



# Use of Inspection Techniques in Requirements Engineering Instruction

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# Discussion Points

- Introduction and Motivation
- Review techniques in general
- N-fold experiment overviews
- Third Party Review Technique
- Perspective Based Reading versus Checklist based reviews
- Results and Analysis
- Discussion

# Introduction

- Why software document reviews are important?
  - Detecting and correcting defects early in the development process can save time and money, and possibly avoid some embarrassment (Shull, Rus, and Basili 2000).
  - Boehm/Basili suggest finding and fixing defects after delivery is “often” 100 time more expensive than fixing during requirements phase. ([www.cebase.org](http://www.cebase.org))
  - Informal reviews can be used to control quality in terms of defects (Wohlin and Runeson 1998)

# Review Techniques

- Various degrees of inspections and walkthroughs exist – various implementations of each also exist
- The basic software inspection process is a static method of testing the software against its requirements (Fagan 1986)
- The N-Fold inspection replicates the inspection process using N independent teams (Martin and Tsai 1990)
- Walkthroughs are mostly used as a training tool with special emphasis on learning about a single document (Gilb and Graham 1993)

# Inspection Technique

- Inspection
  - An effective & efficient way to remove defects (especially in SRS phase)
    - Individual Review: Defect detection
    - Team Meeting: Defect collection
- Previous research in Inspections
  - Two variables
    - Inspection techniques
    - Meeting structure
  - Understand them in isolation
  - Rarely examine the interaction between them

# Inspection Techniques

- Perspective Based Reading (PBR)
  - Original experiment (NASA/GSFC)
    - PBR more effective than Checklist
  - Replications
    - Many conducted
    - Tend to support previous results (not 100%)
    - Investigated other characteristics of PBR
      - Particular defect classes
      - Real team vs. simulated teams
- N-Fold Inspection Method
  - Multiple inspections on the same artifact carried out in parallel
  - Improved performance can be expected
  - Team meetings
    - Pros
      - New defects
      - Meeting gain: about 5%
    - Cons
      - Costly; additional overhead;
      - Not always necessary

# Our N-Fold experiments

- Mix of classroom and real world
- Attempted different procedures in the reviews
- Experiments
  - Third party review
  - Ad hoc N-fold
  - Checklist N-fold
  - Perspective Based Reading (PBR) N-fold

# Third Party Review Technique

- What is Third Party Review Technique?
  - Review by a third party source, not a part of the developer or end user community.
- Main characteristics of the TPR (our experience)
  - Like an IV&V at Requirements Stage
  - Ad hoc team composition and defect recording techniques.
  - Review meeting and preparation schedule totally left to team members
  - Domain knowledge is not essential(?)
  - Presence of the document author is not required.



# Ad hoc N-Fold

- Each reviewer conducts independent review
- Reviewers come together in small groups and each prepare a consensus review document
- Small groups meet together and prepare a group consensus review document
- No review technique specified, no training provided

# Checklist Review

- Each reviewer is provided with a checklist of specific types of errors to look for
- Checklist can be very general, very specific, or a combination of both
- All reviewers are given the same checklist
- Some training is generally required

# Perspective Based Reading

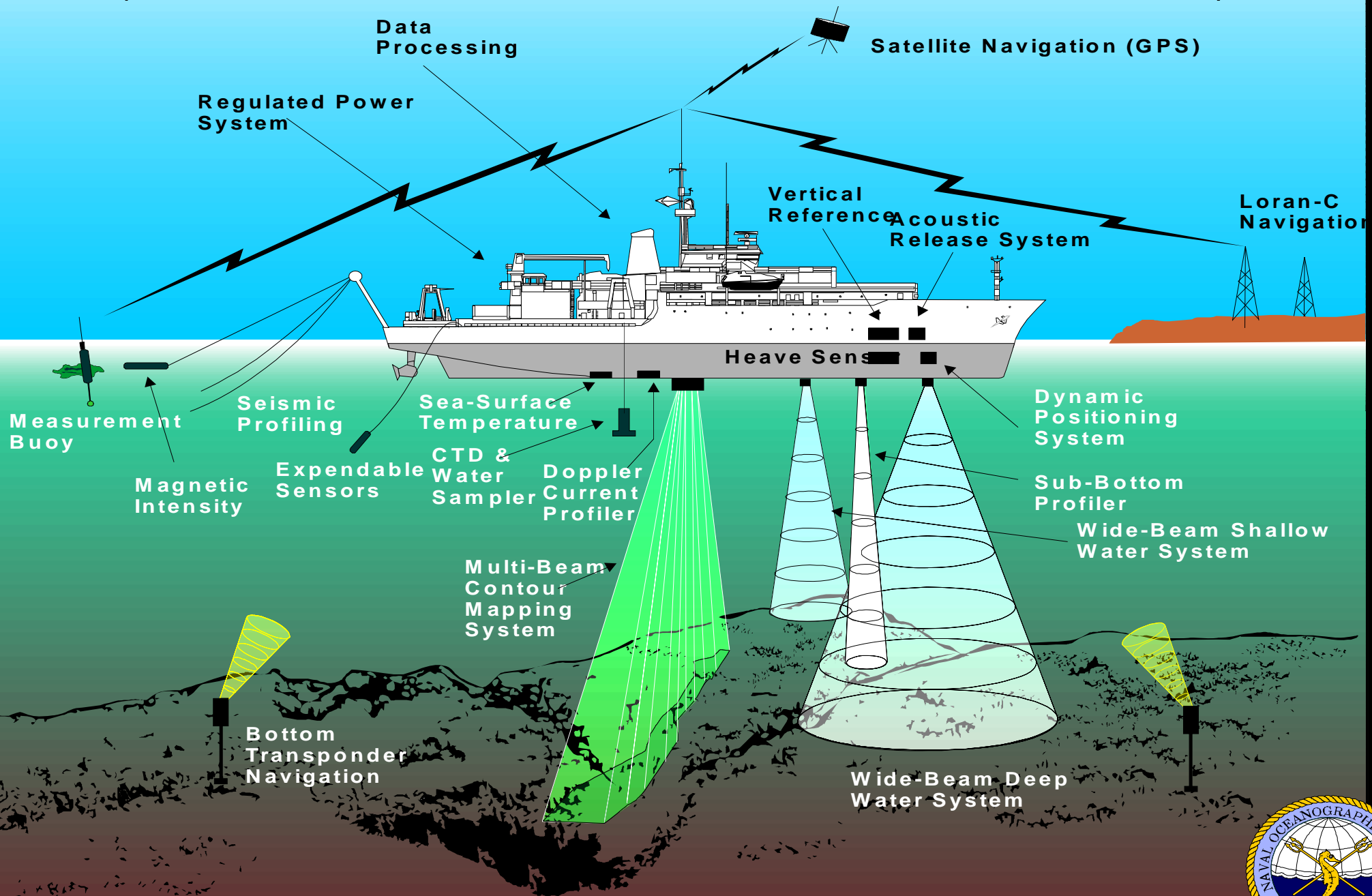
- Each reviewer is given a role to assume when reviewing the requirements document.
- Roles might include security engineer, user, maintenance engineer, tester, designer or others as deemed appropriate
- Training is generally necessary and a set of procedures is supplied to the reviewer

