

Second Committee Meeting

Updated Progress Report

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Fall 2025

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2 Project

- Research Questions
- Methodology

3 Results

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Introduction

Where Were We?

- We wanted to generate test cases in **Drasil**, our software artifact generation framework
 - Started writing test cases manually

Introduction

Where Were We?

- We wanted to generate test cases in **Drasil**, our software artifact generation framework
 - Started writing test cases manually
 - We stopped to understand software testing to follow existing standards
- What happened?
 - The domain of software testing is *much* larger than we expected
 - Software testing terminology and standards are *not* standardized

Introduction

Existing Taxonomies?

- Existing software testing taxonomies:

- Tebes et al. (2020)
- Souza et al. (2017)
- Firesmith (2015)
- Unterkalmsteiner et al. (2014)

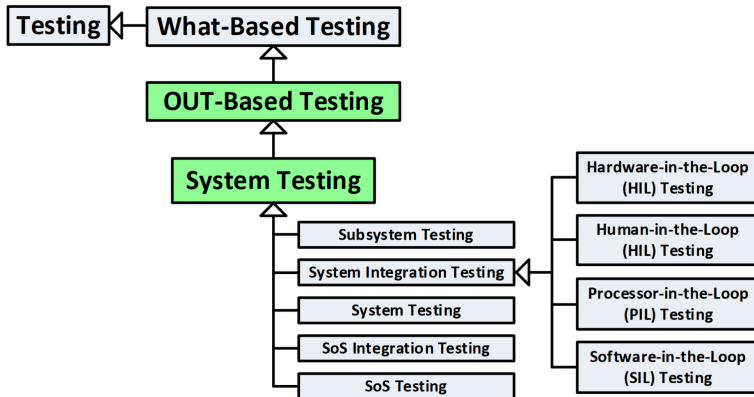
Focus on:

The Testing Process
Organizing Terminology
Relations between Approaches
Traceability between Stages

Introduction

Existing Taxonomies?

What: by Object Under Test (OUT) – System Testing

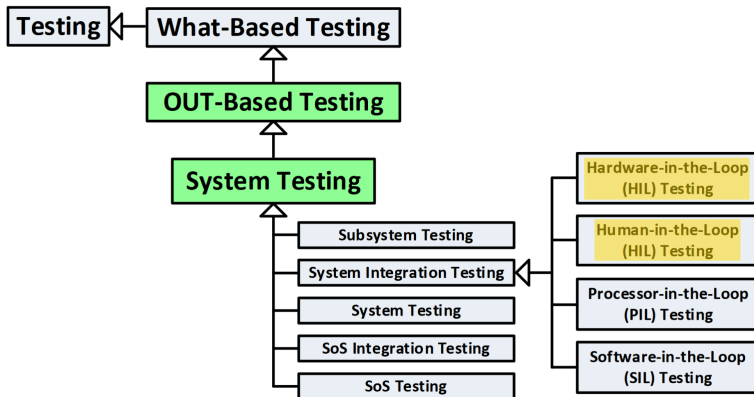


(Firesmith, 2015, p. 23)

Introduction

Existing Taxonomies?

What: by Object Under Test (OUT) – System Testing

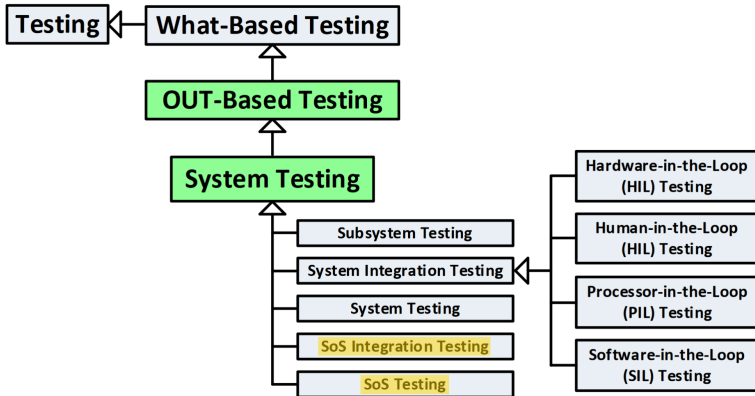


Adapted from (Firesmith, 2015, p. 23)

Introduction

Existing Taxonomies?

