INTRODUCTION TO SOFTWARE ENGINEERING

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VLU

Introduction To Software Engineering

Carnegie Mellon University
The Practical Software Engineering Series

Software Inspections & Reviews

Course Objective

- Upon completion of this course, students will have the ability to:
  - Understand the discipline and principles of Software Engineering.
  - Understand the evolution of software in industry and the global competitive trends.
  - Understand software process, product and services.
  - Understand software modeling & techniques.
  - Demonstrate an appreciation for the breadth of software engineering.

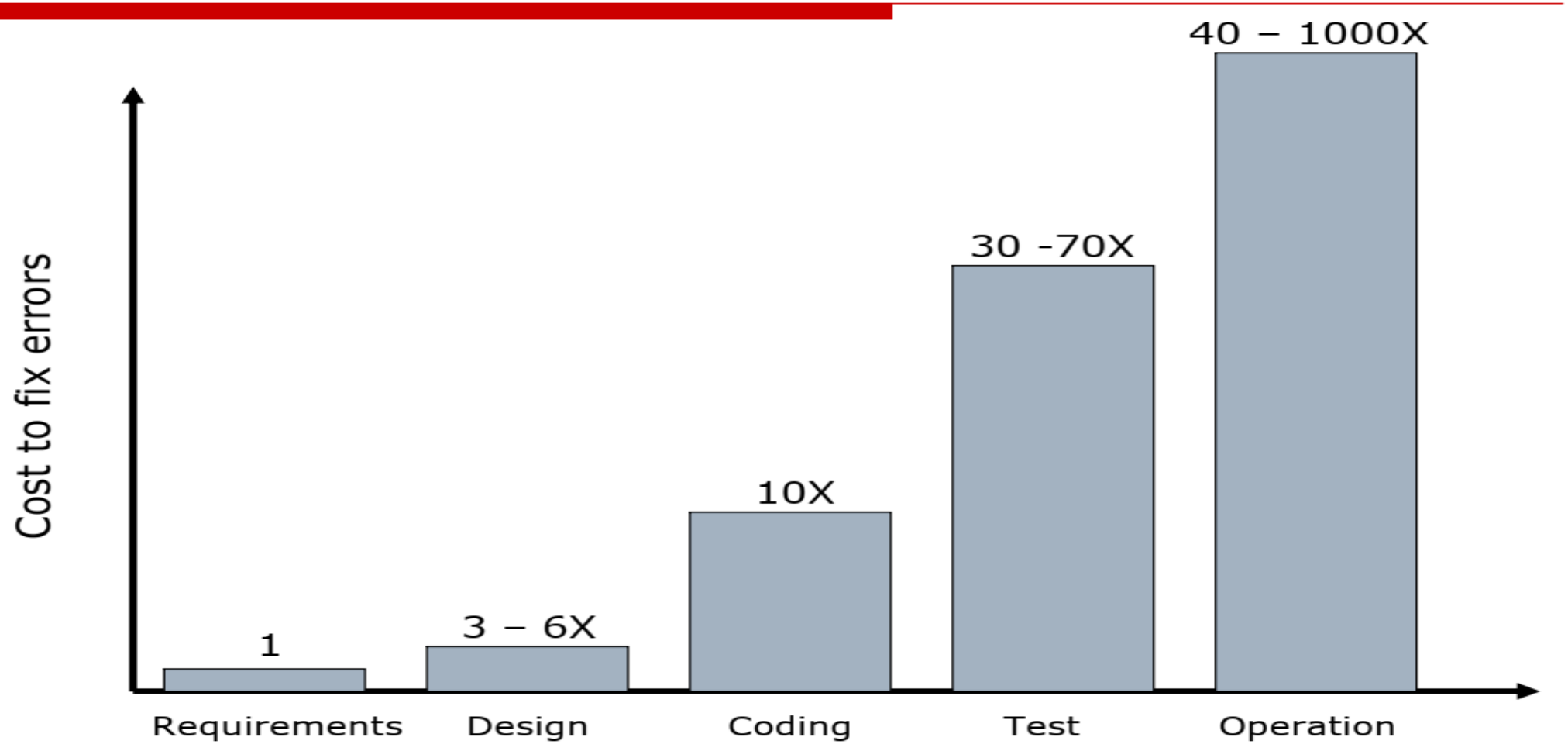
Lecture Learning Objectives

- Upon completion of this lecture, students will be able to:
  - Understand software inspections and reviews.
  - Understand formal and informal reviews.
- Outcomes:
  - Conduct software reviews and inspections.
  - Apply formal methods of software inspection to identify defects and correct them to improve software quality.
  - Understand roles and responsibilities in software inspection.

