IS 2620: Developing Secure Systems

Secure Software Development Models/Methods

Lecture 1
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Objective

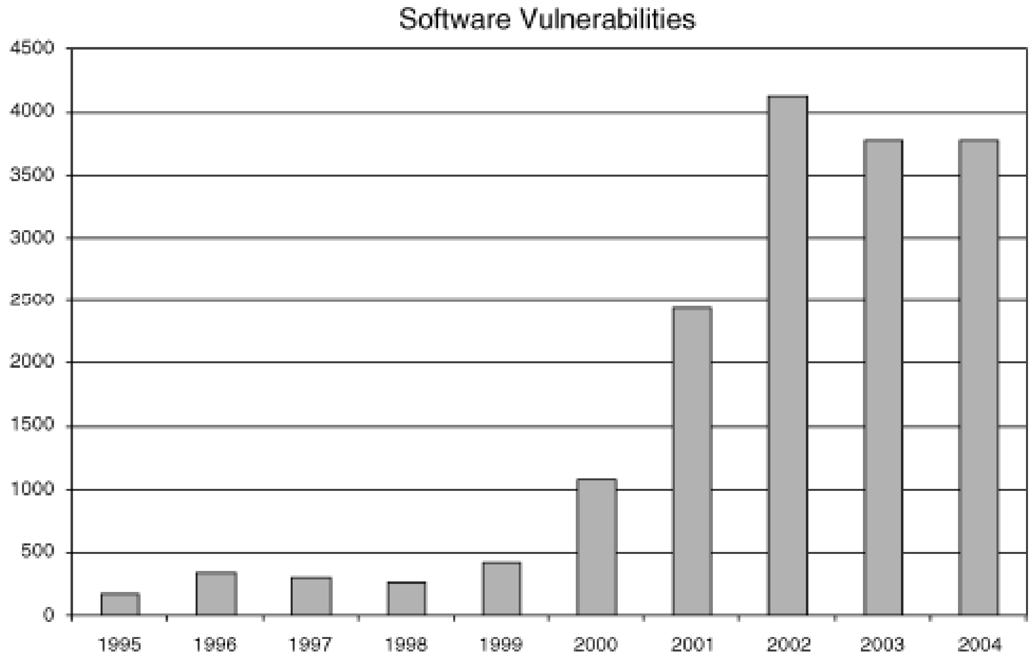
- Understand/Familiarize with various process models for secure software development and assurance
  - Capability Maturity Models
    - CMMI, iCMM, SSE-CMM, TSP
    - Security Assurance Maturity Model
  - Secure software development life cycle models

Software/Systems Security

- Renewed ---- interest & importance
  - "*idea of engineering software so that it continues to function correctly under malicious attack*"
  - Existing software is riddled with design flaws and implementation bugs
    - ~70% related to design flaws*
  - "any program, no matter how innocuous it seems, can harbor security holes"

*http://www.securitymanagement.com/archive/library/atstake_tech0502.pdf

Software Problem



# vulnerabilities
Reported by CERT/CC

- More than half of the vulnerabilities are due to buffer overruns
- Others such as race conditions, design flaws are equally prevalent

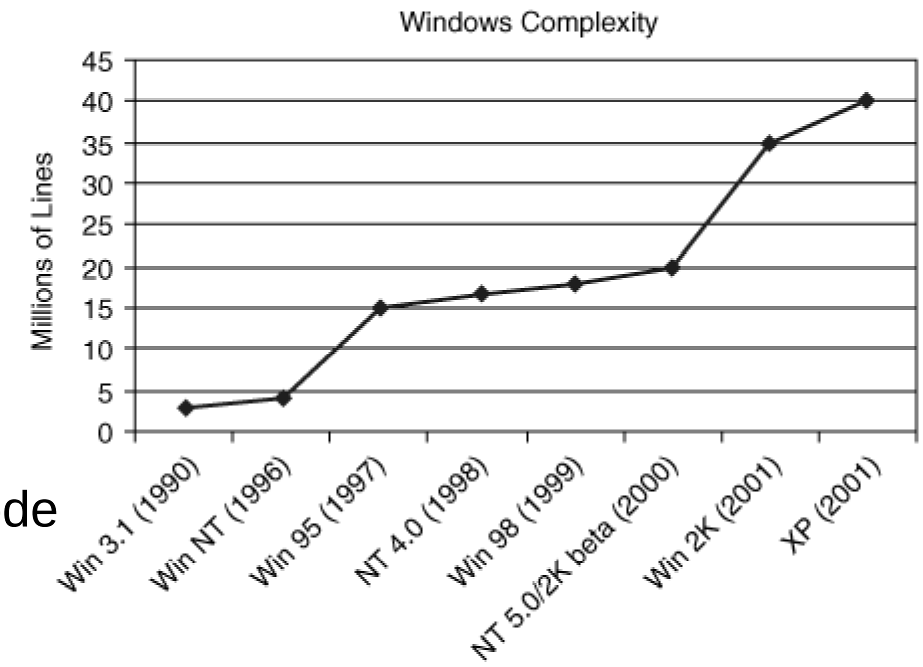
Software security

- It is about
  - Understanding software-induced security risks and how to manage them
  - Leveraging software engineering practice,
  - thinking security early in the software lifecyle
  - Knowing and understanding common problems
  - Designing for security
  - Subjecting all software artifacts to thorough objective risk analyses and testing
- It is a knowledge intensive field

Trinity of trouble

- Three trends
  - Connectivity
    - Inter networked
    - Include SCADA (supervisory control and data acquisition systems)
    - Automated attacks, botnets
  - Extensibility
    - Mobile code – functionality evolves incrementally
    - Web/Os Extensibility
  - Complexity
    - XP is at least 40 M lines of code
    - Add to that use of unsafe languages (C/C++)

Bigger problem today .. And growing



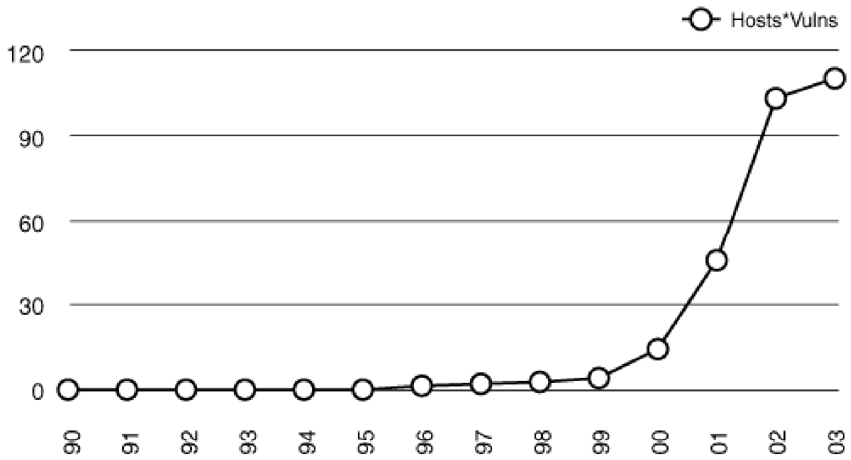
It boils down to ...

more code,

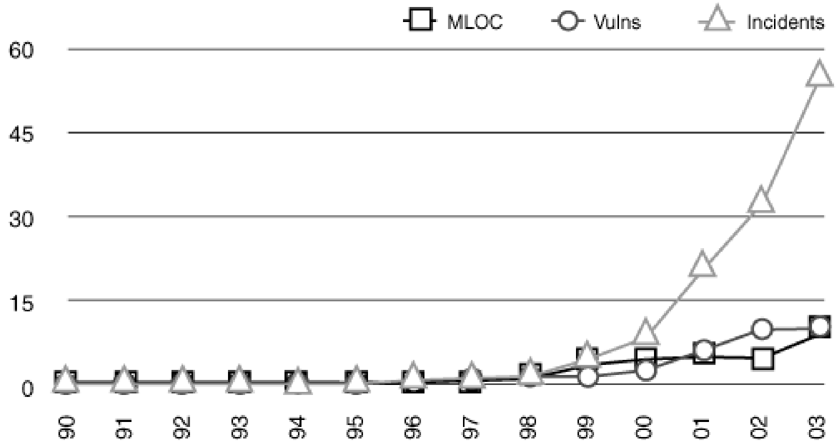
more bugs,

more security problems

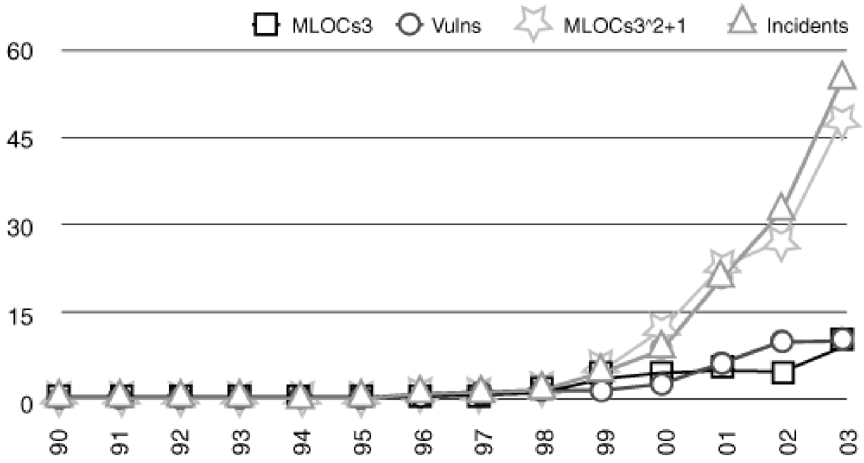
Opportunity (normalized)



Normalized (median, 2-year lag)

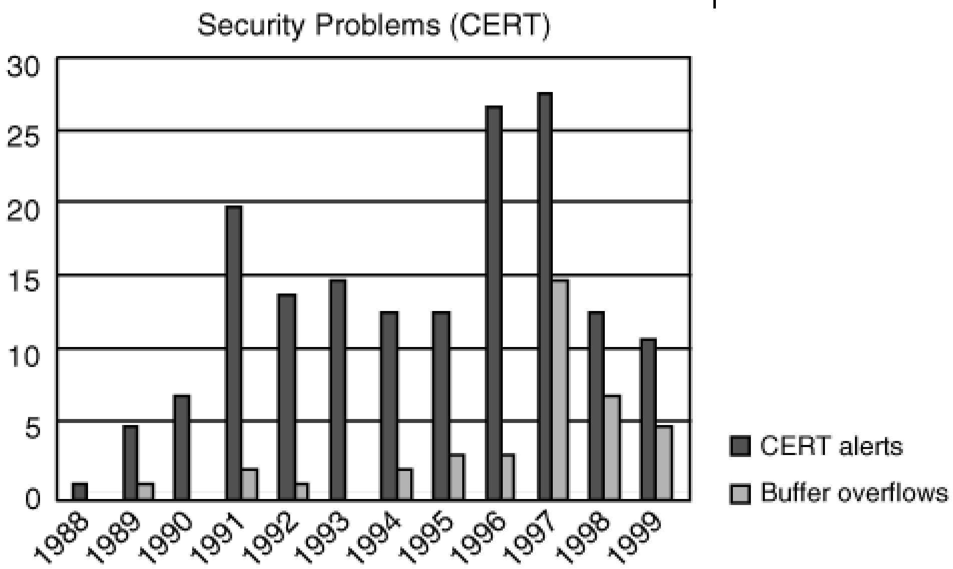


Drivers



Security problems in software

- Defect
  - implementation and design vulnerabilities
  - Can remain dormant
- Bug
  - An implementation level software problem
- Flaw
  - A problem at a deeper level
- Bugs + Flaws
  - leads to Risk



Bug	Flaw
Buffer overflow: stack smashing Buffer overflow: one-stage attacks Buffer overflow: string format attacks Race conditions: TOCTOU Unsafe environment variables Unsafe system calls (fork(), exec(), system()) Incorrect input validation (black list vs. white list	Method over-riding problems (subclass issues) Compartmentalization problems in design Privileged block protection failure (DoPrivilege()) Error-handling problems (fails open) Type safety confusion error Insecure audit log design Broken or illogical access control (role-based access control [RBAC] over tiers) Signing too much code

Process Models

- **Secure Process**
    - *Set of activities performed to develop, maintain, and deliver a secure software solution*
  - Activities could be concurrent or iterative
- **Process model**
  - provides a reference set of best practices
    - process improvement and process assessment.
  - defines the characteristics of processes
  - usually has an architecture or a structure

Process Models

- Process Models
  - Help identify *technical* and *management* practices
    - good software engineering practices to manage and build software
  - Establishes
    - common measures of organizational processes throughout the software development lifecycle (SDLC).
  - But … no guarantees product is bug free

Process Models

- Typically also have a
  - *capability* or *maturity* dimension used for
    - Purposes: ***assessment*** and ***evaluation***.
- Assessments, evaluations, appraisals includes:
  - comparison of a process being practiced to a reference process model or standard
  - understanding process capability in order to improve processes
  - determining if the processes being practiced are
    - adequately specified, designed, and implemented

Software Development Life Cycle (SDLC)

- Four key SDLC focus areas for secure software development
  - Security Engineering Activities
  - Security Assurance
  - Security Organizational and Project Management Activities
  - Security Risk Identification and Management Activities

Based on a survey of existing processes, process models, and standards seems to identify the following

SDLC

- Security Engineering Activities
  - activities needed to *engineer a secure solution*.

    security requirements elicitation and definition,

    secure design based on design principles for security,

    use of static analysis tools,

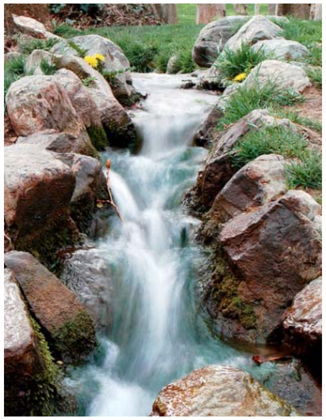
    reviews and inspections, security testing, etc..

- Security Assurance Activities

  verification, validation, expert review,

  artifact review, and evaluations.