What: by Object Under Test (OUT) – System Testing

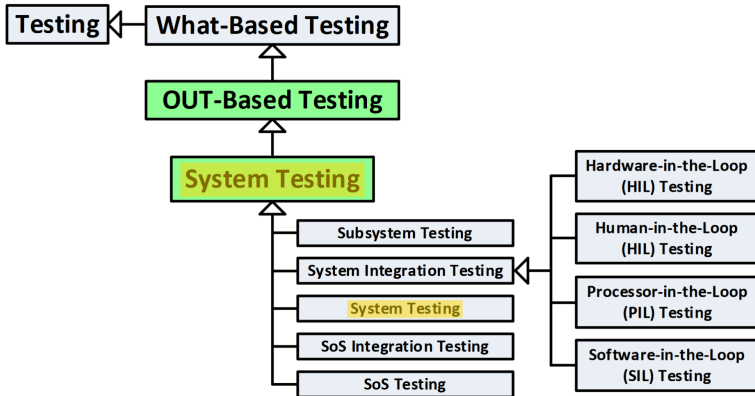


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Introduction

Existing Taxonomies?

What: by Object Under Test (OUT) – System Testing

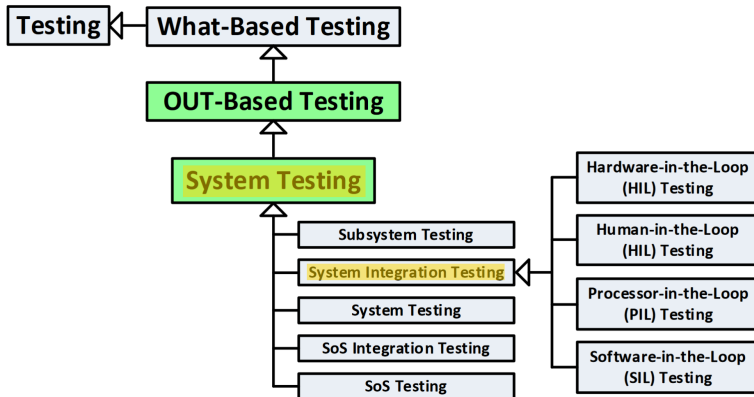


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Introduction

Existing Taxonomies?

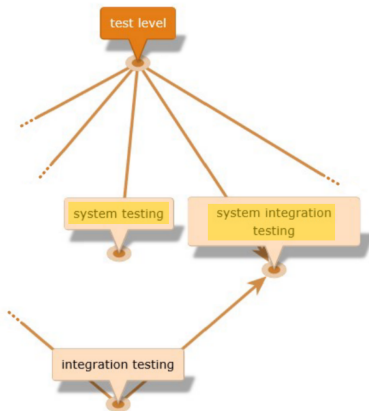
What: by Object Under Test (OUT) – System Testing



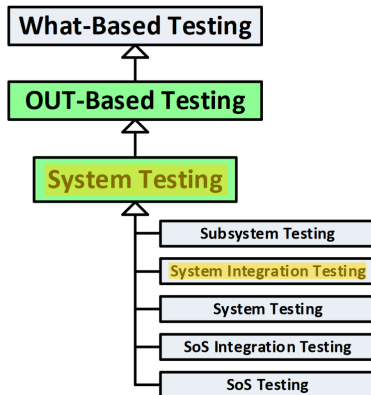
Adapted from (Firesmith, 2015, p. 23)

Introduction

Existing Taxonomies?



Adapted from (Hamburg and Mogyorodi, 2024)



Adapted from (Firesmith, 2015, p. 23)

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Research Questions

Research Question 1

What test approaches do the literature describe?

Research Question 2

Are these descriptions consistent?

Research Question 3

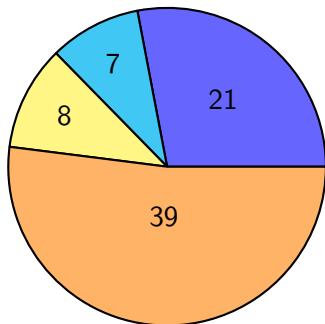
Can we systematically resolve any of these inconsistencies?

Research Question 1

What test approaches do the literature describe?

