Software Engineering

Software Quality Assurance

- <mark>Quality</mark>
  - Quality of design
    - Characteristics that designers specify for an item
    - Performance specifications
    - Encompasses requirements, specifications, design of the system
  - Quality of conformance
    - Degree to which design specifications are followed during manufacturing
    - Focused primarily on implementation
  - User satisfaction
    - Complaint product+
    - Good quality+
    - Delivery within budget+
    - Delivery within schedule
- <mark>Quality control</mark>
  - Series of inspections, reviews, tests
  - Automated, manual, combination

Software Quality Assurance

- **Quality assurance**
  - Auditing and reporting functions of management
  - Provide management with the data necessary to be informed about product quality
  - Management's responsibility to address the problems and apply the necessary resources to resolve quality issues
- **Cost of quality**
  - Includes all costs incurred in the pursuit of quality or in performing quality-related activities
  - Prevention costs
    - Quality planning
    - Formal technical reviews
    - Test equipment
    - Training
  - Appraisal costs
    - In-process and inter-process inspection
    - Equipment calibration and maintenance
    - Testing
  - Failure costs
    - Disappear if no defects appear before shipping

Software Quality Assurance

- ❑ <mark>Cost of quality</mark>
  - ▪ Failure costs
    - • Internal failure costs
      - › Rework
      - › Repair
      - › Failure mode analysis
    - • External failure costs
      - › Complaint resolution
      - › Product return and replacement
      - › Help line support
      - › Warranty work
- ❑ <mark>Software Quality Assurance (SQA) Activities</mark>
  - ▪ Preparing an SQA plan for a project
    - • Developed during project planning
    - • Reviewed by all interested parties
    - • Quality assurance activities performed by the software engineering team

Software Quality Assurance

❑ Software Quality Assurance (SQA) Activities
- Preparing an SQA plan for a project
  - Plan identifies
    › Evaluations to be performed
    › Audits and reviews to be performed
    › Standards that are applicable to the project
    › Procedures for error reporting and tracking
    › Documents to be produced by the SQA group
    › Amount of feedback provided to the software project team
- Participating in the development of the project's software process description
  - Software team selects a process
  - SQA group reviews the process description for compliance with organizational policy, internal software standards, externally imposed standards, other parts of software project plan
- Reviewing software engineering activities to verify compliance with the defined software process
  - SQA group identifies, documents, tracks deviations from the process
  - SQA group verifies that corrections have been made

Software Quality Assurance

❑ Software Quality Assurance (SQA) Activities
- ▪ Auditing designated software work products to verify compliance with those defined as part of the software process
  - • SQA group reviews selected work products, identifies, documents, tracks deviations
  - • SQA group verifies that corrections have been made
  - • SQA group periodically reports the results of its work to the project manager
- ▪ Ensuring that deviations in software work and work products are documented and handled according to a documented procedure
- ▪ Recording any noncompliance and reporting to senior manager
  - • Noncompliance items are tracked until they are resolved

❑ Software Reviews
- ▪ Pointing out the required improvements
- ▪ Confirm those parts where improvement is not needed
- ▪ Achieve a technical work with better quality and manageability
- ▪ Cost impact of software defects
  - • Finding errors is the primary objective
  - • Defects are costly
  - • Early discovery of errors can be cost effective
  - • Design activities introduce 50%-65% of all errors

Software Quality Assurance

❑ Software Reviews
- ▪ Cost impact of software defects
  - • Reviews could be 75% effective in in uncovering design flaws
  - • Review helps reduce the cost of development and support phases
  - • Error uncovered during design--------------------- 1.0 monetary unit to correct
  - • Same error discovered before starting testing------ 6.5 monetary unit to correct
  - • That error found during testing----------------------15 monetary unit to correct
  - • Same error uncovered after release-------------60-100 monetary unit to correct
- ▪ Defect amplification and removal

Development step

Defects   Detection

Errors passed through	Percent efficiency for error detection
Amplified errors 1 : x	
Newly generated errors	

