The opinions contained in this presentation are those of the author and do not necessarily represent those of The MITRE Corporation or its sponsors.
Ten years ago, most of this did not exist for software engineering. It all exists now.
Reaching the Stakeholders

Guide to the Software Engineering Body of Knowledge

Education
- Curriculum
- Accreditation Criteria
  IEEE/ACM Software Engineering 2004 curriculum
  ABET

Professional Development
- Continuing Education
- Certification
  CSDP Online Prep Course
  IEEE CS SWE Book Series
  Certified Software Development Professional

Practice
- Standards of Practice
  IEEE Software and Systems Engineering Standards Committee
  ISO/IEC JTC1/SC7 and other committees
Tools for Integrating Software Engineering Standards

- Knowledge Context
  - Fundamental Principles
  - Software Engineering Body of Knowledge

- Normative Framework
  - Umbrella Standards
    - Reference Processes
    - Vocabulary
    - Measurement Model
    - Product Quality Model
  - Harmonization of Standards across Organizations and Disciplines
    - Driven by importance
    - Driven by opportunity
The existing reference processes of IEEE are:
- 17 processes of 12207
- + Measurement from ISO/IEC 15939
- + Risk Management from IEEE 1540 (now ISO/IEC 16085)
- + 3 software reuse processes from IEEE 1517

All additions were designed to “plug into” 12207.
Reference Processes (Part 2)

- ISO/IEC 12207 Amd 1 and 2 describe **purpose** and **outcomes** of three dozen software life cycle processes.
- ISO/IEC 15288 describes **purpose**, **outcomes** and **activities** of two dozen system life cycle processes.
- There seems to be some overlap.
- The current “harmonization” project is intended to sort this out.
# System Life Cycle Processes of ISO/IEC 15288

## Process Categories of ISO/IEC 15288

<table>
<thead>
<tr>
<th>Enterprise Processes</th>
<th>Agreement Processes</th>
<th>Enterprise Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Processes</td>
<td></td>
<td>Project Processes</td>
</tr>
<tr>
<td>Technical Processes</td>
<td></td>
<td>Technical Processes</td>
</tr>
</tbody>
</table>

**Enterprise Processes**
- Enterprise Environment Management
- Investment Management
- Systems Life Cycle Processes Management
- Resource Management
- Quality Management

**Agreement Processes**
- Project Planning
- Project Assessment
- Project Control
- Decision-Making
- Risk Management
- Configuration Management
- Information Management

**Project Processes**
- Stakeholder Requirements Definition
- Requirements Analysis
- Architectural Design
- Implementation
- Integration
- Verification
- Transition
- Validation
- Operation
- Maintenance
- Disposal
Vocabulary

- IEEE 610.12, Glossary of Software Engineering Terminology, was last revised in 1990.
- JTC1 doesn’t have a system and software engineering vocabulary but does have a few near-misses of varying ages:
- IEEE CS and SC7 have approved a project to develop a shared vocabulary … … but the IEEE CS nominee for editor wasn’t able to take the job.
Measurement Model

- IEEE adopted the measurement model of ISO/IEC 15389 …
- … which, in turn, came from the DoD Practical Software Measurement program.

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

Product Quality Model

- Functionality
  - Suitability
  - Accuracy
  - Interoperability
  - Security
  - Compliance
- Reliability
  - Maturity
  - Fault Tolerance
  - Recoverability
  - Compliance
- Usability
  - Understandability
  - Learnability
  - Operability
  - Attractiveness
  - Compliance
- Efficiency
  - Time
  - Behavior
  - Resource Utilization
  - Compliance
- Maintainability
  - Analyzability
  - Changeability
  - Stability
  - Testability
  - Compliance
- Portability
  - Adaptability
  - Installability
  - Coexistence
  - Replaceability
  - Compliance
- Quality in Use
  - Effectiveness
  - Productivity
  - Safety
  - Satisfaction

http://standards.computer.org/sesc/sesc_pols
Harmonization among Organizations

- ISO
- TMB (Risk Mgmt Vocabulary)
- IEC
- TC176 (Quality Mgmt)
- TC184 (Enterprise Arch)
- JTC1
- TC56 (Dependability)
- TC65 (Safety)
- SC7 (Software and Systems Engineering)
- Study Group (Privacy)
- SC27 (IT Security)
- SC22 (Prog Lang)
Harmonization among Organizations

