

Second Committee Meeting

Updated Progress Report

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McMaster University

Fall 2025

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2 Project

- Research Questions
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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)

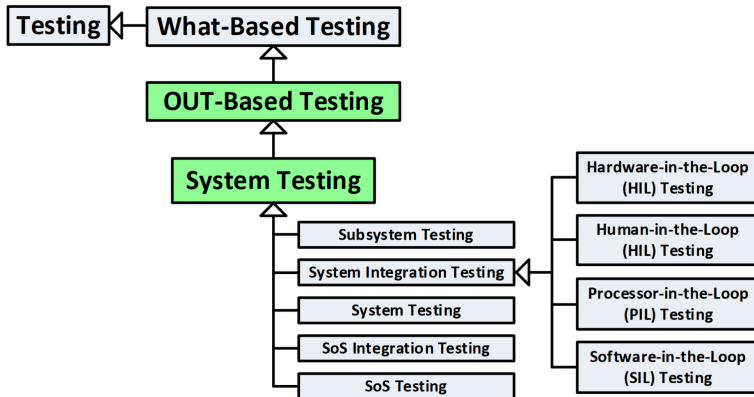
Focus on:

The Testing Process
Organizing Terminology
Relations between Approaches
Traceability between Stages

Introduction

Existing Taxonomies?

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

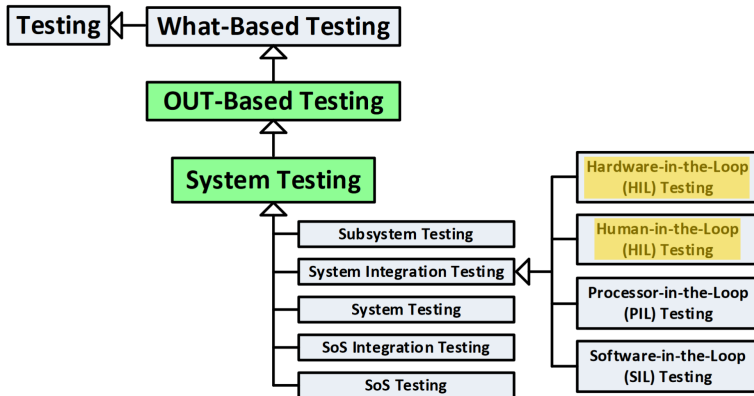


(Firesmith, 2015, p. 23)

Introduction

Existing Taxonomies?

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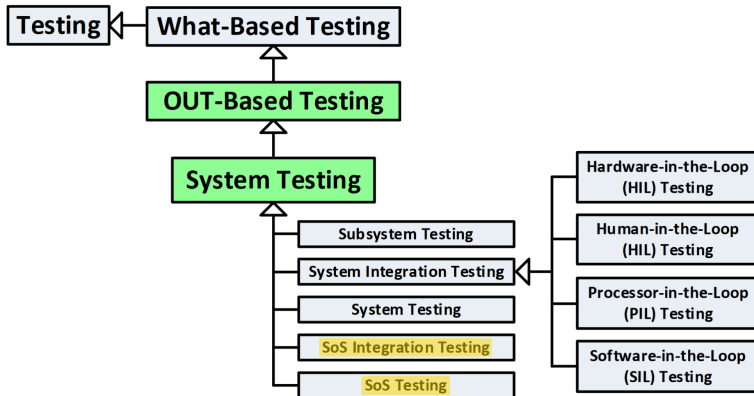


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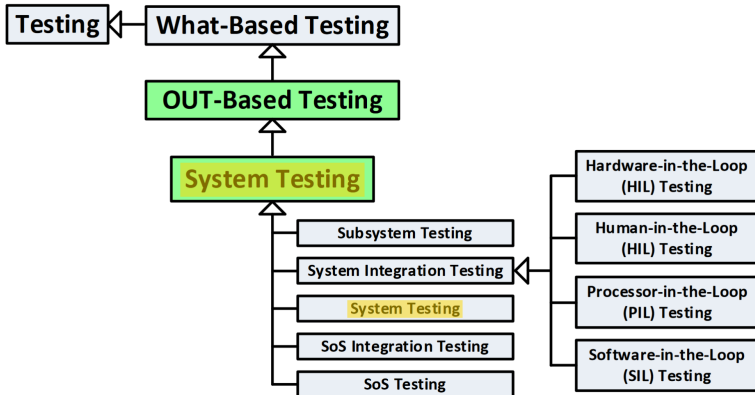


