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El Testing em el Contexto del CMMI Nivel 3

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CES – Jornada de Testing em VIVO

Montevideo, 26 de abril de 2006.

Idiomas de la Presentación

- Inglés...
- Portuñol...
- Español...

Idiomas de la Presentación

- Inglés – slides.
- Portuñol – Juliana hablando.
- Español – participantes preguntando y interactuando.

ESI – European Software Institute

Profit-free Institution.

Founded in 1993 by the European Commission and the Basque Government.

Located at Zamúdio Technological Park, in Bilbao, Spain.

ESI and ESICenter Mission

To contribute to the development of competitiveness of its Patrons and the Industry through the promotion, continuous improvement, and knowledge in Information and Communication Technologies.

www.esi.es
www.esicenter.unisinos.br

Internationalization Activities

Actions

- **Maintaining the services sold by the Institute:**
  - Consulting Unit
  - Training Unit
- **Establishment of a Commercial Net:**
  - Business Unit

ESI@net

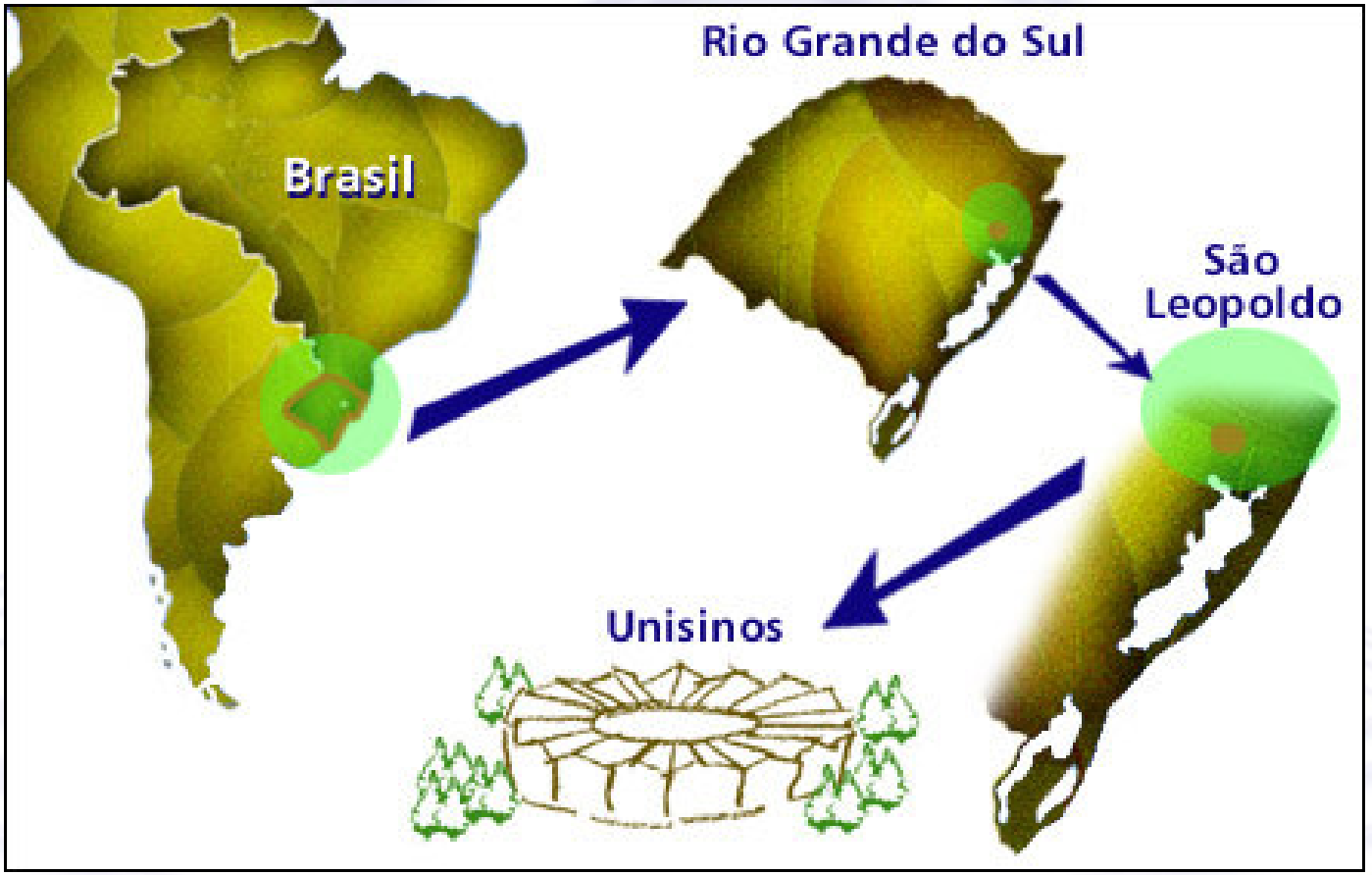
- **Establishment of a Software Engineering Excellence Centers Net:**

ESI@Center

ESI@Center

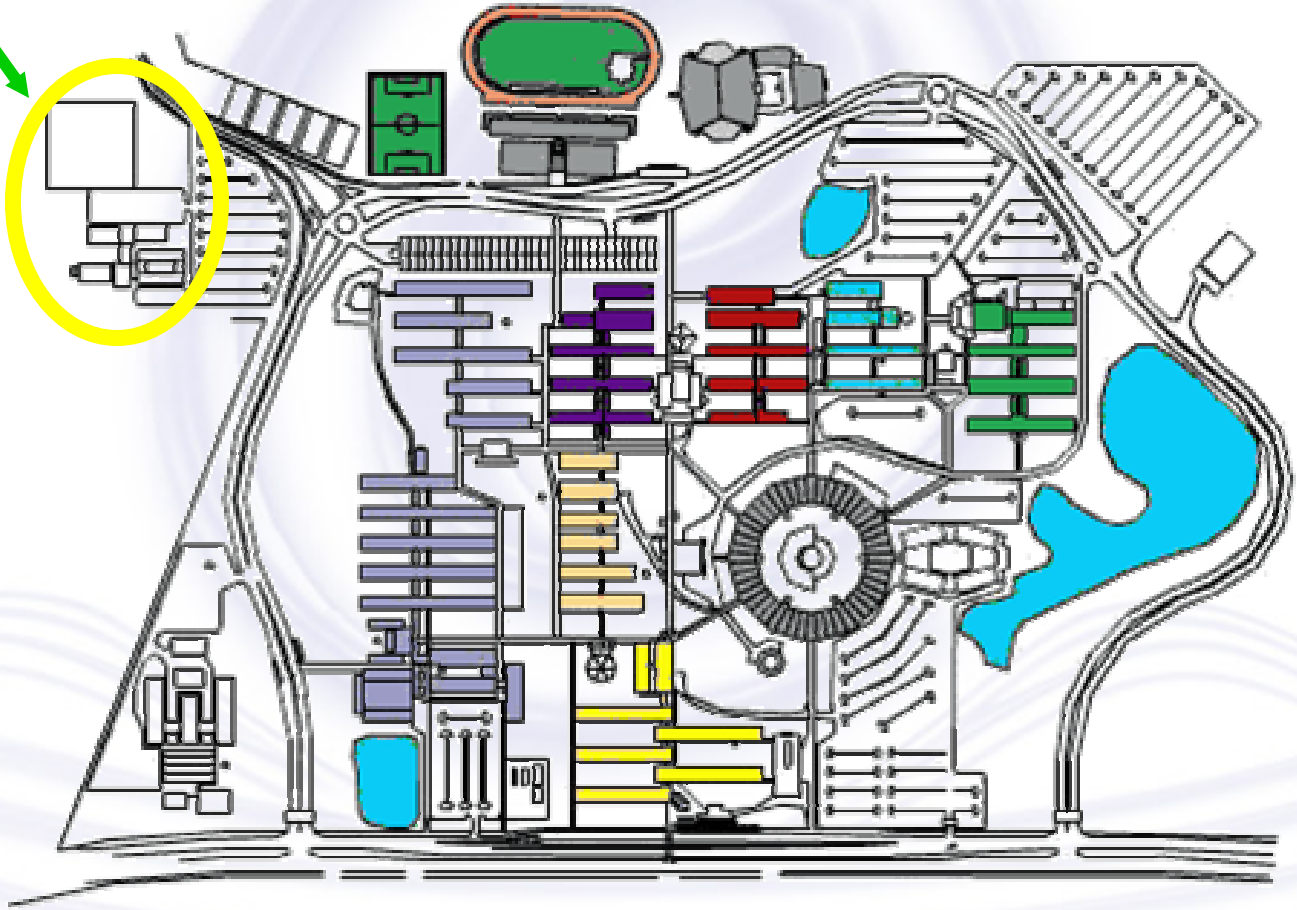
- 6 centers are planned to be created around the world.
- 5 centers created until now:
  - ESICenter UNISINOS – São Leopoldo – Rio Grande do Sul – Brasil - 2002.
  - ESICenter in Shanghai – China - 2002.
  - ESICenter Australia in Melbourne, Australia - 2003.
  - ESICenter Tec de Monterrey in Guadalajara, Mexico - 2004.
  - ESICenter Bulgaria in Sofia, Bulgaria - 2004.