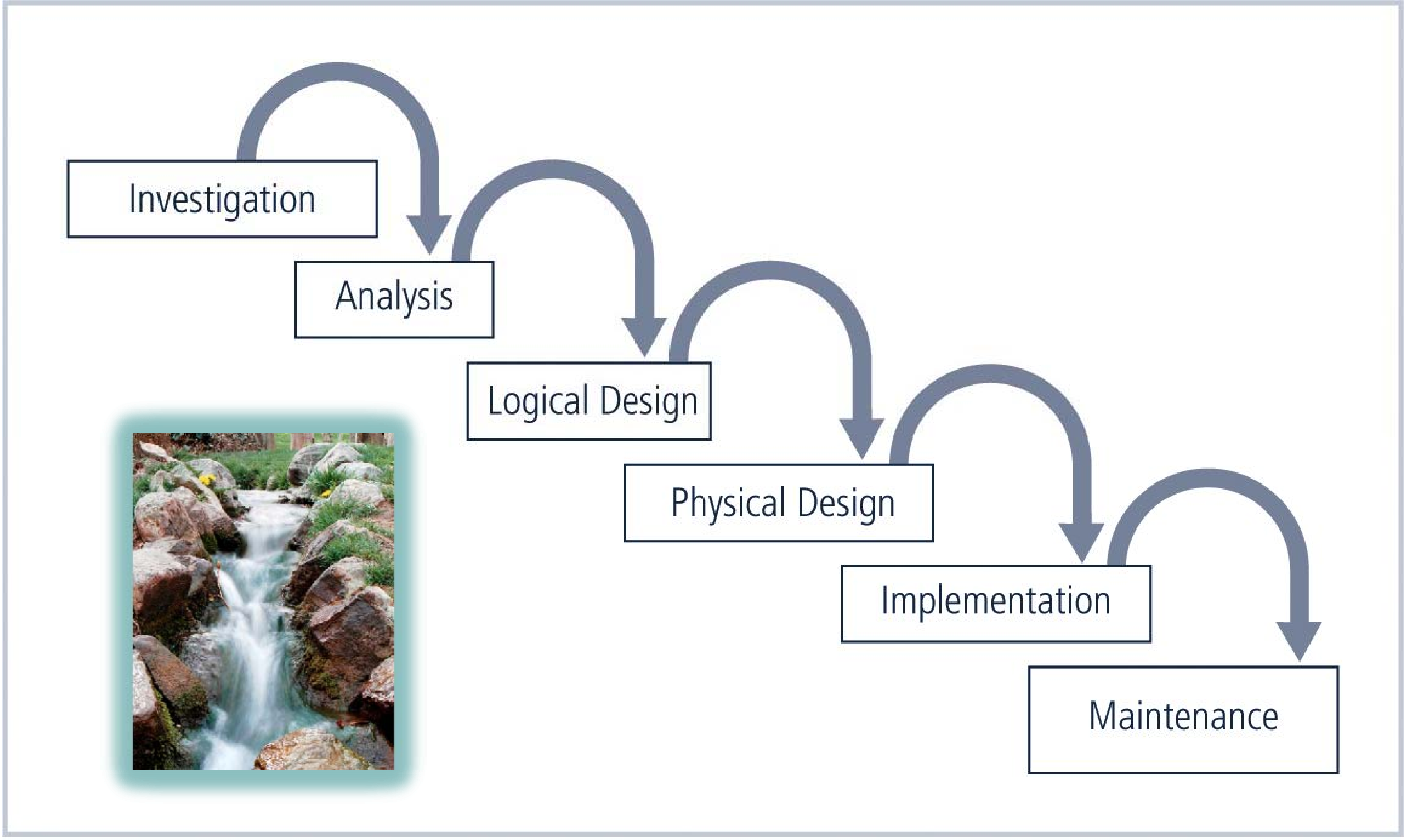
Waterfall Model



SDLC

- Security Focused Activities
  - Organizational management focused
    - organizational policies, senior management sponsorship and oversight, establishing organizational roles, ….
  - Project management focused
    - project planning and tracking,
    - resource allocation and usage
- Security Risk Identification and Management Activities
  - Cost-based Risk analysis
  - Risk mitigation ..

System DLC



Investigation

Analysis

Logical Design

Physical Design

Implementation

Maintenance

Capability Maturity Models (CMM)

- CMM – focuses on process characteristics
  - Provides reference model of mature practices
  - Helps identify the potential areas of improvement
  - Provides goal-level definition for and key attributes for specific processes

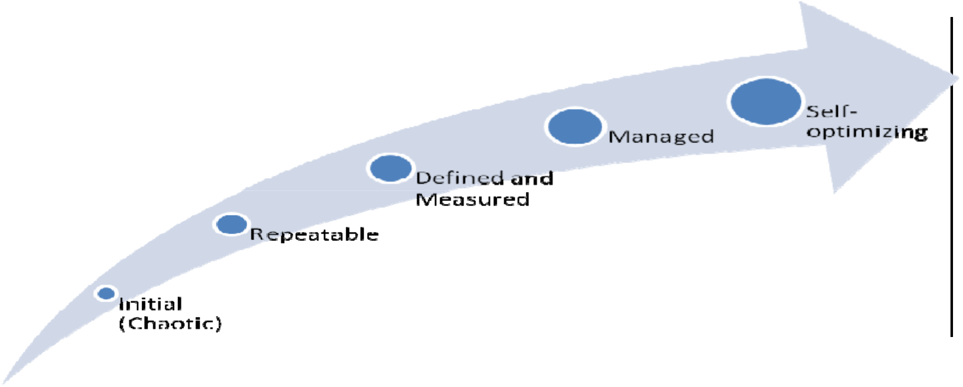
  - **No operational guidance !!**

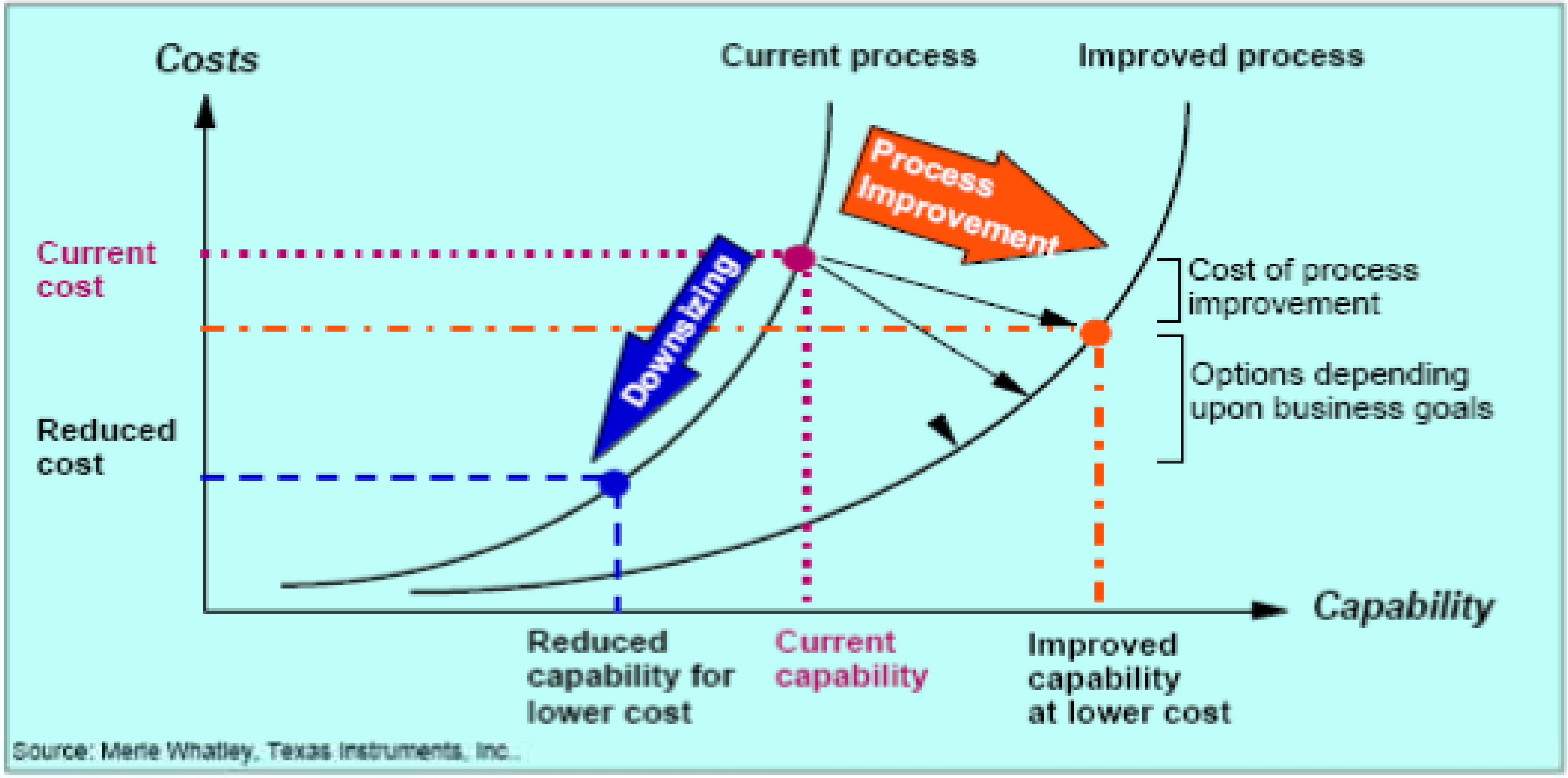
    Focuses on/Defines process characteristics

CMM

- Three CMMs
  - **C**apability **M**aturity **M**odel **I**ntegration® (CMMI®),
  - The **i**ntegrated **C**apability **M**aturity **M**odel (iCMM), and the
  - **S**ystems **S**ecurity **E**ngineering **C**apability **M**aturity **M**odel (SSE-CMM)
    - Specifically to develop secure systems

Why CMM?

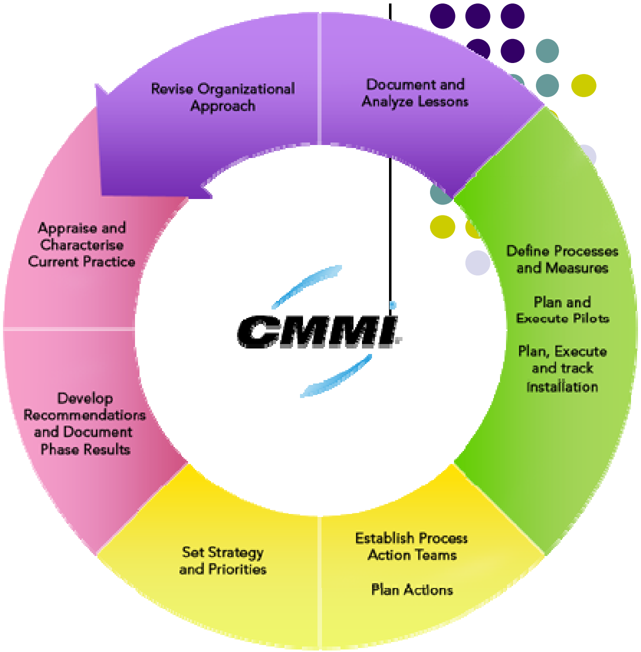




Source: Merle Whatley, Texas Instruments, Inc.

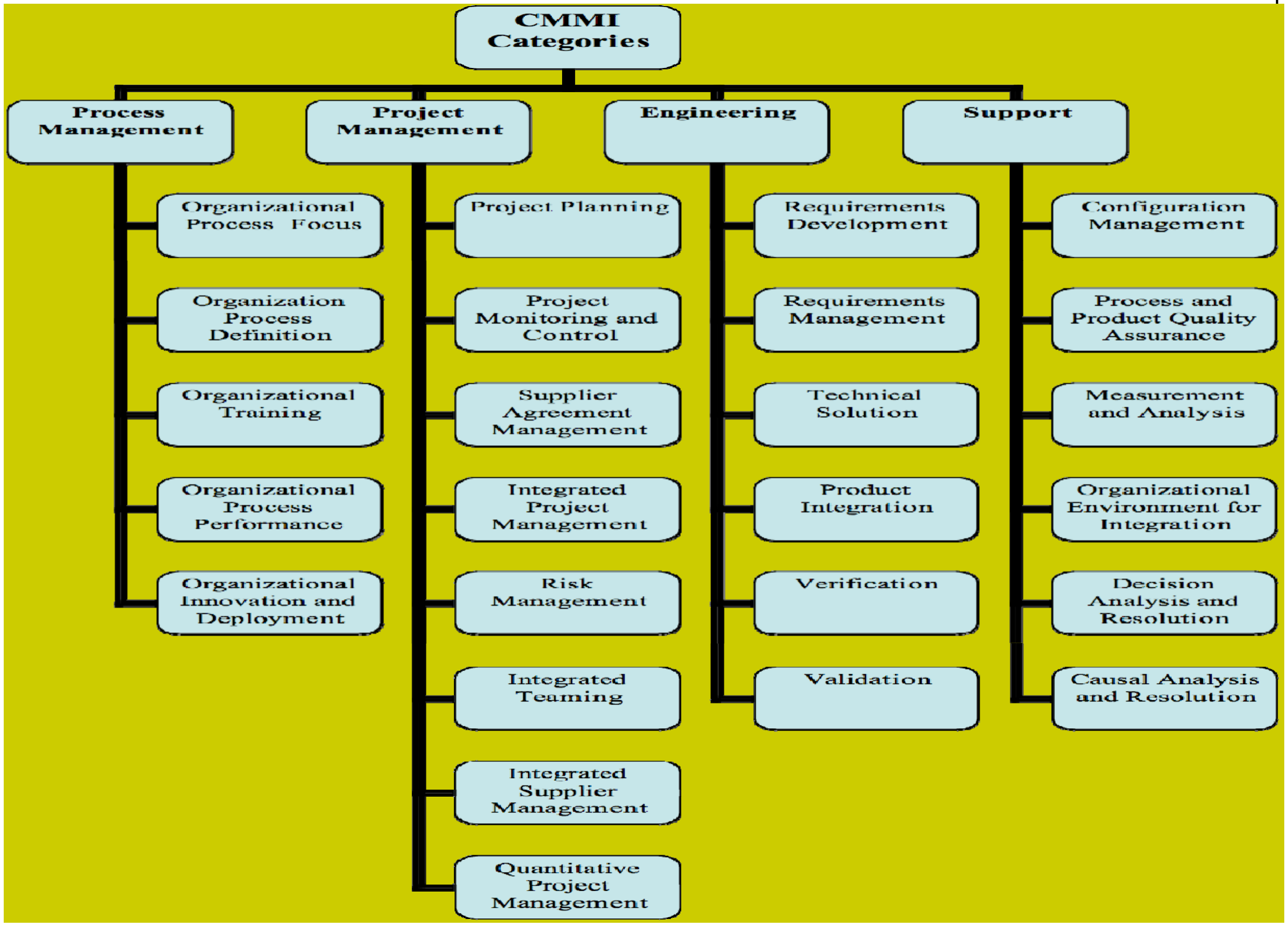
Source: http://www.secat.com/download/locked_pdf/SSEovrw_lkd.pdf

CMMI

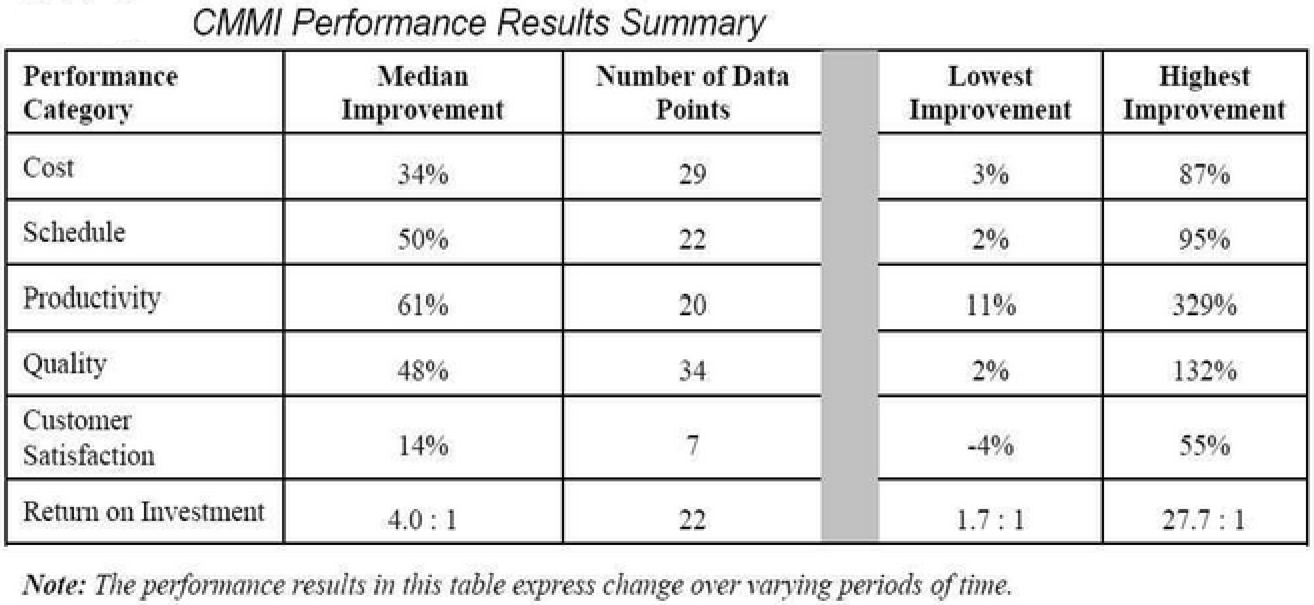

Revise Organizational Approach
Document and Analyze Lessons
Define Processes and Measures
Plan and Execute Pilots
Plan, Execute and track Installation
Establish Process Action Teams
Plan Actions
Set Strategy and Priorities
Develop Recommendations and Document Phase Results
Appraise and Characterise Current Practice
CMMI