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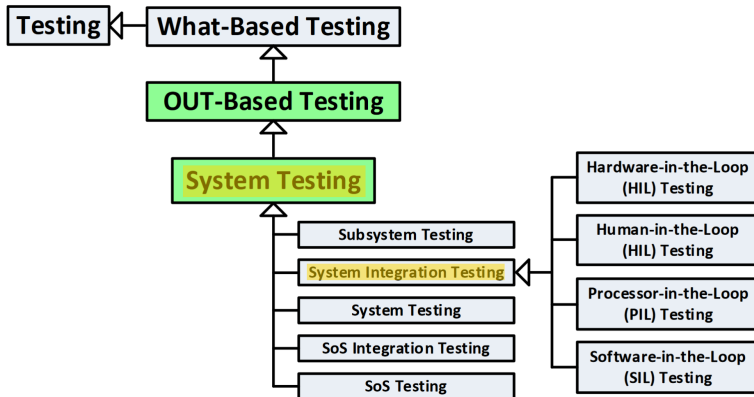


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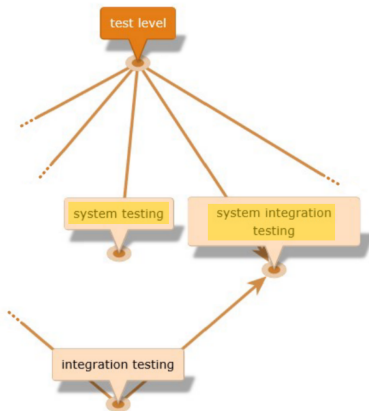
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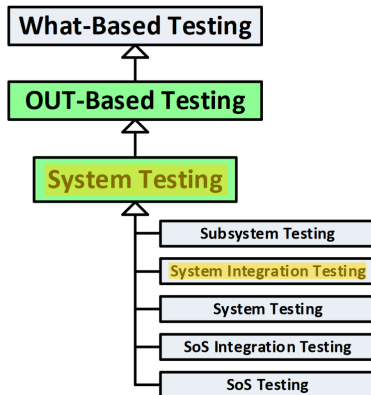
Adapted from (Firesmith, 2015, p. 23)

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 and “snowball” from them
- ➋ Identify all test approaches and testing-related terms described in these authoritative sources
- ➌ Record all relevant data, including implicit data, for each term identified in step 2; test approach data are comprised of:

| | | |
|--------------|---------------|-----------|
| ➊ Names | ➋ Definitions | ➍ Parents |
| ➌ Categories | ➎ Synonyms | ➏ Flaws |
- ➍ Repeat steps 1 to 3 for any missing or unclear terms until the stopping criteria is reached

Research Question 2

Are these descriptions consistent?

- ⑤ Analyze recorded test approach data for additional flaws
 - ① Generate relation graphs
 - ② Automatically detect certain classes of flaws
 - ③ Automatically 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

- 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)

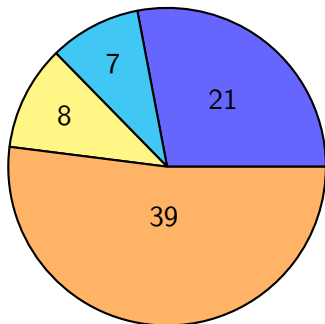
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Information from (ISO/IEC and IEEE, 2022)

- 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

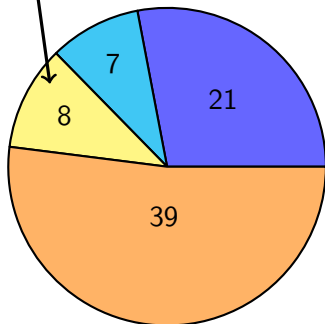
In total, we investigate 75 sources



- 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)