Software Testing & Inspections

- Software quality is the most important aspect of software engineering.
- Testing and inspections focus at improving the quality of software products before reaching users by trying to find and fix errors, defects and other potential problems.
- Testing is usually done after coding is complete. Inspection can be done any time during the software lifecycle.
- Inspection assists in preventing software engineers from inserting defects in the software, and therefore is more effective than testing.
- There is a trade-off between fixing and preventing and the cost of testing, inspecting and fixing defects.

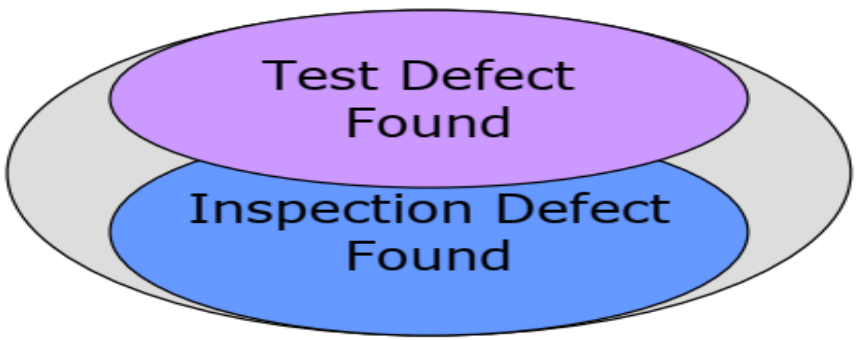
The Cost of Fixing Errors



Source: Boehm: Software Economics

Testing & Inspection

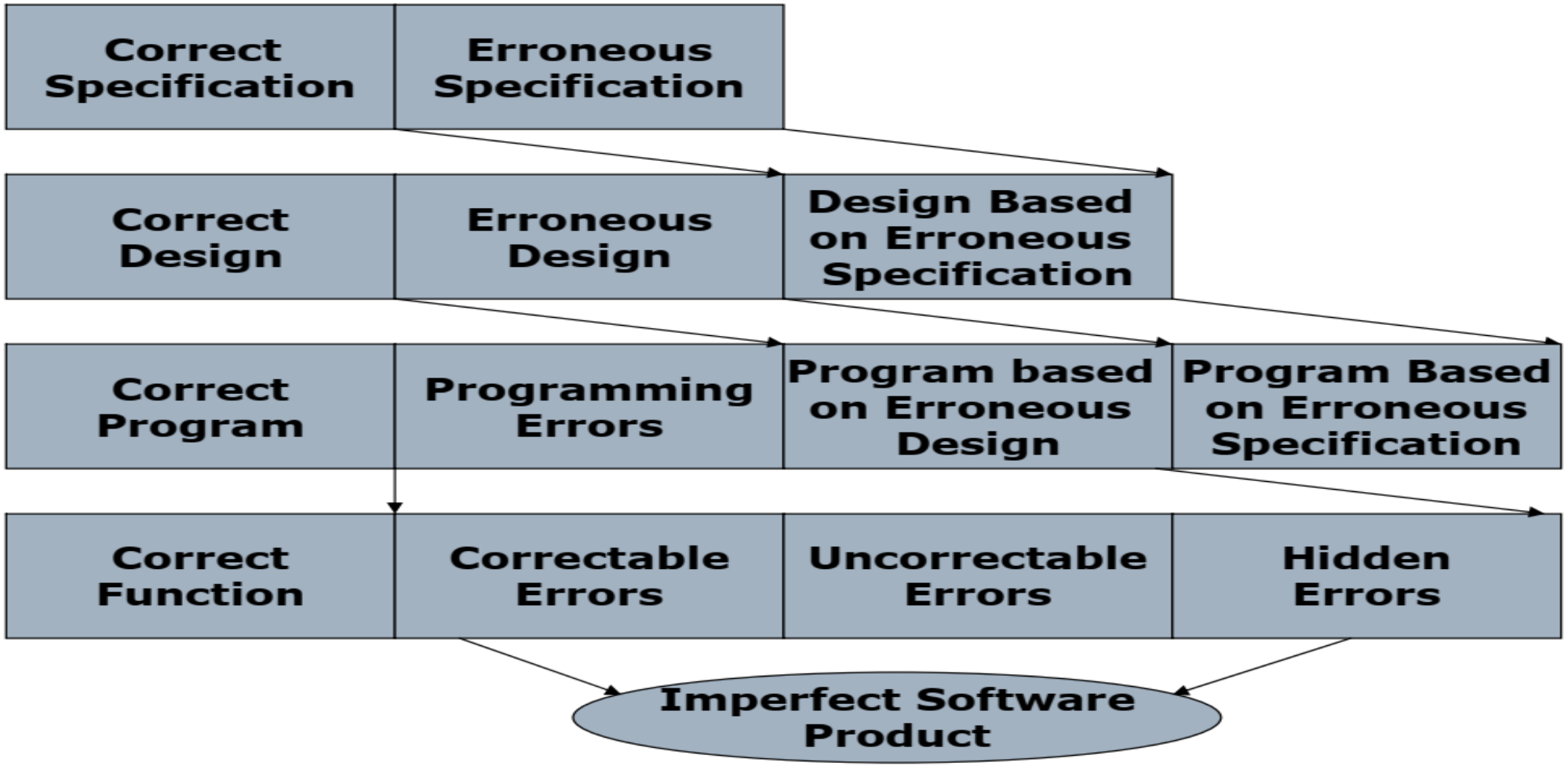
- Testing and inspection are not mutually exclusive alternatives.
- Inspection does not replace testing, they both perform unique functions, one cannot replace the other.
- Inspection can find defects not found in testing and testing can find problems not found in inspection. Software engineers must use both to improve the quality of the software product.
- Both testing and inspection complement each other in defect removal.