Vale do Rio dos Sinos University



Vale do Rio dos Sinos University

Technological Park- Pólo de Informática – ESICenter UNISINOS



ESI@Center


UNITEC
Unidade de Desenvolvimento Tecnológico da UNISINOS

Work Areas – ESICenter UNISINOS

- Software testing (validation and verification).
- Software Process Improvement:
  - 2 SCAMPI lead-appraisers (SEI/CMU).
  - 1 PSP instructor (SEI/CMU).
  - 1 TSP couch (SEI/CMU).
- BITS (Balanced Information Technology Scorecard).

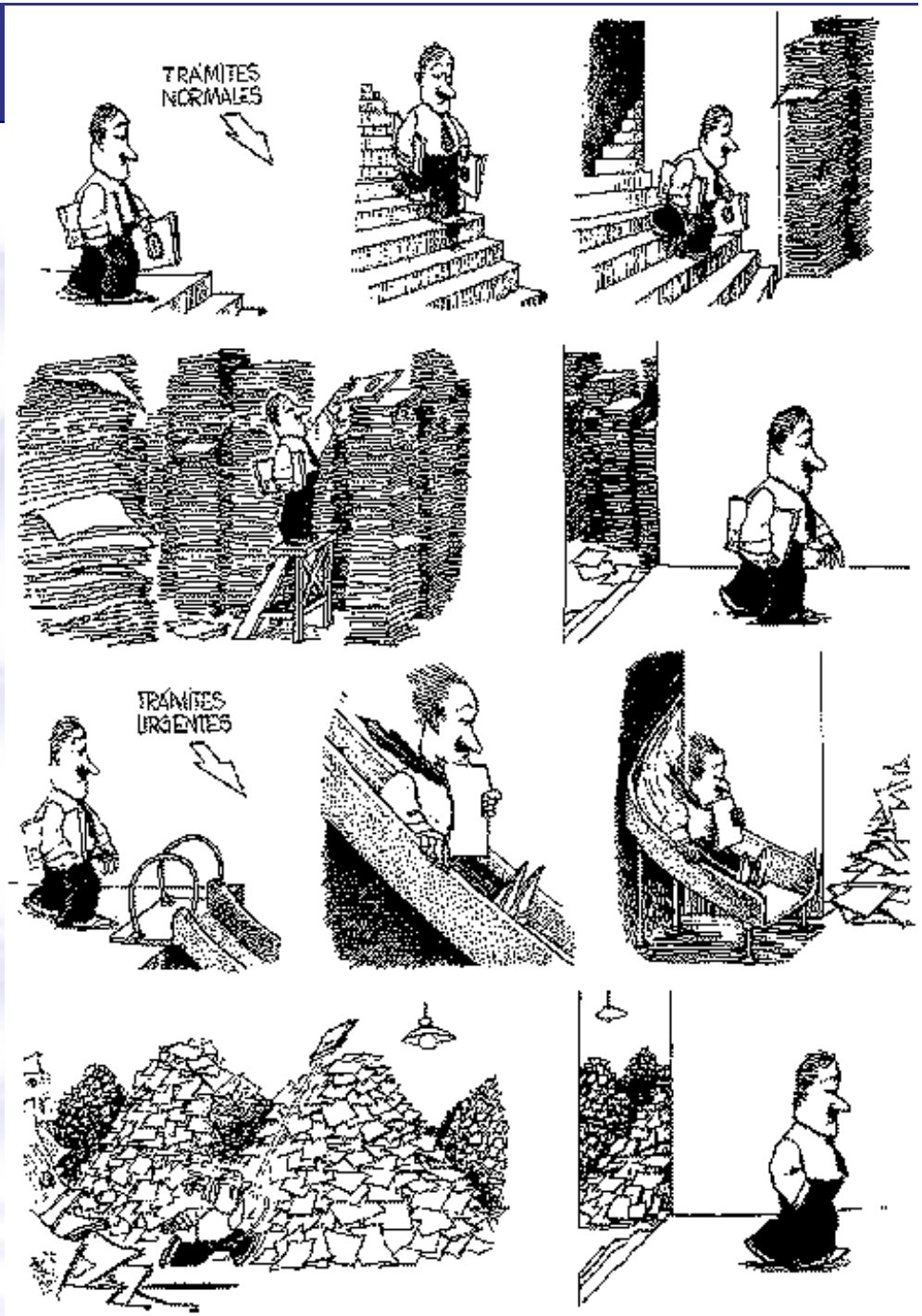
ESICenter UNISINOS Created on 26/03/2002

An Excellence Center in Software Engineering created to promote the technological diffusion of the best practices to ensure software quality.

UNISINOS
UNIVERSIDADE DO VALE DO RIO DOS SINOS

El Testing en el Contexto del CMMI Nivel 3

- Software Processes
- CMMI
- Validation and Verification
- Something about PSP

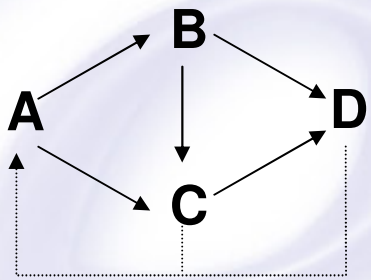

TRÁMITES
NORMALES
TRÁMITES
URGENTES

Software Process Quality

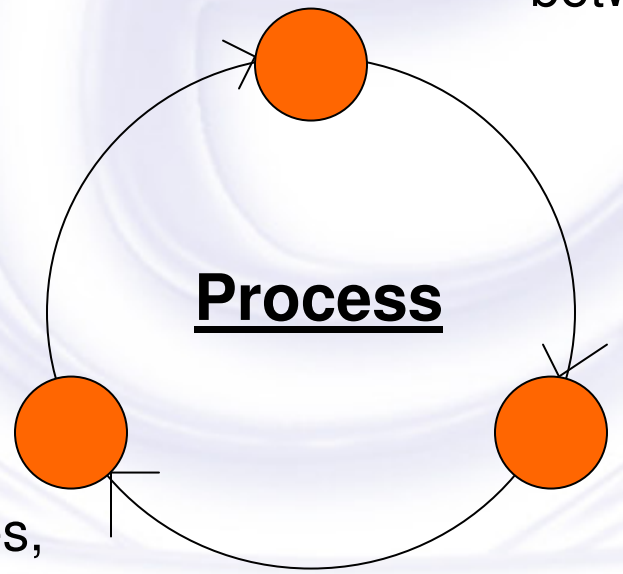
Software Process

- **Process**: a sequence of steps performed for a given purpose (IEEE).
- **Software Process**: a set of activities, methods, practices, and transformations that people use to develop and maintain software and the associated products (Software Engineering Institute – Carnegie Mellon University – SEI/CMU).

Software Process



Procedures and methods defining the relationship between tasks



People with capabilities, training and motivation

Tools and equipment

Software Process Management Premise - SEI/CMU

- The quality of a software system is highly influenced by the quality of the process used to develop and maintain it.
- This premise implies focus on process as well as on product.

An Immature Process SEI/CMU

- *Ad-hoc*: process improvised by the people dealing with it.
- The process is not rigorously followed.
- Highly dependent on people
- Low visibility of progress and quality.
- Functionality and quality are frequently committed relation to a schedule.
- The use of new technology represents high risks.
- Excessive maintenance rework and costs.
- It's hard to predict quality.

A Mature Process SEI/CMU

- Consistent with the way work actually gets done.
- Defined, documented, and continuously improving.
- Supported visibly by management
- Well-controlled (by metrics, for example).
- Disciplined introduction of new technologies.