# TPR N-Fold Design

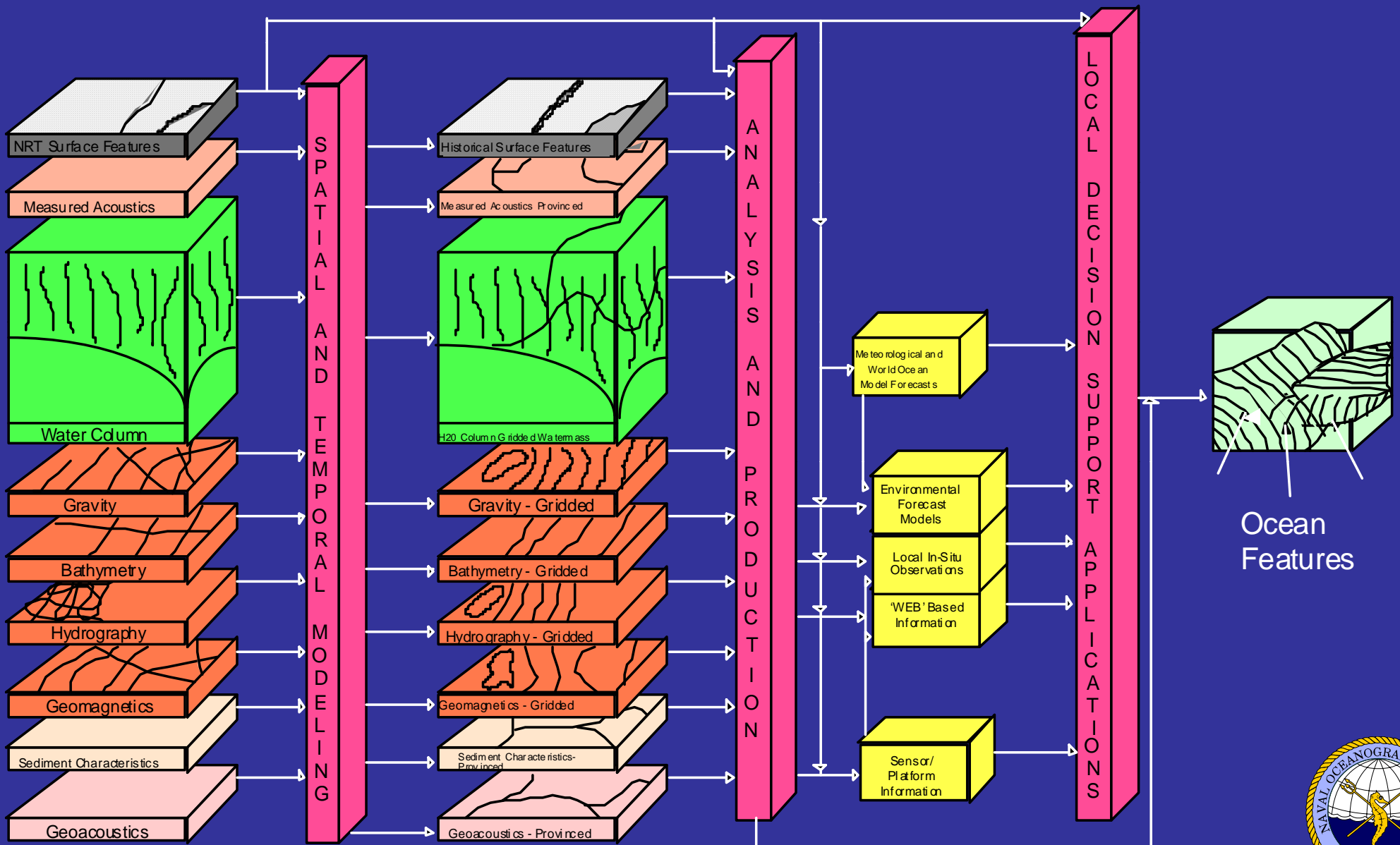
- Major goals
  - To study effectiveness of TPR
  - To study effect of multiple teams
- Document details
  - A data warehousing Functional Requirements Document (FRD) prepared by the Naval Oceanographic Office

# T-AGS 60 Class

(USNS PATHFINDER/SUMNER/BOWDITCH/HENSON)



# NAVOCEANO PRODUCTION VISION



# TPR experiment design

- Subjects and design strategy
  - 15 graduate students in the “Software Requirements Specification” class
  - Introductory lecture on the reviews by the instructor
  - Division of the experimental process into two phases
    - Phases-1: Team A, Team B and Team C
    - Phase-II: Final review team
- Review procedure
  - Document review and reading
  - Defect recording and reporting
  - Number of review meetings and duration

# Data collected

- Analysis parameters
  - Average time spent by each team in reading the document.
  - Total time spent by each team on review meeting(s).
  - Classification of defects into 10 defect types.
  - Average number of defects with respect to multiple teams.
  - Defect detection rate (DDR).
  - Total number of defects detected by each team.
  - Number of defects accepted by the customer



# Defect Reporting

- Defect report format

Problem Serial #: 6

Requirement Source: 3.1

Problem ID: 4

Problem Type: Ambiguity

Problem Details: What details does “location information” encompass?