Software Inspections & Reviews

- Software inspections and reviews are a powerful way to improve the quality and productivity of the software process.
- A fundamental goal is to improve the quality of software by assisting software engineers in recognizing and fixing their errors early in the software process.
- An error often starts with an early misconception that is repeated in the design, code, documentation, and testing, which is the reason for many logic defects that are not found until the software is actually in use.
- Software reviews and inspections are created to detect these errors early in the development process.

Defect Propagation



Software Review & Inspection Goals

- To improve the quality of the software product by assisting software engineers in finding and fixing errors early the development process.
- To verify that the work meets predefined criteria.
- To formally complete a technical task with confidence that it does not have errors before proceeding to the next task.
- To ensure that team members technically agree on the work.
- To provide data on the product and the inspection process.
- To ensure that team members are technically aware of the quality of the product.
- To help build an effective technical team.
- To utilize the best talent in the organization.
- To develop better skills for software engineers.

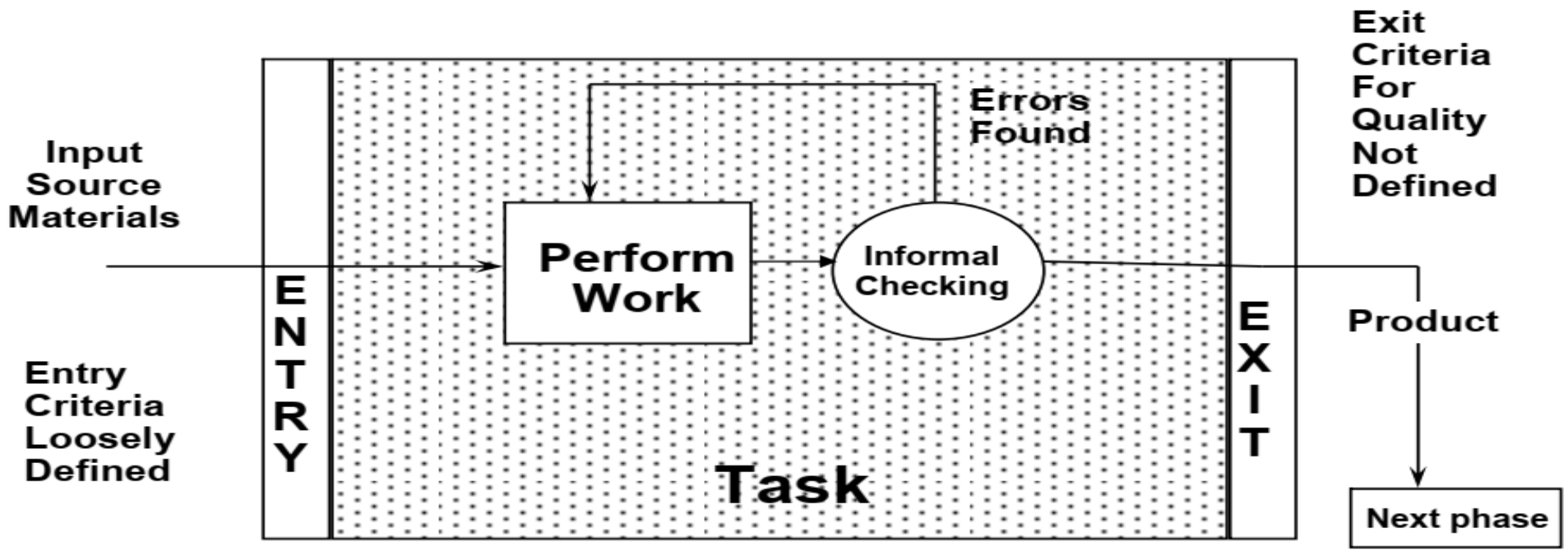
Types of Inspections & Reviews

- There are two major types:
  1. **Informal reviews** (Peer reviews) involves project team members.
     - Walkthroughs
     - Desk checks
     - Structured review
     - Code review
  2. **Formal reviews** (Inspections) may involve management and customers.
     - Management review
     - Customer review
     - Technical review
     - Software inspection

Informal Review (Peer Review)

- **Definition**: Informal review processes are loosely defined to review work chosen by the producer of the work (author) with change being the prerogative of the producer.
  - Software Related
    - Requirements documentation
    - Design documentation
    - Source code
  - Business Related
    - Contracts
    - Plans
    - Procedures
- Peer review is NOT:
  - An attack on your peer's work
  - A chance to show everyone how smart you really are
  - The opportunity to criticize someone
  - Chance for management to collect individual data

Informal Review Process



Informal Review

- Ad-hoc - No pre-scheduled meeting
- No materials sent to reviewers
- Defects are identified and discussed
- Evaluate work product against checklists or personal opinion
- Capture undocumented issues
- Author may collect data for quality record
- Author may fix defects

Informal Reviews – Desk checks

- Typical review among peers on an ad-hoc basis when the producer (author) asks someone to go over a work product or an artifact for a second opinion.
- **Objective**: To identify defects or get second opinion.
- **Focus**: Quality aspect – defects, errors, opinion.
- **Decision making**: Defects left to the producer to correct.
- **Involve**: Mostly software engineers.
- **Output**: Desk check conversation or informal email.