- ➊ Identify authoritative sources on software testing
- ➋ Identify all test approaches and testing-related terms
- ➌ Record data for these terms; test approach data are comprised of:
 - ➊ Names
 - ➋ Definitions
 - ➌ Parents
 - ➍ Categories
 - ➎ Synonyms
 - ➏ Flaws
- ➍ Repeat steps 1 to 3 for any missing or unclear terms

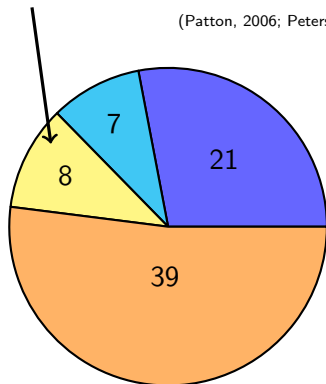
In total, we investigate 75 sources



- Established Standards
- Terminology Collections
- Textbooks
- Papers and Other Documents

Textbooks used at McMaster were our ad hoc starting points

(Patton, 2006; Peters and Pedrycz, 2000; van Vliet, 2000)



- Established Standards
- Terminology Collections
- Textbooks
- Papers and Other Documents

- We build a glossary with a row for each test approach

Name	Category	Definition	Parent(s)	Synonym(s)
A/B Testing	Practice (Fig. 2)	Testing “that allows testers to determine which of two systems or components performs better” (pp. 1, 36)	Statistical Testing (pp. 1, 36), ...	Split-Run Testing (pp. 1, 36)

Information from (ISO/IEC and IEEE, 2022)

- We gather this information from sources by looking for:
 - Glossaries, taxonomies, hierarchies, etc.
 - Testing-related terms
 - Terms described *by* other approaches
 - Terms that *imply* other approaches

Research Question 2

Are these descriptions consistent?

- ⑤ Automatically analyze recorded test approach data
 - ① Visualize approach relations
 - ② Detect certain classes of flaws
 - ③ Analyze manually recorded flaws from step 3.6
- ⑥ Report results of flaw analysis

Research Question 3

Can we systematically resolve any of these inconsistencies?

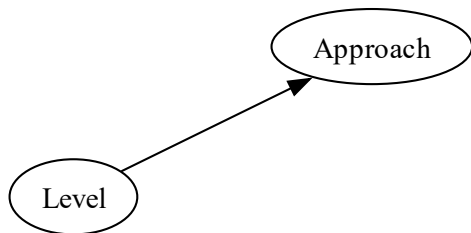
- ⑦ Provide examples of how to resolve these flaws

Approach

Approach: a “high-level test implementation choice” (ISO/IEC and IEEE, 2022, p. 10) used to “pick the particular test case values” (2017, p. 465)

Methodology

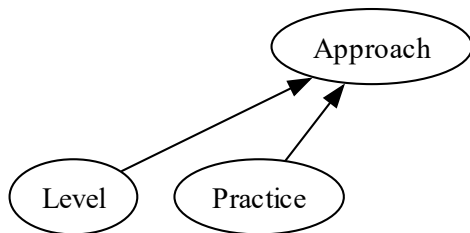
Categories



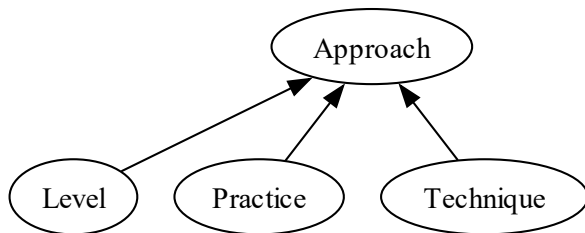
Level: a stage of testing with “particular objectives and ... risks”, each performed in sequence (ISO/IEC and IEEE, 2022, p. 12; 2021a, p. 6; 2021c, p. 6)

Methodology

Categories



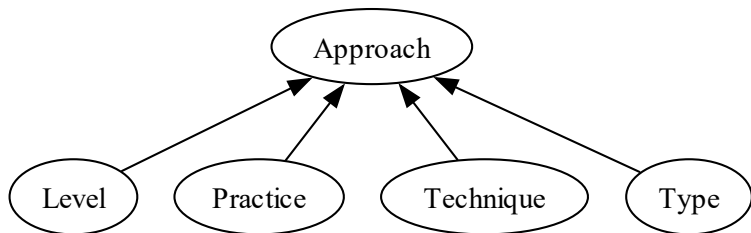
Practice: a “conceptual framework that can be applied to . . . [a] test process to facilitate testing” (ISO/IEC and IEEE, 2022, p. 14; 2017, p. 471)



Technique: a “procedure used to create or select a test model, identify test coverage items, and derive corresponding test cases” (2022, p. 11; 2021a, p. 5; similar in 2017, p. 467)