Recommendation(s): Specify the scope of the location information.

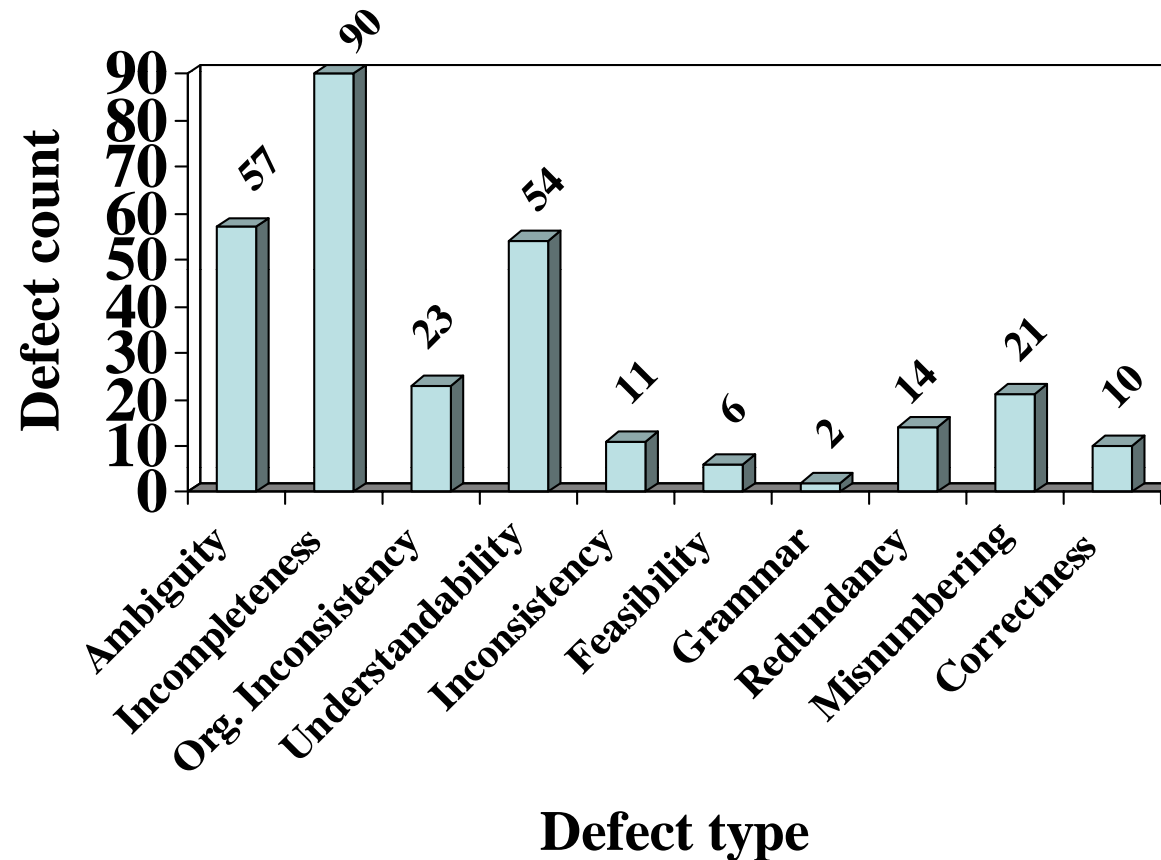
# TPR Results and Analysis

- Summary of individual team results

Team	Time spent in reading (hrs)	Total time spent in review meeting(s) (hrs)	Number of review meetings	Number of defects detected	Defects detected per meeting
A	19.25	1.5	1	88	88
B	26.75	3.25	2	107	53
C	24.75	6.0	3	174	58