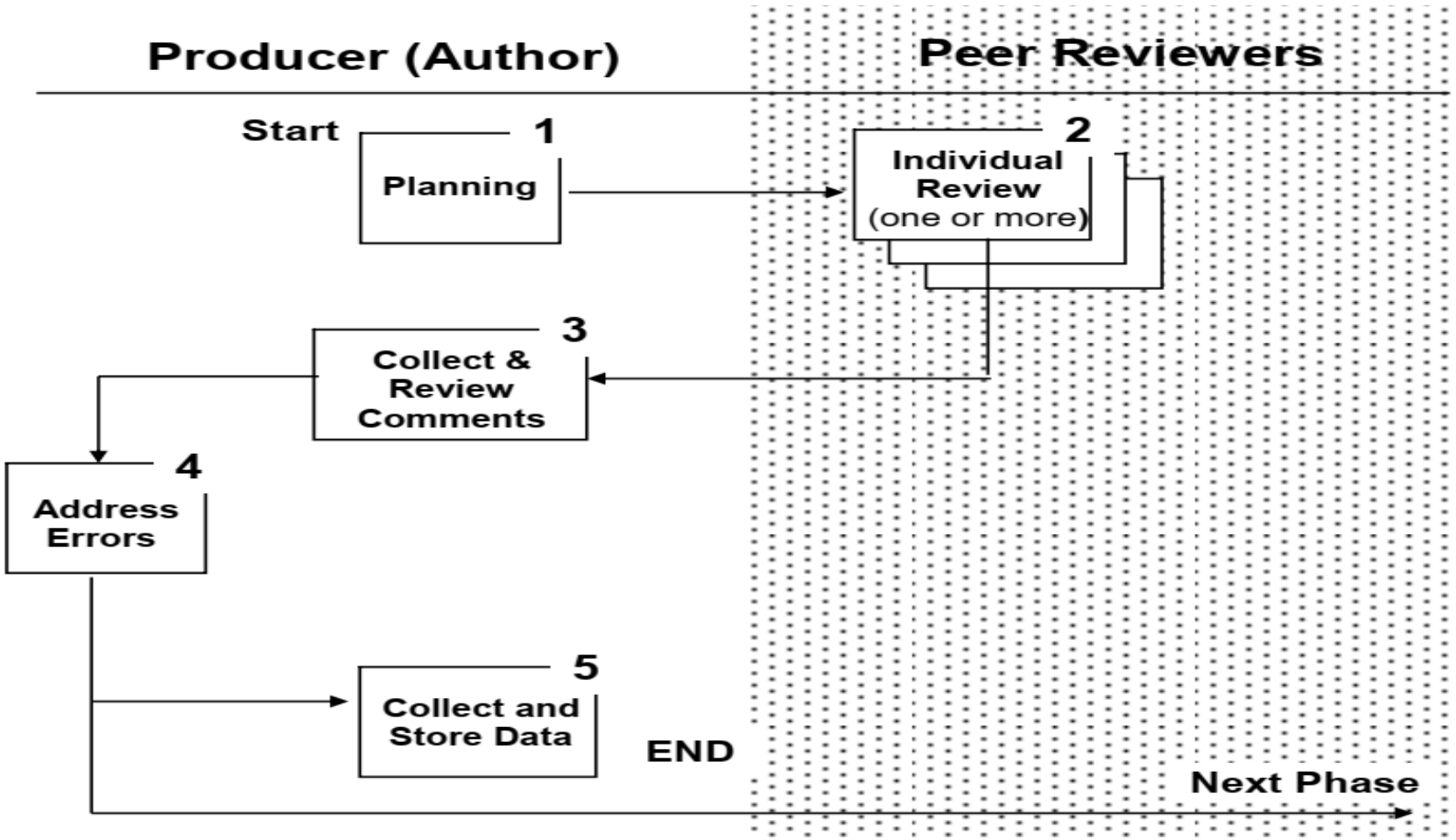
Informal Reviews – Walkthrough

- Typical review among peers when asked to go over a work product or an artifact using checklists - more formal than desk check.
- **Objective**: To identify defects.
- **Focus**: Quality aspect – defects, errors, quality issues.
- **Decision making**: Defects based on checklists are reported to project lead but left to the producer to correct.
- **Involve**: Mostly software engineers.
- **Output**: Walkthrough report.

Informal Reviews – Structured Review

- Scheduled review between the technical lead and team members to review a work product or an artifact using checklists - More formal than a walkthrough.
- **Objective**: To identify defects.