**Examples:**
- IEEE CS maintains a liaison to SC7.
- IEEE has policies re compatibility with other products, e.g. ISO 9001.
- IEEE and SC7 have a shared “Vision of Outcomes”.
- IEEE adopts some key SC7 standards and contributes some of its own to SC7.
- IEEE has adopted PMI PMBOK as IEEE Std 1490.
Harmonization between Software and System Life Cycle Processes

- There is a reasonably good fit of 12207 development activities with 15288 technical processes.
- But how will 15288 enterprise processes fit with other standards?
  - Enterprise Environment Management
  - System Life Cycle Processes Management
  - Quality Management
  - Resource Management
  - Investment Management

<table>
<thead>
<tr>
<th>15288 Technical Processes</th>
<th>Activities of 12207 Development Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stakeholder Reqmts</td>
<td>Sys Reqmts Analysis</td>
</tr>
<tr>
<td>Reqmts Analysis</td>
<td>Sys Arch Design</td>
</tr>
<tr>
<td>Arch Design</td>
<td>SW Reqmts Analysis</td>
</tr>
<tr>
<td>Implementation</td>
<td>SW Arch Design</td>
</tr>
<tr>
<td></td>
<td>SW Detail Design</td>
</tr>
<tr>
<td></td>
<td>SW Code &amp; Test</td>
</tr>
<tr>
<td></td>
<td>SW Integration</td>
</tr>
<tr>
<td></td>
<td>SW Qualification Test</td>
</tr>
<tr>
<td>Integration</td>
<td>Sys Integration</td>
</tr>
<tr>
<td>Verification</td>
<td>Sys Qualification Test</td>
</tr>
<tr>
<td>Transition</td>
<td>SW Installation</td>
</tr>
<tr>
<td>Validation</td>
<td>SW Accept Support</td>
</tr>
<tr>
<td>Delivery …</td>
<td></td>
</tr>
</tbody>
</table>
Harmonization among Disciplines

ISO TC176 QM Standards

ISO 9001 and 9004 Quality Mgmt System

Subsidiary QM Standards

- ISO 10006 Quality in PM
- ISO 10007 Quality in CM
- ISO 10005 Quality Plans

15288 Sys LC Processes

- Project Plan, Assess, & Control
- CM
- QM
- Verification
- Validation

12207 SW LC Processes

- Mgmt
- CM
- QA
- Verification
- Validation

- Liaison between TC176 and SC7
- Cross-membership of IEEE, US TAG to TC176 and ASQ SW.
- SC7 developed 15288 and 90003. IEEE will adopt.
- SC7 considers the relevant subsidiary TC176 standards in its planning.

What about Enterprise Architecture standards from TC 184?
## The State of Harmonization in 1994

<table>
<thead>
<tr>
<th>Topic</th>
<th>Status</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminology</td>
<td>Red</td>
<td>Different vocabulary standards</td>
</tr>
<tr>
<td>Product quality</td>
<td>Yellow</td>
<td>Unrelated standards</td>
</tr>
<tr>
<td>Systems engineering</td>
<td>Yellow</td>
<td>Unrelated standards</td>
</tr>
<tr>
<td>SW life cycle processes</td>
<td>Red</td>
<td>Incompatible standards</td>
</tr>
<tr>
<td>SW process assessment</td>
<td>Yellow</td>
<td>Nothing in IEEE. ISO process assessment incompatible with ISO LC.</td>
</tr>
<tr>
<td>SW life cycle data</td>
<td>Red</td>
<td>Incompatible standards</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Red</td>
<td>Incompatible standards</td>
</tr>
<tr>
<td>Measurement</td>
<td>Yellow</td>
<td>Unrelated standards</td>
</tr>
<tr>
<td>Risk management</td>
<td></td>
<td>No standards at all</td>
</tr>
<tr>
<td>Configuration management</td>
<td>Red</td>
<td>Incompatible standards</td>
</tr>
<tr>
<td>Project management</td>
<td>Red</td>
<td>Incompatible standards</td>
</tr>
<tr>
<td>Verification and validation</td>
<td>Red</td>
<td>Fundamentally different approaches; minor incompatibilities in details</td>
</tr>
<tr>
<td>CASE tools</td>
<td>Yellow</td>
<td>Minor incompatibilities</td>
</tr>
<tr>
<td>User documentation</td>
<td>Red</td>
<td>Incompatible standards</td>
</tr>
<tr>
<td>Notations</td>
<td>Yellow</td>
<td>Unrelated standards</td>
</tr>
<tr>
<td>Safety</td>
<td>Orange</td>
<td>Unrelated approaches</td>
</tr>
<tr>
<td>Others</td>
<td>Yellow</td>
<td>Many unrelated standards</td>
</tr>
</tbody>
</table>
# The State of Harmonization … Today