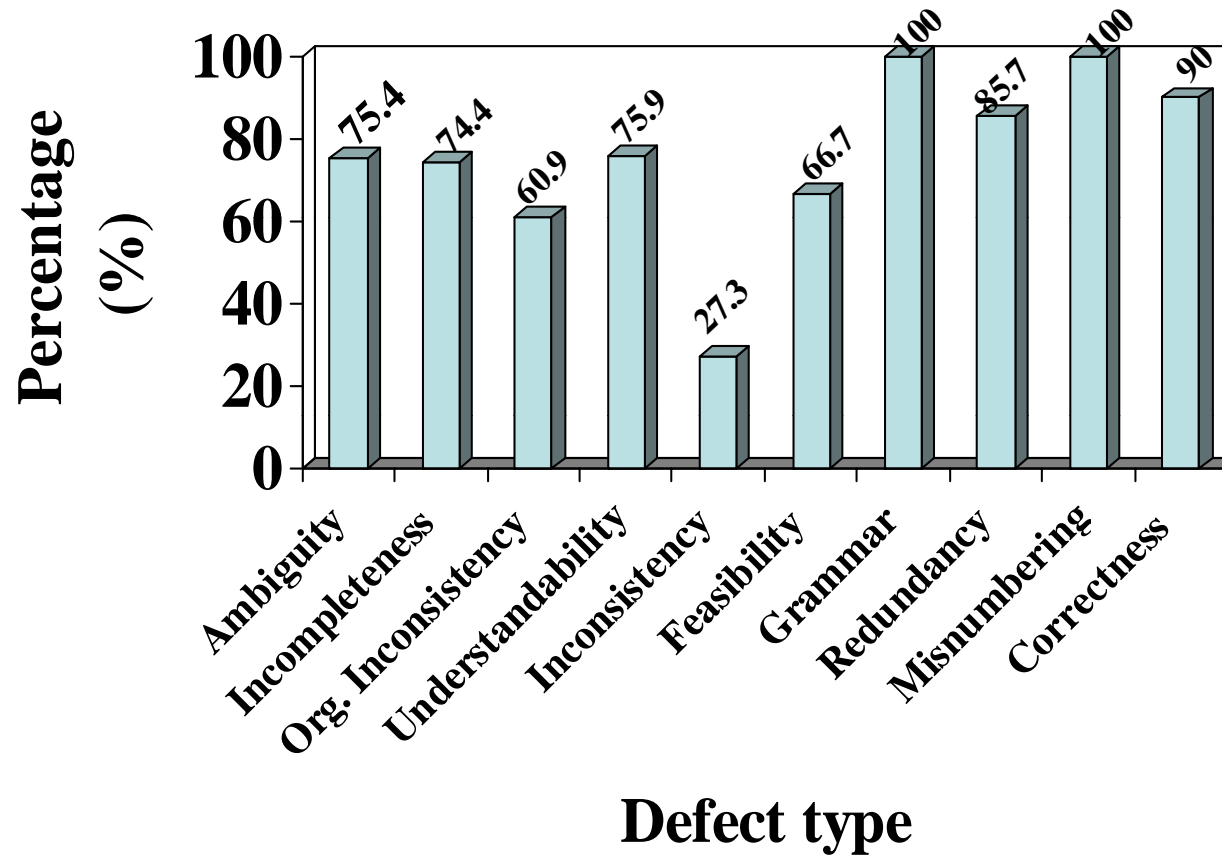
# TPR Results and Analysis

## Defect type distribution



# TPR Results and Analysis

Overall percentage defect acceptance rate



# TPR Results and Analysis

- Main findings:
  - In total 288 defects were detected in a 30 page document.
  - Total time spent for the entire experiment was 88 hours.
  - Average number of defects detected by each team was 96.
  - Multiple teams are more effective than a single team in defect detection.
  - Ambiguity, incompleteness, and understandability were the major defect types and accounted for almost 70% of the total defects detected.
  - In total 23.6% defects were accepted unconditionally and 75% were accepted conditionally.

# TPR Summary

- Review Techniques – inspections, N-Fold inspections and walkthroughs have been proved useful over time.
- Third Party Review Technique is worth consideration and results could likely be improved by:
  - Domain language understanding
  - Customer buy in
  - Better structure with students
  - More experienced reviewers

# Second Study using PBR and Checklist

- Repeated original study to:
  - Examine the impact of inspection process (N-fold) on the effectiveness of inspection techniques (PBR vs. checklist)
  - Using:
    - A real SRS document
    - The N-fold inspection method
- Setting
  - Graduate Requirements Engineering Course
  - Goal: Help students gain hands-on experience with requirements inspection