- **Focus**: Quality aspect – defects, errors, quality issues.
- **Decision making**: Project lead reviews work and discusses with the team – No manager is allowed to avoid personal issues. Changes or defects are assigned to the producer to correct. Project lead will track defects for closure.
- **Involve**: Project lead and software engineers.
- **Output**: Structured review reports.

Structured Review Process Flow



Formal Reviews

- **Definition**: A defined, structured and disciplined methodology of finding defects in all software development activities.

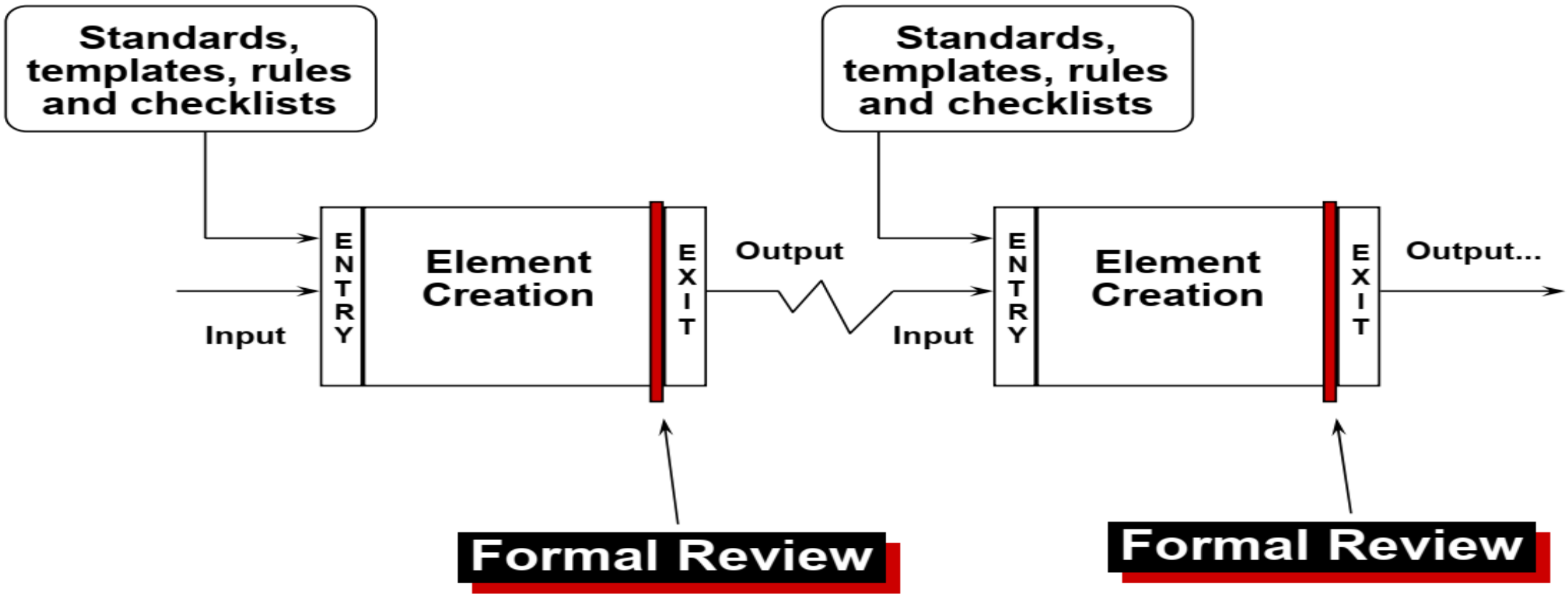
- Formal review processes are defined for a group of people where each is assigned *specific roles* with *specific tasks* to be performed during a *specific time*.