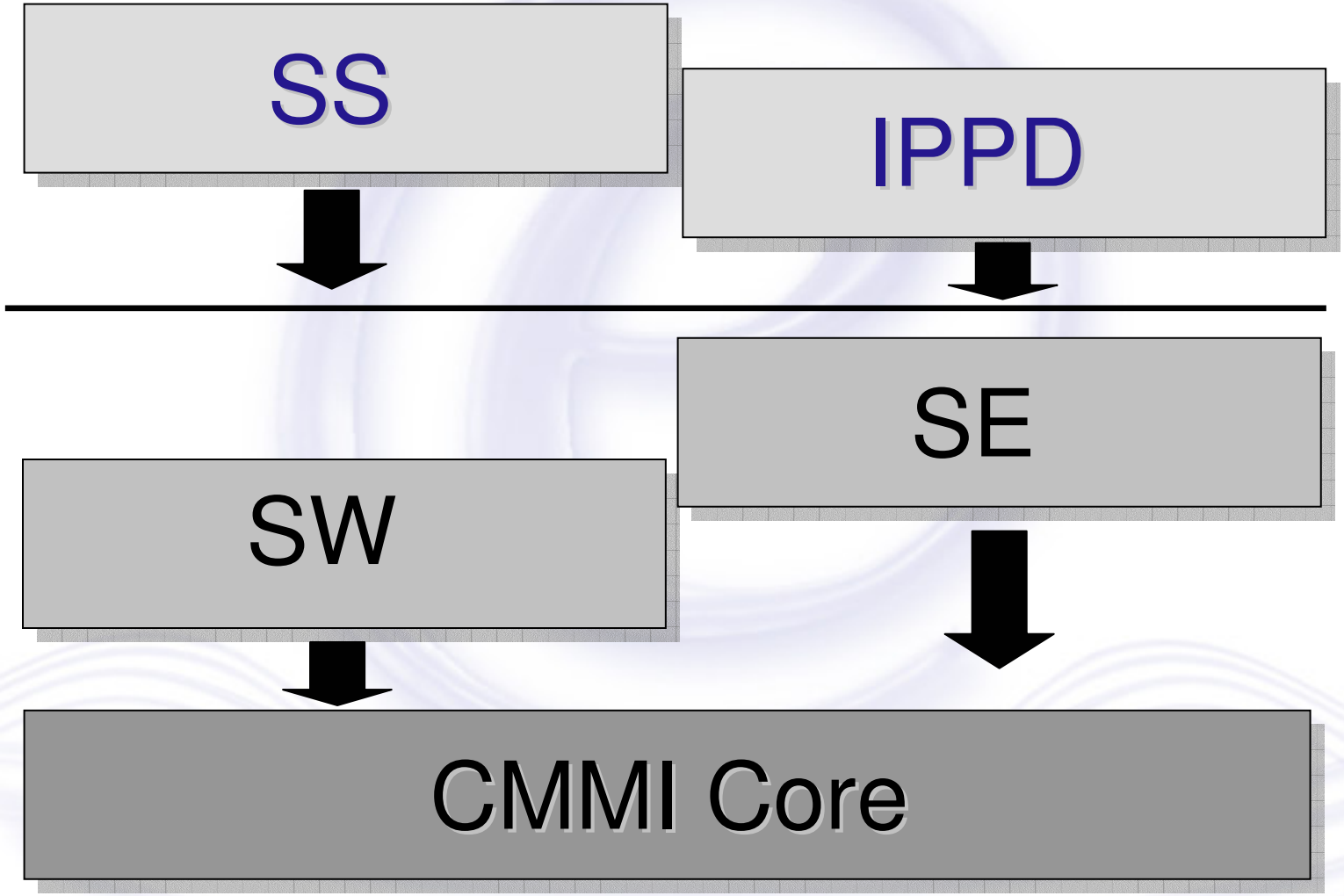
Institutionalized Process

- "That's the way we do things around here".
- Existence of an infrastructure that contains processes applied in a consistent way in the organization.
- The organizational culture conveys the process.
- The culture is conveyed with role models and rewards.
- Processes endure, even if the people who developed them are no longer working at the company.

SW-CMM* and CMMI**

*Capability Maturity Model for Software and
**Capability Maturity Model Integration

CMMI-SE/SW/IPPD/SS, v1.1



CMMI (CMM Integration)

CMMI Version 1.1 (CMMI-SE/SW/IPPD/SS, V1.1)

- Disciplines:
  - Systems Engineering
  - Software Engineering
  - Integrated Product and Process Development
  - Supplier Sourcing

Bodies of knowledge

Disciplines of CMMI Version 1.1

- Systems Engineering (SE)
  - Covers the development of total systems, which may or may not include software.
  - Focus on transforming customer needs, expectations, and constraints into product solutions and supporting these product solutions throughout the life of the product

Disciplines of CMMI Version 1.1

- Software Engineering (SW)
  - Covers the development of software systems.
  - Focus on applying systematic, disciplined, and quantifiable approaches to the development, operation, and maintenance of software.

Disciplines of CMMI Version 1.1

- Integrated Product and Process Development (IPPD)
  - A systematic approach that achieves a timely collaboration of relevant stakeholders throughout the life of the product to better satisfy customer needs, expectations, and requirements.
  - The processes to support an IPPD approach are integrated with the other processes in the organization.

Disciplines of CMMI Version 1.1

- Integrated Product and Process Development (IPPD)
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    better satisfy cus
    requirements.
  - The processes to support an IPP
    with the other processes in the c

Stakeholder:a group or individual that is affected by or in some way accountable for the outcome of an undertaking.; *Relevant Stakeholder*: involved in specified activities and is included in an appropriate plan.

Disciplines of CMMI Version 1.1

- *Supplier Sourcing (SS)*
  - As work efforts become more complex, projects may use suppliers to perform functions or add modifications to products.
  - When those activities are critical, the project benefits from enhanced source analysis and from monitoring supplier activities before product delivery.
  - Covers acquiring products from suppliers under these circumstances.

CMMI – two representations

Continuous Representation

6 maturity levels

by Process Area

Staged Representation

5 maturity levels (stages)

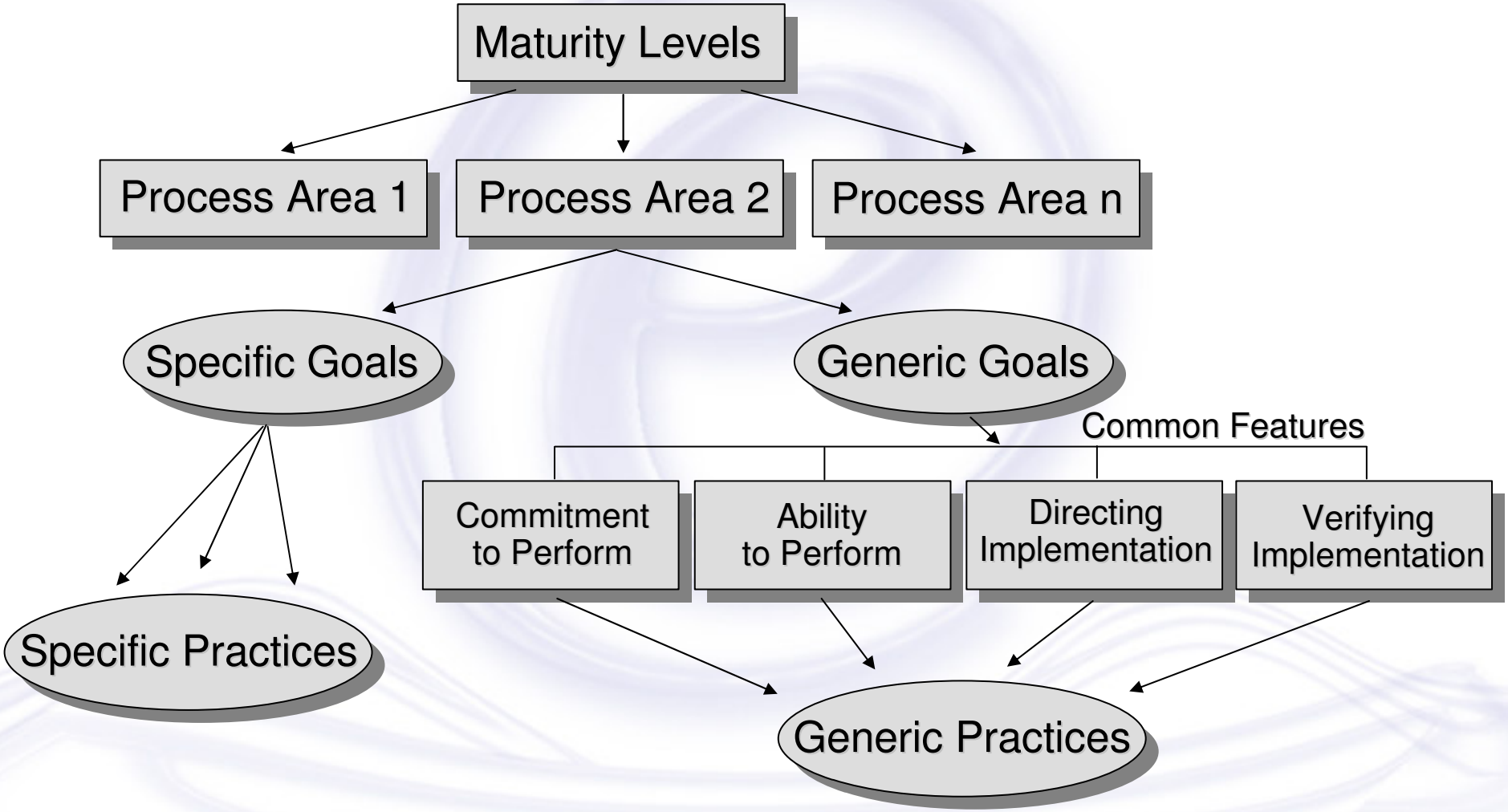
Predefined set of Process Areas for each level

CMMI – Choosing a model

- Which discipline/disciplines?
  - CMMI-SW
  - CMMI-SE/SW
  - CMMI-SE/SW/IPPD
  - CMMI-SE/SW/IPPD/SS
- Which representation?
  - Staged
  - Continuous

CMMI
Staged Representation

CMMI Structure (*staged representation*)