- CMM Integration (CMMI) provides
  - the latest best practices related to –
    - development, maintenance, and acquisition,
  - Includes
    - Mechanisms to improve processes and
    - Criteria for evaluating process capability and process maturity.
- As of Dec 2005, the SEI reports
  - 1106 organizations and 4771 projects have reported results from CMMI-based appraisals
- its predecessor, the software CMM (SW-CMM)
  - Since 80s – Dec, 2005
    - 3049 Organizations + 16,540 projects

CMMI


CMMI Categories
Process Management
Project Management
Engineering
Support
Organizational Process Focus
Organization Process Definition
Organizational Training
Organizational Process Performance
Organizational Innovation and Deployment
Project Planning
Project Monitoring and Control
Supplier Agreement Management
Integrated Project Management
Risk Management
Integrated Teaming
Integrated Supplier Management
Quantitative Project Management
Requirements Development
Requirements Management
Technical Solution
Product Integration
Verification
Validation
Configuration Management
Process and Product Quality Assurance
Measurement and Analysis
Organizational Environment for Integration
Decision Analysis and Resolution
Causal Analysis and Resolution

CMMI



CMMI Performance Results Summary

Performance Category	Median Improvement	Number of Data Points		Lowest Improvement	Highest Improvement
Cost	34%	29		3%	87%
Schedule	50%	22		2%	95%
Productivity	61%	20		11%	329%
Quality	48%	34		2%	132%
Customer Satisfaction	14%	7		-4%	55%
Return on Investment	4.0 : 1	22		1.7 : 1	27.7 : 1

Note: *The performance results in this table express change over varying periods of time.*

Maturity levels

Level 5 timizing

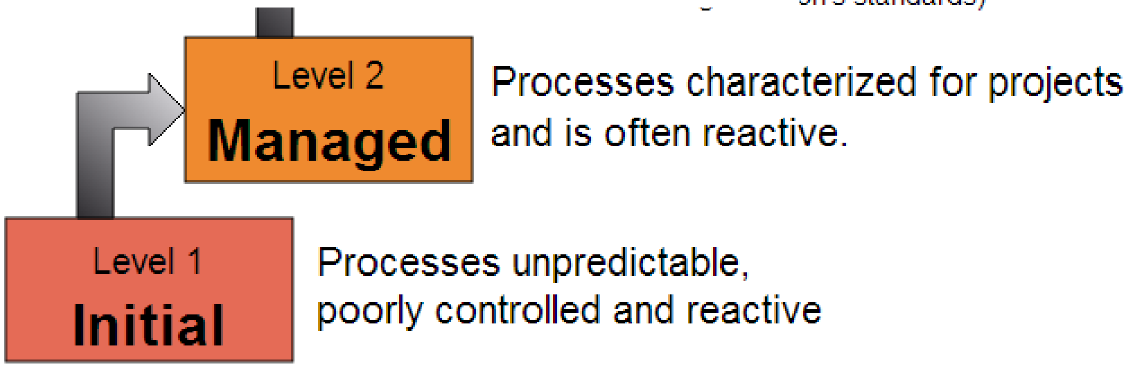
Focus on process improvement

Managed

Processes measured and controlled

ses characterized for the ation and is proactive.

ailor their processes from on's standards)



Level 2 **Managed**

Processes characterized for projects and is often reactive.

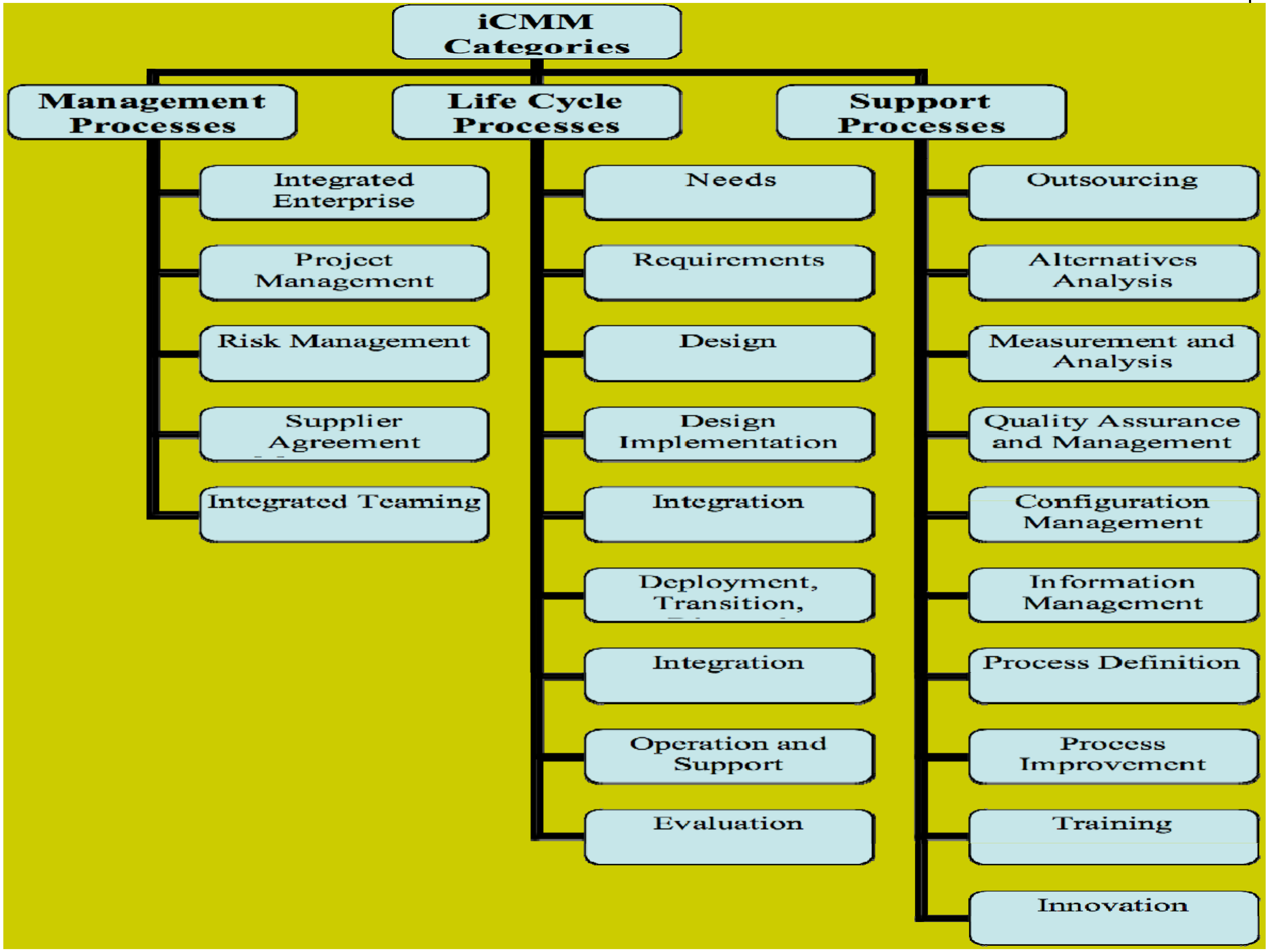
Level 1 **Initial**

Processes unpredictable, poorly controlled and reactive

Integrated CMM

- iCMM is widely used in the Federal Aviation Administration (FAA-iCMM)
  - Provides a single model for enterprise-wide improvement
  - integrates the following standards and models:
    - ISO 9001:2000, EIA/IS 731,
    - Malcolm Baldrige National Quality Award and President's Quality Award criteria,
    - CMMI-SE/SW/IPPD and
    - CMMI-A, ISO/IEC TR 15504, ISO/IEC 12207, and ISO/IEC CD 15288.

Integrated CMM



iCMM Categories

- Management Processes
  - Integrated Enterprise
  - Project Management
  - Risk Management
  - Supplier Agreement
  - Integrated Teaming
- Life Cycle Processes
  - Needs
  - Requirements
  - Design
  - Design Implementation
  - Integration
  - Deployment, Transition,
  - Integration
  - Operation and Support
  - Evaluation
- Support Processes
  - Outsourcing
  - Alternatives Analysis
  - Measurement and Analysis
  - Quality Assurance and Management
  - Configuration Management
  - Information Management
  - Process Definition
  - Process Improvement
  - Training
  - Innovation

Trusted CMM

- Trusted CMM
  - Early 1990 -Trusted Software Methodology (TSM)
  - TSM defines trust levels
    - *Low* emphasizes resistance to unintentional vulnerabilities
    - *High* adding processes to counter malicious developers
  - TSM was later harmonized with CMM
    - Not much in use

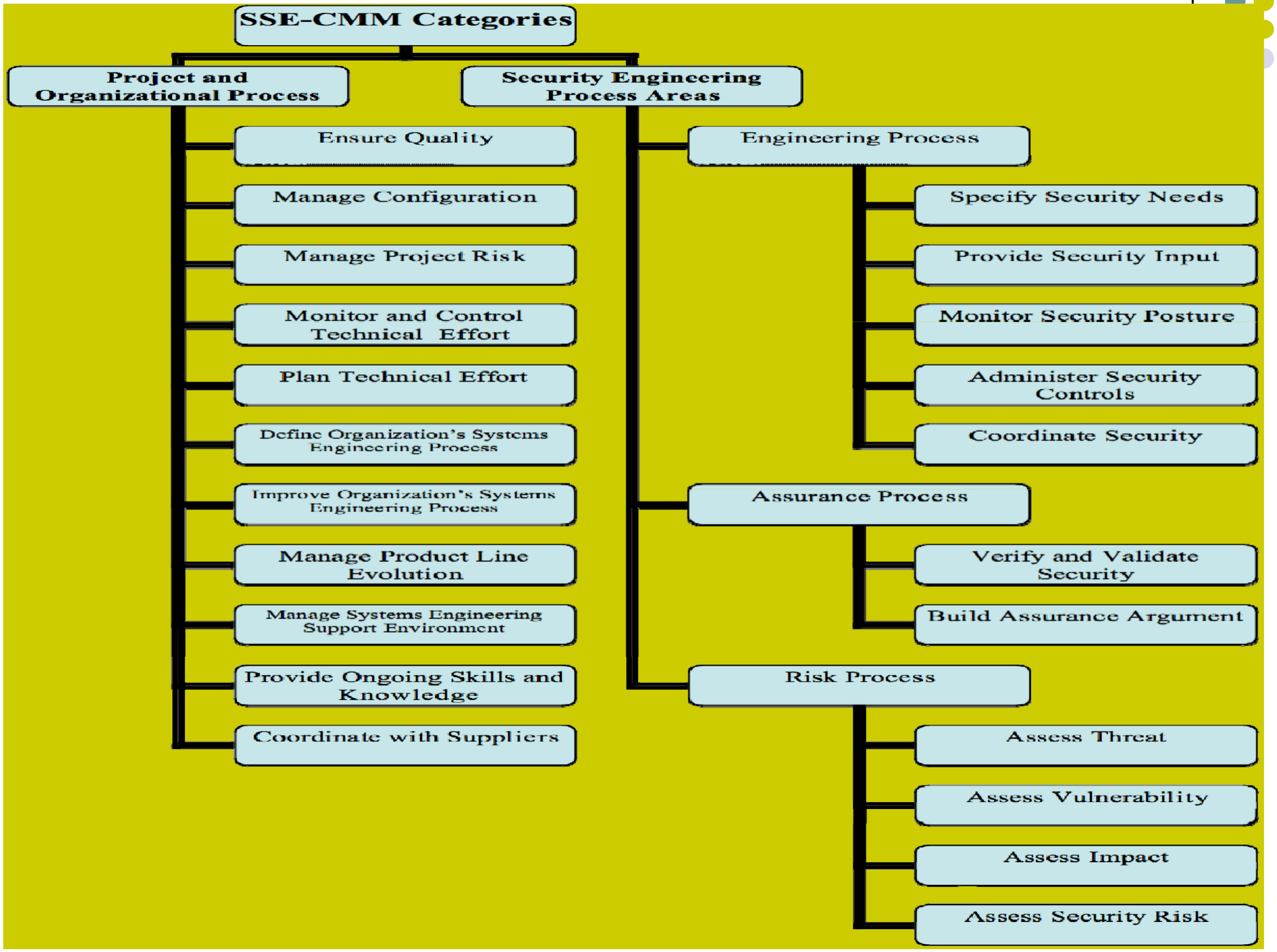
Systems Security Engineering CMM

- The SSE-CMM
  - To improve and assess the ***security engineering capability*** of an organization
- provides a comprehensive framework for
  - evaluating security engineering practices against the generally accepted security engineering principles.
- provides a way to
  - measure and improve performance in the application of security engineering principles.

SSE-CMM: ISO/IEC 21827

- Purpose for SSE-CMM
    - To fill the lack of a comprehensive framework for evaluating security engineering practices against the principles
  - Helps
    - Identify Security Goals
    - Assess Security Posture
    - Support Security Life Cycle
- The SSE-CMM also
    - describes the essential characteristics of an organization’s security engineering processes.
    - The SSE-CMM is now ISO/IEC 21827 standard