Methodology

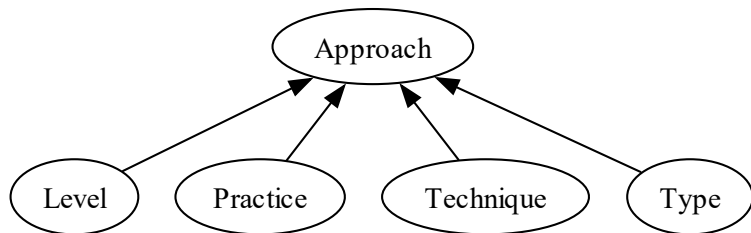
Categories



Type: “testing that is focused on specific quality characteristics”
(ISO/IEC and IEEE, 2022, p. 15; 2021c, p. 7; 2017, p. 473)

Methodology

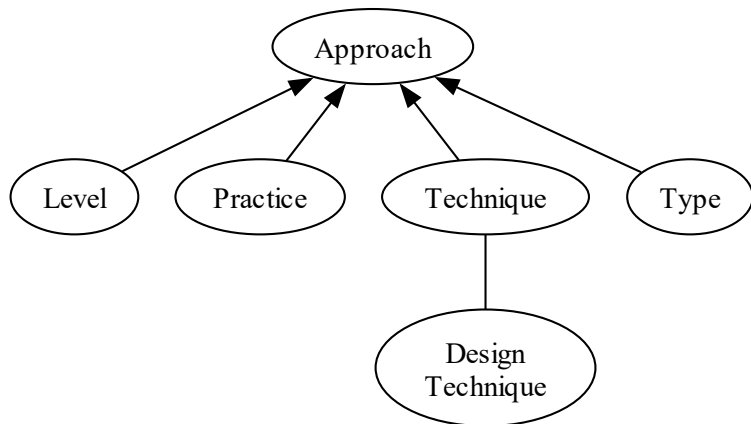
Visualization Notation



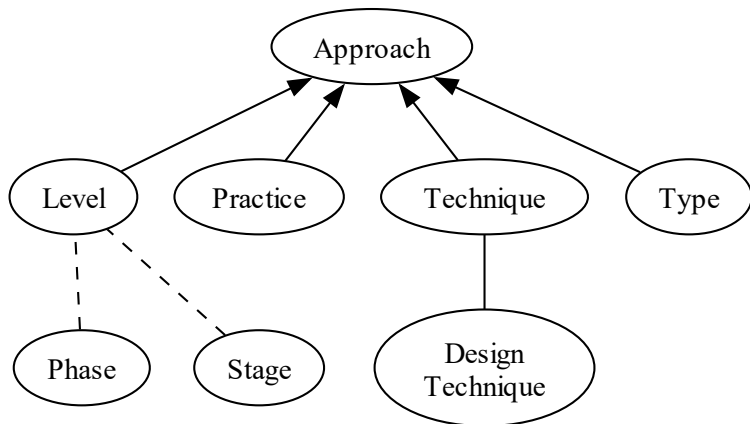
Arrows point from a *child* node to a *parent* node.

Methodology

Visualization Notation



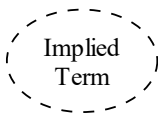
Lines without arrowheads connect *synonyms*.



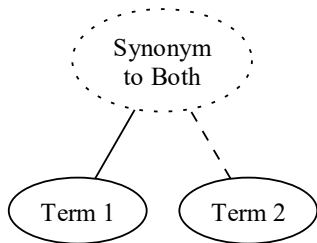
Dashed lines indicate a relationship is *implicit*.

Methodology

Visualization Notation



Dashed outlines indicate a term is *implicit*.



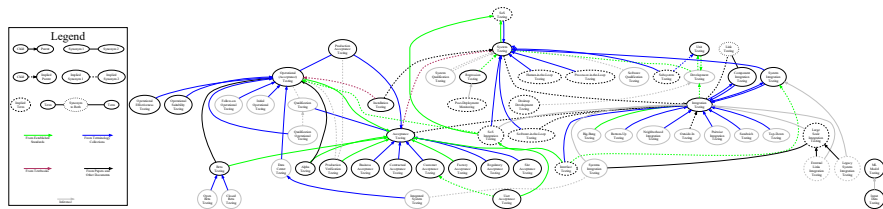
Dotted outlines indicate a term is a *synonym* to more than one term.