Errors from previous step →

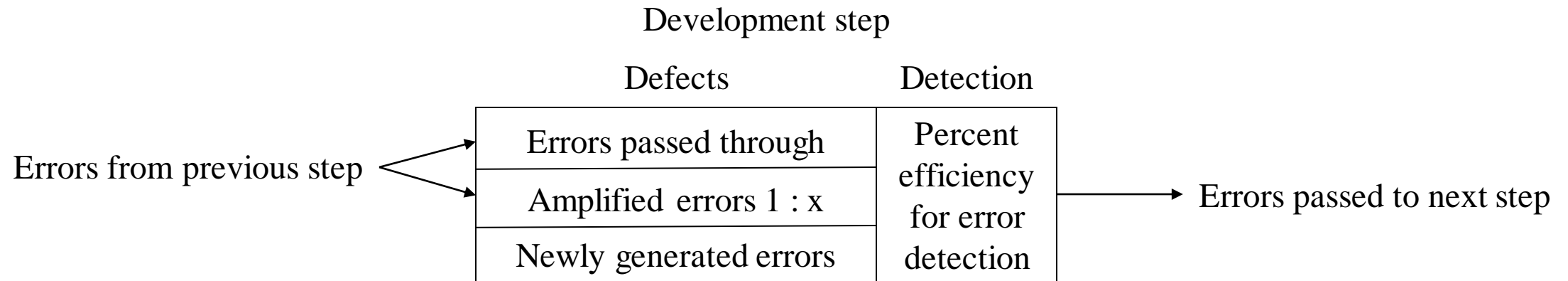→ Errors passed to next step

Figure 1: Defect amplification model

Software Quality Assurance

❑ Software Reviews

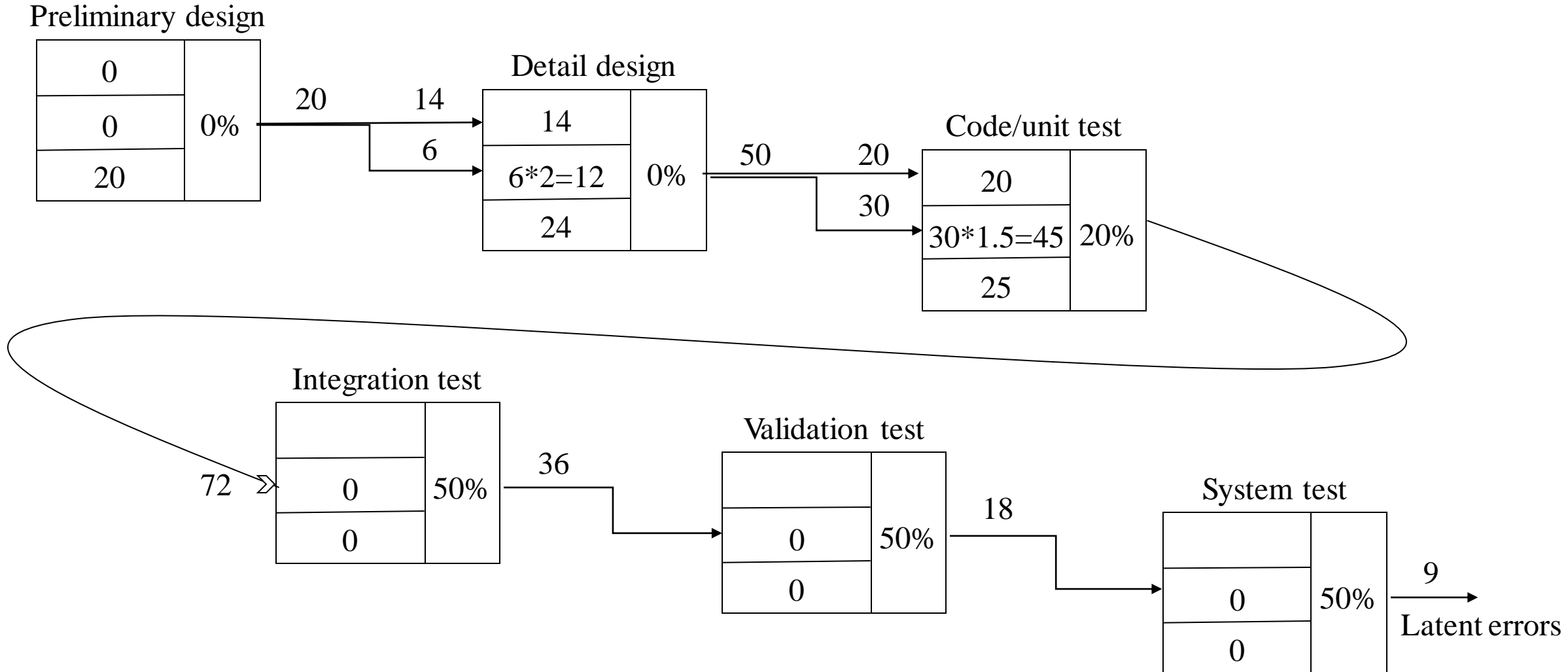▪ Defect amplification and removal

Figure 2: Defect amplification. No reviews

Software Quality Assurance

❑ Software Reviews

    ▪ Defect amplification and removal

        • Total cost for development and maintenance

           › Errors discovered before testing: 18

           › Errors discovered during testing: 63 (36+18+9)