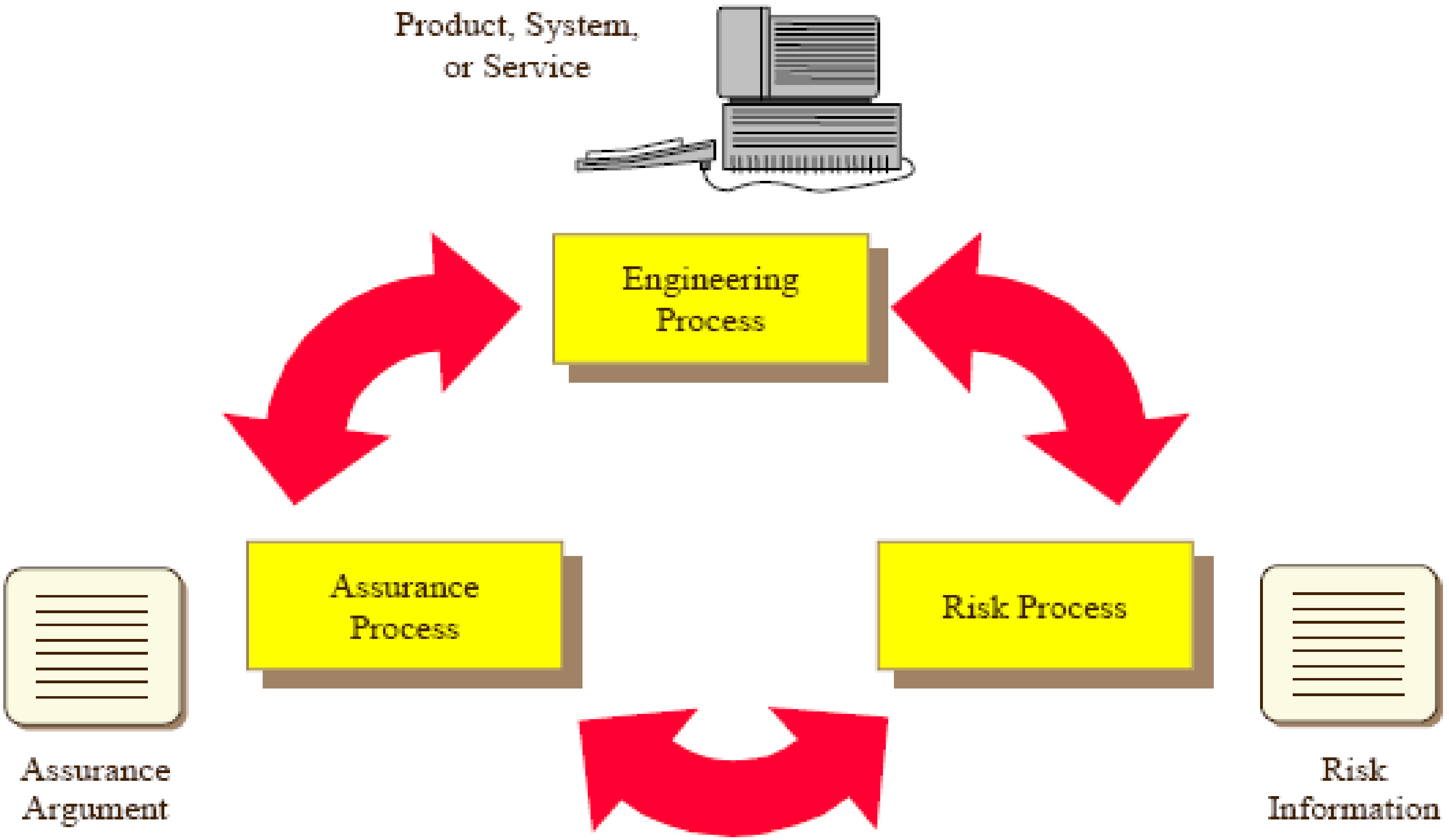
SSE-CMM



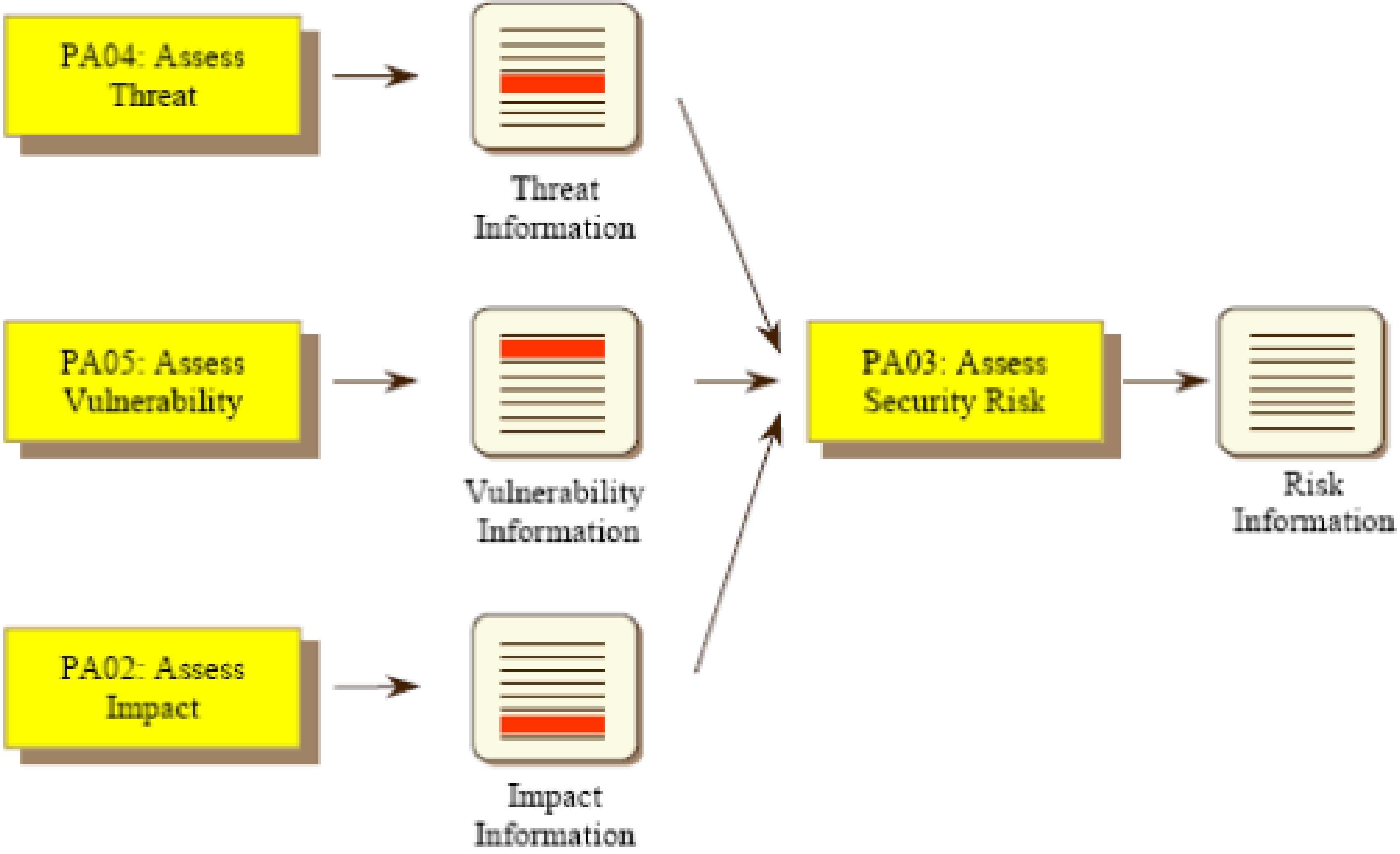
SSE-CMM Categories

- Project and Organizational Process
  - Ensure Quality
  - Manage Configuration
  - Manage Project Risk
  - Monitor and Control Technical Effort
  - Plan Technical Effort
  - Define Organization's Systems Engineering Process
  - Improve Organization's Systems Engineering Process
  - Manage Product Line Evolution
  - Manage Systems Engineering Support Environment
  - Provide Ongoing Skills and Knowledge
  - Coordinate with Suppliers
- Security Engineering Process Areas
  - Engineering Process
    - Specify Security Needs
    - Provide Security Input
    - Monitor Security Posture
    - Administer Security Controls
    - Coordinate Security
  - Assurance Process
    - Verify and Validate Security
    - Build Assurance Argument
  - Risk Process
    - Assess Threat
    - Assess Vulnerability
    - Assess Impact
    - Assess Security Risk

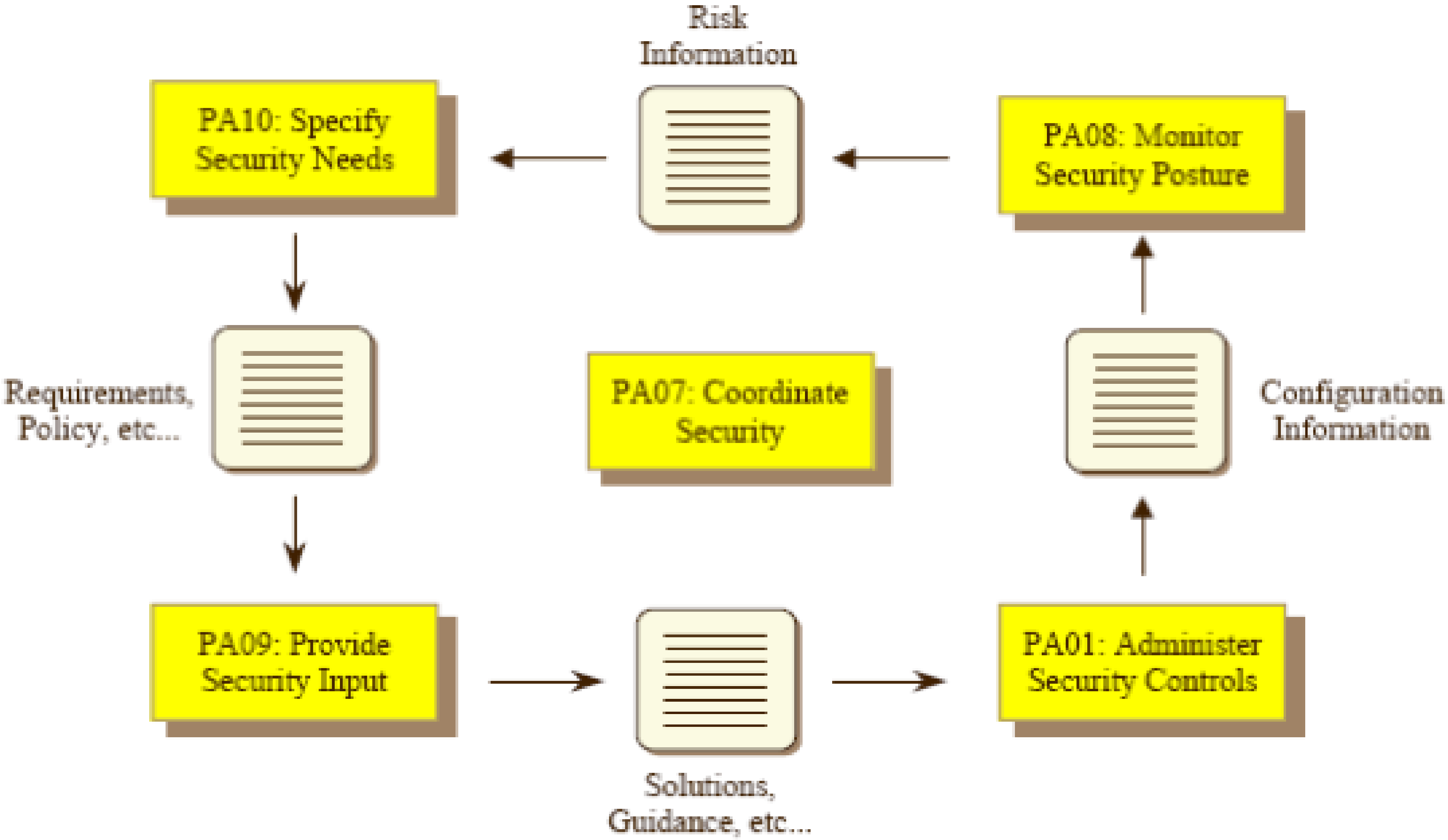
Security Engineering Process



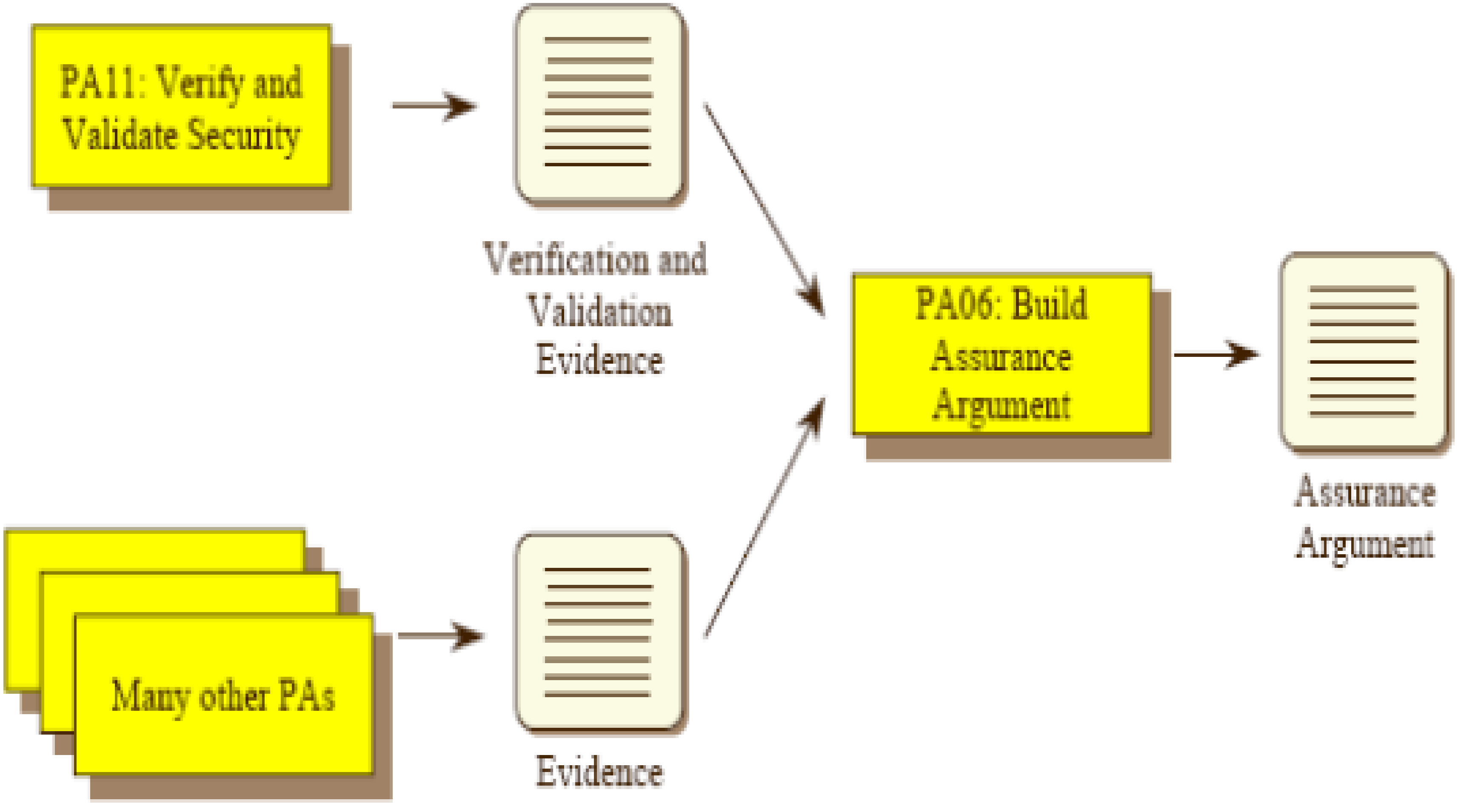
Security Risk Process



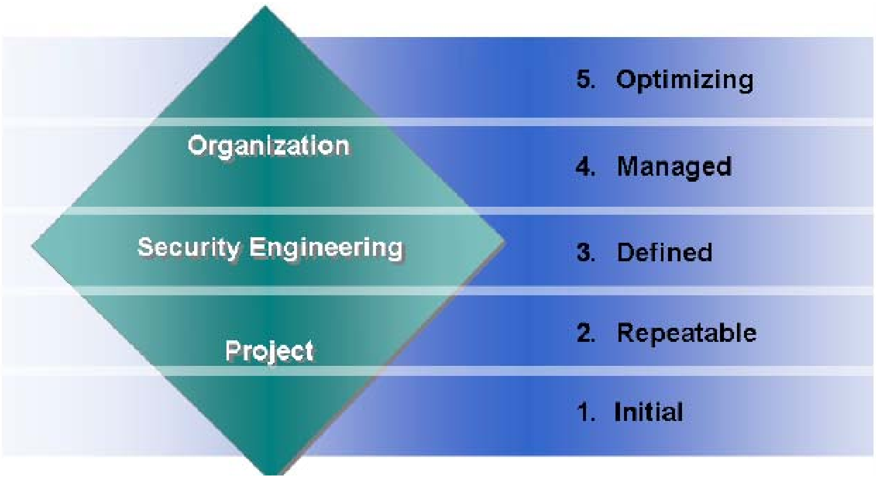
Security is part of Engineering


Risk Information
PA10: Specify Security Needs
PA08: Monitor Security Posture
Requirements, Policy, etc...
PA07: Coordinate Security
Configuration Information
PA09: Provide Security Input
PA01: Administer Security Controls
Solutions, Guidance, etc...

