Fraunhofer USA
Center for Experimental Software Engineering

ANALYZING INSPECTION DATA FOR HEURISTIC EFFECTIVENESS

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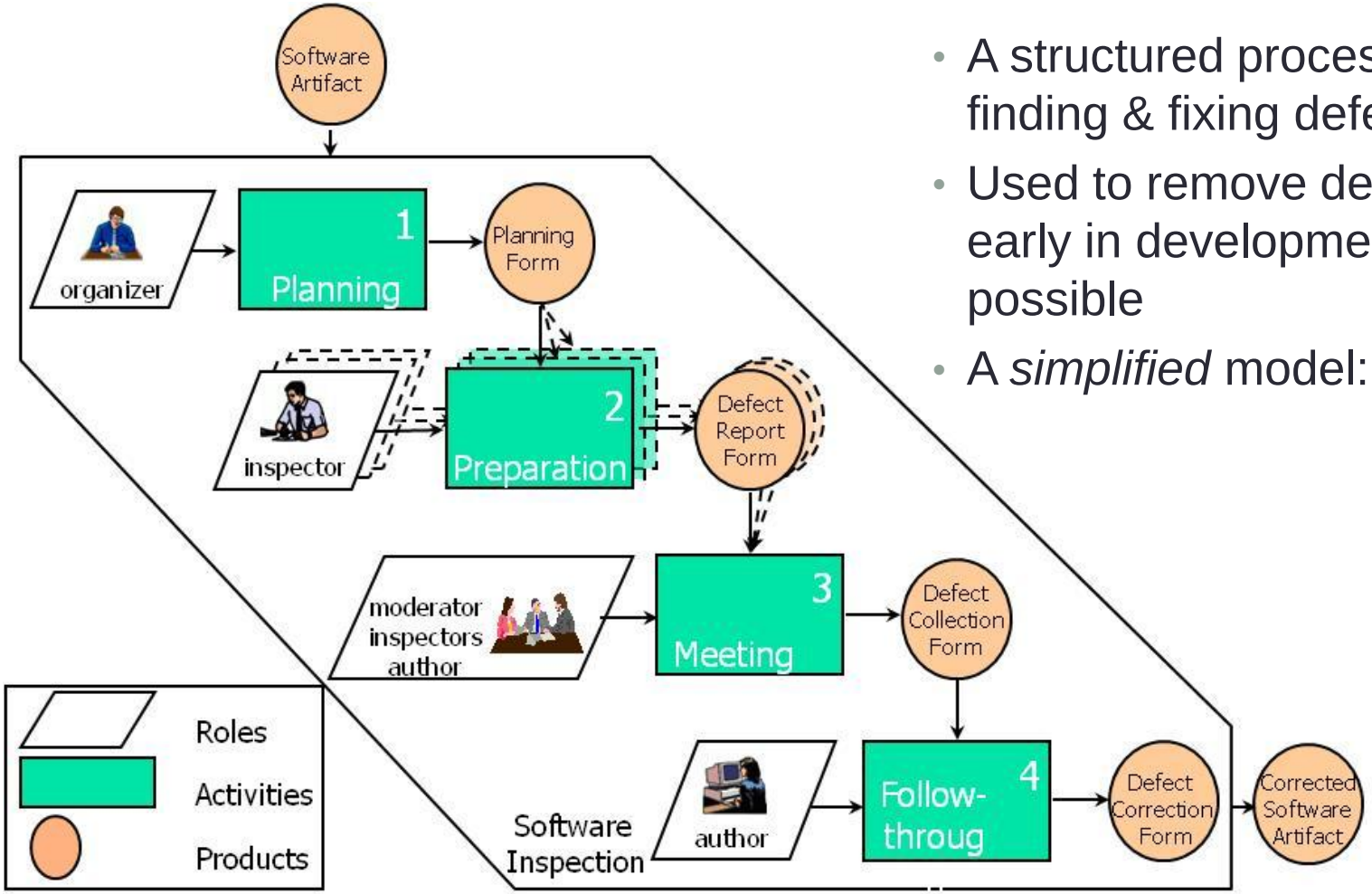
Outline

- Why inspection?
- Why analyze inspection data?
- An analysis example and lessons learned
- Parting thoughts

Formal Software Inspections



- A structured process for finding & fixing defects
- Used to remove defects as early in development as possible
- A *simplified* model:

Why do inspections matter?