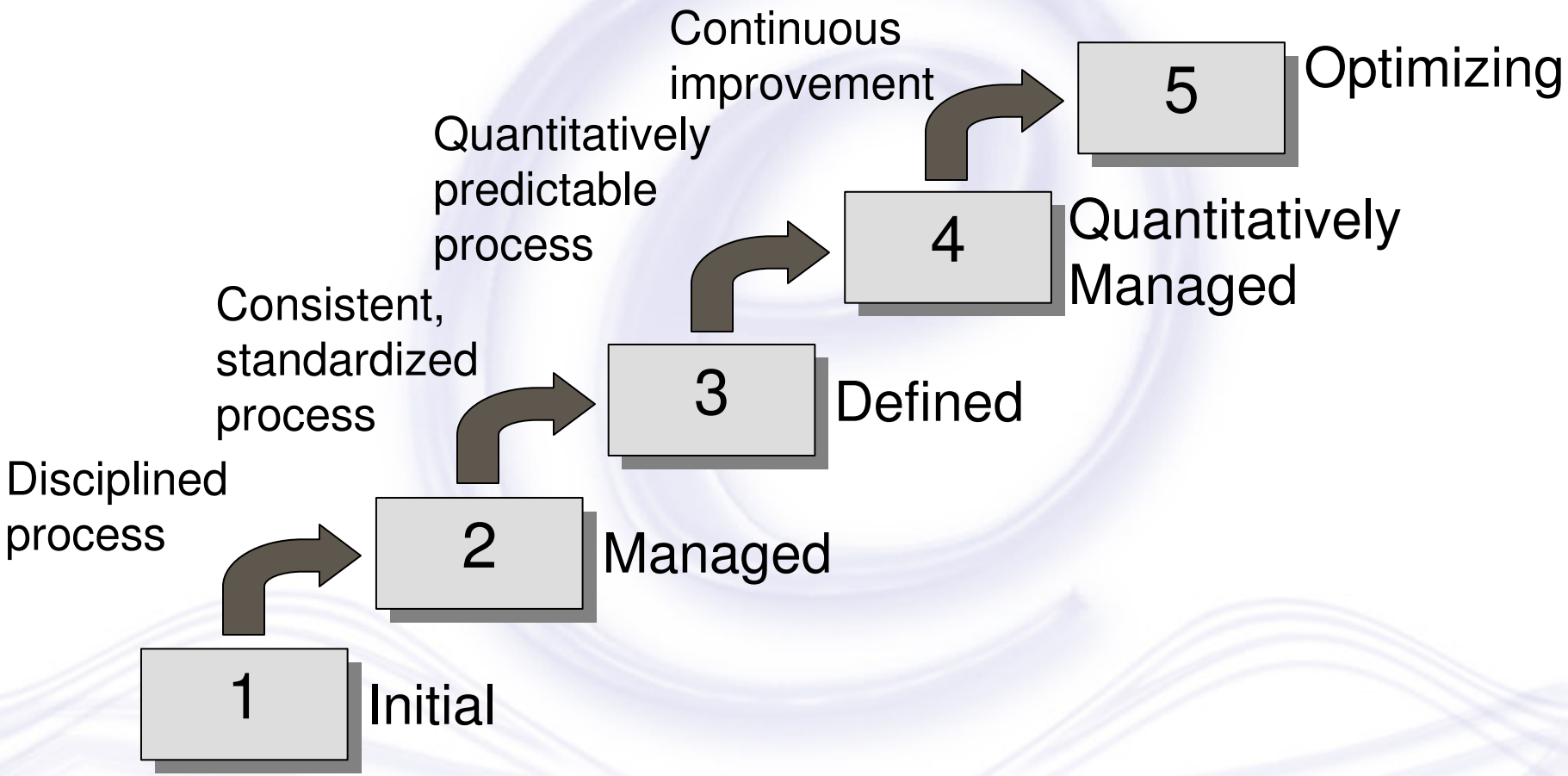


Maturity levels

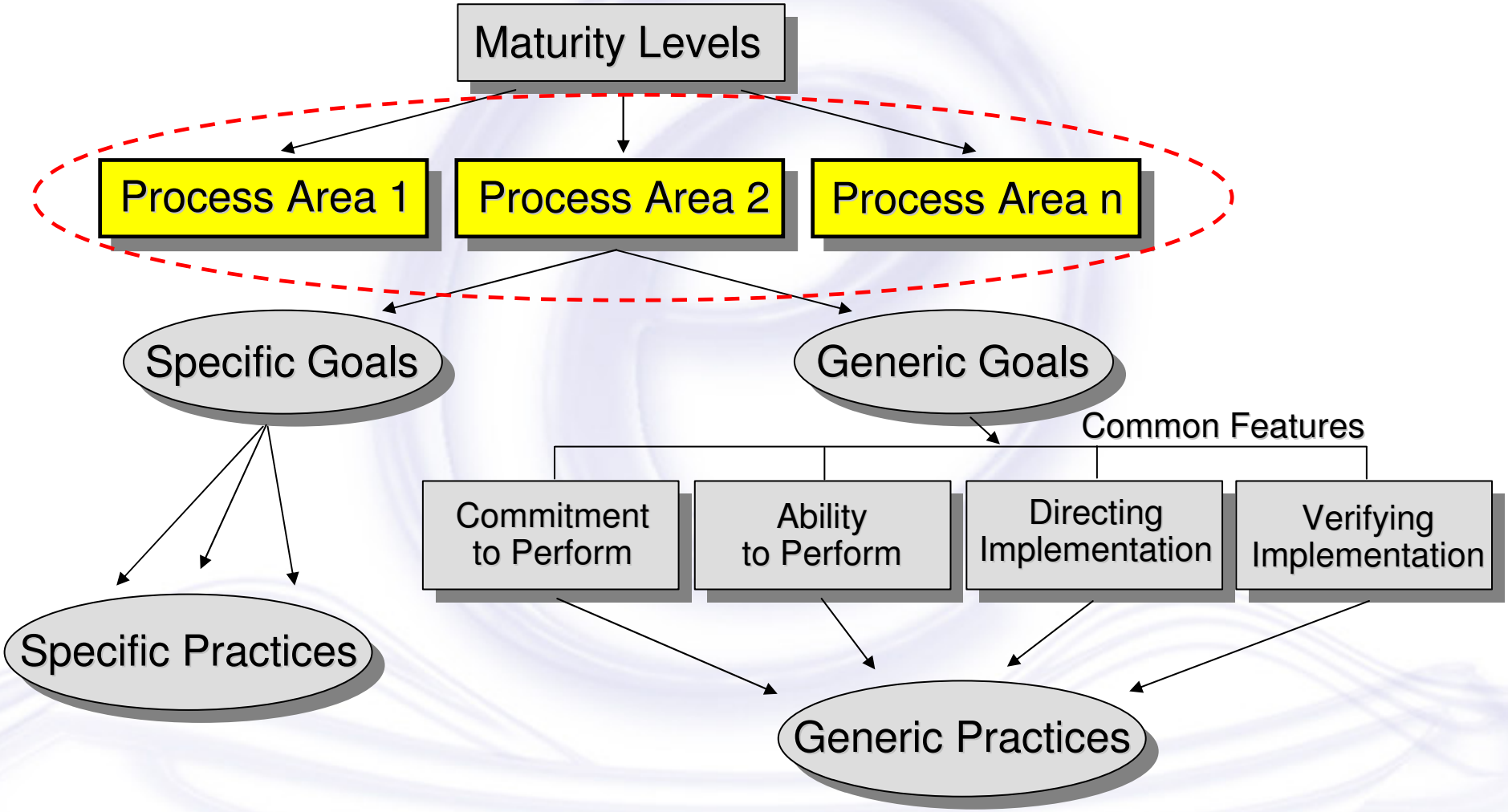
In CMMI models with a staged representation, there are five maturity levels, each a layer in the foundation for ongoing process improvement, designated by the numbers 1 through 5:

1. Initial
2. Managed
3. Defined
4. Quantitatively Managed
5. Optimizing

Maturity levels



CMMI Structure (staged representation)



Process Areas (PAs)

A process area is a cluster of related practices in an area that, when performed collectively, satisfy a set of goals considered important for making significant improvement in that area.

- All CMMI process areas are common to both continuous and staged representations);
- In the staged representation, process areas are organized by maturity levels.

The 7 *Process Areas* of Level 2

- Requirements Management (REQM)
- Project Planning (PP)
- Project Monitoring and Control (PMC)
- Supplier Agreement Management (SAM)
- Measurement and Analysis (MA)
- Process and Product Quality Assurance (PPQA)
- Configuration Management (CM)

The 14 Process Areas of Level 3

- Requirements Development (RD)
- Technical Solution (TS)
- Product Integration (PI)
- **Verification (VER)**
- **Validation (VAL)**
- Organizational Process Focus (OPF)
- Organizational Process Definition (OPD)
- Organizational Training (OT)
- Integrated Project Management for IPPD (IPM for IPPD)*
- Risk Management (RSKM)
- Integrated Teaming (IT)**
- Integrated Supplier Management (ISM)***
- Decision Analysis and Resolution (DAR)
- Organizational Environment for Integration (OEI)**

*If the IPPD discipline is not integrated into the model, this PA will have another version (IPM)

**only if the IPPD discipline is integrated into the model

***only if the SS discipline is integrated into the model

The 2 Process Areas of Level 4

- Organizational Process Performance (OPP)
- Quantitative Project Management (QPM)

The 2 Process Areas of Level 5

- Organizational Innovation and Deployment (OID)
- Casual Analysis and Resolution (CAR)