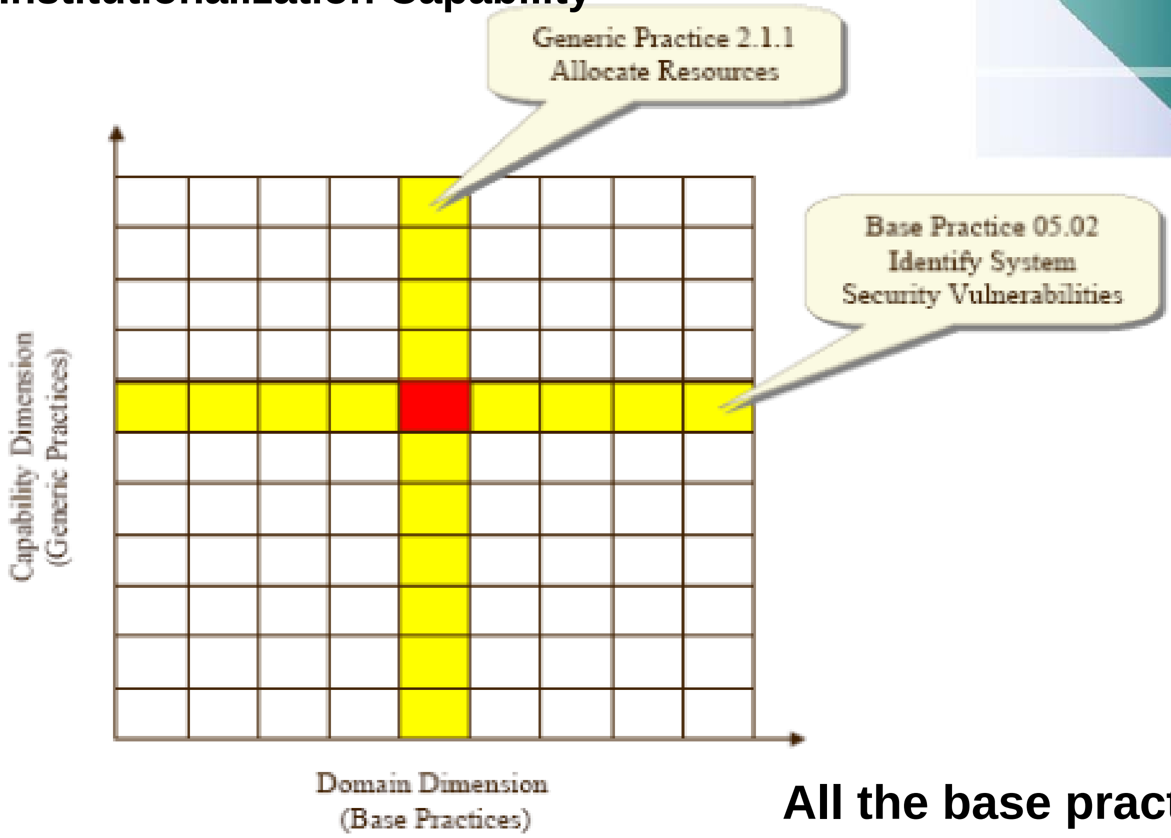
Assurance


PA11: Verify and Validate Security
Verification and Validation Evidence
Many other PAs
Evidence
PA06: Build Assurance Argument
Assurance Argument

SSE-CMM Dimensions



Practices (generic) that indicate Process Management & Institutionalization Capability



All the base practices

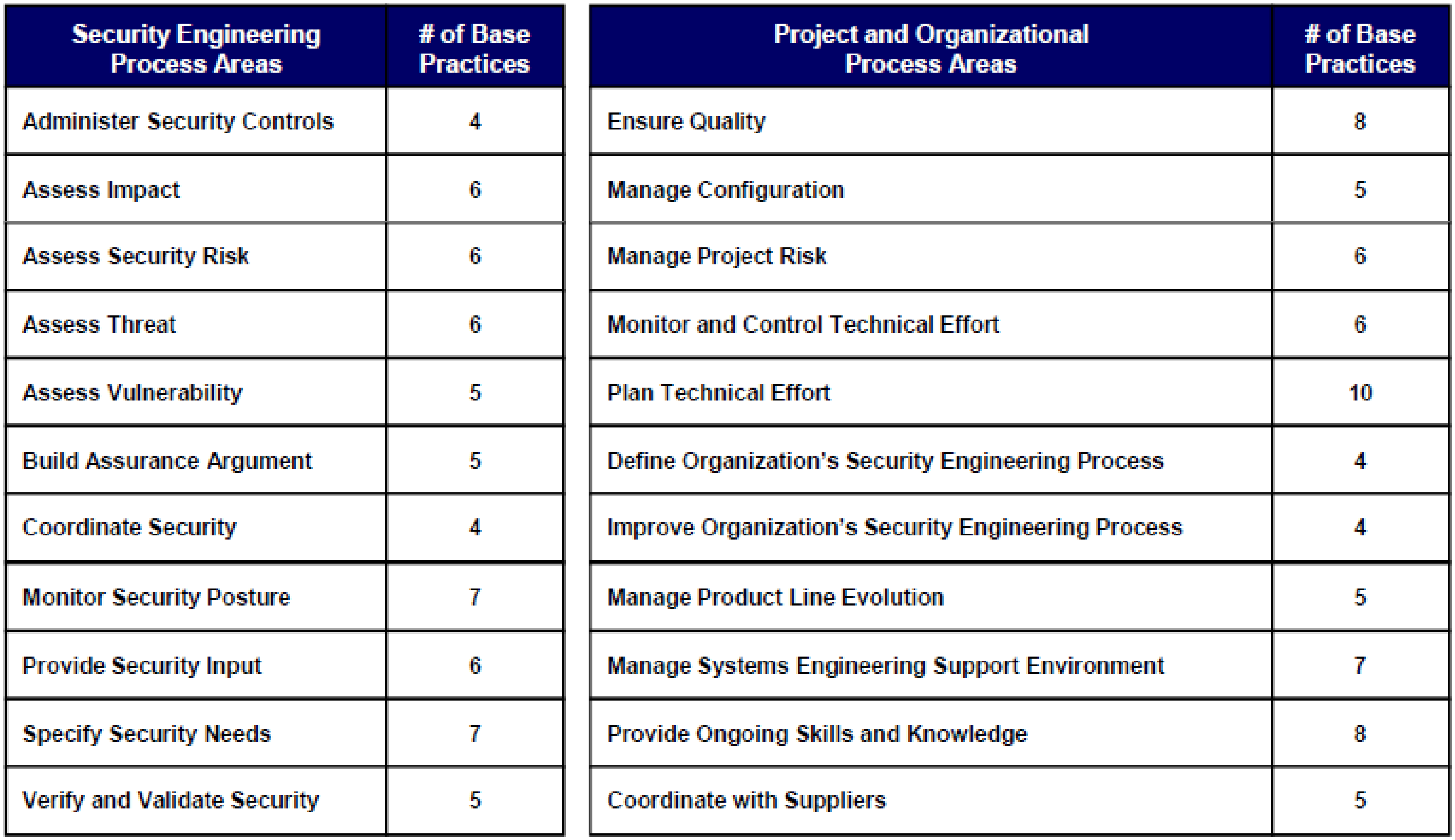
SSE-CMM

- 129 base practices organized into 22 process areas
  - *Security engineering :* 61 of these - organized in 11 process areas
  - *Project* and *Organization* domains : remaining
- Base practice
  - Applies across the life cycle of the enterprise
  - Does not overlap with other base practices
  - Represents a “*best practice*” of the security community
  - Does not simply reflect a state of the art technique
  - Is applicable using multiple methods in multiple business context
  - Does not specify a particular method or tool

Process Area

- Assembles related activities in one area for ease of use
- Relates to valuable security engineering services
- Applies across the life cycle of the enterprise
- Can be implemented in multiple organization and product contexts
- Can be improved as a distinct process
- Can be improved by a group with similar interests in the process
- Includes all base practices that are required to meet the goals of the process area

Process Areas



Security Engineering Process Areas	# of Base Practices
Administer Security Controls	4
Assess Impact	6
Assess Security Risk	6
Assess Threat	6
Assess Vulnerability	5
Build Assurance Argument	5
Coordinate Security	4
Monitor Security Posture	7
Provide Security Input	6
Specify Security Needs	7
Verify and Validate Security	5

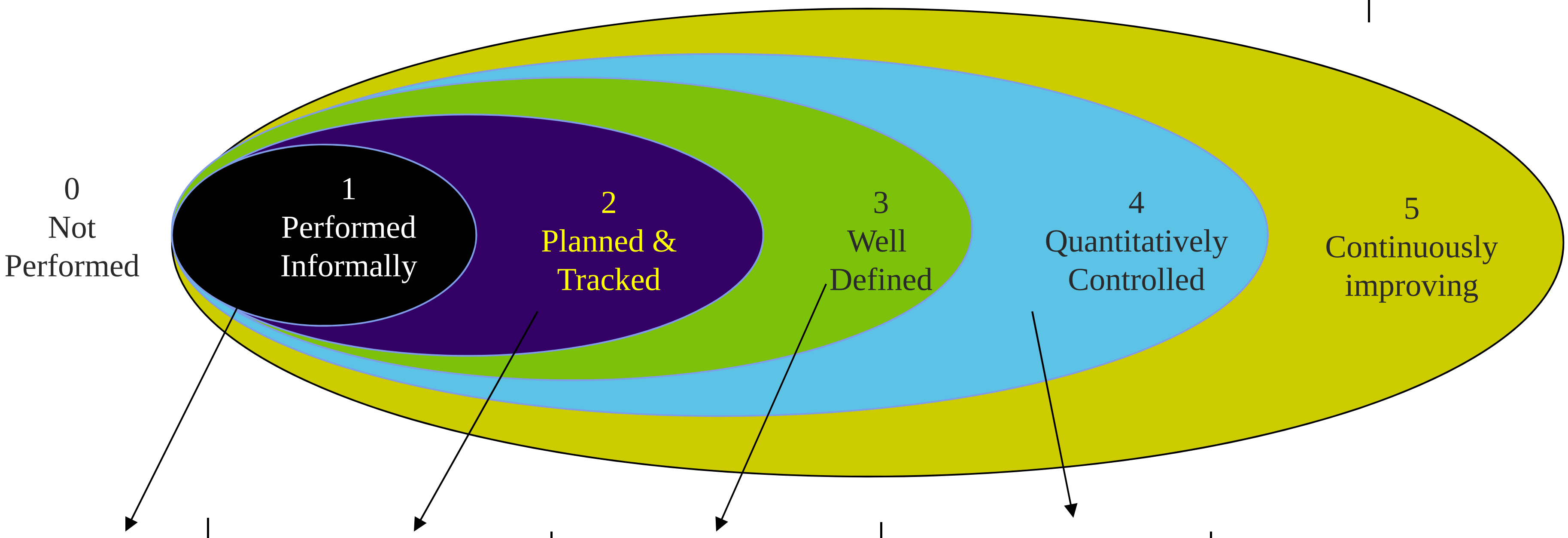
Project and Organizational Process Areas	# of Base Practices
Ensure Quality	8
Manage Configuration	5
Manage Project Risk	6
Monitor and Control Technical Effort	6
Plan Technical Effort	10
Define Organization's Security Engineering Process	4
Improve Organization's Security Engineering Process	4
Manage Product Line Evolution	5
Manage Systems Engineering Support Environment	7
Provide Ongoing Skills and Knowledge	8
Coordinate with Suppliers	5

Generic Process Areas

- Activities that apply to all processes
- They are used during
  - Measurement and institutionalization

- Capability levels
  - Organize common features
  - Ordered according to maturity

