

# Investigating the Impact of Active Guidance on Design Inspection

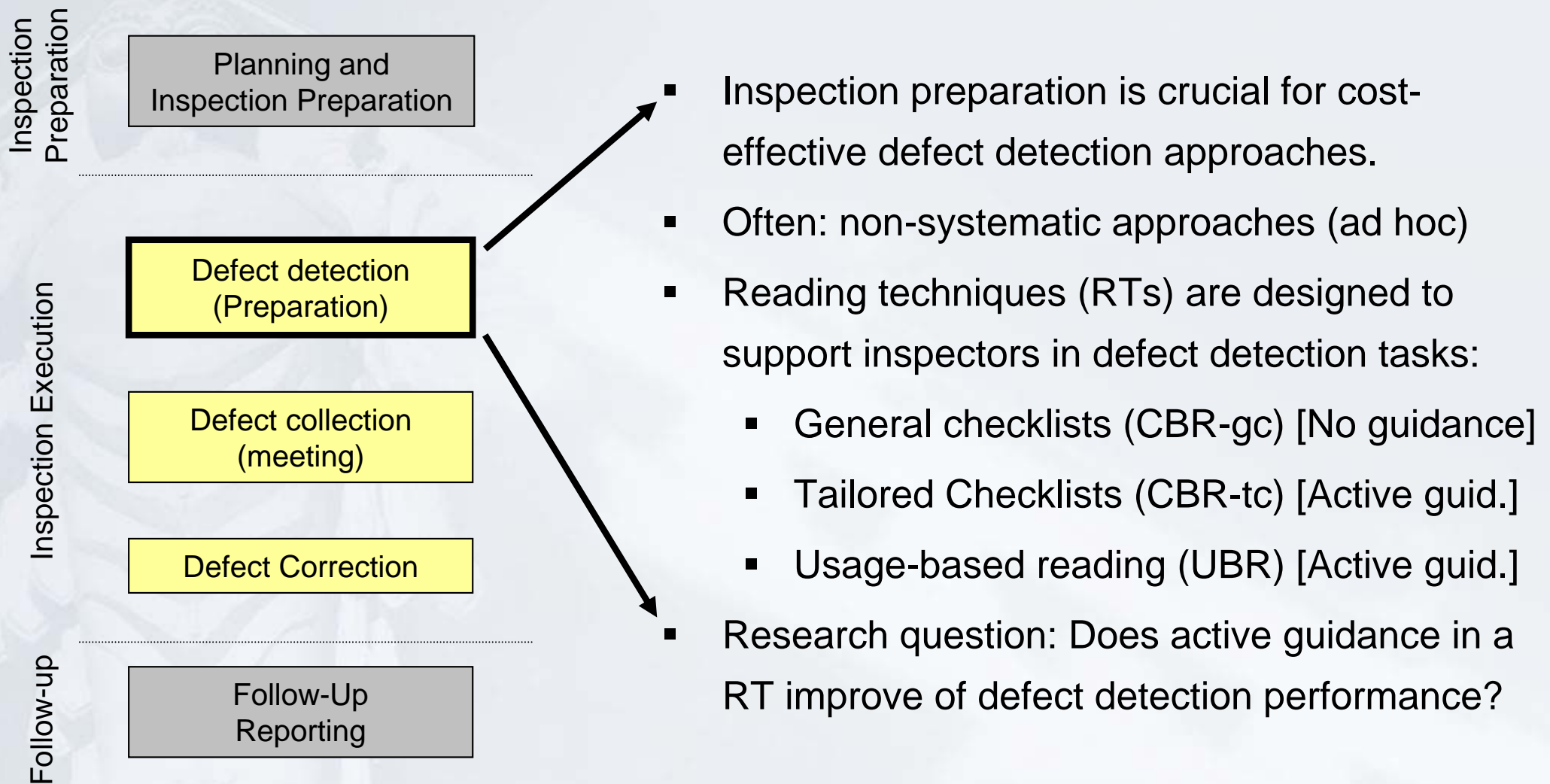
Dietmar Winkler, Stefan Biffel, Bettina Thurnher

Vienna University of Technology,  
Institute of Software Technology and Interactive Systems

[Dietmar.Winkler@qse.ifs.tuwien.ac.at](mailto:Dietmar.Winkler@qse.ifs.tuwien.ac.at)

<http://qse.ifs.tuwien.ac.at>

- **Software Inspection ...**
  - Is a static analysis technique to verify quality properties of software.
  - Supports structured quality improvement.
  - Enables defect detection in early stages of software development.
  - Does not require executable code (applicable to design documents).
  
- **Inspection procedure follow three steps:**
  - 1. Defect detection (individual activity, with reading technique support)
  - 2. Defect collection (team activity to identify false positives)
  - 3. Defect repair
  
- **Reading techniques support inspectors in their defect detection process (e.g., checklists / usage-based reading technique).**



Reading is a key activity to detect defects.

- **Passive Reading Techniques**

- Inspectors follow a sequence of individual steps (e.g. a given checklist)
- and let the inspector figure out how to proceed best.