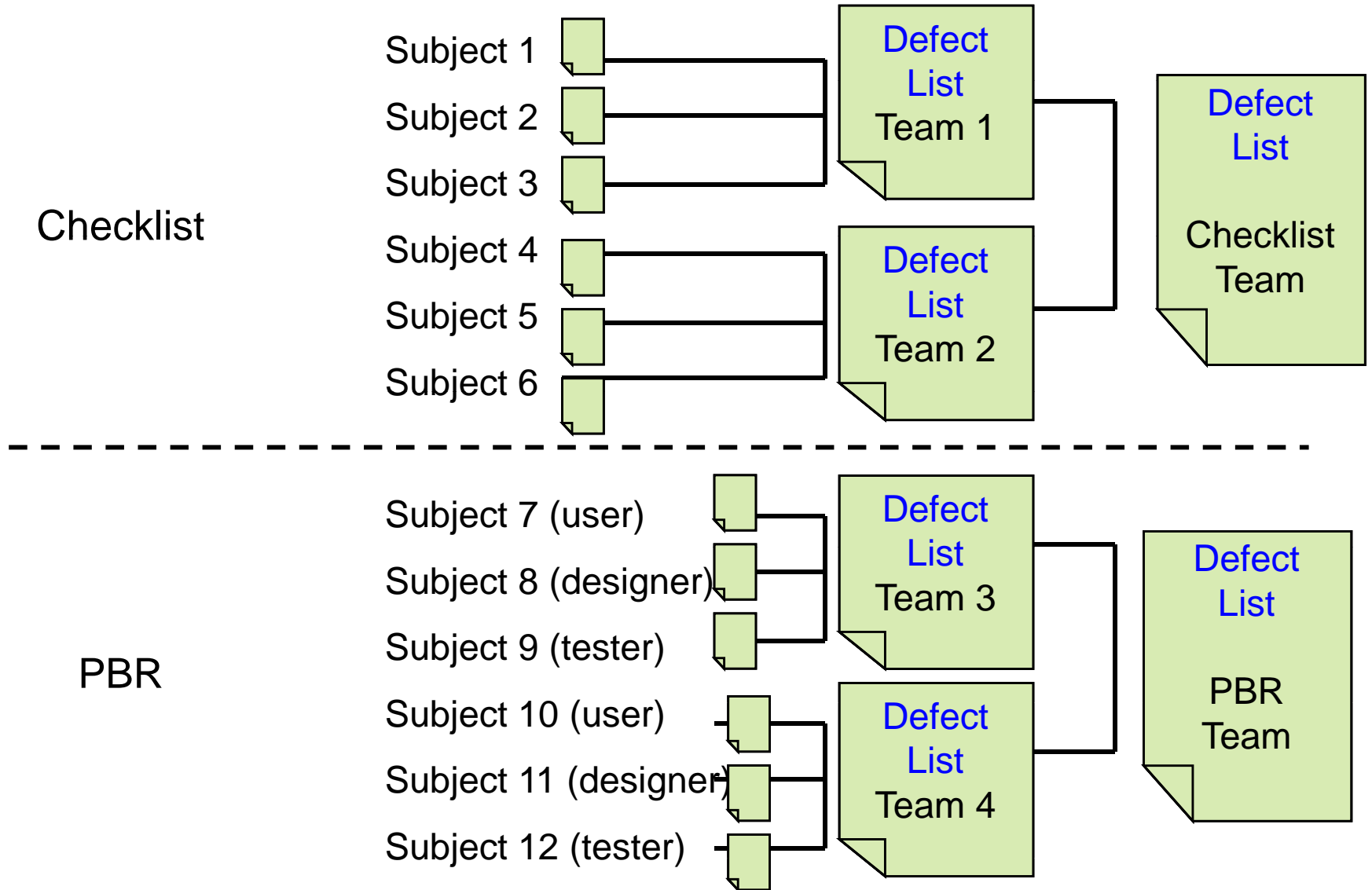
# Design of Second Study

Training

Individual Review

Team Meetings

Checklist





# Design Modifications

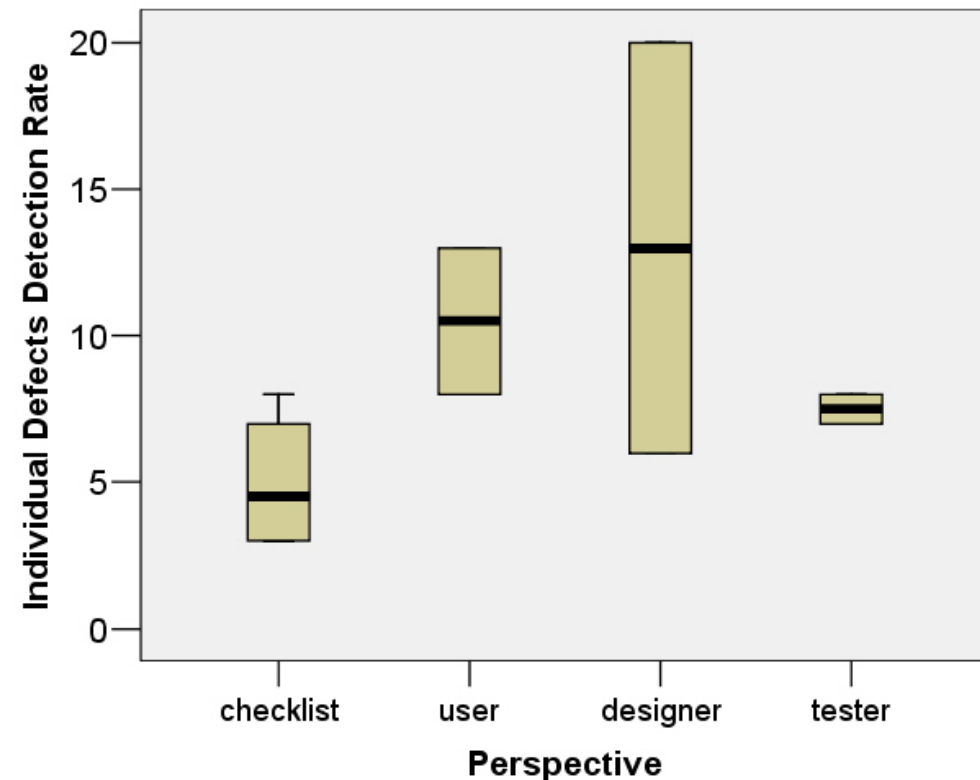
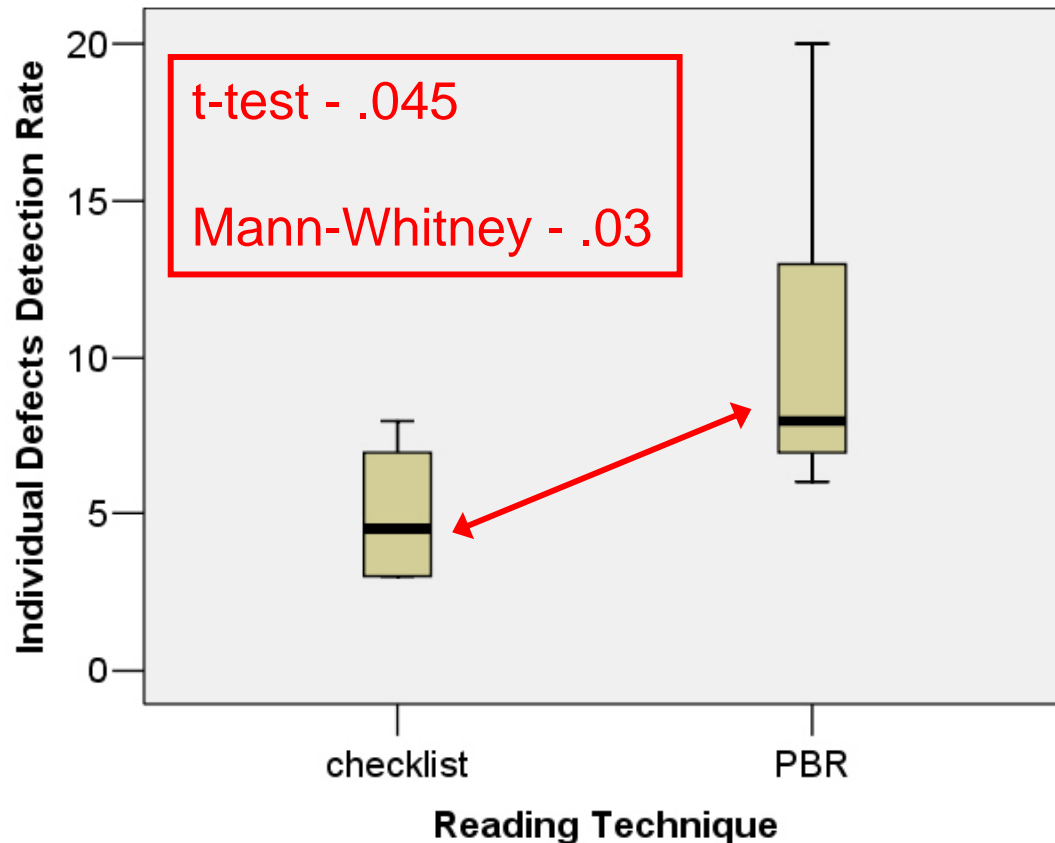
- Subject Training:
  - Original: No training – ad hoc review
  - Replication: Training provided on checklist and PBR
- Customer interaction:
  - Original: Customer review of results
  - Replication: No customer review of results
- Inspection process:
  - Original: Ad Hoc
  - Replication: PBR and Checklist
- Oversight
  - Original: No oversight, student team leads
  - Replication: Research student oversight and two faculty members conducting training