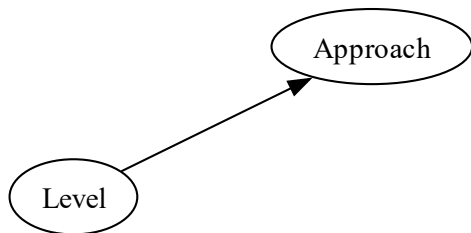
- Established Standards
- Terminology Collections
- Textbooks
- Papers and Other Documents

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

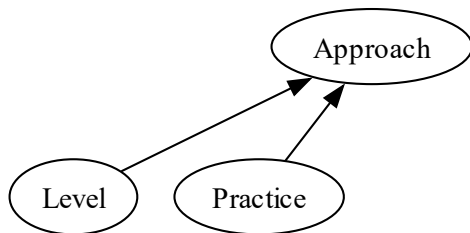
Categories



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

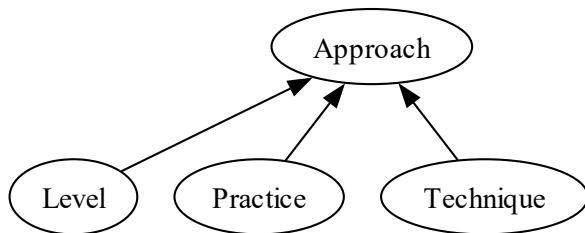
Categories



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)

Methodology

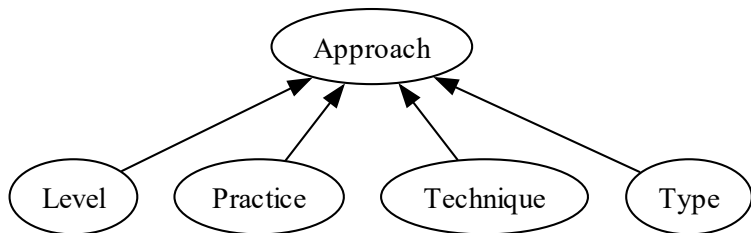
Categories



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

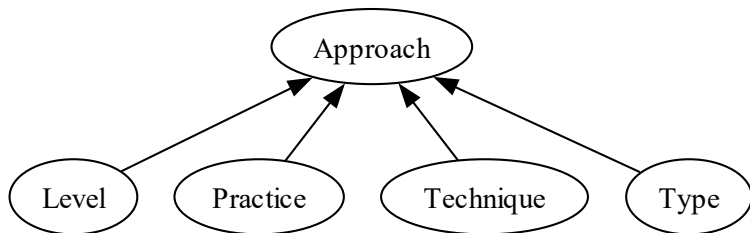
Categories



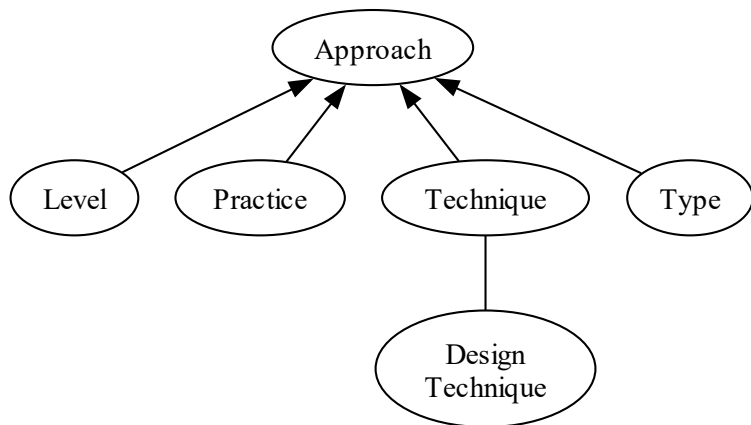
Type: “Testing that is focused on specific quality characteristics”
(ISO/IEC and IEEE, 2022, p. 15; 2021c, p. 7; 2017, p. 473)