Visualization of Test Approaches

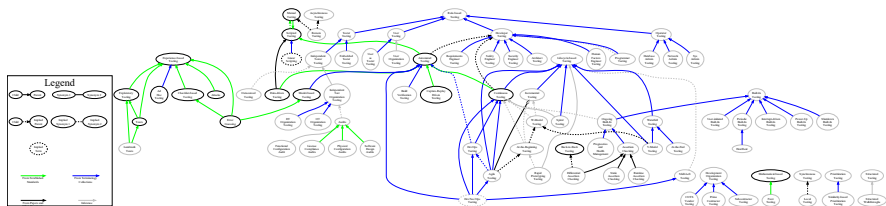
Visualization of Test Approaches

! Dimension too large.

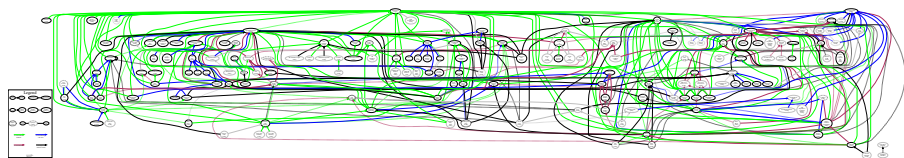
Visualization of Test Levels



Visualization of Test Practices



Visualization of Test Techniques



Visualization of Test Types

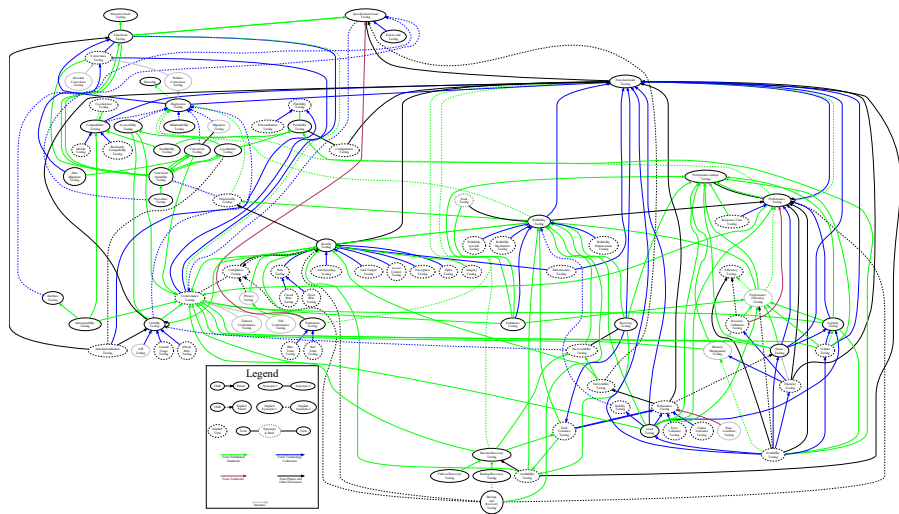


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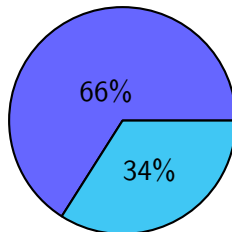
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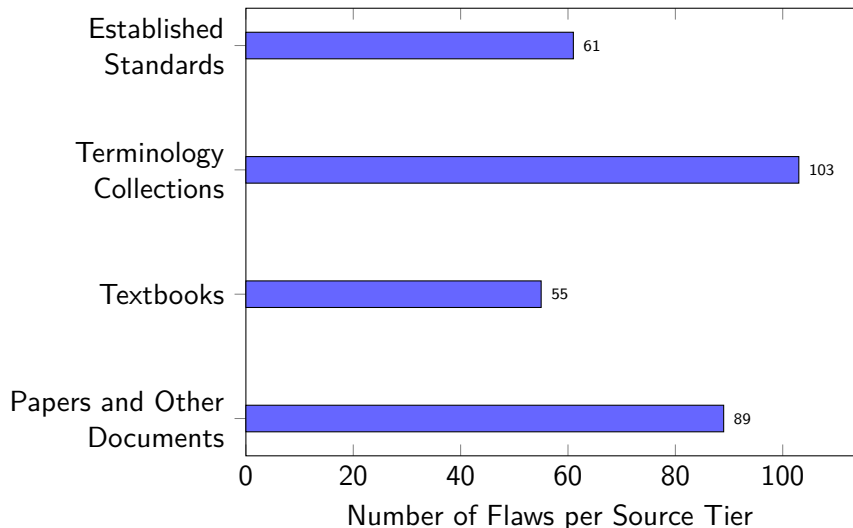
4 Next Steps

