal candidate area for this type of automation is SCM.
  -
- Many IEEE SWE standards provide documentation templates and describe in detail what the processes should contain.

Think of these standards as an *in-house software process consultant* who has recommended, based upon years of experience, the proper methodologies and techniques to be used in support of software development.

Perform Gap Analysis (Learn)

It is important to gauge how effectively process improvements have been implemented for continuous process improvement to be successful.

- Develop a benchmarking appraisal to support gap analysis activities.
- Provides a baseline for future process improvement efforts and will identify weaknesses and strengths.
- Review the associated appraisal methodology used in support of the CMMI®
  - ARC
  - SCAMPI

Looking at the Specifics..

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CMMI-SW Cross-Reference

Level 2 CMMI-SW KPA	IEEE Standards
Requirements Management	IEEE Std 830 – 1998 IEEE Recommended Practice for Software Requirements Specifications
Project Planning	IEEE Std 1058 – 1998 IEEE Standard for Software Project Management Plans
Project Monitoring and Control	IEEE Std 1058 – 1998 IEEE Standard for Software Project Management Plans
Process and Product Quality Assurance	IEEE Std 730 – 2002 IEEE Standard for Software Quality Assurance
Configuration Management	IEEE Std 828 – 1998 IEEE Standard for Software Configuration Management Plans
Supplier Agreement Management	IEEE Std 1062 – 1998 IEEE Recommended Practice for Software Acquisition
Measurement and Analysis	IEEE Std 1045 – 2002 IEEE Standard for Software Productivity Metrics

1st - Framework Definition

- Software Life Cycle
  - **IEEE/EIA 12207.0**, *Industry Implementation of International Standard ISO/IEC12207:1995 —Standard for Information Technology —Software life cycle processes*
    - **IEEE/EIA 12207.1**, *Industry Implementation of International Standard ISO/IEC12207:1995 — (ISO/IEC 12207) Standard for Information Technology —Software life cycle processes – Life Cycle Data*
    - **IEEE/EIA 12207.2**, *Industry Implementation of International Standard ISO/IEC12207:1995 — (ISO/IEC 12207) Standard for Information Technology —Software life cycle processes – Implementation considerations*
- Systems Life Cycle
  - **ISO/IEC 15288**, *Systems engineering — System life cycle processes*

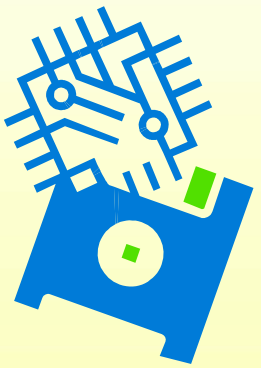
www.computer.org/Standards

PA - Requirements Management

IEEE Std 830-1998, IEEE Recommended Practice for Software Requirements Specifications.

Outlines the requirements for what comprises a good Software Requirements Specification (SRS):

- Establishes the basis for agreement between the customers and the suppliers on what the software product is to do.
- Reduces the development effort.
- Provides a basis for estimating costs and schedules.
- Provides a baseline for validation and verification.
- Facilitates transfer.
- Serves as a basis for enhancement.



Does not directly address Requirements Traceability!

PA - Project Planning

IEEE Std 1058, IEEE Standard for Software Project Management Plans.

- Specifies a suggested format for a project management plan:
  - This document may be used as a guide for documenting the practices and procedures unique to each organization for all types of software efforts.
  - The IEEE Standard for Project Management Plans can be used as a model for this CMMI Level 2 process.
- The purpose of CMMI Level 2 Software Project Planning is to establish reasonable plans for performing software engineering and software project management.

PA - Project Monitoring and Control

Simply initially estimating the duration and total cost of a software effort is not sufficient.

- Planning must continue throughout the software development and maintenance process.
- Project monitoring (tracking) and control of the management process encompasses most of the development process.

This includes all activities that project management has to perform to ensure that the project objectives are met and that development proceeds according to the plan.

- Monitor cost, schedule, quality, and potential risk.
- Take corrective action when necessary.

PA - Supplier Agreement Management

IEEE Recommended Practice for Software Acquisition, IEEE Std 1062- 1998.