- Formal inspection is applicable to all development phases:
  - One of few assurance techniques that are available in the earliest phases
- A long history of research and experience shows it is one of the most cost-effective practices for achieving quality software:
  - "Cost savings rule": Cost to find & fix software defects is about 100x more expensive after delivery than in early lifecycle phases.
    - IBM: 117:1 between code and use
    - Toshiba: 137:1 between pre- and post-shipment
    - Data Analysis Center for Software: 100:1
  - "Inspection effectiveness rule": Inspections find over 50% of the defects in an artifact, regardless of the lifecycle phase applied.
    - 50-70% across many companies (Laitenberger)
    - 64% on large projects at Harris GCSD (Elliott)
    - 60% in PSP design/code reviews (Roy)
    - 50-95%, rising with increased discipline (O'Neill)

Why analyze inspection data - Scenario 1

I'm going to run an inspection, and I'm not entirely comfortable with all the decisions I have to make: inspection team, page rate, etc.

I'm working on mission-critical software and want to maximize number of defects found

I'm working on a scientific prototype and want to maximize efficiency.

- **How the analysis helps:** Analyzing past inspection can yield heuristics (for team size, page rate) that can be a starting point for inspection planners:
  - There can be separate heuristics depending on project goal (effectiveness or efficiency)
  - Don't need to be enforced strictly, but provide a basis from which to define deviations

Why analyze inspection data - Scenario 2

Somebody performed inspections and I'm trying to understand how much confidence to have in the quality of the software as a result.

- **How the analysis helps:** allows comparisons between different inspection instances, and evaluation of likely effectiveness
  - How likely is it that the inspection did a good job of finding a majority of defects based on what we've seen from other inspections with similar planning parameters?

An analysis example - motivation

- In early-90s, a large organization identified heuristics for key parameters based on best practices and early inspection data focusing on maximizing defect detection.

Team Size	Too small: miss important expertise Too large: drive up costs, dampen discussion	Rule of thumb: 4-6
Page Rate	Too large – thorough review impossible	Rule of thumb: For reqts: <=15 pg/hr For code: <=10 pg/hr For design and test: <= 20 pg/hr
Meeting Length	Too long: danger of fatigue	<2 hours

- Software development environments have changed a lot in the past 20 years.
- Economic climate shifts focus toward efficiency - “Do more with less”.
- Are these heuristics still applicable in contemporary setting?
  - Are they still being followed?
  - Do they still provide the same significant benefit as when they were initially conceived?
  - How do the heuristics fare in providing an efficiency benefit?

We analyzed a large set of inspection data to answer these questions

Our Inspection Data

- data from 2700+ inspections in a governmental organization developing complex and highly critical software system.
- Data spanned across 19 years (1988-2007).
- We scrubbed and verified the data.