Methodology

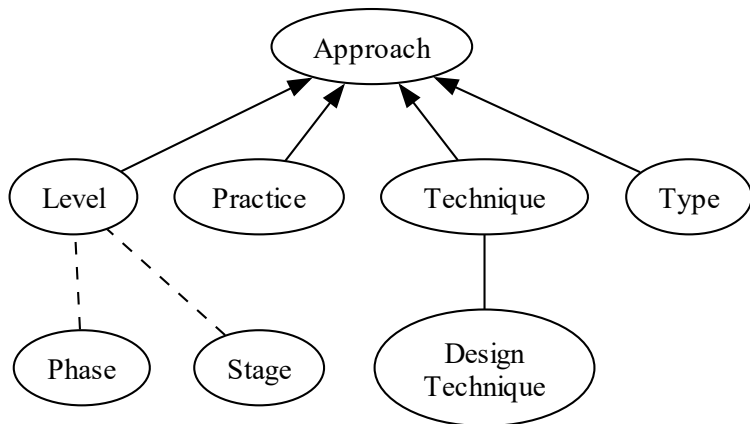
Visualization Notation



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



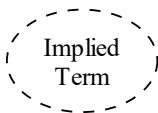
Lines without arrowheads connect *synonyms*.



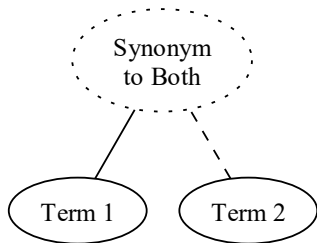
Dashed lines indicate a relationship is *implicit*.

Methodology

Visualization Notation



Dashed outlines indicate a term is *implicit*.



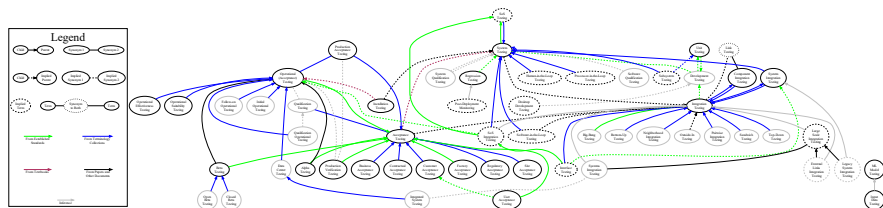
Dotted outlines indicate a term is a *synonym* to more than one term.

Graph of Test Approaches

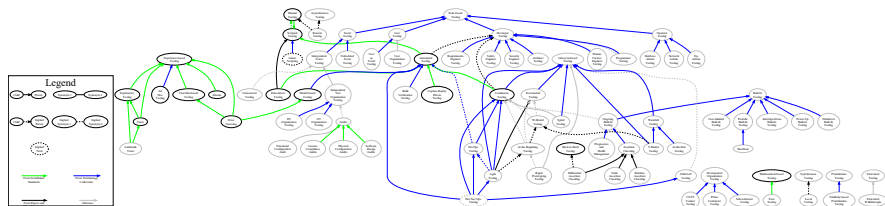
Graph of Test Approaches

! Dimension too large.