# Results

## Individual Performance

- **Hypothesis 1**

- *Individuals applying PBR perform better than individuals using checklist reading techniques with respect to their mean defect detection rate.*

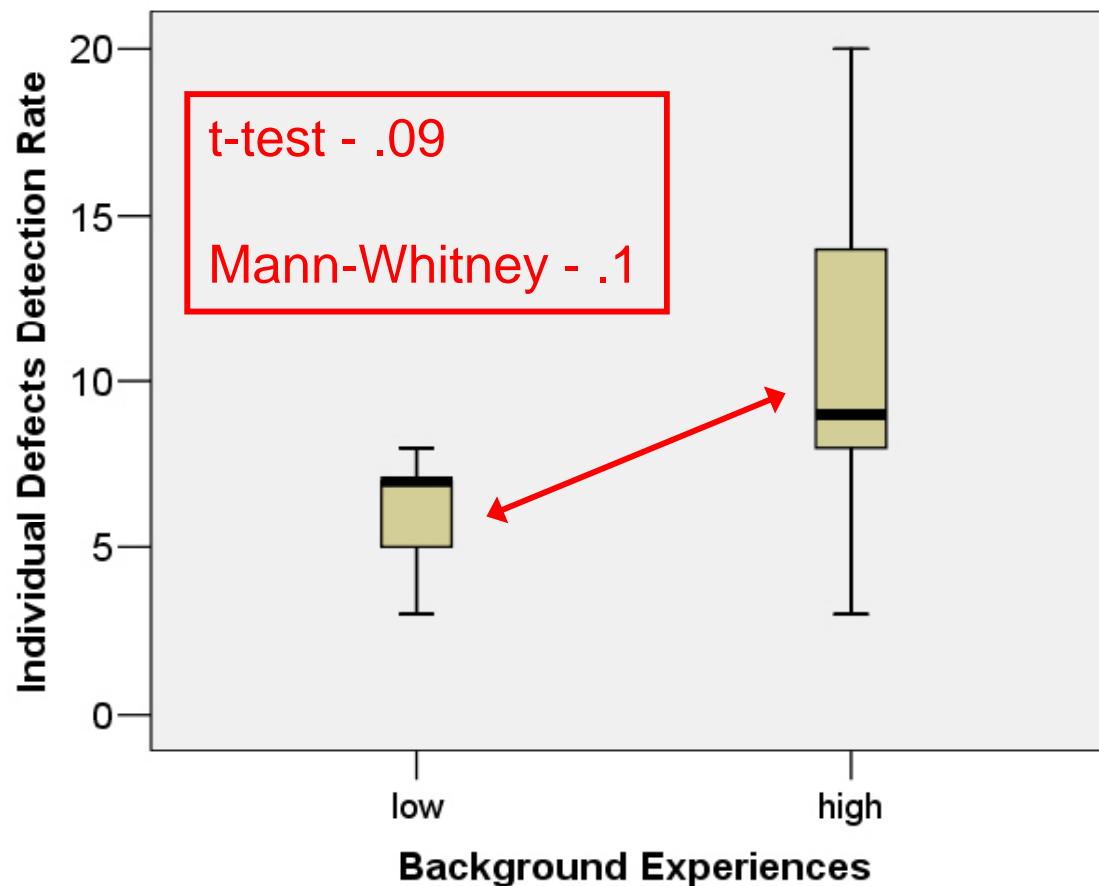


# Results:

## Individual Performance

- **Hypothesis 2**

- *The experience of the subjects has no influence on their mean defect detection rate.*