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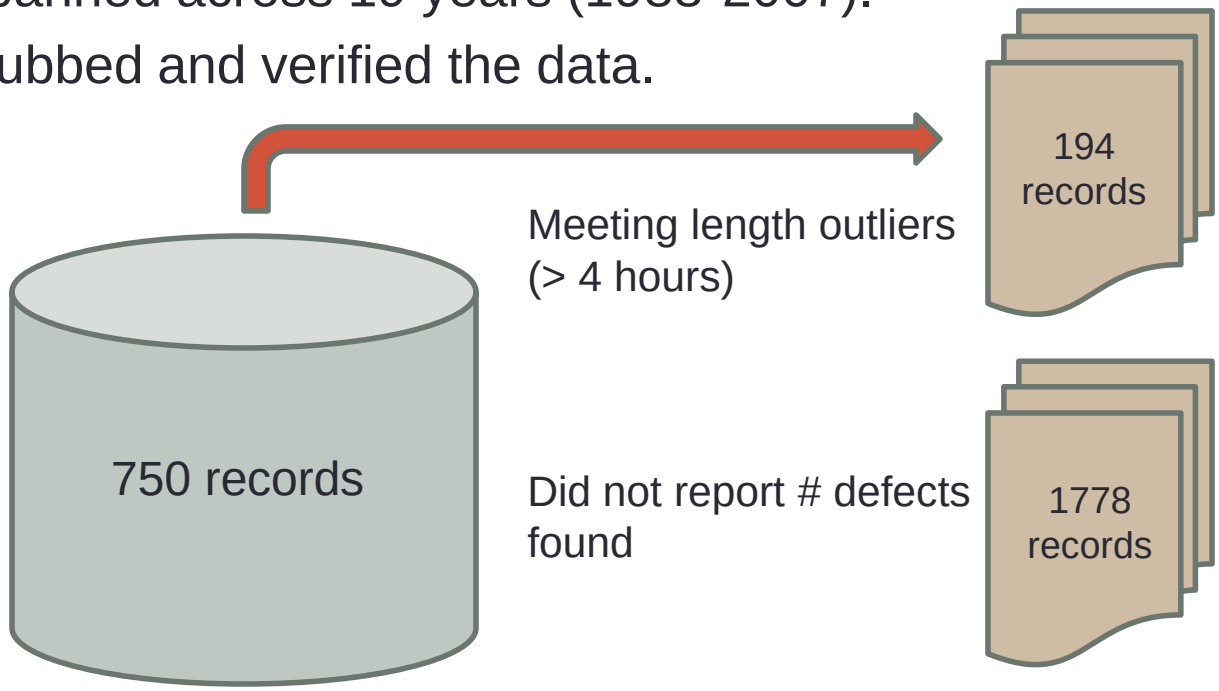
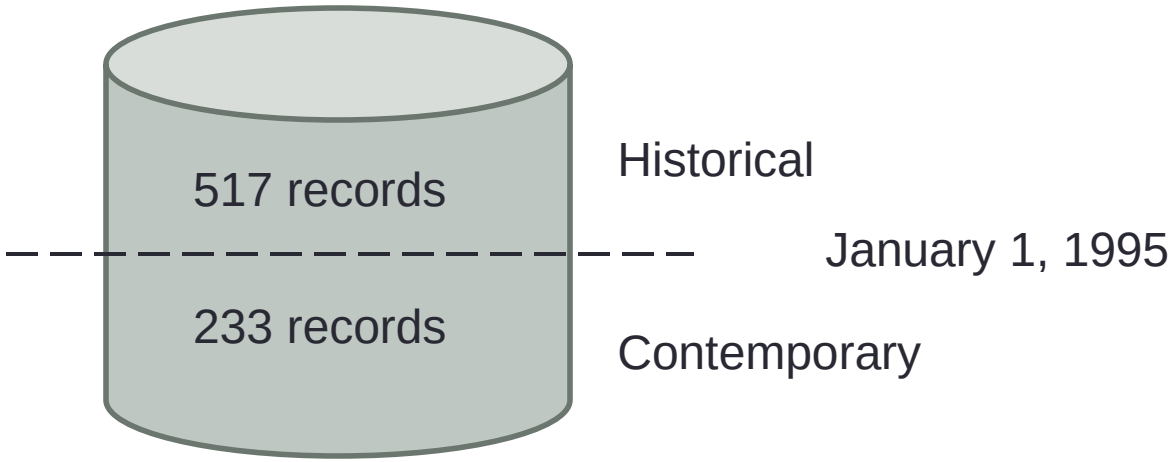


Retained records with extreme values, e.g: page rates of > 100 pg/hour, meeting length < 30 min