           › Errors discovered after release: 09

           › Cost=(6.5*18)+(15*63)+(70*9)=1692 monetary unit

Software Quality Assurance

❏ Software Reviews
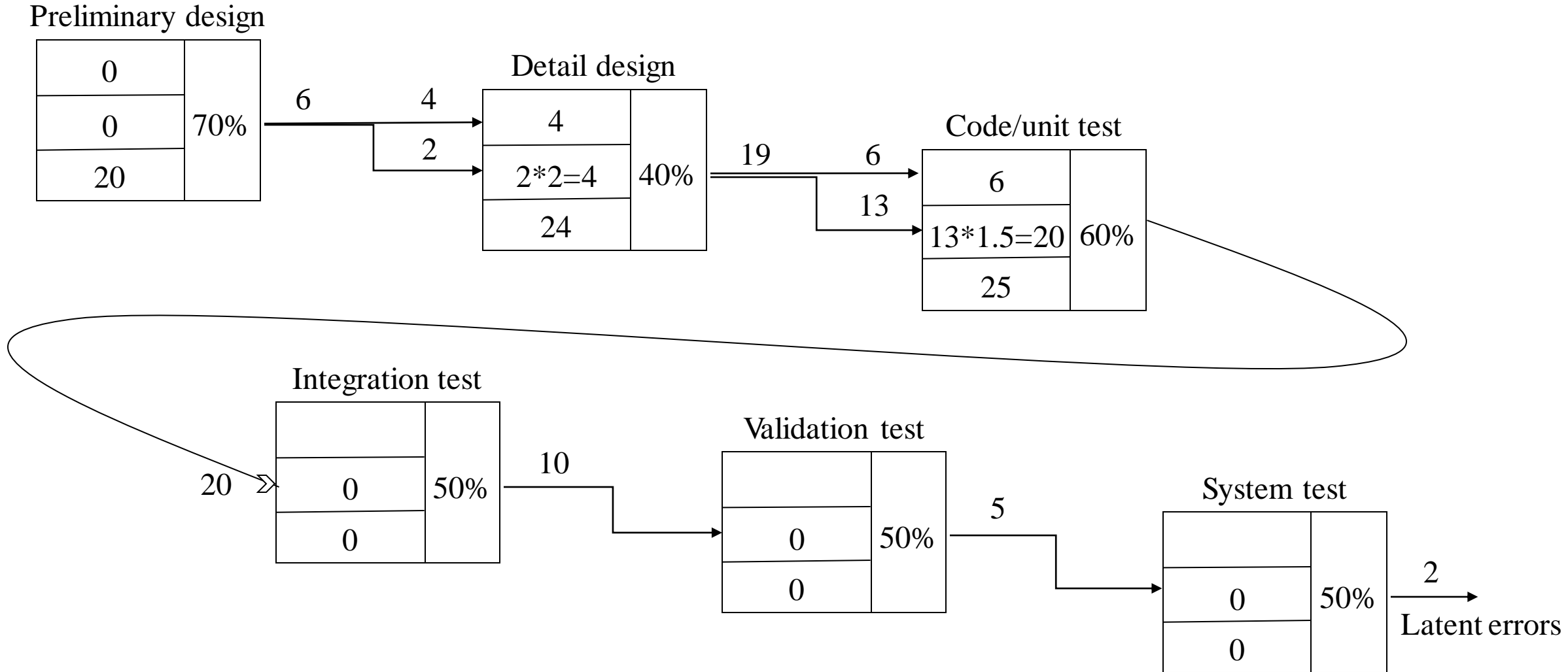   ▪ Defect amplification and removal

Figure 3: Defect amplification. Reviews conducted

Software Quality Assurance

❑ Software Reviews
- ▪ Defect amplification and removal
  - • Total cost for development and maintenance
    - › Errors discovered during design: 27 (14+13)
    - › Errors discovered before testing: 31
    - › Errors discovered during testing: 18 (10+5+3)
    - › Errors discovered after release: 02
    - › Cost=(1*27)+(6.5*31)+(15*18)+(70*2)=639 monetary unit
❑ Statistical SQA
- ▪ Information about software defects is collected and categorized
- ▪ An attempt is made to trace each defect to its underlying cause (non conformance to specifications, design error, violation of standards, poor communication with the customer)
- ▪ Using the Pareto principle (80 percent of the defects can be traced to 20 percent of all causes), isolate the 20 percent (the "vital few")
- ▪ Once the vital few causes have been identified, move to correct the problems that have caused the defects