- **Active Reading Techniques**

- Provide details on the inspections process (*how to perform an inspection*).
- Includes a separation of perception (*what to inspect*), e.g. focus on different defect severity classes, defect types, etc.
- Provide guidance through the most important parts of the document.
- Support inspectors in their defect detection process.

## Generic checklists (CBR-gc):

- Generic checklists offer only **little guidance** for inspectors.
- Predefined set of questions according to defect type, severity classes and location.
- General purpose approach, independent of the application domain.
- Application of checklist questions to requirements documents sequentially.
- Strongly dependent on inspector capability and domain knowledge.

## Tailored checklists (CBR-tc):

- Provides a process for inspection proceeding:
- Analysis of requirements and system functions first.
- Individual tailoring of requirements according to their subjective importance; active participation of inspectors is an important aspect of the inspection process.
- **Active guidance** through domain specific guidelines for requirements prioritization.

## Usage-Based Reading (UBR):

- Use cases govern inspection process (user focus).
- Application of use cases and scenarios to requirements documents in a pre-defined order of use cases (prioritized by a group of experts).
- Goal: focus on crucial and most important defects first.
- **Active guidance** through guidelines and prioritized use-cases.

- **Inspection effort** includes individual preparation time (tailoring of checklist items) and inspection duration (we did not consider inspection pre-work, e.g. use case prioritization and checklist generation).
- **Effectiveness** is the number of defects according to defect severity classes in relation to the overall number of seeded defects of the individual defect severity class.
- **Efficiency** is the number of defects found per time interval (e.g., defects found per hour)
- Hypotheses:
  - Active Guidance will improve effectiveness and efficiency.
  - Effectiveness (UBR) > Effectiveness (CBR-tc) > Effectiveness (CBR-gc)
  - Efficiency (UBR) > Efficiency (CBR-tc) > Efficiency (CBR-gc)



- **A replicated and extended experiment** (Thelin et al, 2003 and 2004) to investigate active guidance on reading technique application.
- **Three experiment phases processed:** (a) training & preparation, (b) individual inspection, and (c) data submission.
- **Software Artifacts:**
  - Textual requirements document describing a taxi management system containing 9 pages, 2500 words and 2 sequence charts.
  - Use case document contains 24 use cases in task notation.
  - Guidelines for CBR-gc/tc and UBR reading technique approaches and questionnaire.
- **Subjects (experiment participants):**
  - 127 software engineering students (24 CBR-gc, 48 CBR-tc, 55 UBR).
  - CBR-gc used as control group.
- **39 Reference Defects (13 crucial, 15 major, 11 minor defects) seeded in the design specification**

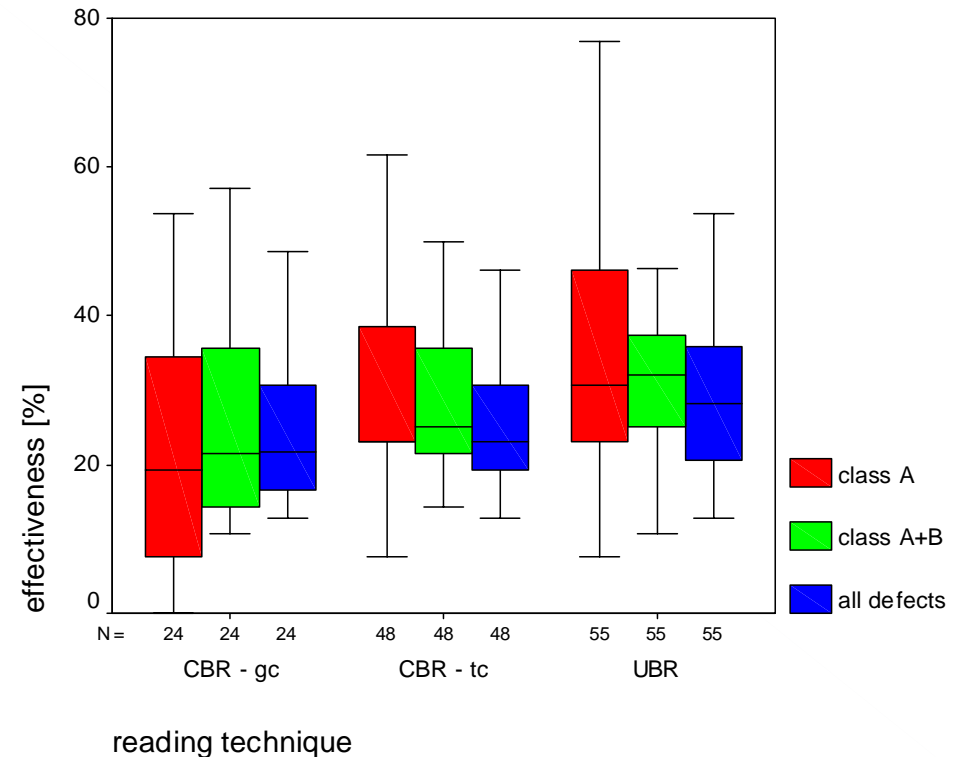


- **Inspection Effort** includes individual preparation time (derivation of requirements and system functions) and individual inspection duration.
- All three RTs have on average **similar total effort**.
- Longer preparation time and shorter inspection time for tailored checklists (CBR-tc.)
- CBR-gc and UBR show similar distribution on preparation and inspection duration.