- Most formal reviews:
  - Follow the defined process.
  - Use of checklists, standards, templates and guides.
  - Adapt to any work product.
  - Document results in reports.
  - Collect data and metrics.
  - Verify corrective actions are addressed.

Checklists

- A checklist specifies the quality characteristics for a document or deliverable undergoing a Formal Review.
- Checklists are required for all Formal Reviews.
- Checklists are used:
  - During a review to help find and classify errors.
  - By the author during creation to keep errors from being introduced.
  - By other authors and review teams (reusability).

Formal Reviews



Formal Reviews - Customer Reviews

- Typically conducted by management on a predetermined schedule as required by the contract, policies, standards and plans to review status with customers.
- **Objective**: Review progress, obtain commitment, seek approval and funding.
- **Focus**: Contract aspect – schedule, funding, quality.
- **Decision making**: Approval to continue, changes in schedule, funding or resources.
- **Involve**: Management and customers.
- **Output:** Customer reports.

Formal Reviews - Management Reviews

- Typically conducted by managers on a periodic basis to review progress within an organization.
- **Objective**: Ensure progress, review corrective actions and the allocation of resources.
- **Focus**: Managerial aspect – schedule, resources, quality.
- **Decision making**: Plan actions, changes in schedule, resources.
- **Involve**: Management, technical lead.
- **Output**: Management review report.

Formal Reviews - Technical Reviews

- Typically conducted by the project manager or project leader on a periodic basis to review technical progress on a project.
- **Objective**: Evaluate conformance to requirements and design and ensure integrity of all changes to the project.
- **Focus**: Technical aspect – requirements, architect, design and software components.
- **Decision making**: Make recommendations to management for technical changes in the project.
- **Involve**: Project manager, technical lead and maybe engineers.
- **Output**: Technical review report.

Formal Reviews – Software Inspections

- Typically conducted by a trained moderator on a periodic basis to identify defects and solutions in a project.
- **Objective**: To detect and identify defects.
- **Focus**: Quality aspect – defects, errors, quality issues.
- **Decision making**: Plan actions, changes in schedule, resources.
- **Involve**: Management, technical lead and engineers.
- **Output**: Defect list, characteristics, severity, inspection report.

Software Inspection

- A well-defined process to closely examine software and non-software documentation to:
  - Find errors and omissions
  - Reduce rework
  - Verify conformance to standards
  - Check traceability to "high level" documents
  - Check for maintainability
  - Help identify reuse opportunities
  - Provide a better understanding of the documentation
  - Enhance team-building and communication
  - Assure the integrity of system development