- 563 test approaches →
- 77 software qualities
(may imply test approaches)
- 308 flaws in the software
testing literature

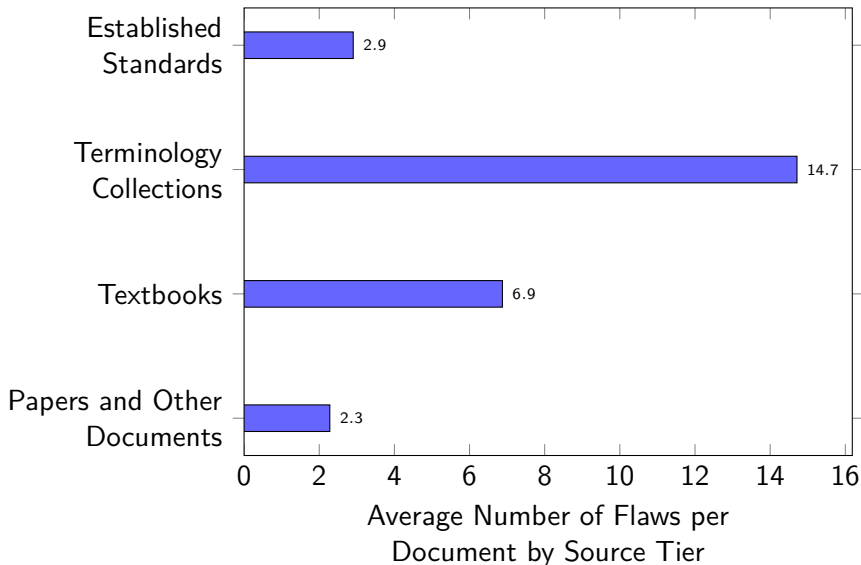


■ Defined
■ Not defined

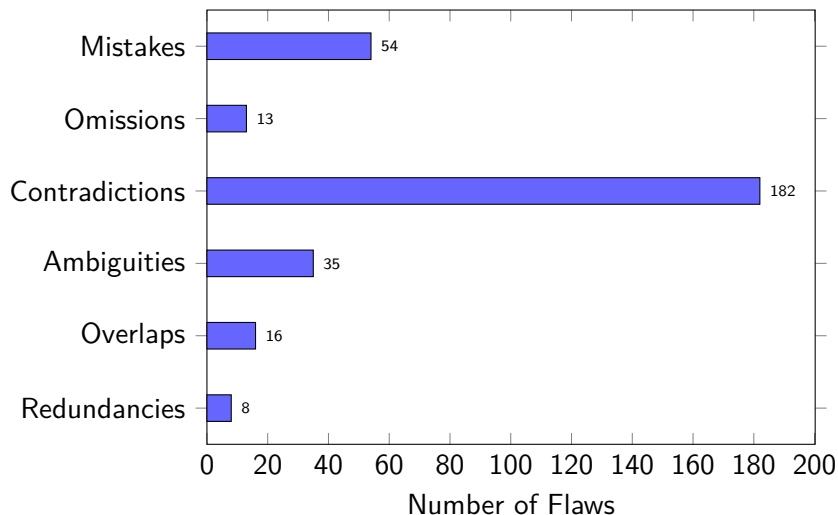
Flaw Summary by Source Tier



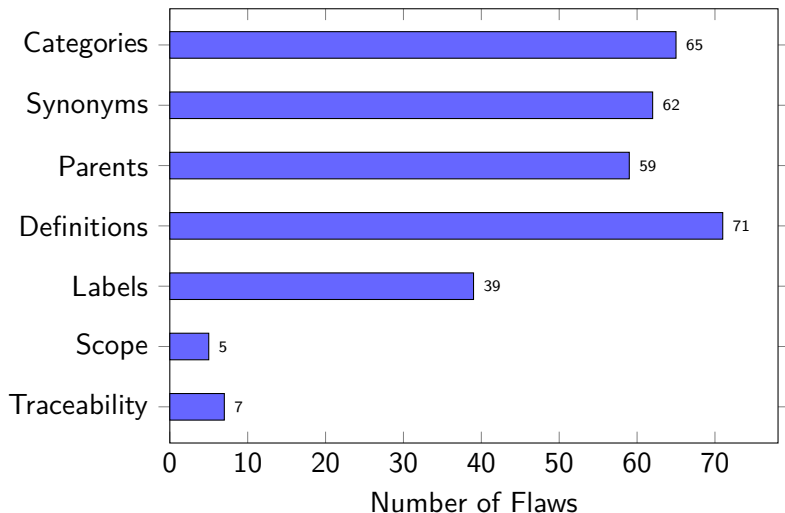
Normalized Flaw Summary



Flaw Summary by Manifestation



Flaw Summary by Domain

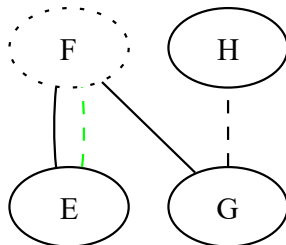


Automated Flaws

Intransitive Synonyms

Some terms are given as a synonym to two (or more) disjoint terms, making their relations ambiguous

Name	Synonym(s)
E	F (Author, 2022; implied by StdAuthor, 2021)
G	F (Author, 2017), H (implied by 2022)
H	X (StdAuthor, 2021)



Some prominent examples:

① **Functional Testing:**

- *Conformance Testing*
- *Correctness Testing*
- Specification-based Testing

Source(s)

(Washizaki, 2025a, p. 5-7)

(Washizaki, 2025a, p. 5-7)

(ISO/IEC and IEEE, 2017, p. 196; ...)

Some prominent examples:

① Functional Testing:

- *Conformance Testing*
- *Correctness Testing*
- Specification-based Testing

Source(s)

(Washizaki, 2025a, p. 5-7)

