

# CISC 327 - Software Quality Assurance

## Lecture 4

### Software Process Evaluation

# Project

- The project description has been posted
- Deadline for forming teams of 3:
  - **Friday, September 21st**

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# Software Process Evaluation

- How can we measure software processes?
  - Today we look at methods for **evaluating** and **improving** software processes, regardless of which process is being used
  - There are several methods and **standards** for software process evaluation
  - Most are aimed at improving existing development processes as they are applied, calling **maturing** them
  - Idea is that as a company or team gains experience with a process, they **continually improve** it to make it better in their use

# Today's Lecture

- Defect Prevention Process (DPP)
- Quality standards:  
Maturity models and certification standards
  - Capability Maturity Model (CMM)
  - Malcolm Baldrige processes
  - ISO 9000

# The Defect Prevention Process

- **DPP - Defect Prevention Process**
  - DPP is not itself a software development process, but rather a process for continually **improving** the development process
  - Modelled on quality assurance techniques used in **Japan** for decades

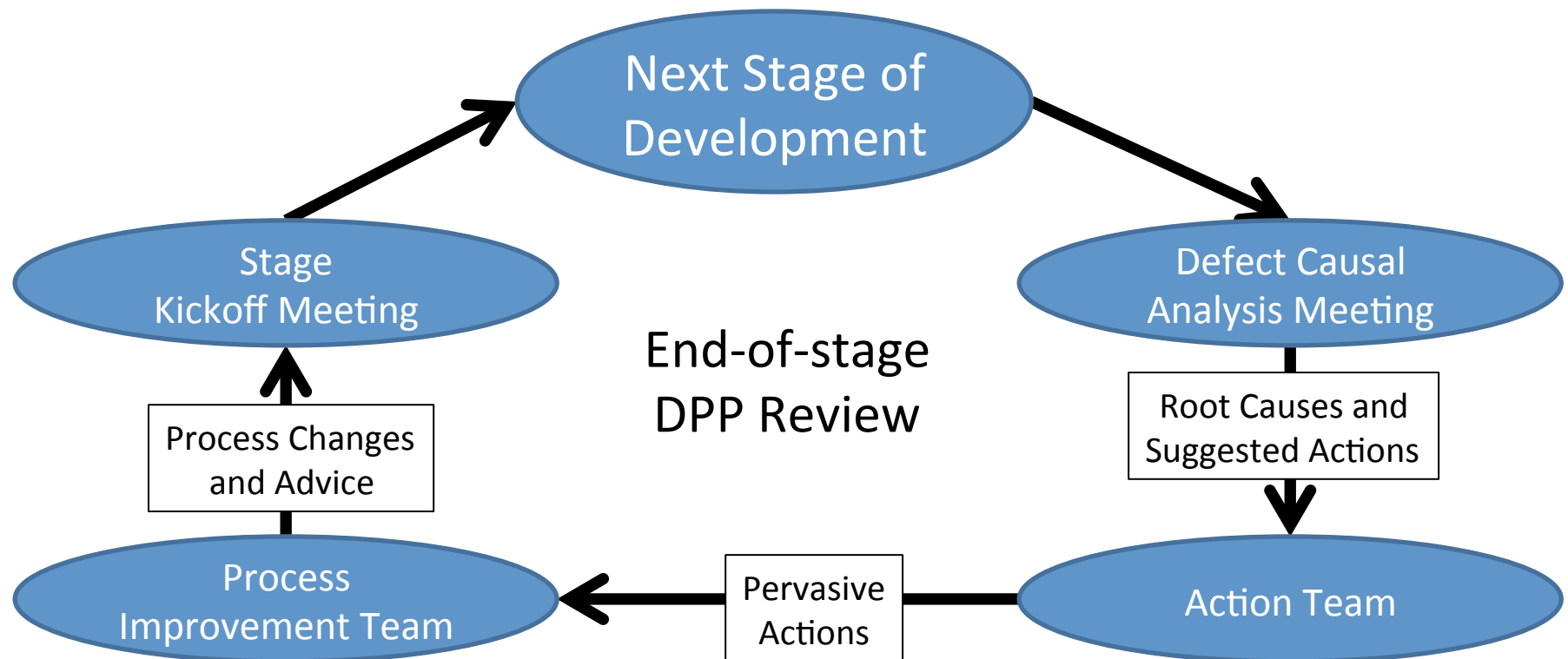
# 3 Steps of DPP

- Based on three simple steps:
  - Analyze existing **defects** or **errors** to trace their root causes **in the process** (how they were missed)
  - Suggest **preventive actions** to eliminate the defect root causes from the process
  - Implement the preventive actions to **improve the process**