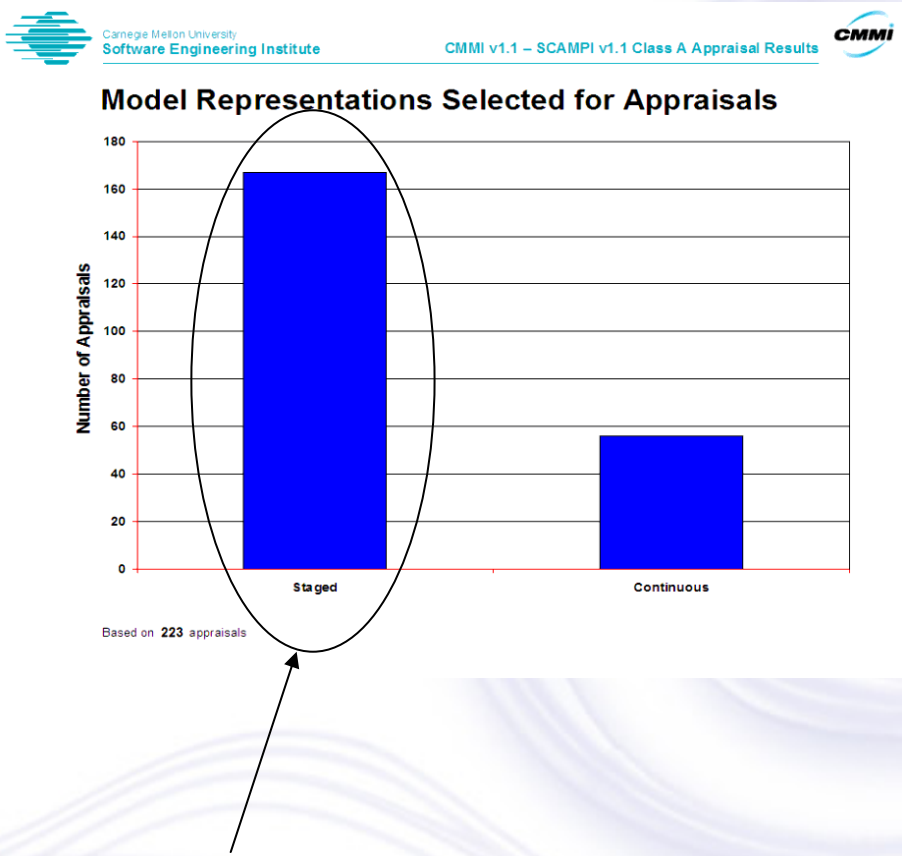
Process Areas Categories

- CMMI process areas can be grouped into four categories:
  - Process Management;
  - Project Management;
  - Engineering; and
  - Support.

PAs x maturity levels x categories

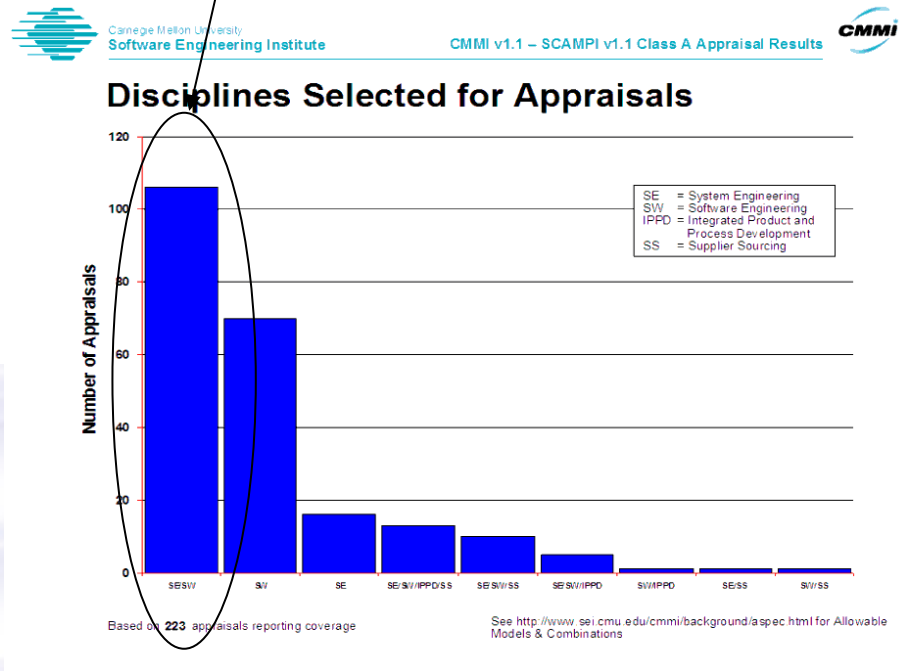
Categ. / Level	Process management		Project management		Eng.	Support	
	Bas.	Adv.	Bas.	Adv.		Bas.	Adv.
5		**OID**					**CAR**
4		**OPP**		**QPM**			
3	**OPF, OPD, OT**			**IPM for IPPD, RSKM, IT, ISM**	**RD, TS, PI, VER, VAL**		**OEI, DAR**
2			**PP, PMC, SAM**		**REQM**	**MA, PPQA, CM**	
1							