(Washizaki, 2025a, p. 5-7)

(ISO/IEC and IEEE, 2017, p. 196; ...)

② Portability Testing:

- Configuration Testing
- Flexibility Testing

(Kam, 2008, p. 43)

(ISO/IEC, 2023)

③ Soak Testing:

- Endurance Testing
- Reliability Testing

(ISO/IEC and IEEE, 2021c, p. 39)

(Gerrard, 2000a, Tab. 2; 2000b, Tab. 1, p. 26)

Automated Flaws

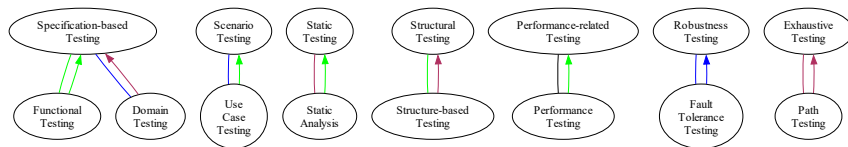
Irreflexive Parents

We also find some test approaches that are given as parents of themselves:

- ① Performance Testing (Gerrard, 2000a, Tab. 2; 2000b, Tab. 1)
- ② System Testing (Firesmith, 2015, p. 23)
- ③ Usability Testing (Gerrard, 2000a, Tab. 2; 2000b, Tab. 1)

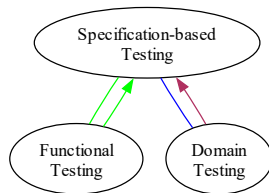
Automated Flaws

Synonym and Parent-Child Overlaps



Automated Flaws

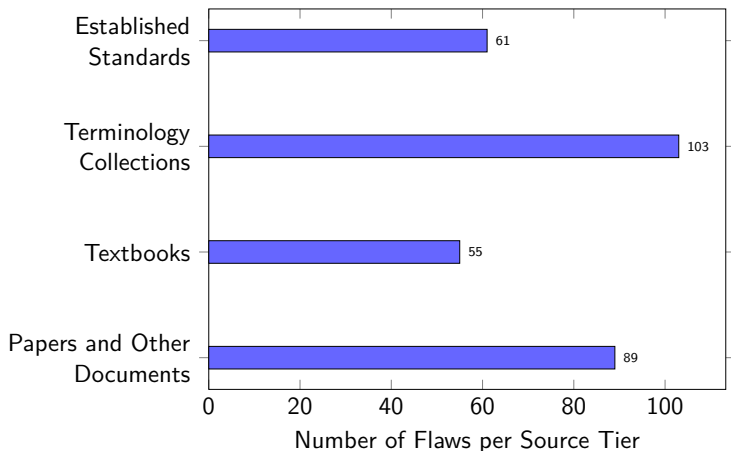
Synonym and Parent-Child Overlaps



- Functional testing is a:
 - Synonym (ISO/IEC and IEEE, 2017, p. 196;
van Vliet, 2000, p. 399; Kam, 2008, pp. 44–45, 48; ...)
 - Child (ISO/IEC and IEEE, 2021c, p. 38; Kam, 2008, p. 42)
- Domain testing is a:
 - Synonym (Washizaki, 2024, p. 5-10)
 - Child (Peters and Pedrycz, 2000, Tab. 12.1)