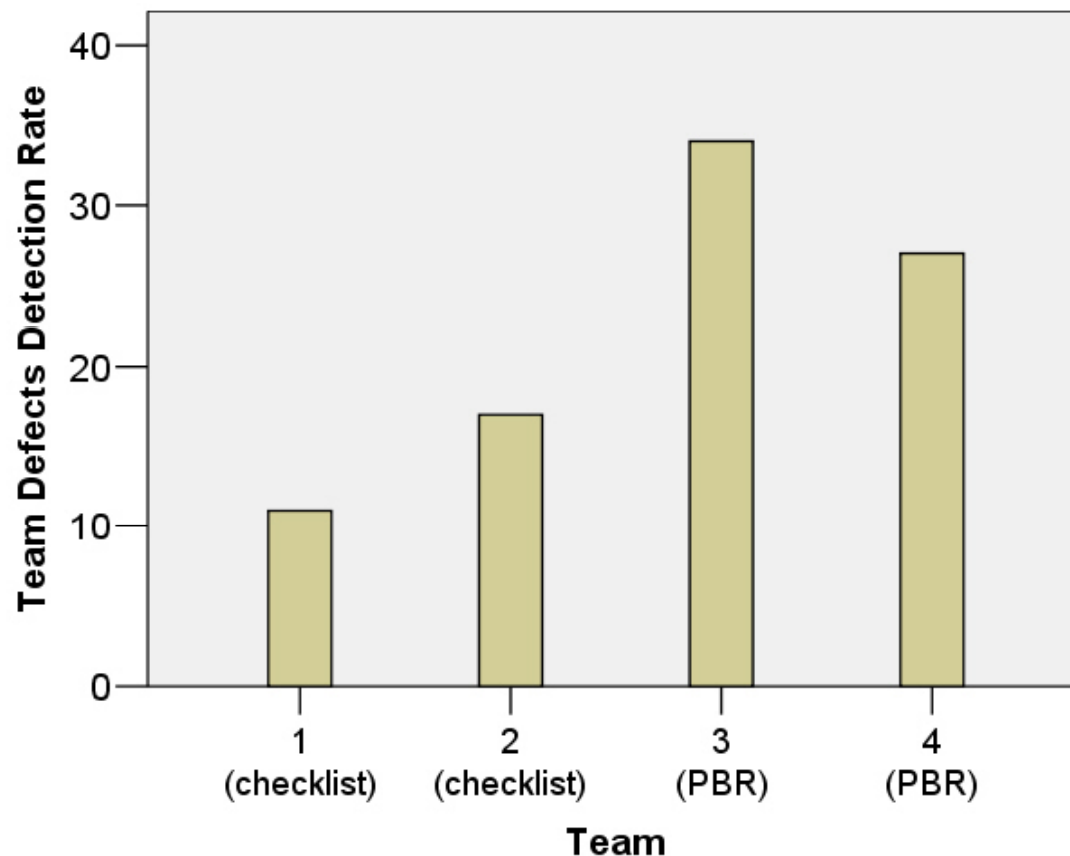


# Results:

## Team Performance

- **Hypothesis 3**

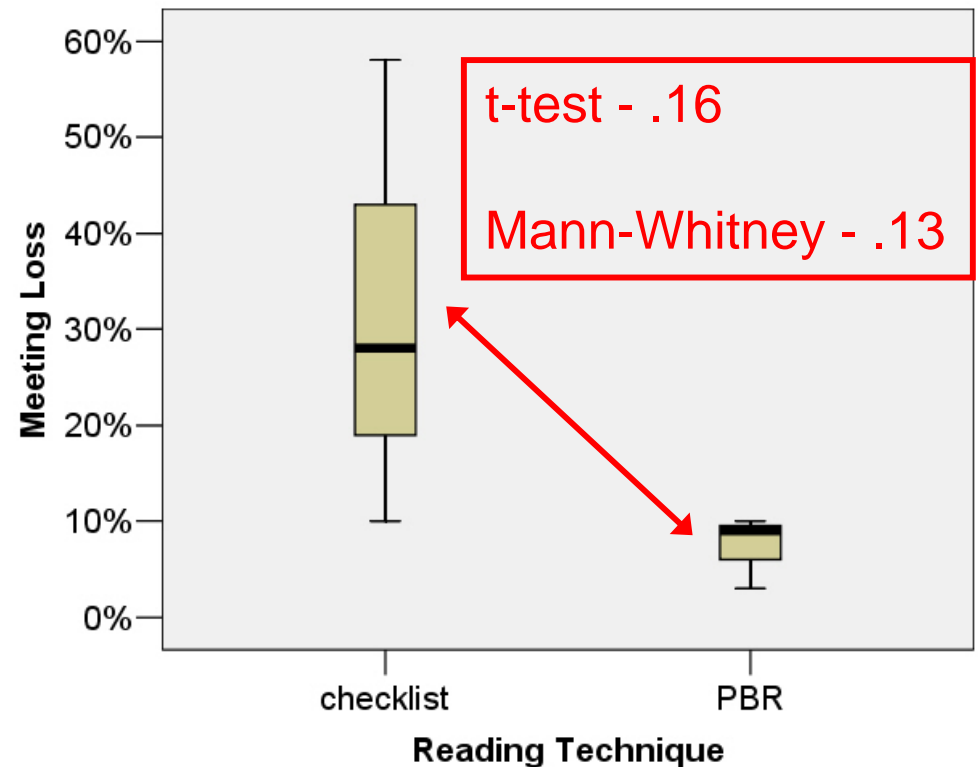
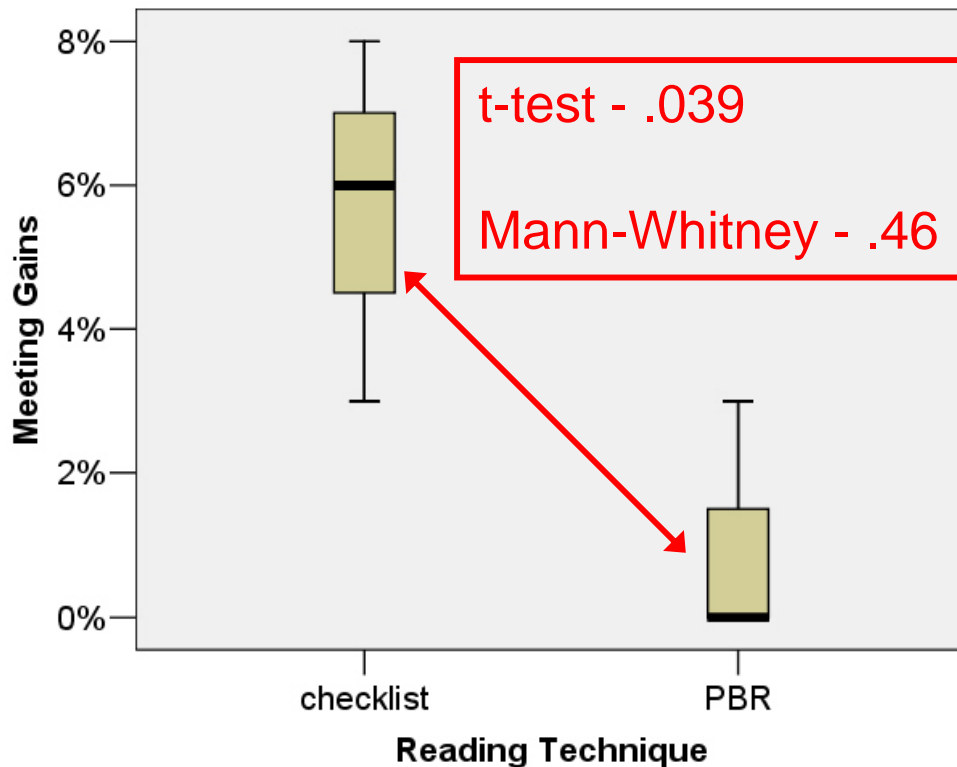
- Teams applying PBR perform better than teams using a checklist with respect to their mean defect detection rate.