# The Defect Prevention Process

- **Formal DPP Reviews**

- First used at **IBM** Communications Programming Lab (1985)





# 4 Components of DPP

- 1) Defect Causal Analysis Meeting

- At end of each stage of development, **review** and **analyze** defects that occurred in that stage
- Developers trace **root causes** of errors; suggest possible actions to prevent **similar errors** in future

- 2) Action Team

- Action team has **cross-organization** members
- Evaluates suggested actions, **initiates** actions across the organization, including development team actions
- Size varies; could be just one person (Jones 1985)

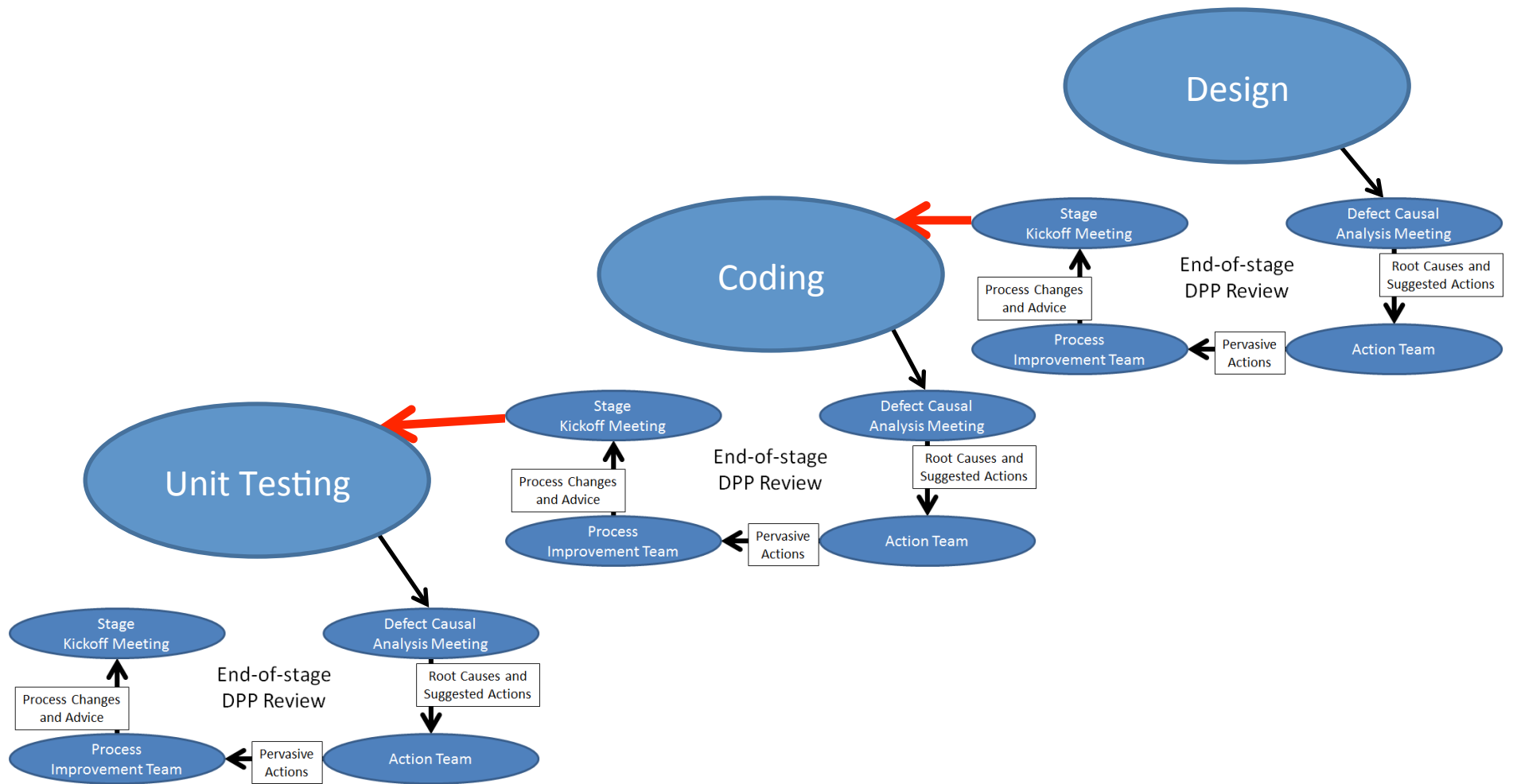
# 4 Components of DPP

- 3) Process Improvement Team
  - Members of the development team
  - Implements **process changes** and provides advice for next stage of development
- 4) Stage Kickoff Meeting
  - Development teams meet to review process changes and re-emphasize focus on quality

# DPP vs. Postmortem

- A traditional “postmortem analysis”, at the end of the entire project, would also look at defects and their causes
- DPP happens throughout the stages, not just at the end...

# DPP Applied to Waterfall Model



# Process Quality Standards

- **Software Process Assessments and Standards**
  - Two kinds:
    - **1. Maturity models**

attempt to measure how **mature** the software process in a particular organization is, and thus how likely it is to produce quality results
    - **2. Certification standards**

measure an organization's software process against a defined **standard**, and **certify** the organization if its process meets the standard

# Capability Maturity Model (CMM)

- The SEI Process Capability Maturity Model
  - CMM defines a **five-level scale** of process maturity; an organization's software process is assessed as "**CMM-1**", "**CMM-3**", "**CMM-5**" indicating its level on the scale
  - Used by government agencies and companies in the **U.S.**
  - Assessed using an 85-item **questionnaire**

# Capability Maturity Model (CMM)

- CMM Level 1 - "Initial"
  - Characteristics: **chaotic**; unpredictable cost, schedule, and quality
- CMM Level 2 - "Repeatable"
  - Characteristics: **intuitive**; cost and quality highly variable, reasonable control of schedules, **ad hoc** methods and procedures