- Provides information on the recommended practice for acquiring software:
  - Describes the software acquisition life cycle.
  - Offers support in preparing contract requirements, proposal evaluation, and supplier selection.
  - Provides insight into the management of a software supplier and product acceptance.
  - Offers a series checklists which consist of information designed to help organizations establish their own software acquisition process.

This standard describes a set of quality practices that can be applied during one or more steps of the software acquisition process.

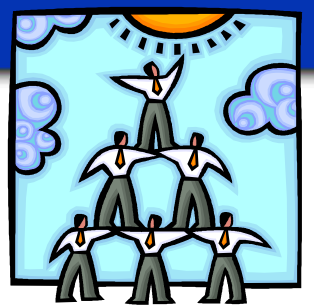
PA – Process and Product Quality Assurance

- The purpose of IEEE Std 730-1998 is to provide uniform, minimum acceptable requirements for the preparation and content of Software Quality Assurance Plans:

- Recommended approaches to good SQA practices are describe in IEEE Std 730.1-1995.

Combined, these two plans describe the requirements in support of industry standard SQA practices.

PA - Configuration Management



SCM as described by IEEE Std 838-1998:

"SCM constitutes good engineering practice for all software projects, whether phased development, rapid prototyping, or ongoing maintenance. It enhances the reliability and quality of software by providing a structure for identifying and controlling documentation, code, interfaces, and databases to support all life cycle phases supporting a chosen development/maintenance methodology that supports the requirements, standards, policies, organization, and management philosophy producing management and product information concerning the status of baselines, change control, tests, releases, audits, etc."

The plan basically provides a framework for organizations to follow. Use of this standard offers a reasonably stable cross-project development environment.

PA - Measurement & Analysis

- **IEEE Std 1044, Standard Classification for Software Anomalies.**
  - Defines a uniform approach to the classification and documentation of the variances found in software products.

- **IEEE Std 1045, Standard for Software Productivity Metrics.**
  - Provides a framework for measuring and reporting software productivity. It is meant for those who want to measure the productivity of the software process in support of their software product.

Through the application of these standards - issues with life cycle processes are identified and improved.

Implementation Summary

Examine each CMMI Level 2 Key Practice (*Co, Ab, Me, Ve,* and *Ac)*.

Identify supporting portions of IEEE standards. Do not consider each standard in isolation, rather consider the ***complete set*** of those most directly supporting CMMI Level 2 items.

Document ***your*** processes using the IEEE standards and Level 2 capabilities.

- *Small projects may require less formality in planning than large projects, but all components of each standard should be addressed by every software project.*
- *Components may be included in the project level documentation, or they may be merged into a system-level or business-level plan, depending upon the complexity of the project.*

Common Implementation Pitfalls

- Being overly prescriptive
- Remaining confined to a specific stage
- Lack of incentives
- No metrics taken
- Documentation for the sake of documentation

What to watch out for..

Each organization using IEEE standards should develop a set of practices and procedures that provide detailed guidance for preparing and updating plans based upon standards.

- There are some holes relating to PT&O and metrics.
- Pay special attention to CMMI general requirements.
- Funding for process improvement activities is not specifically referenced in IEEE plans, this must be included in the project management plan.
- Need to specifically address requirements traceability throughout product lifecycle.

In Conclusion

- Leverage the expertise contained in the IEEE Software and Systems Engineering Standards.
- Fix timelines to produce goal driven process improvement.
- Define your processes in outline form.
- Perform a gap analysis.
- Redefine your processes.
- Use IEEE standards to develop your baseline process documentation.
- Perform self-audit using CMMI PAs.
- Readjust processes/plans based upon audit results.

Make a plan. Then follow the plan. - Watts Humphrey

Get Involved

IEEE Computer Society:
http://www.computer.org/

IEEE Software Engineering Standards:
http://standards.computer.org/sesc/

IEEE Software Engineering Online:
http://billing.computer.org/portal/index.jsp

CMM/CMMI:
http://www.sei.cmu.edu

To Order IEEE Standards ($320):
http://www.computer.org/cspress/CATALOG/st01121.htp

Need More Help?

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