Capability Levels



0
Not
Performed

1
Performed
Informally

2
Planned &
Tracked

3
Well
Defined

4
Quantitatively
Controlled

5
Continuously
improving

Base Practices Performed

Committing to perform

Planning performance

Disciplined performance

Tracking performance

Verifying performance

Defining a standard process

Tailoring standard process

Using data

Perform a defined process

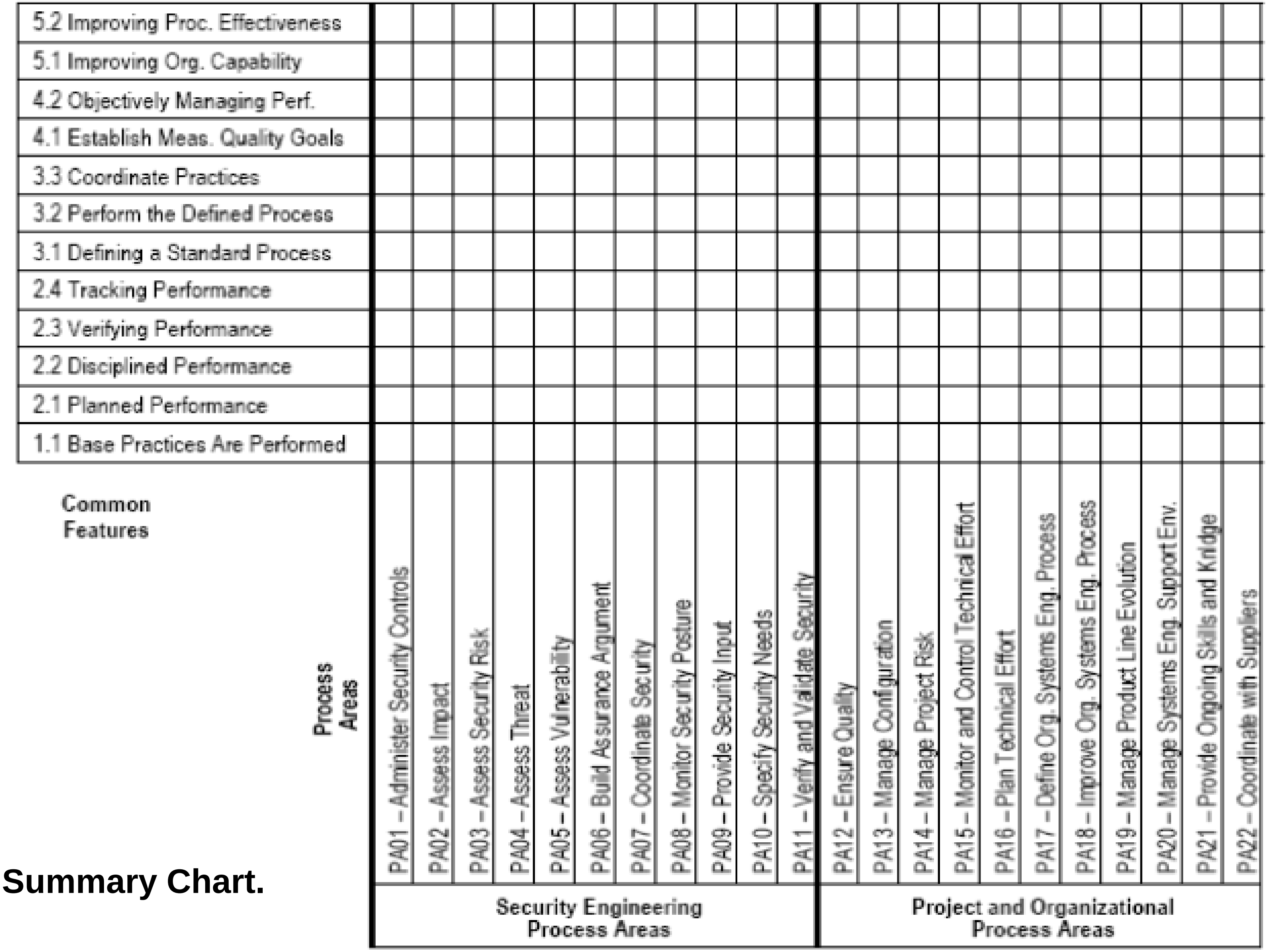
Establishing measurable quality goals

Determining process capability to achieve goals

Objectively managing performance

Establishing quantitative process goals

Improving process effectiveness



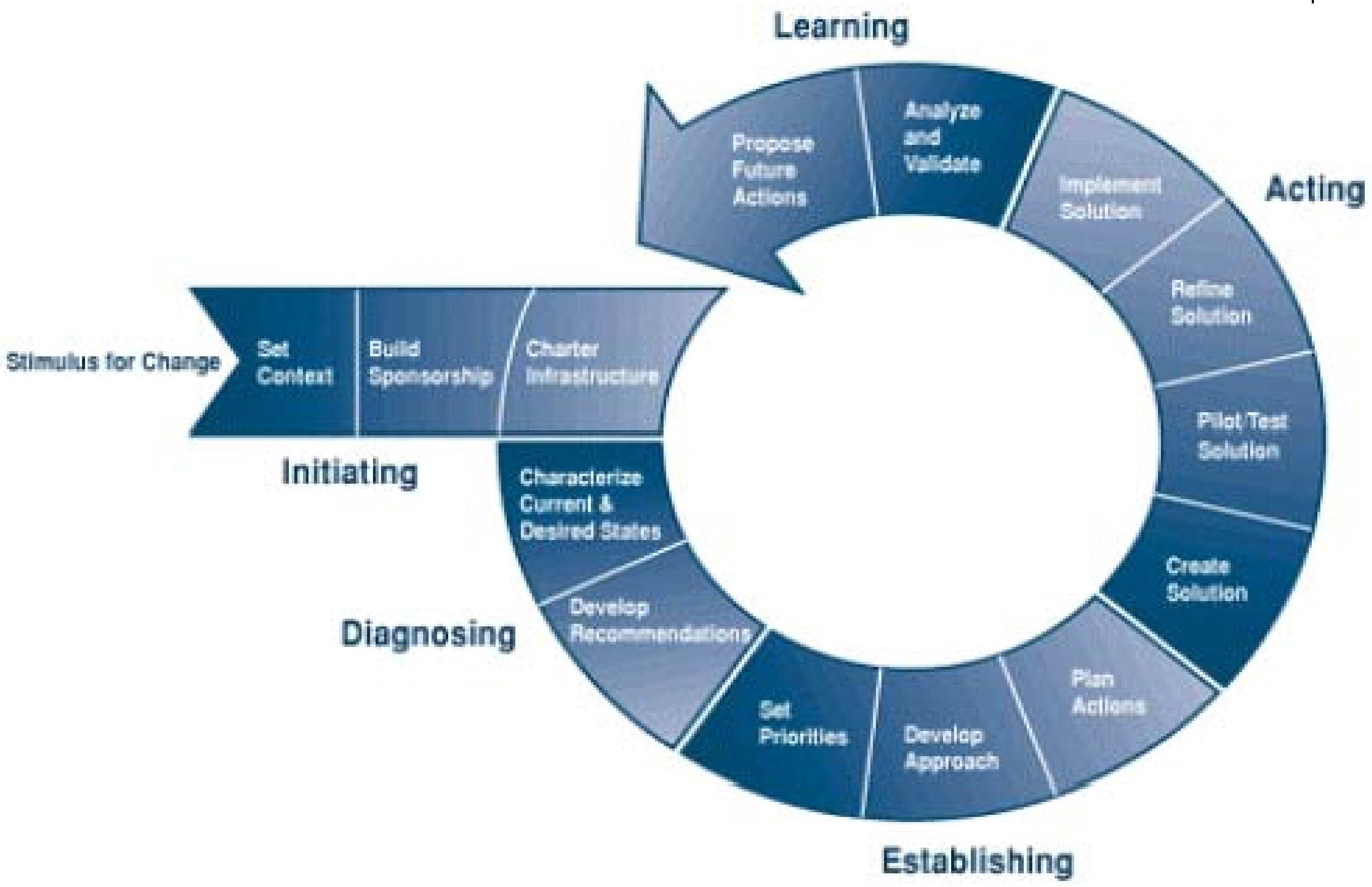
Common Features / Process Areas	PA01 – Administer Security Controls	PA02 – Assess Impact	PA03 – Assess Security Risk	PA04 – Assess Threat	PA05 – Assess Vulnerability	PA06 – Build Assurance Argument	PA07 – Coordinate Security	PA08 – Monitor Security Posture	PA09 – Provide Security Input	PA10 – Specify Security Needs	PA11 – Verify and Validate Security	PA12 – Ensure Quality	PA13 – Manage Configuration	PA14 – Manage Project Risk	PA15 – Monitor and Control Technical Effort	PA16 – Plan Technical Effort	PA17 – Define Org. Systems Eng. Process	PA18 – Improve Org. Systems Eng. Process	PA19 – Manage Product Line Evolution	PA20 – Manage Systems Eng. Support Env.	PA21 – Provide Ongoing Skills and Knldge	PA22 – Coordinate with Suppliers
5.2 Improving Proc. Effectiveness																						
5.1 Improving Org. Capability																						
4.2 Objectively Managing Perf.																						
4.1 Establish Meas. Quality Goals																						
3.3 Coordinate Practices																						
3.2 Perform the Defined Process																						
3.1 Defining a Standard Process																						
2.4 Tracking Performance																						
2.3 Verifying Performance																						
2.2 Disciplined Performance																						
2.1 Planned Performance																						
1.1 Base Practices Are Performed																						
	Security Engineering Process Areas											Project and Organizational Process Areas										

Summary Chart.

Using SSE-CMM

- Can be used in one of the three ways
  - Process improvement
    - Facilitates understanding of the level of security engineering process capability
  - Capability evaluation
    - Allows a consumer organization to understand the security engineering process capability of a provider
  - Assurance
    - Increases the confidence that product/system/service is trustworthy

Process Improvement



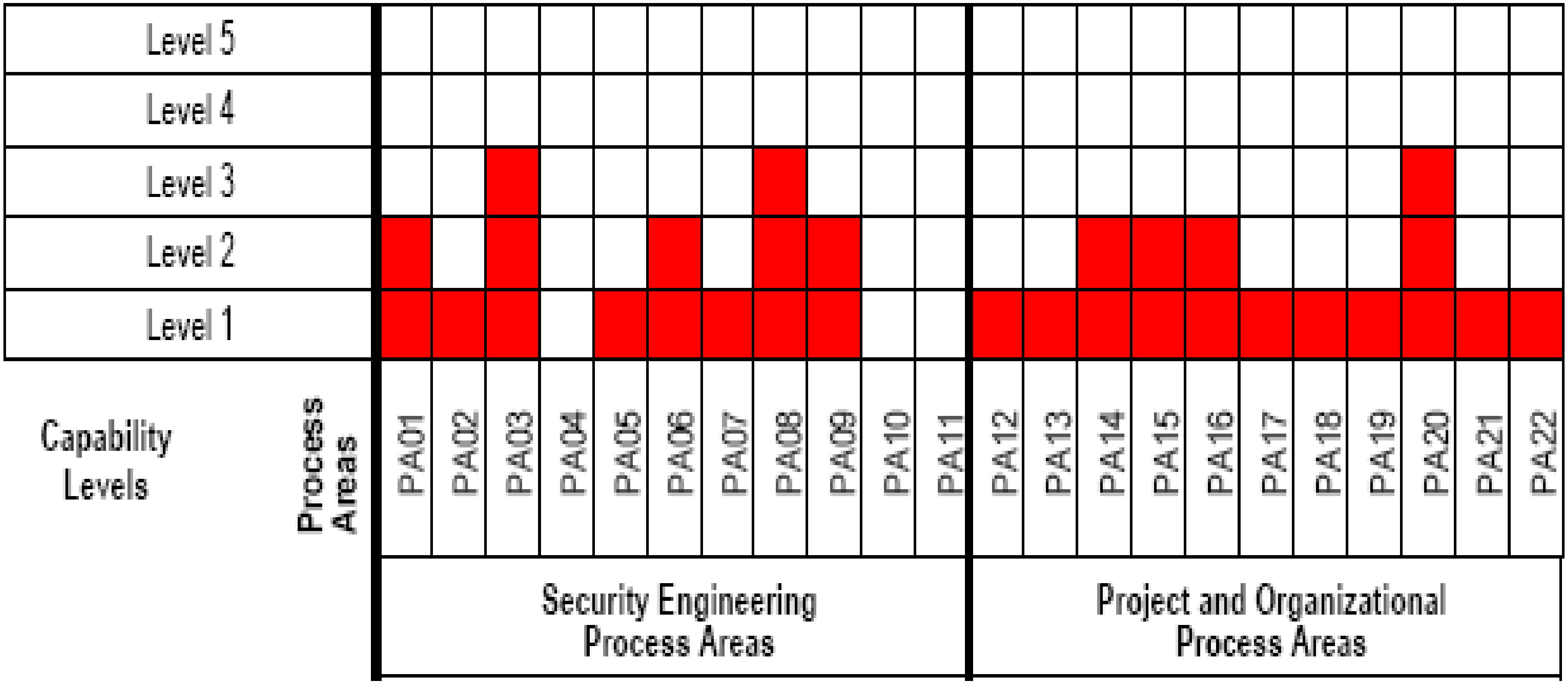
Capability Evaluation

- No need to use any particular appraisal method
- SSE-CMM Appraisal (SSAM) method has been developed if needed
- SSAM purpose
  - Obtain the baseline or benchmark of actual practice related to security engineering within the organization or project
  - Create or support momentum for improvement within multiple levels of the organizational structure

SSAM Overview

- Planning phase
  - Establish appraisal framework
- Preparation phase
  - Prepare team for onsite phase through information gathering (questionnaire)
  - Preliminary data analysis indicate what to look for / ask for
- Onsite phase
  - Data gathering and validation with the practitionerinterviews
- Post-appraisal
  - Present final data analysis to the sponsor

Capability Evaluation



Capability Levels / Process Areas	PA01	PA02	PA03	PA04	PA05	PA06	PA07	PA08	PA09	PA10	PA11	PA12	PA13	PA14	PA15	PA16	PA17	PA18	PA19	PA20	PA21	PA22
Level 5																						
Level 4																						
Level 3			🟥					🟥												🟥		
Level 2	🟥		🟥			🟥		🟥	🟥					🟥	🟥	🟥				🟥		
Level 1	🟥	🟥	🟥		🟥	🟥	🟥	🟥	🟥			🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥
	Security Engineering Process Areas											Project and Organizational Process Areas										

Assurance

- A mature organization
  - more likely to create a product or system with appropriate assurance
- Process evidence
  - to support claims for the product trustworthiness
- It is conceivable that
  - An immature organization could produce high assurance product.

CMI/iCMM/SSE-CMM

- CMMI / iCMM used by more organizations than the SSE-CMM
  - Because of the integration of process disciplines and coverage of enterprise issues,
- One weakness CMMI and iCMM
  - have gaps in their coverage of safety and security.
- Joint effort sponsored by FAA and the DoD
  - to identify *best safety and security* practices for use in combination with the iCMM and the CMMI.

Safety/Security additions

- The proposed Safety and Security additions include the following four goals:
  - Goal 1 – An ***infrastructure*** for safety and security is established and maintained.
  - Goal 2 – Safety and security ***risks*** are identified and managed.
  - Goal 3 – Safety and security ***requirements*** are satisfied.
  - Goal 4 – Activities and products are ***managed*** to achieve safety and security requirements and objectives.

Goal 1 related practices

1. Ensure safety and security awareness, guidance, and competency.
2. Establish and maintain a qualified work environment that meets safety and security needs.
3. Ensure integrity of information by providing for its storage and protection, and controlling access and distribution of information.
4. Monitor, report and analyze safety and security incidents and identify potential corrective actions.
5. Plan and provide for continuity of activities with contingencies for threats and hazards to operations and the infrastructure

Goal 1 – An infrastructure for safety and security is established and maintained.

Goal 2 related practices

1. Identify risks and sources of risks attributable to vulnerabilities, security threats, and safety hazards.
2. For each risk associated with safety or security, determine the causal factors, estimate the consequence and likelihood of an occurrence, and determine relative priority.
3. For each risk associated with safety or security, determine, implement and monitor the risk mitigation plan to achieve an acceptable level of risk.

Goal 2 – Safety and security risks are identified and managed.

Goal 3 related practices

1. Identify and document applicable regulatory requirements, laws, standards, policies, and acceptable levels of safety and security.
2. Establish and maintain safety and security requirements, including integrity levels, and design the product or service to meet them.
3. Objectively verify and validate work products and delivered products and services to assure safety and security requirements have been achieved and fulfill intended use.
4. Establish and maintain safety and security assurance arguments and supporting evidence throughout the lifecycle.

Goal 3 – Safety and security requirements are satisfied.

Goal 4 related practices

1. Establish and maintain independent reporting of safety and security status and issues.
2. Establish and maintain a plan to achieve safety and security requirements and objectives.
3. Select and manage products and suppliers using safety and security criteria.
4. Measure, monitor and review safety and security activities against plans, control products, take corrective action, and improve processes.

Goal 4 – Activities and products are managed to achieve safety and security requirements and objectives.

Team Software Process for Secure SW/Dev

- TSP
  - provides a framework, a set of processes, and disciplined methods for applying software engineering principles at the team and individual level
- TSP for Secure Software Development (TSP-Secure)
  - focus more directly on the security of software applications.

Team Software Process for Secure SW/Dev

- TSP-Secure addresses secure software development (three ways).
  1. **“Secure software is not built by accident”**
     - Plan: TSP-Secure addresses planning for security.
     - Self-direct: Since schedule pressures and people issues get in the way of implementing best practices, TSP-Secure helps to build self-directed development teams, and then put these teams in charge of their own work.

TSP-Secure

1. Since security and quality are closely related,
   - TSP-Secure helps manage quality throughout the product development life cycle.
2. Since people building secure software must have an awareness of software security issues,
   - TSP-Secure includes security awareness training for developers.

TSP-Secure

- Teams
  - Develop their own plans
  - Make their own commitments
  - Track and manage their own work
  - Take corrective action when needed

TSP-Secure

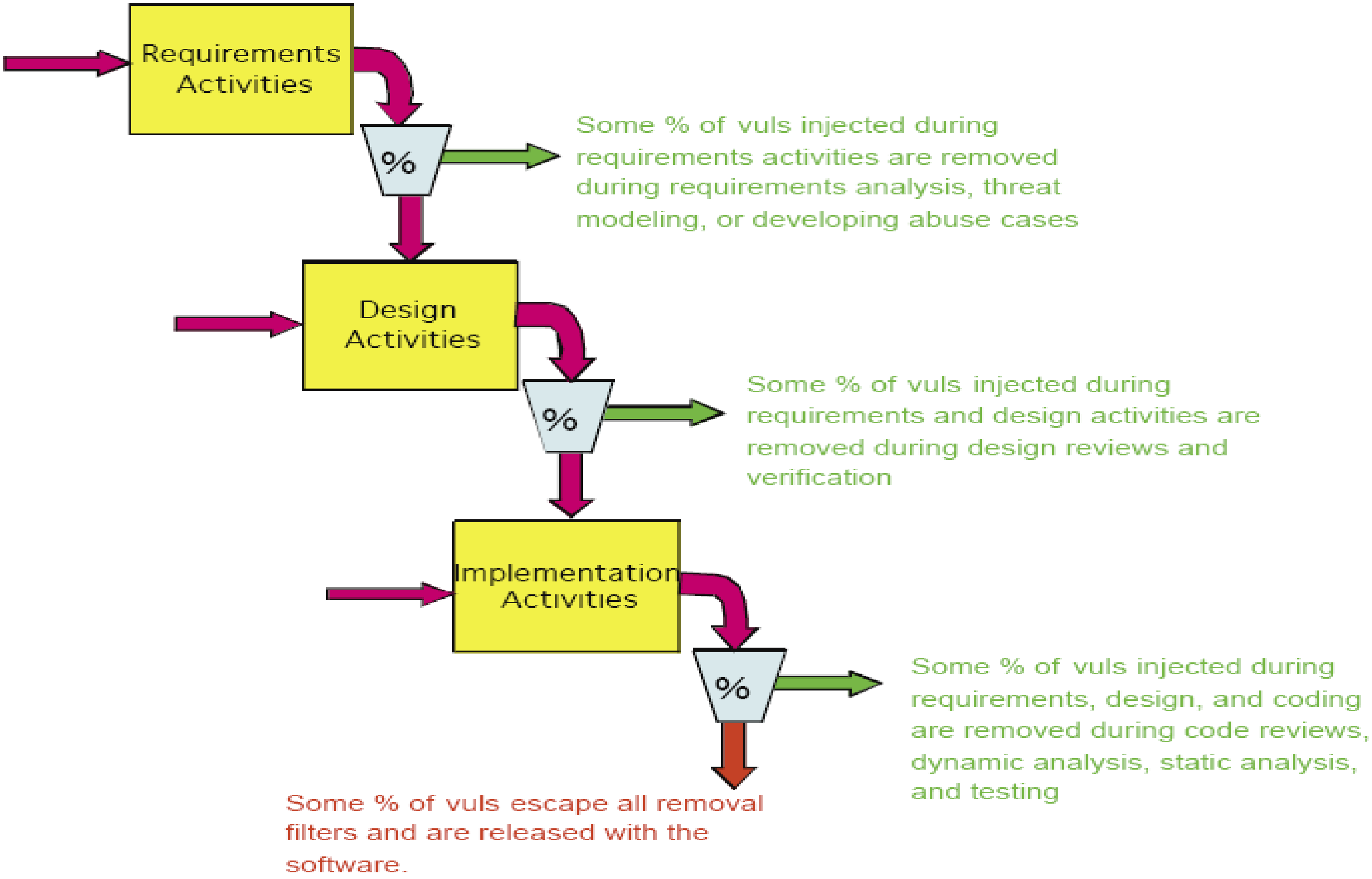
- Initial planning – “Project Launch” (3-4 days)
  - Tasks include
    - identifying security risks,
    - eliciting and defining security requirement, secure design, and code reviews,
    - use of static analysis tools, unit tests, and Fuzz testing.
- Next, the team executes its plan, and ensures all security related activities are taking place.
  - Security status is presented and discussed during every management status briefing.