Use of disciplines and representations

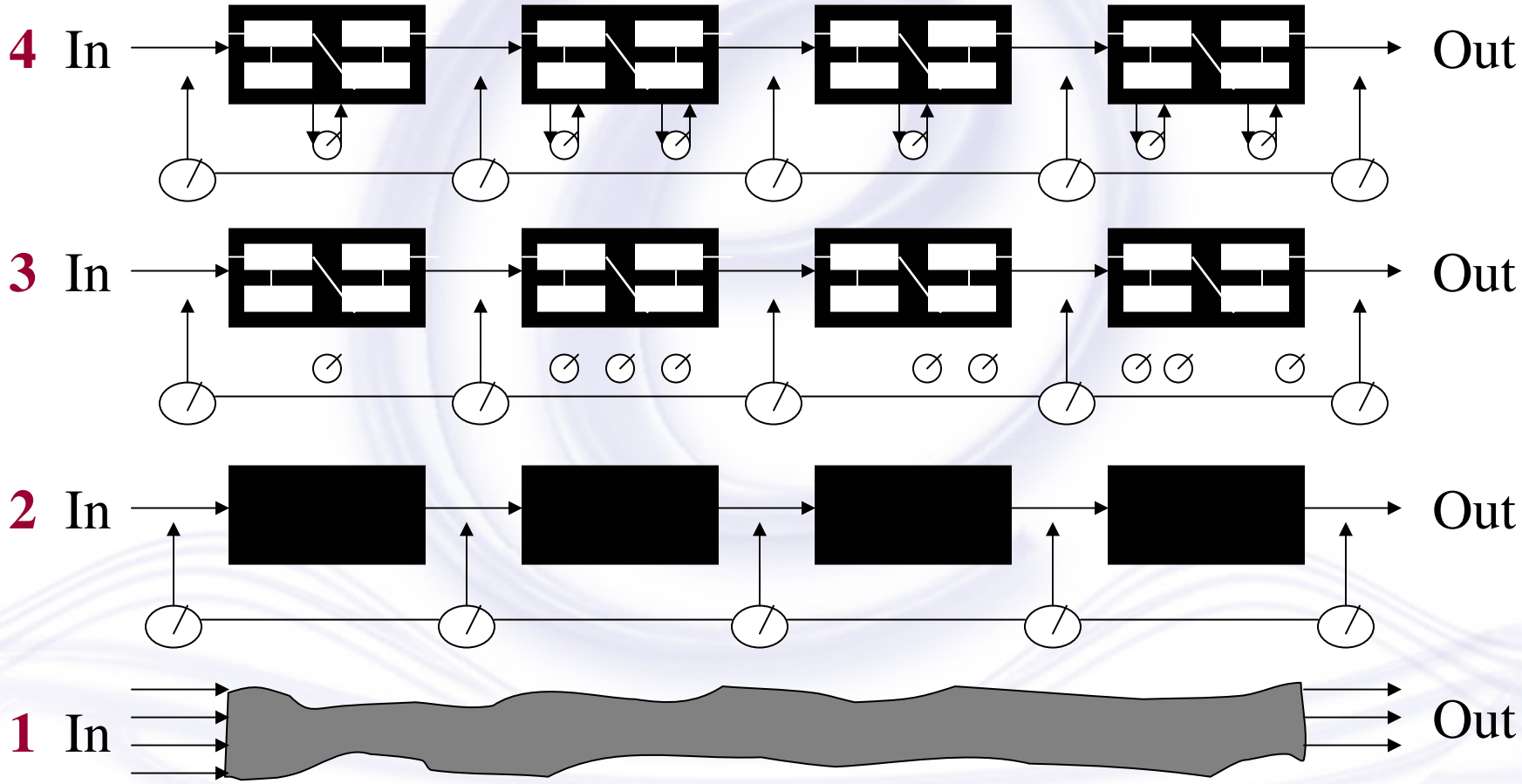


SW+SE

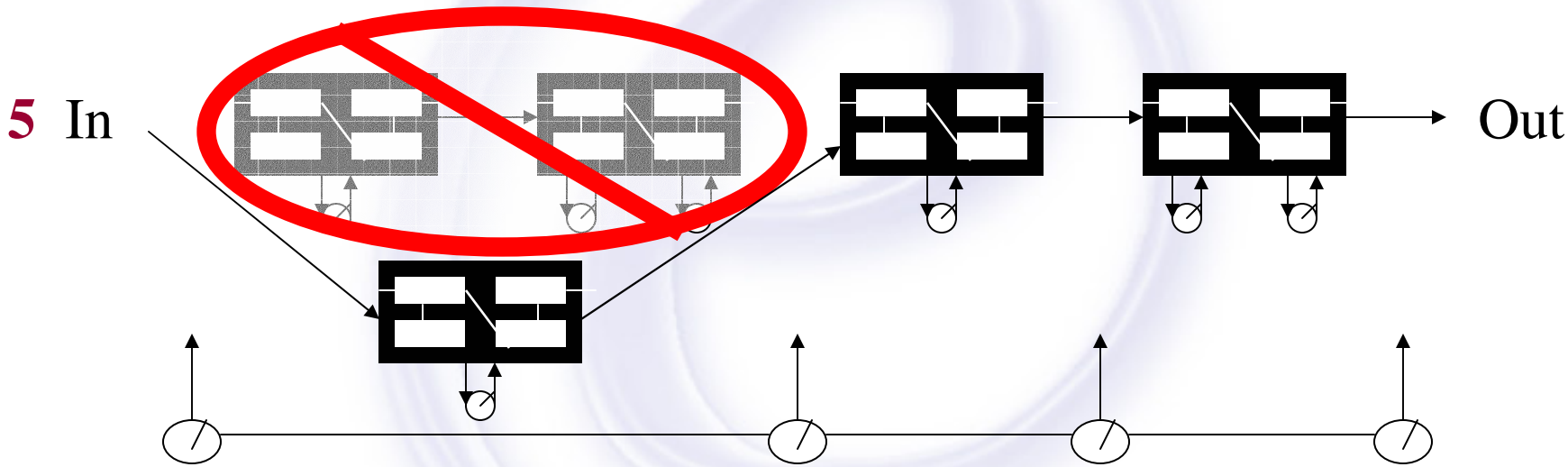
Staged



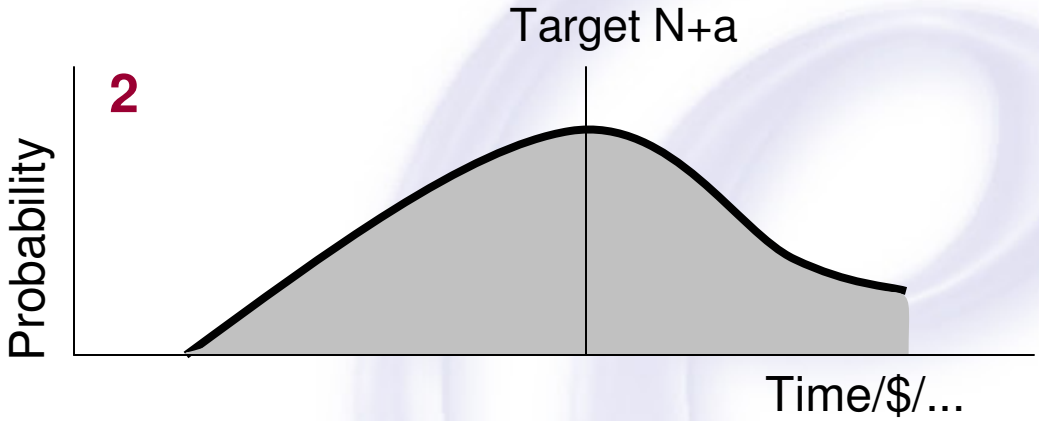
Visibility



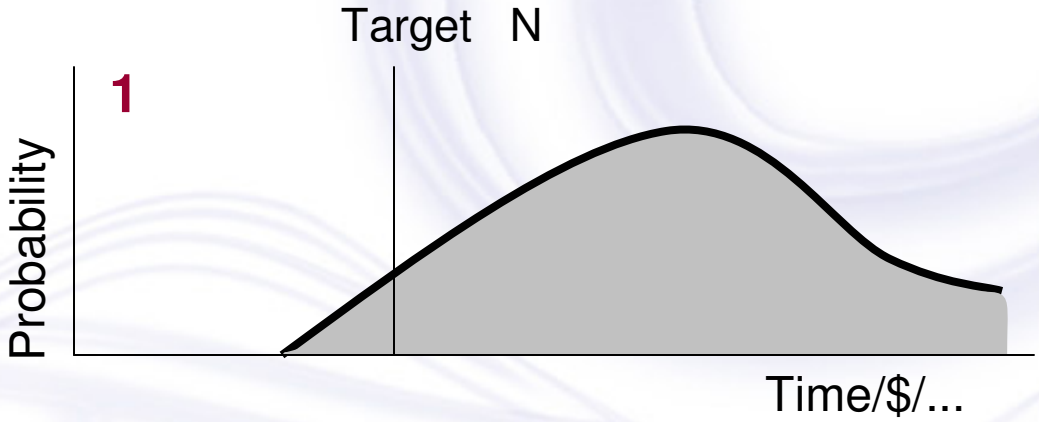
Visibility



Maturity level = capability

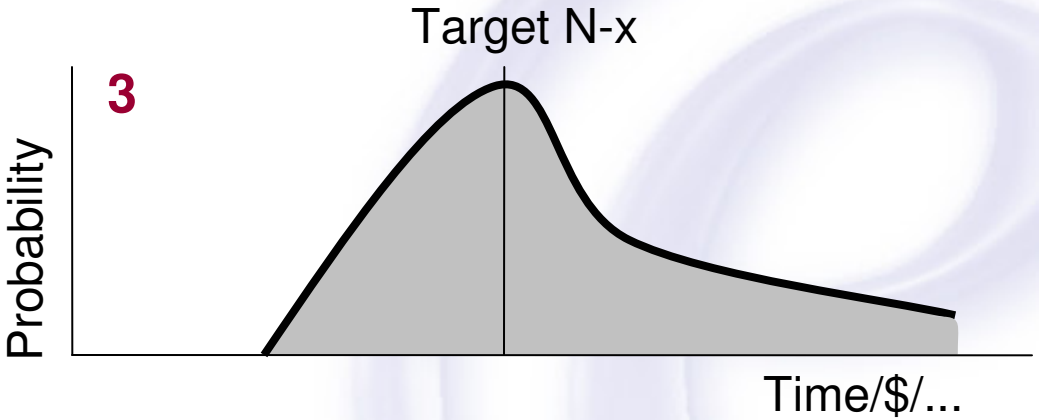


Plans based on past performances are more realistic at Level 2 organizations

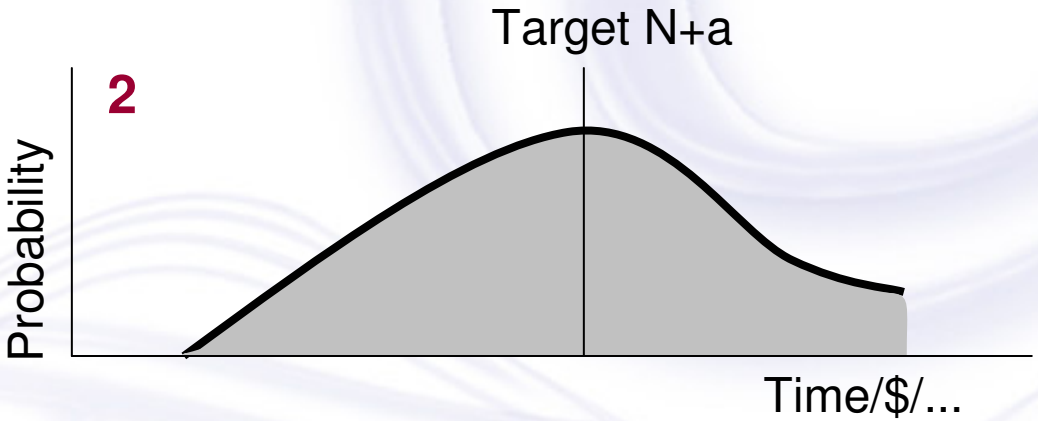


Schedule and cost estimates are usually uncontrolled at Level 1 organizations

Maturity level = capability

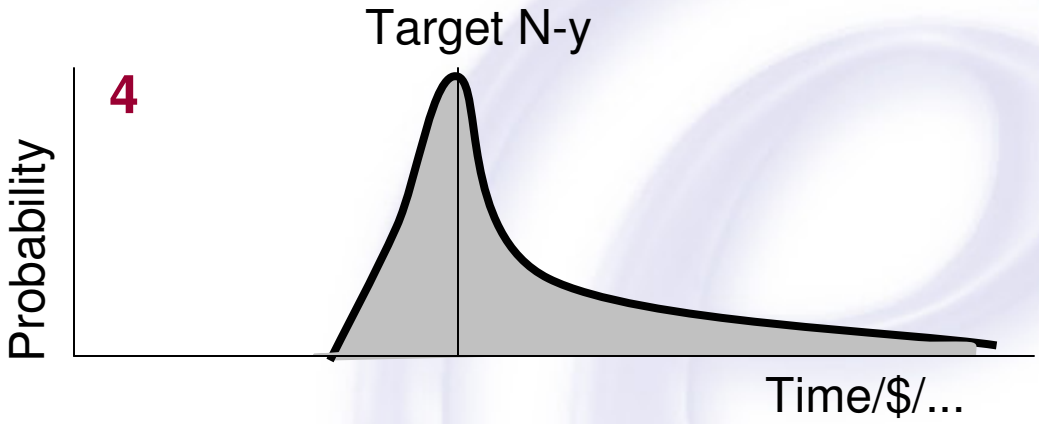


With well-defined processes, performance increases at Level 3 organizations

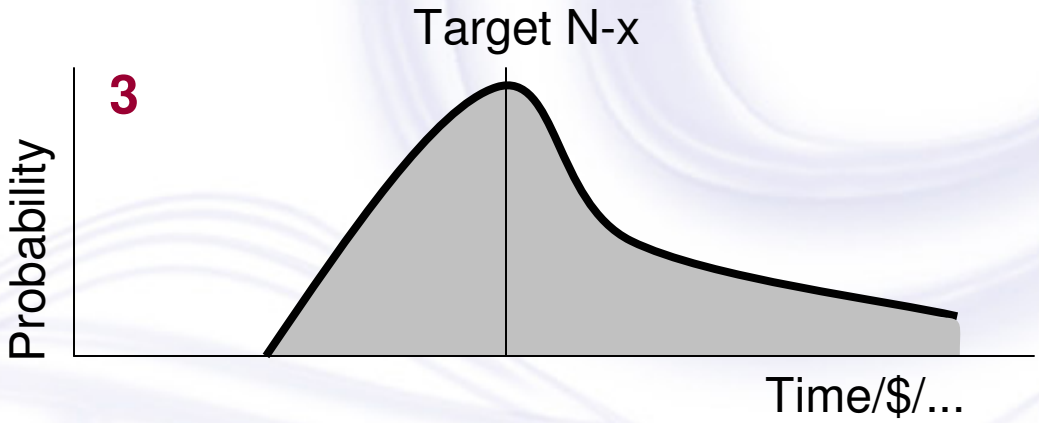


Plans based on past performance are more realistic at Level 2 organizations

Maturity level = capability

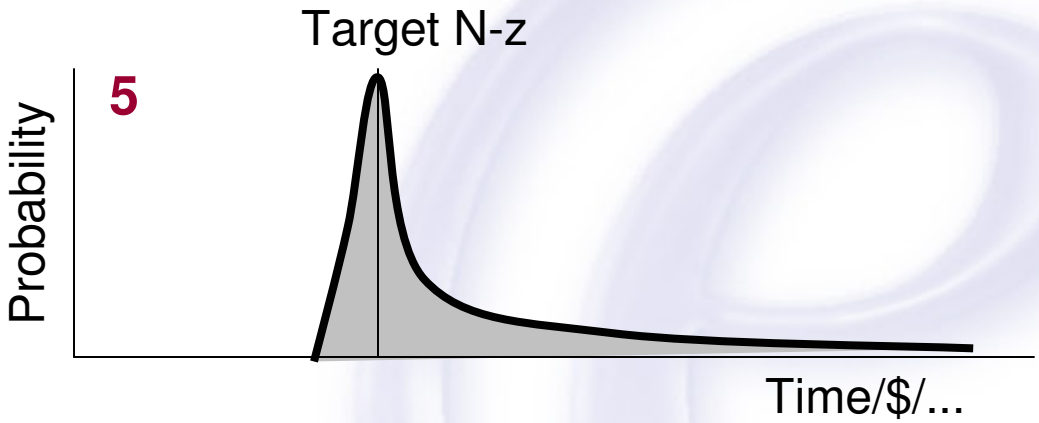


Based on process and product quantitative analysis, performance continues improving at Level 4 organizations

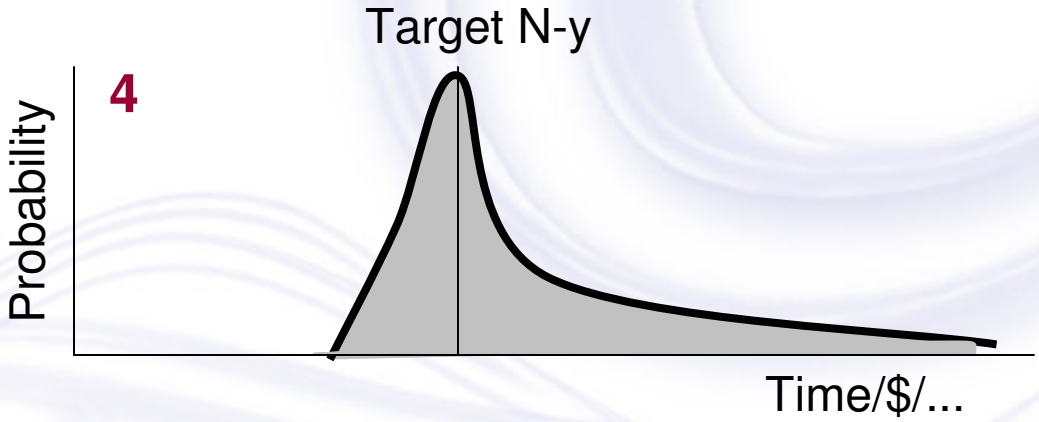


With well-defined processes, performance increases at Level 3 organizations

Maturity level = capability



Performance improves continuously at Level 5 organizations



Based on process and product quantitative analysis, performance continues improving at Level 4 organizations

References

- **SEI's website: www.sei.cmu.edu**

  www.sei.cmu.edu/cmmi

- **Book: The Capability Maturity Model: Guidelines for Improving the Software Process**

  Carnegie Mellon University / Software Engineering Institute

  (Mark C. Paulk, Charles V. Weber, Bill Curtis, Mary Beth Chrissis)

  Addison-Wesley

PAs – Validation and Verification

Verification X Validation

- **Verification**: compares the program against the specification. Are we building the program correctly?
- **Validation**: analyses the conformity of the results obtained to the expected ones. Are we building the right system?

Software Testing

- "The test consists of executing a program with the aim of finding errors (*bugs*)". "The Art of Software Testing" – *Myers*, 1979.

Validation – VAL

- **Purpose:** to demonstrate that a product or product component fulfills its intended use when placed in its intended environment.

- Whenever possible, validation should be accomplished using the product or product component operating in its intended environment. (...) However, validation issues can be discovered early in the life of the project using work products.

Validation – VAL

- The definition of the Generic Goals (GG) and the Generic Practices (GP) are the same for all the PAs:
  - GG3: Institutionalize a defined process:
    - GP 2.1 – Establish na organizational policy.
    - GP 2.2 – Plan the process.
    - GP 2.3 – Provide resources.
    - GP 2.4 – Assign responsability.
    - GP 2.5 – Train people.
    - GP 2.6 – Manage configurations.
    - GP 2.7 – Identify and involve relevant stakeholders.
    - GP 2.8 – Monitor and control the process.
    - GP 2.9 – Objectively evaluate adherence.
    - GP 2.10 – Review status with higher level management.
    - GP 3.1 – Establish a defined process.
    - GP 3.2 – Collect improvement information.

Validation – VAL

- SG1 – Prepare for Validation
  - SP 1.1-1 Select products for validation.
  - SP 1.2-2 Establish the validation environment.
  - SP 1.3-3 Establish validation procedures and criteria.

- Examples of sources for validation criteria:
  - Product requirements.
  - Standards.
  - Customer acceptance criteria.
  - Environmental performance.
  - Tresholds of performance deviation.

Validation – VAL

- SG2 – Validate Product or Product Components
  - SP 2.1-1 Perform validation.
    - Typical work products:
      - Validation reports.
      - Validation results.
      - Validation cross-reference matrix.
      - As-run procedures log.
      - Operational demonstrations.
  - SP 2.2-2 Analyze validation results.
    - Typical work products:
      - Validation deficiency reports.
      - Validation issues.
      - Procedure change request.

Verification – VER

- **Purpose:** to ensure that selected work products meet their specified requirements.

- Verification is inherently an incremental process, because it occurs throughout the development of the product and work products, beginning with verification of the requirements, progressing through the verification of the evolving work products, and cultimating in the verification of the completed product.

Verification – VER

- The definition of the Generic Goals (GG) and the Generic Practices (GP) are the same for all the PAs:
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    - GP 2.10 – Review status with higher level management.
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    - GP 3.2 – Collect improvement information.

Verification – VER

- SG1 – Prepare for Verification
  - SP 1.1-1 Select products for verification.
  - SP 1.2-2 Establish the verification environment.
  - SP 1.3-3 Establish verification procedures and criteria.
- SG2 – Perform Peer Reviews
  - SP 2.1-1 Prepare for peer reviews.
  - SP 2.2-1 Conduct peer reviews.
  - SP 2.3-2 Analyze peer review data.
- SG3 – Verify Selected Work Products
  - SP 3.1-1 Perform verification.
  - SP 3.2-2 Analyze verification results and identify corrective action.