# Results: Team Meetings

- **Hypothesis 4 & 5**

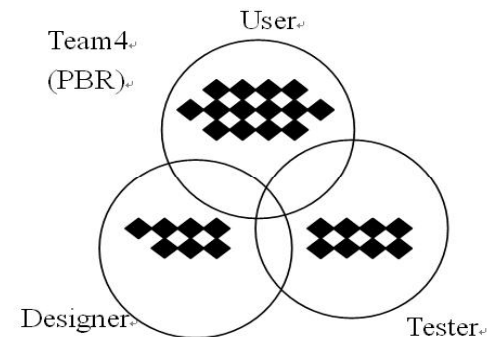
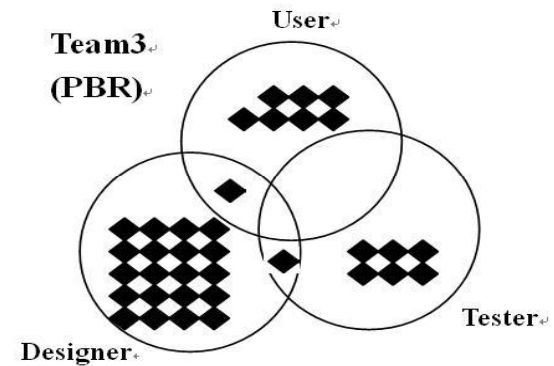
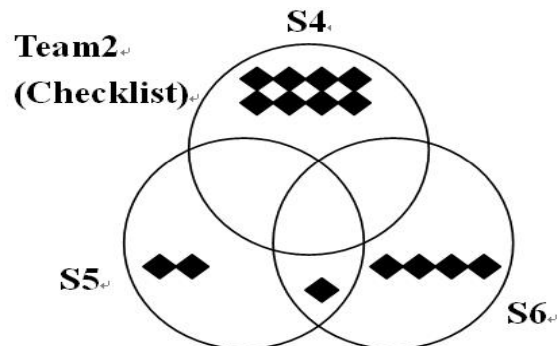
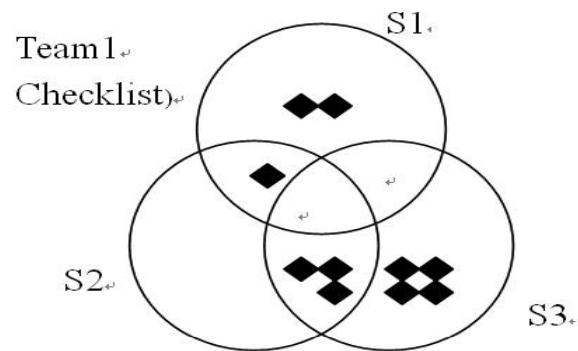
- *There is a difference between the meeting **gains** and **losses** in the meeting-based N-fold inspection using PBR and checklist reading techniques .*



# Results: Defect Overlap

- **Hypothesis 6**

- *The overlap of commonly detected defects among perspectives in PBR teams is lower than the overlap among individuals in checklist teams.*

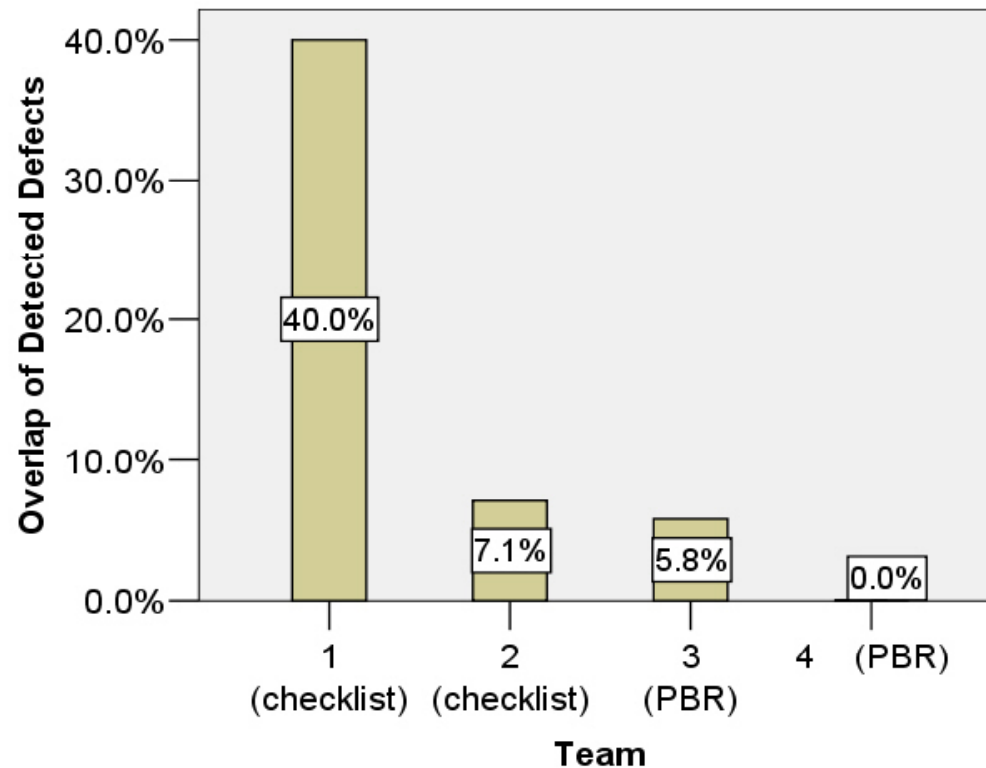


# Results:

## Defect Overlap

- **Hypothesis 6**

- *The overlap of commonly detected defects among perspectives in PBR teams is lower than the overlap among individuals in checklist teams.*



# Conclusions from Second Experiment

- The individuals and teams applying PBR found more defects than those using checklist
- Checklist teams had more effective team meetings during the N-fold inspection process (in terms of gains and losses)
- The defects detected by PBR teams showed
  - Less overlap
  - More even distribution through the whole SRS
- Effectiveness and necessity of a team meeting depends greatly on the type of technique used for the individual reviews



# Summary

- Almost any form of N-fold seems better than individual reviews
- More time is needed for N-fold, but the payoff seems worth the expenditure
- Structured N-fold with a focus seems better than ad hoc
- PBR appears to be a better and more effective technique for requirement reviews

# Contact Information

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