		CBR-gc	CBR-tc	UBR
Mean	Preparation	43.3	46.0	42.8
	Inspection	120.3	110.0	117.7
	Total	163.5	155.9	160.6
Std.Dev	Preparation	15.7	19.0	22.5
	Inspection	27.9	30.8	28.1
	Total	25.1	34.6	29.5

# Results: Effectiveness

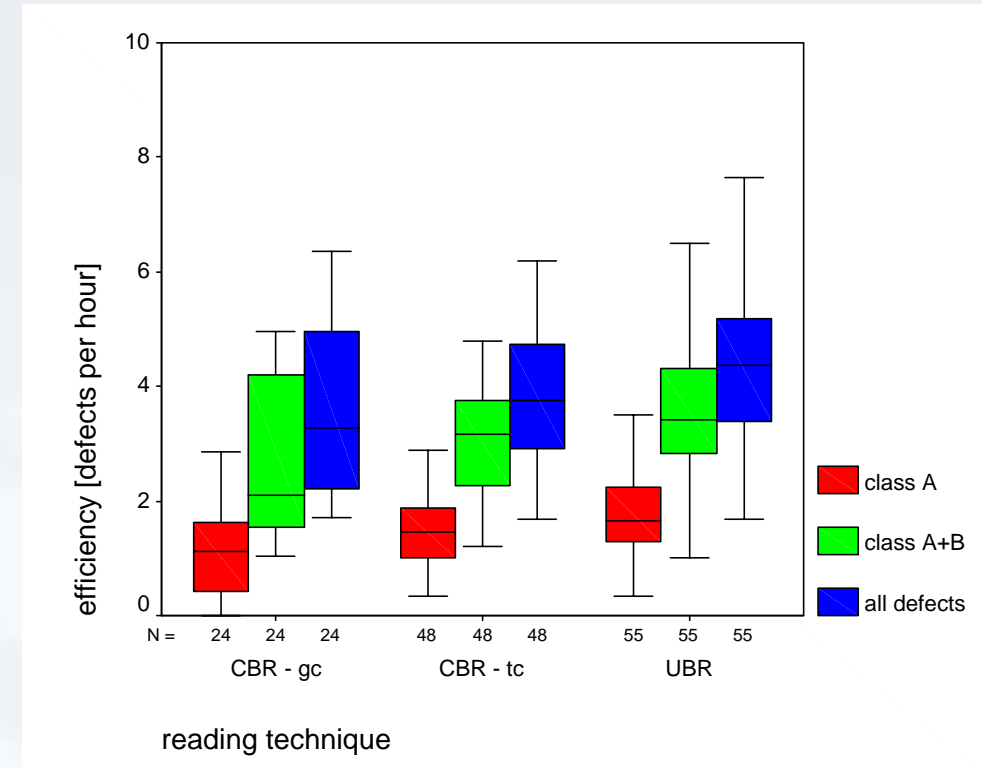
- **Effectiveness** is the number of defects found in relation to the number of seeded defects at a defect severity class.
- Focus on crucial defects (class A), important (class A+B) and all defects.
- Effectiveness (UBR) > Effe (CBR-tc) > Effe (CBR-gc) for all defect severity classes.
- The performance advantage of UBR is greatest for important (class A+B) defects.



Significant differences at all RTs and defect severity classes.

# Results: Efficiency

- Efficiency combines the measures of effort and effectiveness and is measured as the defect detection rate per hour.
- Efficiency (UBR) > Effi (CBR-tc) > Effi (CBR-gc).
- Significant differences concerning CBR-gc/UBR according to crucial (class A) and important (class A+B) defects.
- Significant differences concerning CBR-gc/CBR-tc according to crucial (class A) defects.



	Class A	Class A+B	All defects
CBR-gc / UBR	0,002(S)	0,023 (S)	0,053(-)
CBR-tc / UBR	0,059(-)	0,098(-)	0,079(-)
CBR-gc / CBR-tc	0,039(S)	0,166(-)	0,400(-)

## ▪ **Summary**

- Active guidance support inspection proceeding (UBR and CBR-tc).
- UBR expert know-how has significant effects on defect detection rates.
- Both RTs with active guidance perform significantly better than CBR-gc.
- Effort: Similar overall amount of inspection duration, but higher preparation and a lower inspection time of CBR-tc.
- Effectiveness: Highest effectiveness of UBR and lowest effectiveness of CBR-gc because of pre-defined priorities of use cases. CBR-tc is somewhat between them.
- Efficiency: Highest efficiency of UBR reading technique approaches (expert rating of use cases).

## ▪ **Further work**

- Investigation of the impact of inspector capability on inspection performance.