Verification – VER

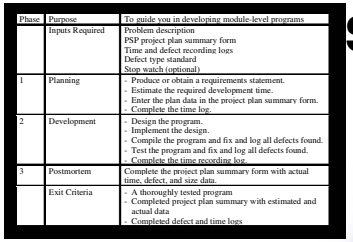
- Typical work products of the SP 3.2-2:
  - Analysis report (e.g., causal analysis of nonconformances).
  - Trouble reports.
  - Change requests for the verification methods, criteria, and environment.
  - Corrective actons to verification methods, criteria and environment.

PSP – Personal Software Process

Watts Humphrey – SEI/CMU

www.sei.cmu.edu/tsp

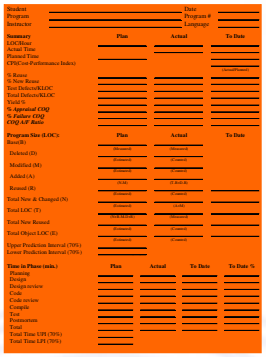
The PSP Process Elements



Phase	Purpose	To guide you in developing module-level programs
	Inputs Required	Problem description PSP project plan summary form Time and defect recording logs Defect type standard Stop watch (optional)
1	Planning	- Produce or obtain a requirements statement. - Estimate the required development time. - Enter the plan data in the project plan summary form. - Complete the time log.
2	Development	- Design the program. - Implement the design. - Compile the program and fix and log all defects found. - Test the program and fix and log all defects found. - Complete the time recording log.
3	Postmortem	Complete the project plan summary form with actual time, defect, and size data.
	Exit Criteria	- A thoroughly tested program - Completed project plan summary with estimated and actual data - Completed defect and time logs

Scripts — **Document the process entry criteria, phases/ steps, and exit criteria. The purpose is to guide you as you use the process.**

Measures — **Measure the process and the product. They provide insight into how the process is working and the status of the work.**



Forms — **Provide a convenient and consistent framework for gathering and retaining data**

Standards — **Provide consistent definitions that guide the work and gathering of data.**

What is Quality?

- Basic definition: Meeting the user's needs
- There are three categories of product quality.
  - functionality
  - properties (e.g., maintainability, reliability, usability)
  - defects
- Customers focus primarily on functionality and, to a lesser extent, properties.
- The development process must focus on defects.

What is a Defect?

- A defect is something in a product that is incorrect.
  - It is not what was intended.
  - It must be changed to produce a correct product.
- Defects can result in
  - incorrect functionality
  - poor operation
  - improper installation
  - confusing or incorrect documentation
  - error-prone modification and enhancement
- Defects can occur in finished products, in specifications, or even in plans and requirements documents.

Why Focus on Defects?

- In software organizations, a significant number of resources are dedicated to fixing defects.
- Defects are very costly. As we will see, it is beneficial to find and remove defects early in the process.
- The reasons for managing defects are to
  - produce better products
  - improve your ability to develop products on time and within budget

Defects at the Personal Level

- In the PSP, defects are the basic quality measure.
- PSP focuses on finding, removing, and managing defects at the individual level.
- The personal level is where the defects are injected, and this is where the individual should
  - remove them
  - determine their causes
  - learn to prevent them
- A quality personal process is one that finds and removes defects before the products are shipped.

Defect Removal Techniques

- Reviews (inspections, walkthroughs, personal reviews)
  - examine the product or interim development artifacts of the product
  - find and eliminate defects
- Testing
  - exercises the product or parts of the product
  - proves that the product works correctly
  - identifies potential defects or symptoms

Inspections

- Inspections were introduced by Fagan at IBM in 1976.
- The objective is to find problems.
- Inspections follow a structured process.
  - Peers perform them.
  - Managers do not attend.
  - Each participant has a defined role.
  - Preparation is required.
- Inspections are useful for requirements, designs, code, test cases, plans, and the like.

Walkthroughs

- Walkthroughs are less formal and less structured than inspections.
- The objective is to communicate, discuss, or obtain approval.
- Walkthroughs typically follow a meeting format.
  - The developer leads the audience through the product.
  - The audience may include peers, managers, or other interested parties.
  - No preparation is required.
- Walkthroughs are most useful for requirements and system design issues.

Personal Reviews

- Personal reviews are structured, data-driven reviews conducted by individuals on their own work.
- The objective is to find defects before the individual's part of the product is integrated into the larger system.
- In a personal review, individuals
  - privately review their products
  - certify that their product is defect-free
- Reviews can be used for reviewing
  - products
  - interim products
  - any documentation that supports the product (such as requirements, designs, or test procedures)

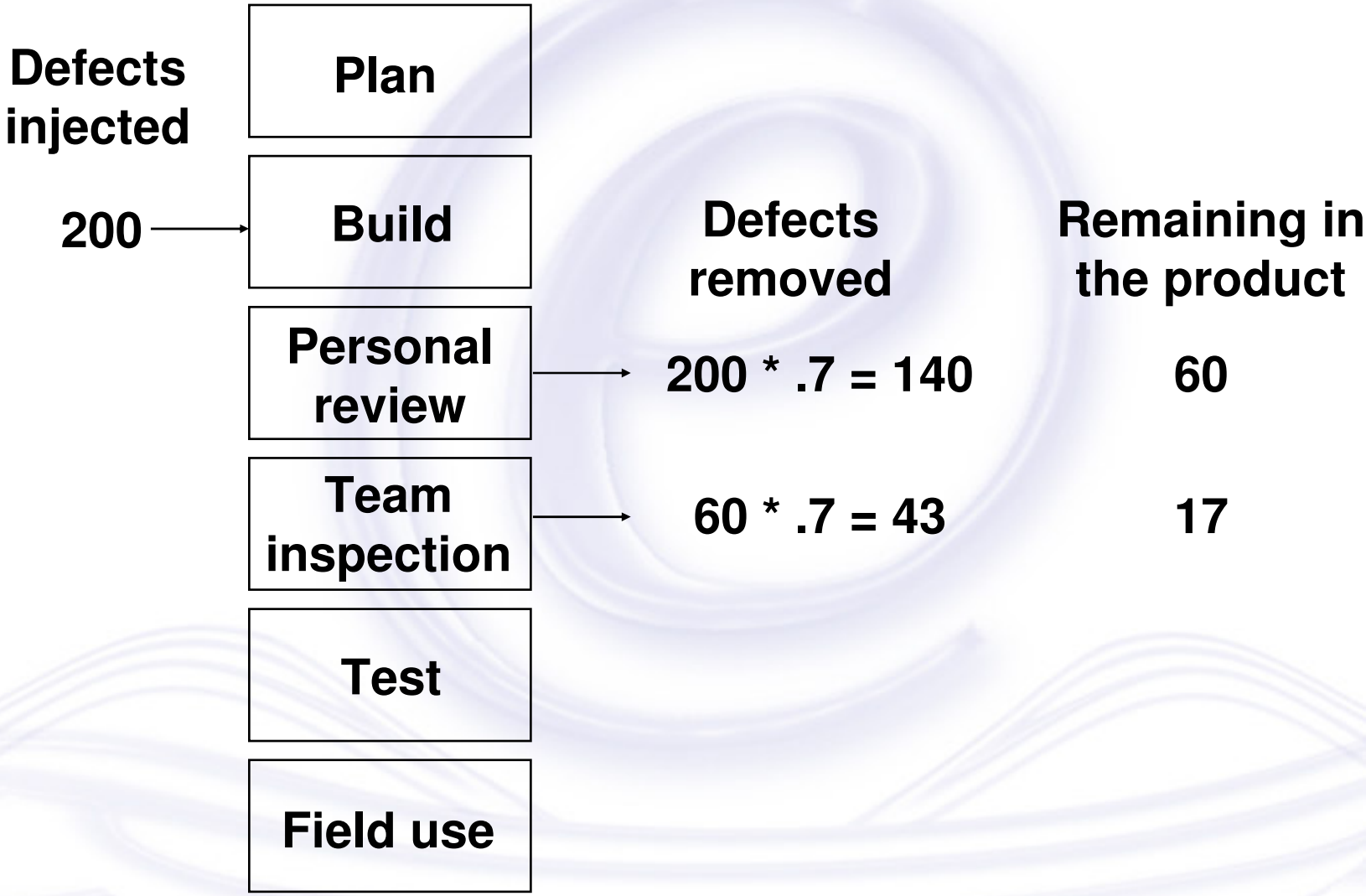
Testing

- In testing, the products are exercised to prove that they
  - do what they are supposed to
  - do not do what they are not supposed to
- Testing occurs at various levels throughout the development process.
  - unit testing
  - integration testing
  - system testing
  - acceptance testing
  - site testing
  - field trials

One Way to Think About Defects

- Think of defects as land mines.
  - They are hard to find.
  - They don't cause problems until you stumble across them.
  - When you find them, you could be in serious trouble.
- Finding defects through testing or using the product is like clearing a path through a mine field: travelers are only safe on the cleared pathways.
- Disciplined processes use personal reviews to clear the entire "mine field."

A Simple Example of Filters



A Personal Quality Strategy

- Emphasis on quality must start at the beginning.
- A high-quality personal process must
  - focus on removing defects early
  - record data on every defect
  - use these data to assess product quality
  - use these data to improve the process
- When individuals follow this strategy, they
  - produce higher-quality products
  - are more capable of meeting schedules and budgets

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El Testing em el Contexto del CMMI Nivel 3

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Muchas gracias!!

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