TSP-Secure

- Basis
  - Defective software is seldom secure
  - Defective software is not inevitable
    - Consider cost of reducing defects
    - Manage defects throughout the lifecycle
  - Defects are leading cause of vulnerabilities
    - Use multiple defect removal points in the SD: *Defect filters*

TSP-Secure

- Key questions in managing defects
  - What type of defects lead to security vulnerabilities?
  - Where in the software development life cycle should defects be measured?
  - What work products should be examined for defects?
  - What tools and methods should be used to measure the defects?
  - How many defects can be removed at each step?
  - How many estimated defects remain after each removal step?
- TSP-Secure includes training for developers, managers, and other team members.



Requirements Activities

%

Some % of vuls injected during requirements activities are removed during requirements analysis, threat modeling, or developing abuse cases

Design Activities

%

Some % of vuls injected during requirements and design activities are removed during design reviews and verification

Implementation Activities

%

Some % of vuls injected during requirements, design, and coding are removed during code reviews, dynamic analysis, static analysis, and testing

Some % of vuls escape all removal filters and are released with the software.

Correctness by Construction

- CbC Methodology from Praxis Critical Systems
  - Process for developing high integrity software
  - Has been successfully used to develop safety-critical systems
  - Removes defects at the earliest stages

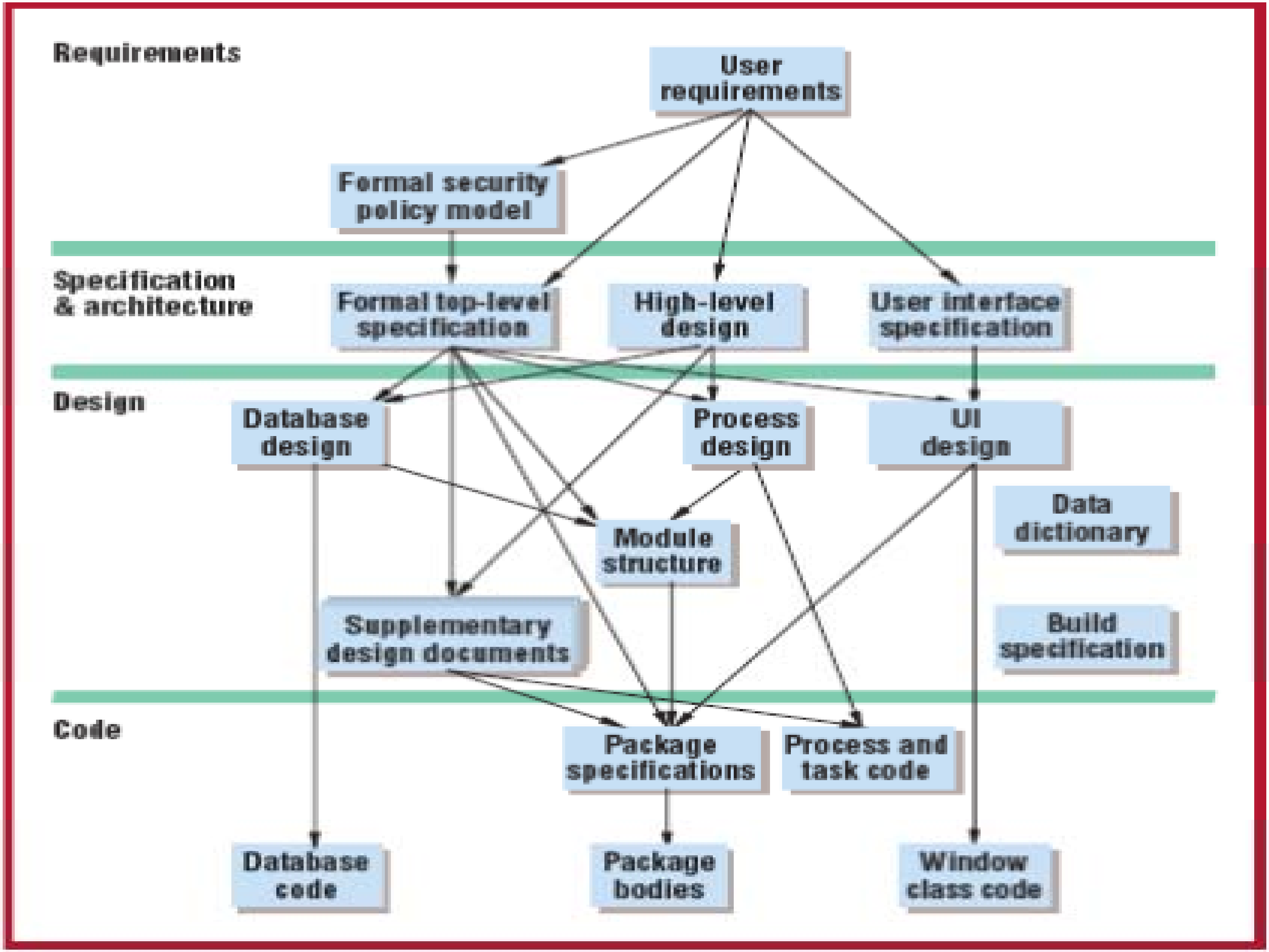
  - uses formal methods to specify behavioral, security and safety properties of the software.

Correctness by Construction

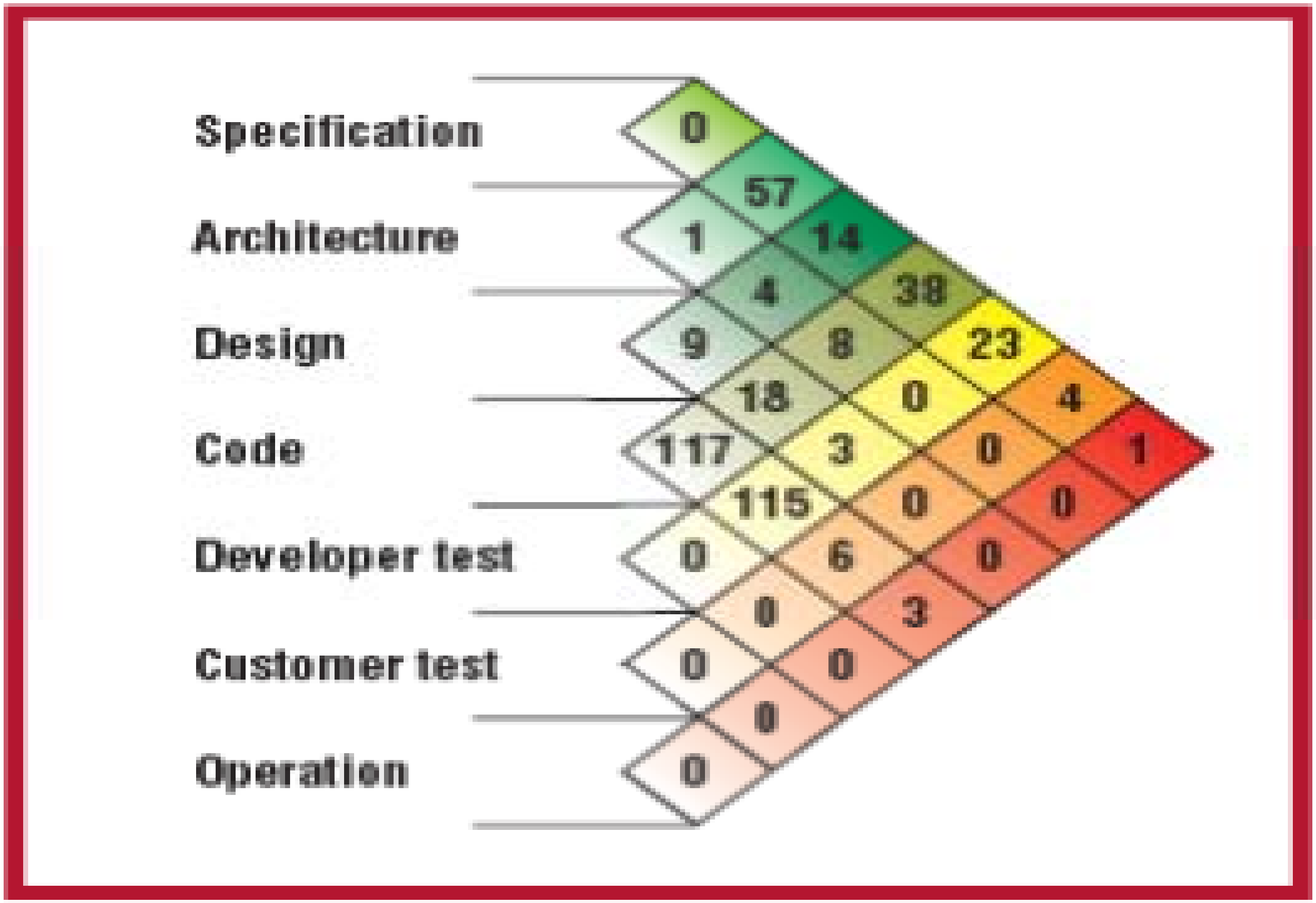
- The seven key principles of Correctness-by-Construction are:
  - Expect requirements to change
  - Know why you're testing (debug + verification)
  - Eliminate errors before testing
  - Write software that is easy to verify
  - Develop incrementally
  - Some aspects of software development are just plain hard
  - Software is not useful by itself

Correctness by Construction

- Correctness-by-Construction is
  - one of the few secure SDLC processes that incorporate formal methods into many development activities.
  - Requirements are specified using Z, and verified.
  - Code (in Spark) is checked by verification software.


Requirements
User requirements
Formal security policy model
Specification & architecture
Formal top-level specification
High-level design
User interface specification
Design
Database design
Process design
UI design
Data dictionary
Module structure
Build specification
Supplementary design documents
Code
Package specifications
Process and task code
Database code
Package bodies
Window class code

Correctness by Construction Defect detection/Correction



Effort and Defect Rate

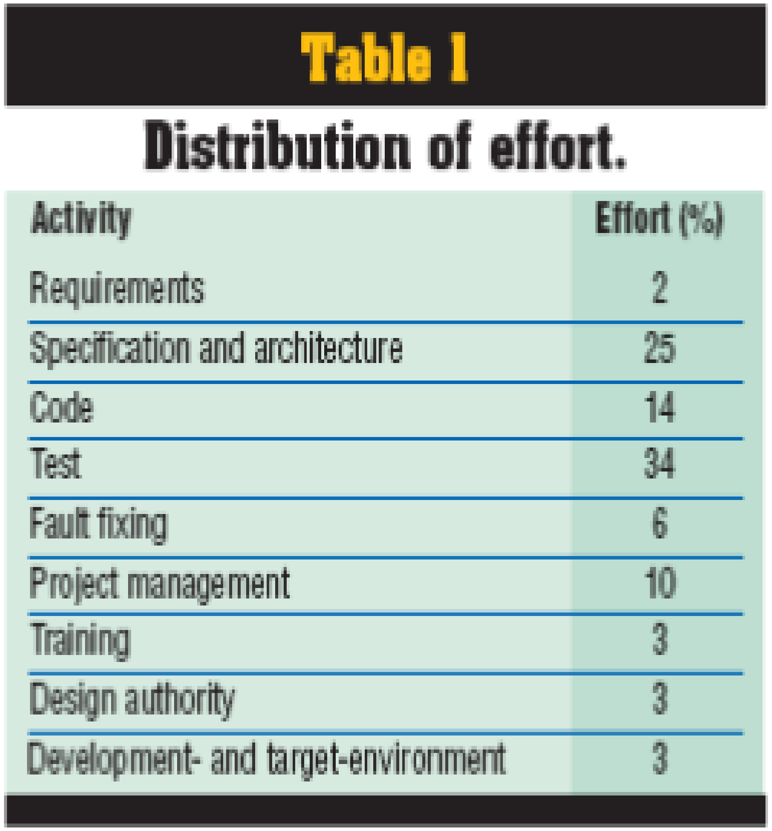
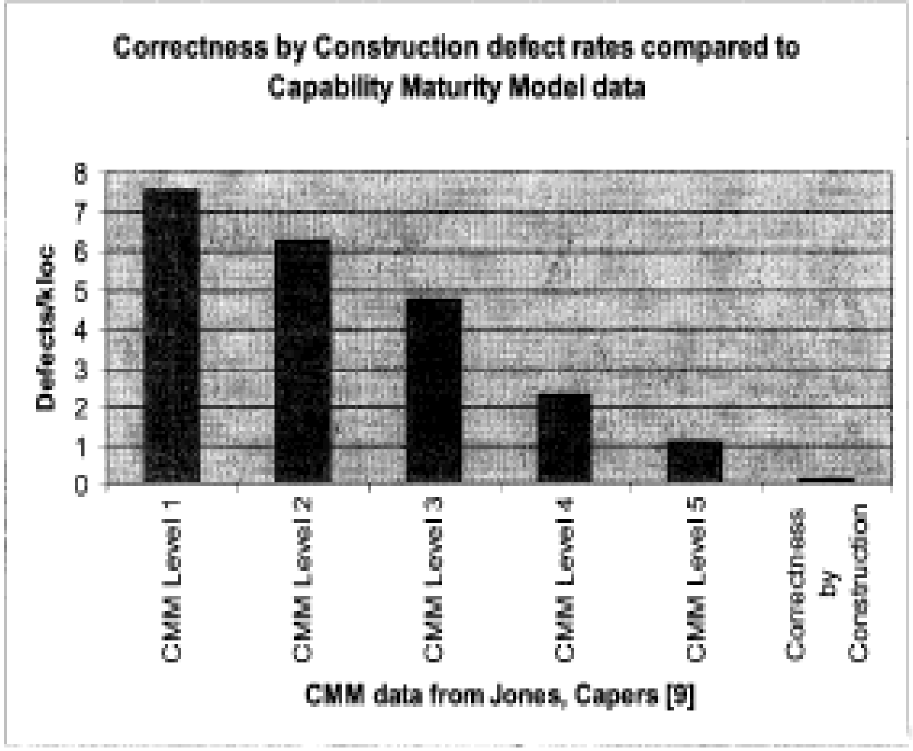


Table 1

Distribution of effort.