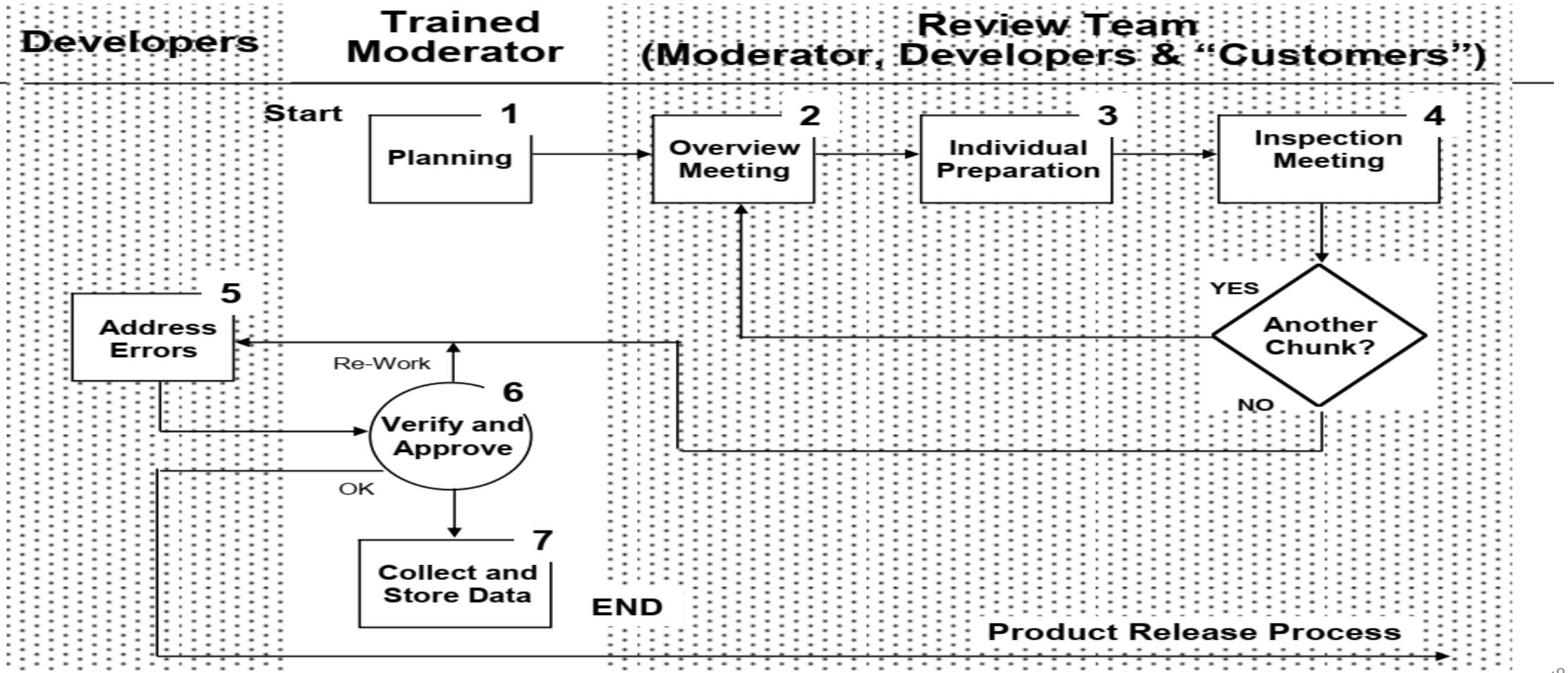
- Defects found early in the process are less expensive and easier to fix than defects found later.

Software Inspection Roles

- **Moderator**: Manages and coordinates the entire process.
- **Author**: Produces the work product being reviewed.
- **Reviewer**: Analyzes the work.
- **Recorder**: Documents information on forms.

- Most formal reviews have the following phases:
  - Planning – Identifies work and inspection team.
  - Overview – Understands roles, responsibilities and authorities.
  - Preparation – Familiarity with and analysis of work products.
  - Inspection – Review of work products in a scheduled meeting.
  - Rework – Assigns corrective action items.
  - Follow up – Reports and verifies corrective defects are addressed.

Formal Inspection Process Flow



Inspection Process

- All formal inspection follows a defined process:
  - Conducted by a designated leader – the Moderator.
  - Materials distributed before the review.
  - Reviewers have assigned roles (reviewer, author, recorder).
  - Criteria and checklists are specified in advance.
- All defects are recorded and tracked.
- Metrics are defined and collected:
  - Number, severity and types of defects.
  - Time spent in review and preparation.
  - Time required to fix defects.

Severity

- **Major Error**

  An issue or defect that can significantly increase costs to find and fix later in the development process or operational stages. Could conceivably make the product being produced unusable for it's intended purpose.

- **Minor Error**

  An issue or defect that is not major. The costs of fixing later is not significantly higher than fixing now.

  - Everything else!

Focus Area

- Clarity
- Completeness
- Compliance
- Consistency
- Correctness/Logic
- Data usage
- Functionality
- Interface
- Level of detail
- Maintainability
- Performance
- Reliability
- Testability
- Traceability

Planning Phase

- Determine work product to be inspected.
- Determine need and schedule for overview meetings.
- Select reviewers and assign roles.
- Schedule inspection meeting – time and place.
- Assemble and distribute "Inspection package" at least one week before inspection date to give maximum time for high quality inspection by reviewers.
- Inspection package includes:
  - Work to be inspected
  - Checklists
  - Criteria
  - Forms
  - Reviewer's guide

Overview Meeting

- Only held if needed to train the inspection team on the work product or to review the inspection process.
- Present information and the defined process.
- Answer questions to clarify issues on work product being inspected.
- Assign the primary focus to each reviewer such as: functionality, maintainability, performance, etc.
- Review roles, responsibilities, focus areas, logistics, checklists, standards and rules for establishing high performance during the next phase.