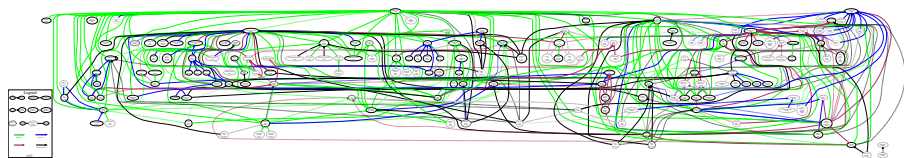
Graph of Test Levels



Graph of Test Practices



Graph of Test Techniques



Graph of Test Types

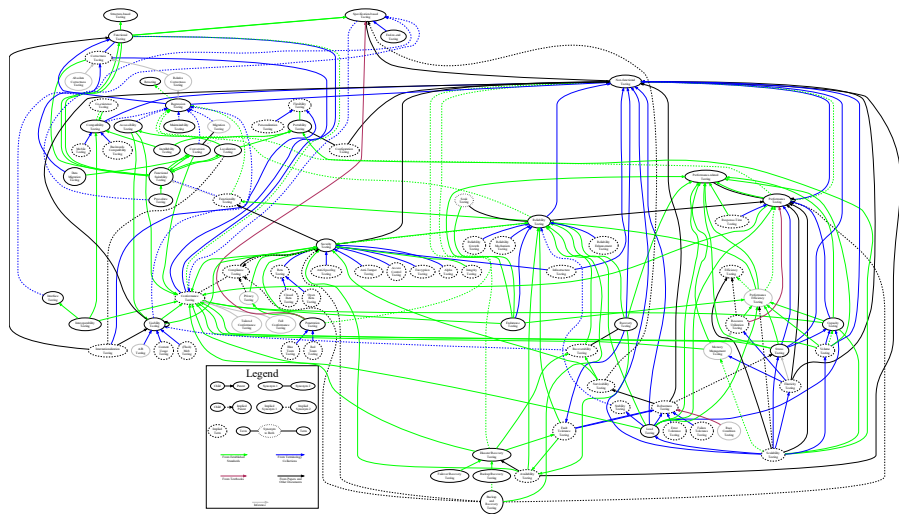


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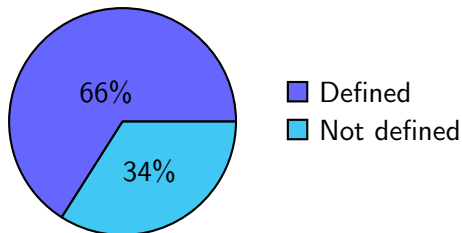
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- Research Questions
- Methodology

3 Results

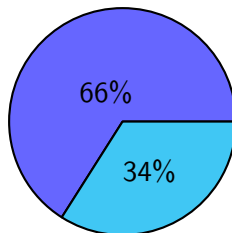
4 Next Steps

- 563 test approaches →



Overview

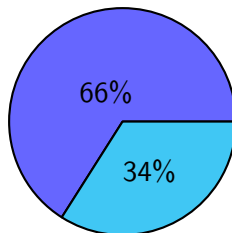
- 563 test approaches →
- 77 software qualities
(may imply test approaches)