<table>
<thead>
<tr>
<th>Topic</th>
<th>Status</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminology</td>
<td>Yellow</td>
<td>Joint project underway to adopt and revise IEEE vocabulary</td>
</tr>
<tr>
<td>Product quality</td>
<td>Yellow</td>
<td>Unrelated standards</td>
</tr>
<tr>
<td>Quality management</td>
<td>Yellow</td>
<td>IEEE is adopting ISO 9000 approach; lots of loose ends</td>
</tr>
<tr>
<td>Systems engineering</td>
<td>Yellow</td>
<td>Harmonization and cross-adopt of standards underway</td>
</tr>
<tr>
<td>SW life cycle processes</td>
<td>Green</td>
<td>But some loose ends remain</td>
</tr>
<tr>
<td>SW process assessment</td>
<td>Yellow</td>
<td>Harmonization underway</td>
</tr>
<tr>
<td>SW life cycle data</td>
<td>Yellow</td>
<td>Development of shared standard underway</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Yellow</td>
<td>Project to merge IEEE and ISO standards is nearly complete</td>
</tr>
<tr>
<td>Measurement</td>
<td>Green</td>
<td>But some loose ends remain</td>
</tr>
<tr>
<td>Risk management</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>Configuration management</td>
<td>Yellow</td>
<td>ISO dropped its incompatible standard; systems issues remain</td>
</tr>
<tr>
<td>Project management</td>
<td>Yellow</td>
<td>New project to merge the incompatible standards</td>
</tr>
<tr>
<td>Verification and validation</td>
<td>Red</td>
<td>Fundamentally different approaches; minor incompatibilities in details</td>
</tr>
<tr>
<td>CASE tools</td>
<td>Yellow</td>
<td>Minor incompatibilities</td>
</tr>
<tr>
<td>User documentation</td>
<td>Red</td>
<td>Incompatible standards; discussion underway</td>
</tr>
<tr>
<td>Notations</td>
<td>Yellow</td>
<td>Unrelated standards</td>
</tr>
<tr>
<td>Safety</td>
<td>Orange</td>
<td>Unrelated approaches; I'm leading a study group</td>
</tr>
<tr>
<td>Others</td>
<td>Yellow</td>
<td>Many unrelated standards</td>
</tr>
</tbody>
</table>
Current Situation

- IEEE has been integrating and stabilizing selected software and systems engineering standards for the last decade.
- IEEE standards are now supported by compatible professional development and certification material.
- Integration of software engineering discipline is largely completed.
- Integration with systems engineering and quality management is underway.
- “Horizon” for integration is being pushed out further.
A Success Story: Harmonization of SW Engineering Standards and Professional Development

- SWEBOK Guide cites key standards.
- CSDP uses SWEBOK Knowledge Areas + 1
- IEEE organizes its collection via the SWEBOK KAs.
- CCSE started with SWEBOK and rebalanced for undergrads.
Plans for 2005

- **SWEBOK**
  - Publication in book format by IEEE CS Press and by ISO
  - Gain approval of a plan for evolution
- **CSDP**
  - Favorable result from SC7 study group to create an international basis for certification.
- **Standards**
  - Kick off joint vocabulary project
  - Complete cross-adoption of risk management standard
  - Get good proposal for harmonization of system / software / QM processes
    - Complete IEEE adoption of ISO/IEC 15288
    - Reconcile IEEE 1220 with ISO/IEC 15288. (Complete first cut. Fast-track to ISO for second cut.)
  - Merge IEEE and ISO maintenance standards
  - Approve plan to merge IEEE / SC7 project management standards
  - ISO withdraws conflicting CM standard
  - Fast-track IEEE Web Site Engineering standard to ISO
  - ISO decides to adopt IEEE architecture description standard
  - Reconcile two collections of CASE tool standards
  - ISO decides to adopt IEEE standard on user documentation
  - IEEE adopts ISO “flow-down” of ISO 9001 (quality management) to software
  - IEEE and ISO agree on plan for standard for life cycle data products
  - ISO adopts “assurance cases” into their standards. IEEE mirrors the approach in its safety planning standard