Overview Meeting

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Inspection Meeting

- Moderator reviews meeting procedures.
- Moderator calls for “Global issues” of the work product.
- Reviewers identify defects, issues, missing items.
- Recorder documents findings with red line notes.
- Moderator determines need for re-inspection.
- Moderator calls for other issues in work product.
- Team should avoid solutions, only defects are discussed.
- Each issue is limited to 2 minutes of discussion.

Rework Phase

- Resolve defects with primary emphasis on major defects.
- Translate action items for open issues to tasks with schedules.
- Eliminate “red-line” errors.

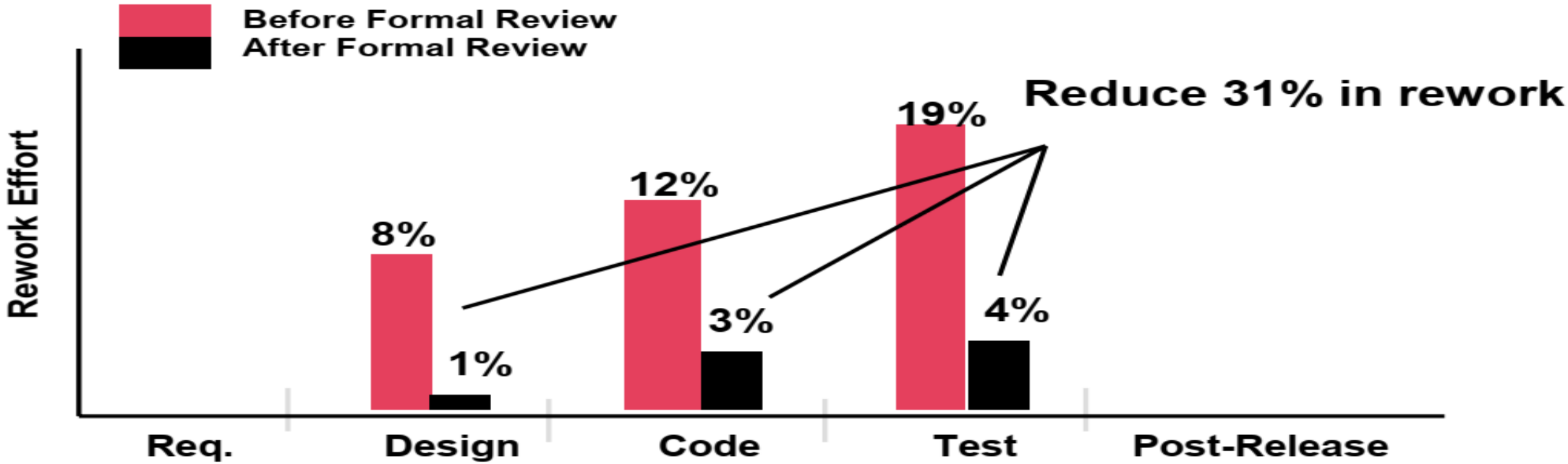
Follow Up Phase

- Moderator meets with producers (author) to:
  - Verify rework on defects is complete.
  - Verify exit criteria for inspection is set.
  - Document “Inspection completion” package.
  - Update metrics database with inspection data.
  - Close out any action.
  - Provide results and lessons learned to project manager.

Moderator Responsibilities

- Moderator facilitates the inspection by:
  - Following the defined process.
  - Promoting synergism with team as a whole.
  - Limiting discussion to 2 minutes per item.
  - Discouraging “solution discussion”.
  - Reporting status of inspection progress to management without discrediting team members (i.e., defects are not associated with names).
  - Completing and documenting inspection package for referencing, recording and tracking.

Benefits Of Formal Inspection



Formal Review increased effort by 4%
decreased rework by 31%

Cost: Benefit ratio is 4% : 31% or 1: 7.75

Summary

- Reviews and Inspections can improve the quality of the software product by assisting software engineers in finding and fixing their errors early the development process.
- Formal reviews such as inspections, are a major improvement over informal reviews (peer review/walkthroughs).
- Results of formal review can enhance communication, skills, understanding, and most importantly, improve quality of the product.