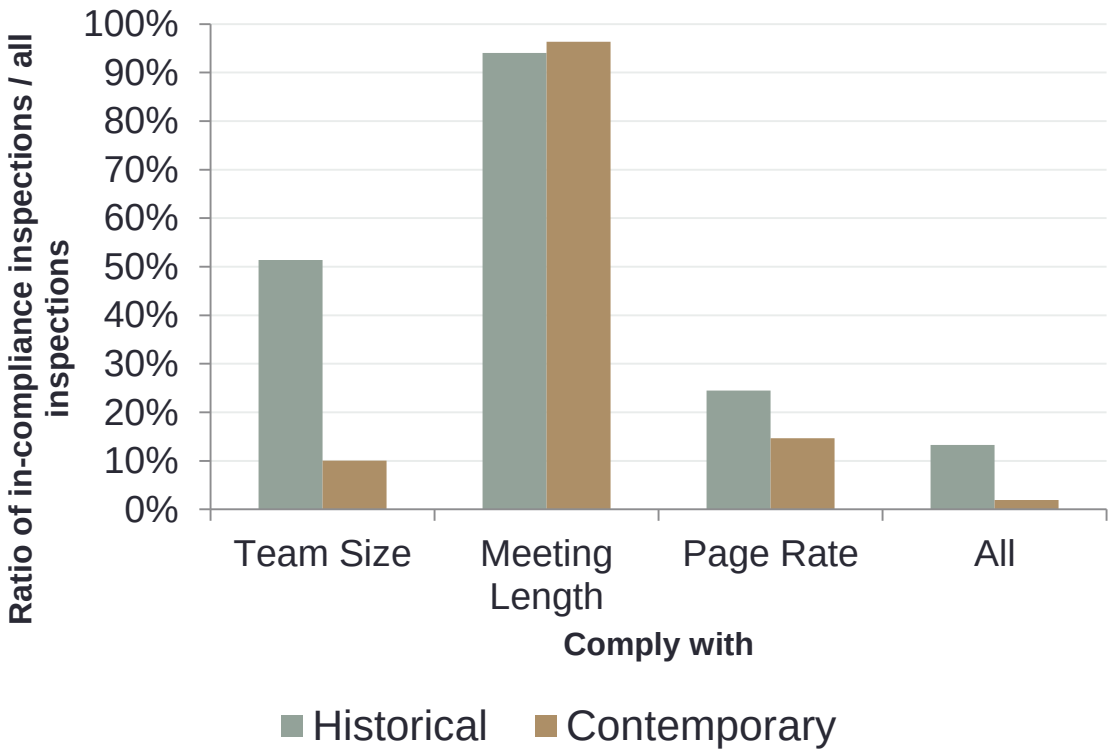
Analysis Approach

- Split inspection data into two sets.



- For each set – calculate and statistically compare inspection performance for when inspections complied with heuristics (**in-compliance**) and when they did not comply with heuristics (**out-compliance**).
  - Performance measured in term of effectiveness (# of defects) and efficiency (# of defects/hour)

Analysis Results – Degree of adherence



Observation – With the exception of meeting length, current inspections tend not to follow heuristics:

- Contemporary inspections tends to employ smaller team size
- 62% (83) of inspections that were not compliance with page rate work inspected > 50 pages/hour

Observation – Only small percentage of inspections follow all heuristics, for both historical and contemporary inspections

Analysis follow up:

- Investigate why fewer teams follow the heuristics.
- Investigate impact of not adhering to the heuristics.
- Determine if heuristics need to be updated.

Analysis Result - Inspection Effectiveness

	Team Size	Meeting Length	Page Rate
Historical	↑	↓	↑
Contemporary	↑	↓	⊘

↑ Being in compliance increases effectiveness

↓ Being in compliance reduces effectiveness

⊘ No observed difference between being in- or out-of-compliance

Although effectiveness seems to decrease, too few inspections actually deviated from the heuristic to be confident of the trend

Observation – Page rate heuristic seems to be a viable candidate to be updated considering (1) fewer inspections follow the current heuristic and (2) no difference in result when the heuristic was followed.

Analysis Result - Inspection Efficiency

	Team Size	Meeting Length	Page Rate
Historical			
Contemporary			

 Being in compliance increases effectiveness

 Being in compliance reduces effectiveness

 No observed differences between being in- or out-of-compliance

Observation – Heuristics did not seem adequate to address the efficiency goal. Additional analyses should be done to provide a set of planning heuristics that are more successful in providing cost-effective inspections.

Analysis next steps:

- Re-formulate guidelines for the three points of control.
  - Understand the interaction between the planning parameters.
  - Identify “sweet spot”, if it exists.
- Investigate the effect of context variables (e.g. project characteristics) when planning inspections.
- Gather more inspection data and generalize our analysis to larger set of data.

Parting Thoughts

- Many benefits from gathering and analyzing inspection data:
  - Establish best practice and guidance, backed by concrete evidence, for performing “good” inspections.
  - Establish baseline for evaluating inspection performance.
  - Enable continuous improvement and response to changes.
- Take analysis results with a grain of salt
  - Be aware of data collection and analysis perils that can threaten accuracy of analysis.

Questions?