Conclusion

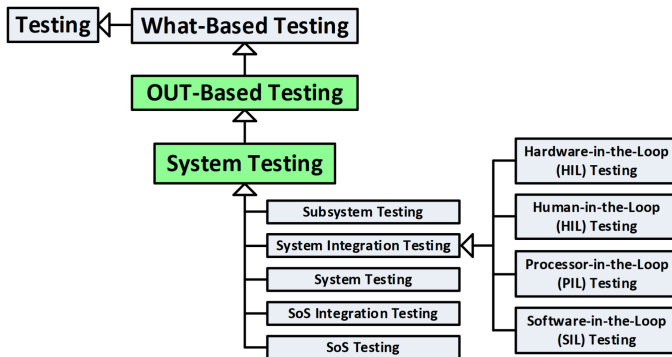
- The software testing literature is flawed, so don't assume everyone is on the same page



Conclusion

- The software testing literature is flawed, so don't assume everyone is on the same page
- Even if they are, there can still be issues!

What: by Object Under Test (OUT) – System Testing



(Firesmith, 2015, p. 23)

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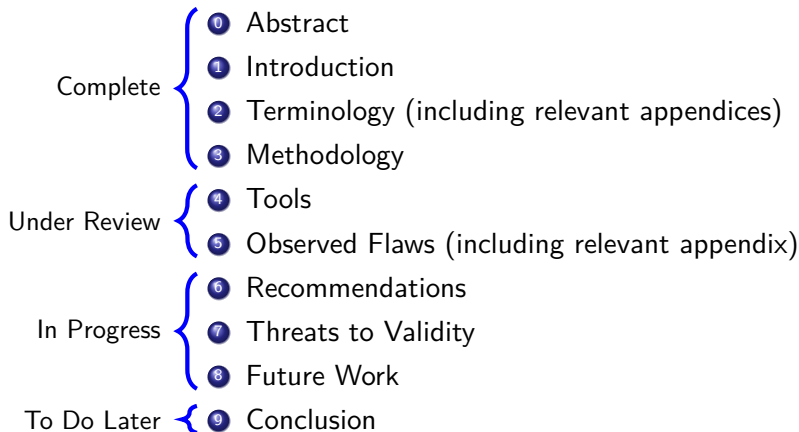
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Thesis Chapters



Scheduling Next Presentations

Seminar		Defense	
Oct. 27	2:00–3:00	Nov. 10	2:00–5:00
Oct. 28	2:30–3:30	Nov. 11	10:00–1:00 or 2:30–4:00
Oct. 29	1:30–3:30	Nov. 17	2:00–5:00
Nov. 3	2:00–5:00	Nov. 18	11:00–1:00 or 2:30–4:00
Nov. 4	11:00–1:00 or 2:30–4:00	Nov. 19	9:30–10:30 or 1:00–3:30
Nov. 5	9:30–11:30 or 1:00–3:30		

Acknowledgment

- Dr. Spencer Smith and Dr. Jacques Carette have been great supervisors and valuable sources of guidance and feedback
- The format of this presentation was *heavily* based on a previous presentation by Jason Balaci, who also provided a great thesis template
- ChatGPT was used to help generate supplementary Python code for constructing visualizations and generating \LaTeX code, including regex
- ChatGPT and GitHub Copilot were both used for assistance with \LaTeX formatting

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- Michael Unterkalmsteiner, Robert Feldt, and Tony Gorschek. A Taxonomy for Requirements Engineering and Software Test Alignment. *ACM Transactions on Software Engineering and Methodology*, 23(2):1–38, March 2014. ISSN 1049-331X, 1557-7392. doi: 10.1145/2523088. URL <http://arxiv.org/abs/2307.12477>. arXiv:2307.12477 [cs].

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