■ Defined
■ Not defined

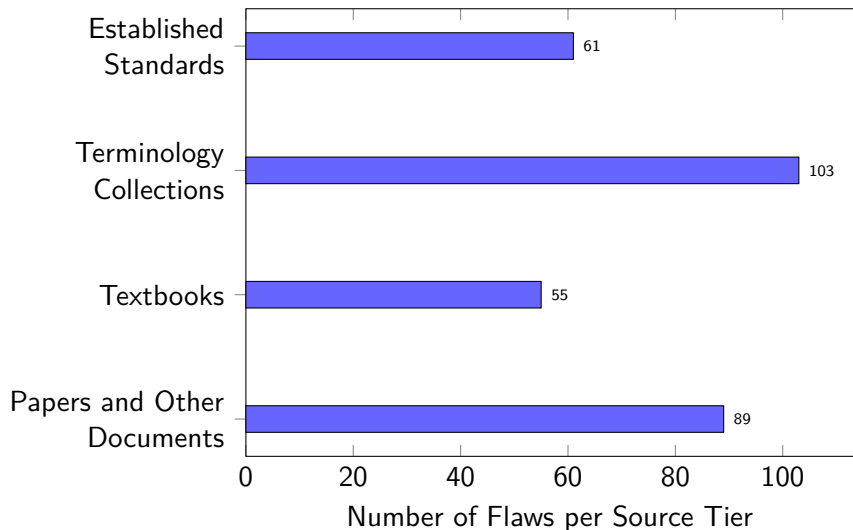
Overview

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

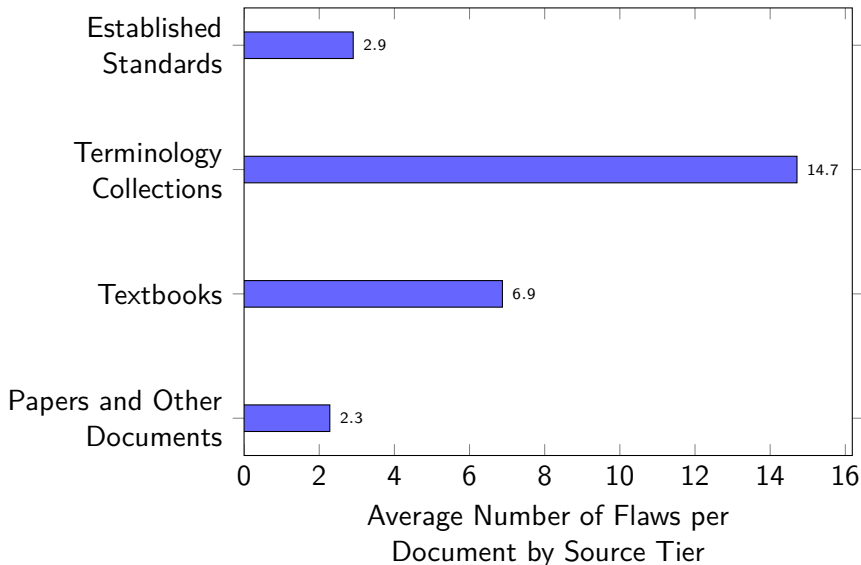


■ Defined
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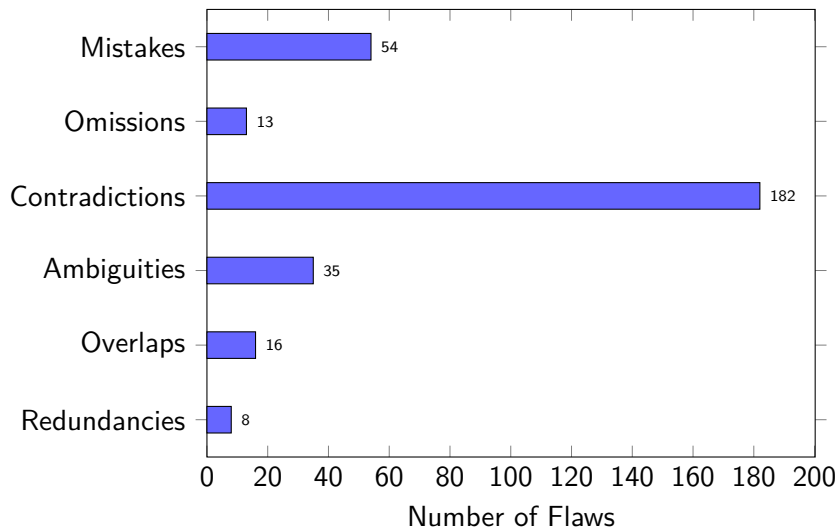
Flaw Summary by Source Tier



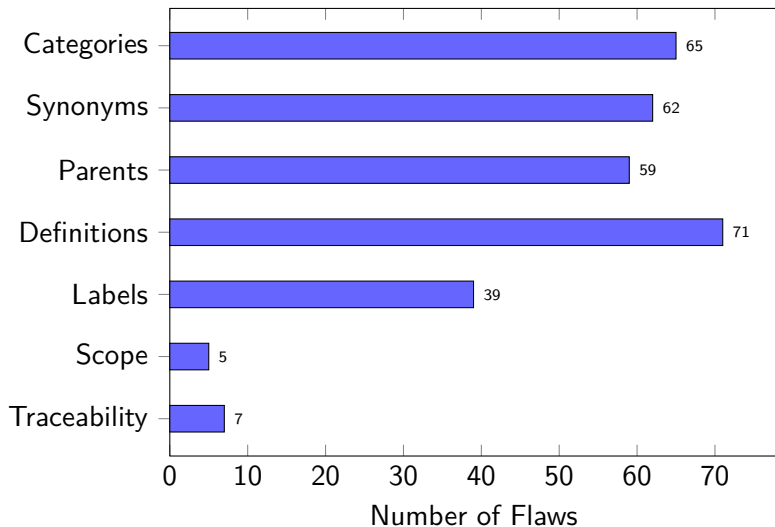
Normalized Flaw Summary



Flaw Summary by Manifestation



Flaw Summary by Domain



Automated Flaws

Intransitive Synonyms

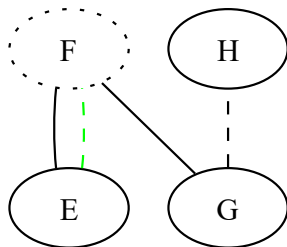
- The literature gives some terms as a synonym to two (or more) disjoint, unrelated terms, making their synonym relations ambiguous