  - Key elements: **requirements** management, project **planning**, **software configuration** management, **quality assurance** procedures

# Capability Maturity Model (CMM)

- CMM Level 3 - "Defined"
  - Characteristics: **qualitative**; reliable costs and schedules, improving but unpredictable quality
  - Key elements: **process** definition and improvement, **training** program, integrated software management, product **engineering**, intergroup **coordination**, peer **reviews**



# Capability Maturity Model (CMM)

- CMM Level 4 - "Managed"
  - Characteristics: **quantitative**; reasonable **statistical control** over product quality
  - Key elements: process **measurement** and analysis, quality **management**
- CMM Level 5 - "Optimizing"
  - Characteristics: **quantitative** basis for continual process **automation** and **improvement**
  - Key elements: defect prevention, technology innovation, process change management

# The CMM Integration (CMMI)

- **Integrate** practices from four CMMs to **generalize** (not just for software maturity)
  - Maturity Level 1: **Initial**
    - Processes are **ad-hoc** and **chaotic**
  - Maturity Level 2: **Managed**
    - Focuses on **basic project management**
  - Maturity Level 3: **Defined**
    - Focuses on **process standardization**
  - Maturity Level 4: **Quantitatively Managed**
    - Focuses on **quantitative management**
  - Maturity Level 5: **Optimizing**
    - Focuses on **continuous process improvement**

# SPR Maturity Assessment

- Software Productivity Research (SPR) Assessment
  - Much like CMM, but focuses more broadly on corporate strategy and tactical issues, as well as CMM's issues of software organization and process
  - Also uses a questionnaire, but has 400 questions as opposed to CMM's 85, and uses a 5-point scale instead of yes/no answers
    - Excellent, Good, Average, Below Average, Poor

# SPR Maturity Assessment

- **SPR Assessment**
  - Assessment uses **measures** such as:
    - Quality and productivity **measurements**
    - **Experience** of programmers in defect removal and testing
    - Project quality and reliability **targets**
    - Defect removal **history** in each phase (design, coding, testing, release)