Activity	Effort (%)
Requirements	2
Specification and architecture	25
Code	14
Test	34
Fault fixing	6
Project management	10
Training	3
Design authority	3
Development- and target-environment	3



Correctness by Construction defect rates compared to Capability Maturity Model data

CMM data from Jones, Capers [9]

Agile Methods

- Agile manifesto
  - “We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:
    - *Individuals and interactions* over processes and tools
    - *Working software* over comprehensive documentation
    - *Customer collaboration* over contract negotiation
    - *Responding to change* over following a plan

Agile manifesto principles

- Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
- Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
- Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
- Business people and developers work together daily throughout the project.
- Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
- The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
- Working software is the primary measure of progress.
- Agile processes promote sustainable development. The sponsors, developers and users should be able to maintain a constant pace indefinitely.
- Continuous attention to technical excellence and good design enhances agility.
- Simplicity—the art of maximizing the amount of work not done—is essential.
- The best architectures, requirements and designs emerge from self-organizing teams.
- At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

Agile Processes

- Among many variations
  - Adaptive software development (ASP)
  - Extreme programming (XP)
  - Crystal
  - Rational Unified Process (RUP)

TSP Revisited
- How TSP Relates to Agile ..

- *Individuals and interactions* over processes and tools

- TSP holds that the individual is key to product quality and effective member interactions are necessary to the team's success.
  - Project launches strive to create gelled teams.
  - Weekly meetings and communication are essential to sustain them.
  - Teams define their own processes in the launch.

How TSP Relates

- *Working software* over comprehensive documentation

- TSP teams can choose evolutionary or iterative lifecycle models to deliver early functionality—the focus is on high quality from the start. TSP does not require heavy documentation.
  - Documentation should merely be sufficient to facilitate effective reviews and information sharing.

How TSP Relates

- *Customer collaboration* over contract negotiation

- Learning what the customer wants is a key focus of the “launch”. Sustaining customer contact is one reason for having a customer interface manager on the team.
  - Focus on negotiation of a contract is more a factor of the organization than of whether TSP is used.

How TSP Relates

- *Responding to change* over following a plan

- TSP teams expect and plan for change by:
  - Adjusting the team's process through process improvement proposals and weekly meetings.
  - Periodically re-launching and re-planning whenever the plan is no longer a useful guide.
  - Adding new tasks as they are discovered; removing tasks that are no longer needed.
  - Dynamically rebalancing the team workload as required to finish faster.
  - Actively identifying and managing risks.

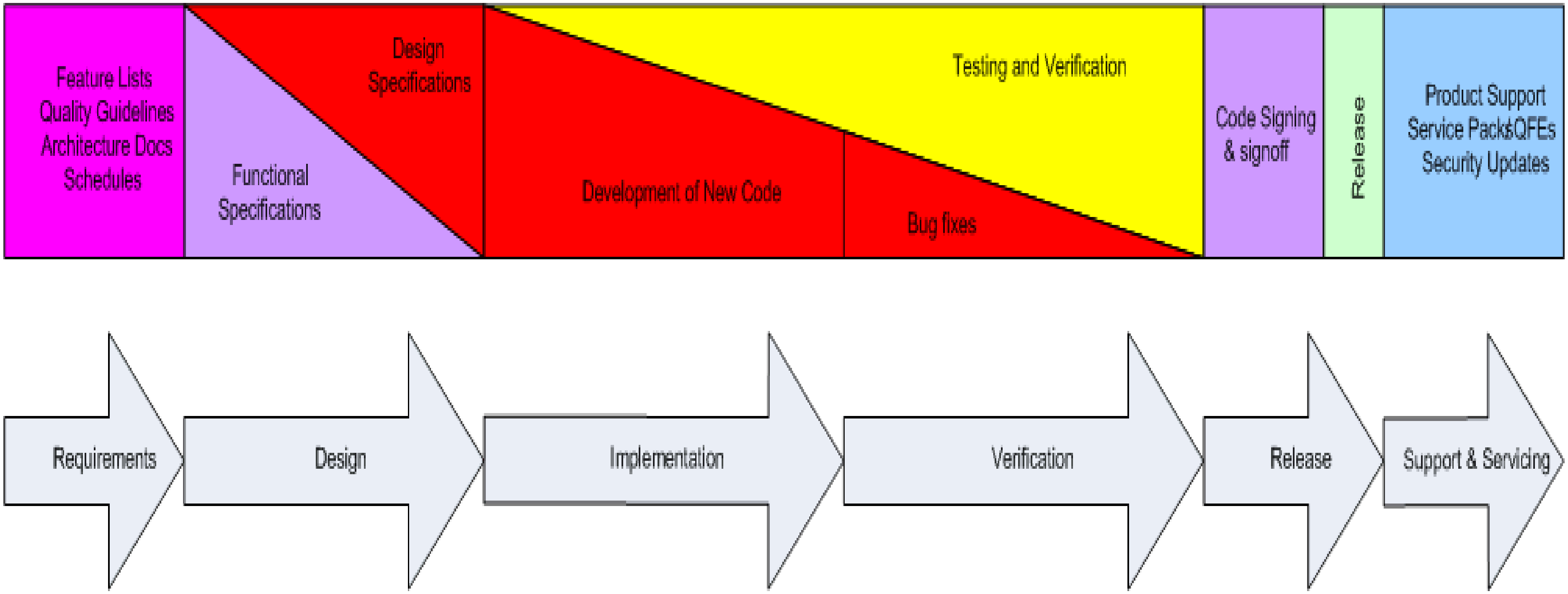
Security assurance method or technique		Match (2)	Indepen-dent (8)	(semi)-automated (4)	Mis-match (12)
Re-quire-ments	Guidelines		X		
	Specification analysis				X
	Review				X
Design	Application of specific architectural approaches		X		
	Use of secure design principles		X		
	Formal validation				X
	Informal validation				X
	Internal review	X			
	External review				X
Implementation	Informal correspondence analysis				X
	Requirements testing			X	
	Informal validation				X
	Formal validation				X
	Security testing			X	
	Vulnerability and penetration testing			X	
	Test depth analysis				X
	Security static analysis			X	
	High-level programming languages and tools		X		
	Adherence to implementation standards		X		
	Use of version control and change tracking		X		
	Change authorization				X
	Integration procedures		X		
	Use of product generation tools		X		
	Internal review	X			
	External review				X
	Security evaluation				X

Besnosov Comparison

- 50% of traditional security assurance activities are not compatible with Agile methods (12 out of 26),
- less than 10% are natural fits (2 out of 26),
- about 30% are independent of development method, and
- slightly more than 10% (4 out of 26) could be semi-automated and thus integrated more easily into the Agile methods.

Microsoft Trustworthy Computing SDLC

- Generally accepted SDL process at MS
- (actually spiral not “waterfall” as it indicates)



Feature Lists
Quality Guidelines
Architecture Docs
Schedules

Design Specifications

Functional Specifications

Testing and Verification

Development of New Code

Bug fixes

Code Signing & signoff

Release

Product Support
Service Packs/QFEs
Security Updates

Requirements

Design

Implementation

Verification

Release

Support & Servicing

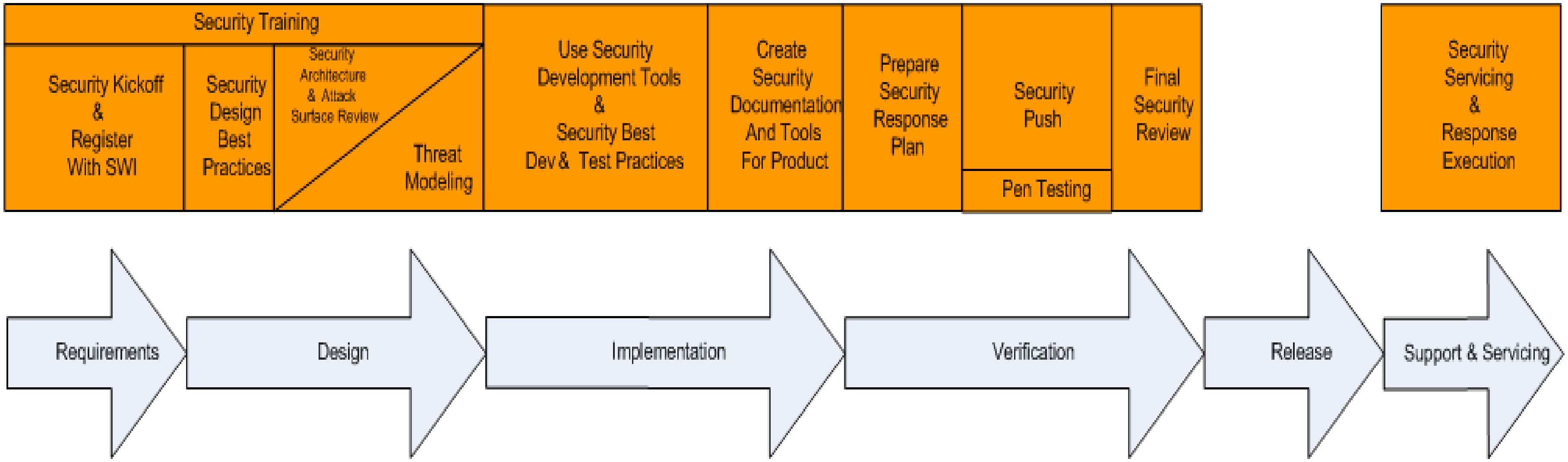
SDL Overview

- MS's SD^3 + C paradigm
  - Secure by Design
  - Secure by Default
  - Secure by Deployment
  - Communications
    - software developers should be prepared for the discovery of product vulnerabilities and should communicate openly and responsibly

The SDL is updated as shown next

SDL at MS

- Add the SD^3 + C praradigm



Security Training

Security Kickoff & Register With SWI

Security Design Best Practices

Security Architecture & Attack Surface Review

Threat Modeling

Use Security Development Tools & Security Best Dev & Test Practices

Create Security Documentation And Tools For Product

Prepare Security Response Plan

Security Push

Pen Testing

Final Security Review

Security Servicing & Response Execution

Requirements

Design

Implementation

Verification

Release

Support & Servicing

Design Phase

- Define Security architecture and design guidelines
  - Identify tcb; use layering etc.
- Document the elements of the software attack surface
  - Find out default security
- Conduct threat modeling
- Define supplemental ship criteria

Implementation phase

- Apply coding and testing standards
- Apply security testing tools including fuzzing tools
- Apply static analysis code scanning tools
- Conduct code reviews

Verification Phase

- “Security push” for Windows server 2003
  - Includes code review beyond those in implementation phase and
  - Focused testing
- Two reasons for “security push”
  - Products had reached the verification phase
  - Opportunity to review both code that was developed or updated during the implementation phase and “legacy code” that was not modified

Results

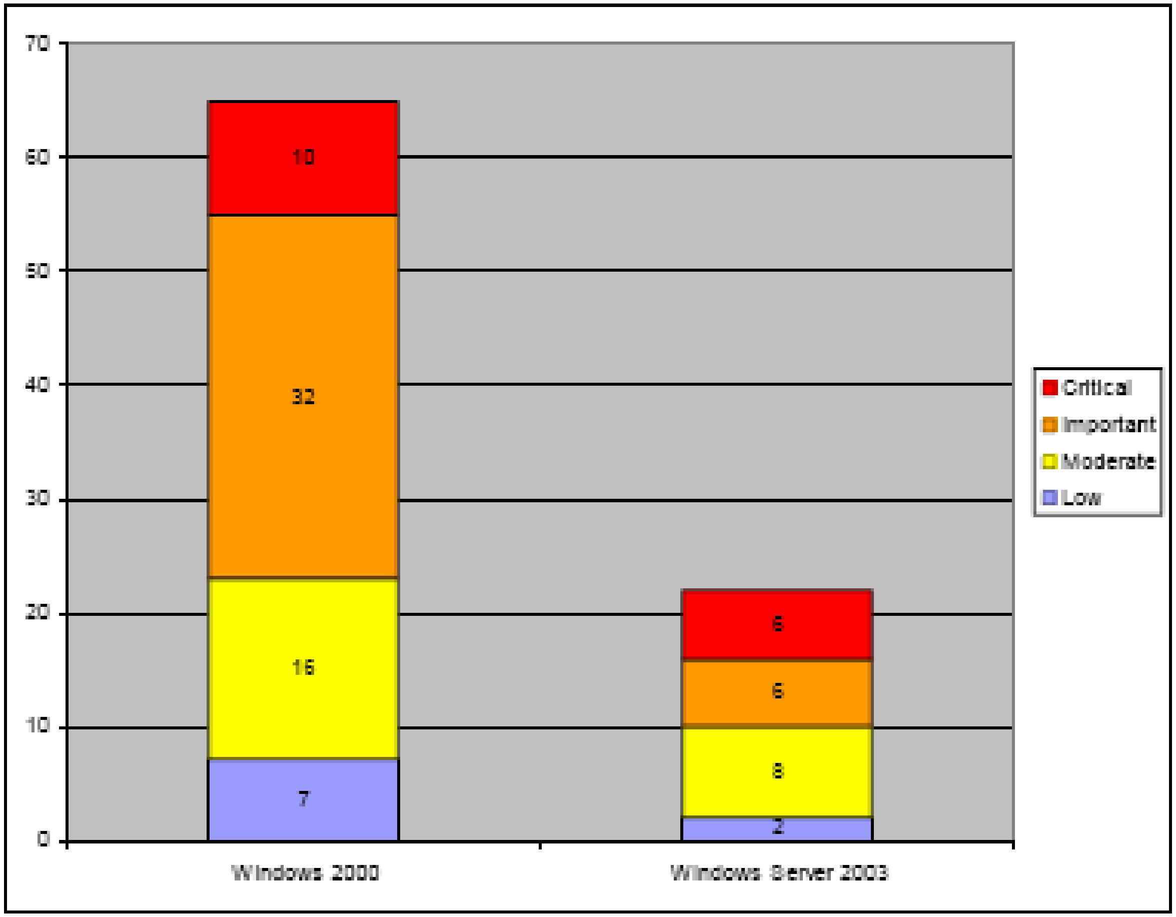
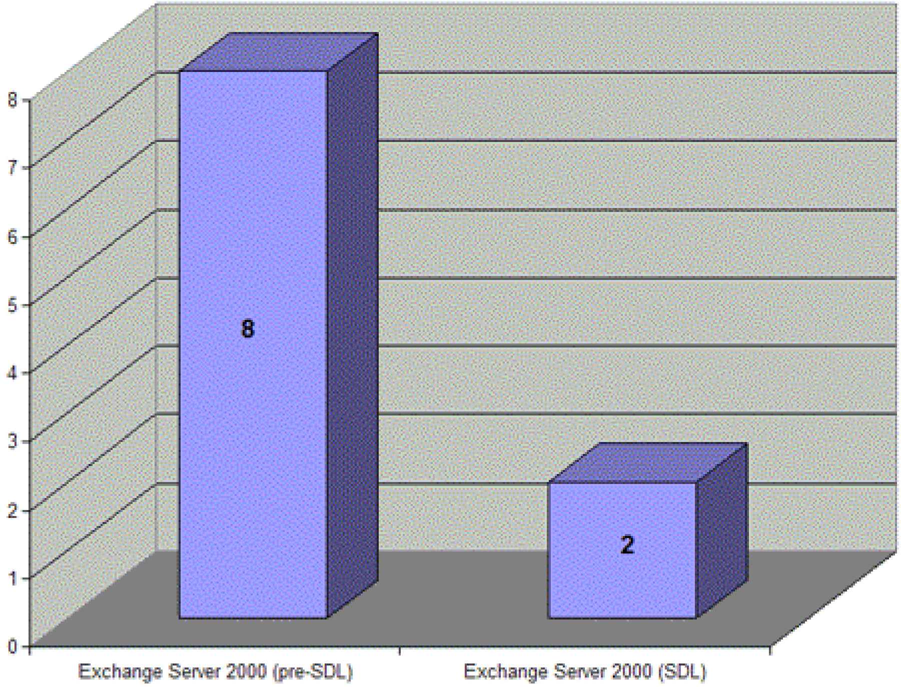


Figure 3. First Year Security Bulletins: Windows 2000 vs. Windows Server 2003

Results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1
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2
Exchange Server 2000 (pre-SDL)
Exchange Server 2000 (SDL)

- Topic to be continued …