Automated Flaws

Intransitive Synonyms

- The literature gives some terms as a synonym to two (or more) disjoint, unrelated terms, making their synonym relations ambiguous
- We include these in our generated visualizations

| 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

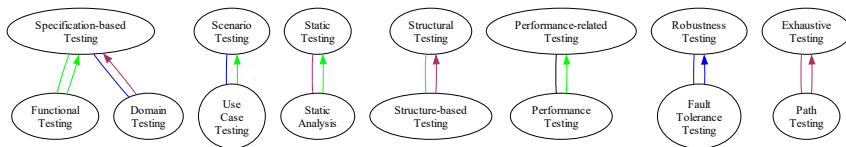
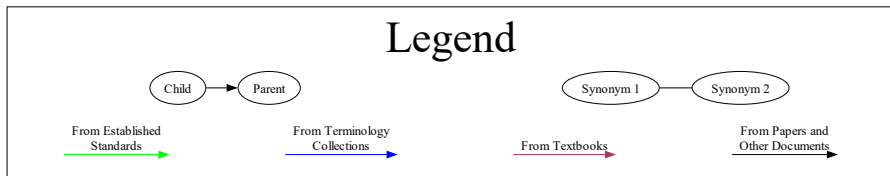
Irreflexive Parents

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)

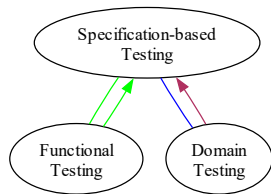
Automated Flaws

Synonym and Parent-Child Overlaps



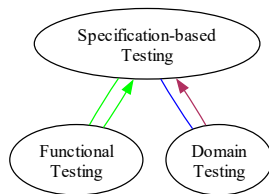
Automated Flaws

Synonym and Parent-Child Overlaps



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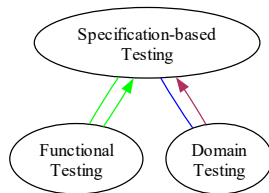
Synonym and Parent-Child Overlaps



- 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)

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)

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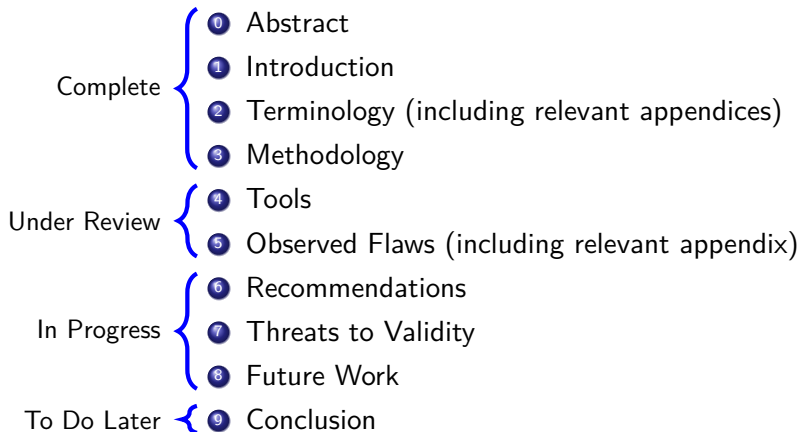
3 Results

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Thesis Chapters

- 0 Abstract
- 1 Introduction
- 2 Terminology (including relevant appendices)
- 3 Methodology
- 4 Tools
- 5 Observed Flaws (including relevant appendix)
- 6 Recommendations
- 7 Threats to Validity
- 8 Future Work
- 9 Conclusion

Thesis Chapters



Acknowledgment

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 - They have helped me refine the scope of this project
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- The past and current Drasil team have created a truly amazing framework!

Thank you!
Questions?

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