# Baldrige Assessment Standard

- Malcolm Baldrige National Quality Award (MBNQA)
  - Originally U.S. Department of Commerce award, given to recognize outstanding achievement in **quality** management and achievement in **any** industry
  - Also basis of IBM's **Market Driven Quality** strategy and the **European Quality Award**
  - An "**examination**" for award criteria, companies get a "mark" out of 1,000

# Baldrige Assessment Standard

- **MBNQA**
  - 28 examination items, in seven categories: **leadership**, information and **analysis**, quality **planning**, human resources, quality **assurance**, quality **results**, customer satisfaction
  - Three evaluation dimensions of each item
    - **Approach**: methods used to achieve the examination item
    - **Deployment**: how well approach is actually applied
    - **Results**: quality of outcome in examination item

# Malcolm Baldrige, Jr.

- **26th U.S. Secretary of Commerce**
  - January 20, 1981 to July 25, 1987
  - In his prior career in business, he led the conversion of a **troubled** brass mill to a **highly diversified** manufacturer of industrial goods
  - His experience with **process improvement** led to the guidelines in the National Quality Improvement Act of 1987

# Impact of the MBNQA

- Evaluated in 2001 for economic benefit
  - Social costs of the program were US\$119 million
  - Net private benefits to the economy were estimated at US\$24.65 billion
  - The social benefit-to-cost ratio was 207:1
  - Prior to the quality improvement act, many U.S. businesses either did not believe that quality mattered for them or they did not know where to begin
  - <https://www.nist.gov/document-17640>



# ISO 9000 Standard

- **ISO 9000**
  - A set of **standards** and guidelines for quality assurance **management**
  - Many customers, especially in Europe, **require** ISO 9000 registration of their suppliers
  - Companies become ISO 9000 "**registered**" as a result of a **formal audit** by ISO
  - ISO 9000 standards are **documentation-based**
    - Every aspect of every step of every process must be backed up by formal **documents** in a precisely defined format keeping records of how processes are applied

# ISO 9000 Standard

- ISO 90003
  - ISO 90003 gives the standards for software **development, supply, and maintenance**
  - ISO 90003 specifies 20 **elements** to be assessed, with detailed requirements for each element

# ISO 90003

Management responsibility	Inspection, measuring, and test equipment
Quality system	Inspection and test status
Contract review	Control of nonconforming products
Design control	Corrective action
Document control	Handling, packaging, delivery
Purchasing	Quality records
Purchaser-supplied product	Internal quality audits
Product identification and traceability	Training
Process control	Servicing
Inspection and testing	Statistics

# ISO 9000 Standard

- **ISO 9000**
  - Standards are **complex, detailed, and stringent**
  - "Say what you do, do what you say, and **prove it.**"
- **Example:**
  - The documentation standard goes so far as to specify:
    - **owner** of document must be specified on title page
    - distribution of document must be **controlled** with an archived **master copy**, distribution **record book**, etc.
    - **version** level must be clearly identified
    - all pages must be **consecutively numbered**
    - **total** number of pages must be indicated on title page
    - procedure for **destruction** of obsolete documents must be documented

# ISO 9000 Standard

- **ISO 9000**
  - Most companies (60–70%) **fail** the ISO audit the first time
  - Most software companies are deficient in **corrective actions** and **document control**
  - Companies take steps to meet the standards in these areas and usually can be **registered** on the second try
  - Over **a million** organizations worldwide are independently certified

# Criticisms of ISO 9000

- Companies may **misunderstand** the goal
  - ISO 9000 certification is **desirable for getting customers**
  - A company must want to **apply** the knowledge gained from obtaining ISO 9000 certification to **improve quality processes**
    - It is not enough to simply get the certificate and be done with it!
    - "A company can produce a **poor quality product consistently**, and with the proper documentation can put an ISO 9000 stamp on it."

# Summary

- **Software Process Evaluation**
  - Software processes can be continually improved using meta-processes such as the **Defect Prevention Process**
  - Software processes can be evaluated with respect to their **maturity** or by comparison with a process **standard**
  - Maturity models include **CMM** and **SPR**
  - Process quality standards include **Baldrige** and **ISO 9000**

# Summary

- Today's References
  - Kan, Metrics and Models in Software Quality Engineering, ch. 2 (§§2.7–2.8)
- Next Time
  - the eXtreme Programming software process
  - The 2018 CISC 327 software project