

Second Committee Meeting

Updated Progress Report

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Fall 2025

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2 Project

- Research Questions
- Methodology

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Where Were We?

Introduction

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

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Where Were We?

Introduction

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

Existing Taxonomies?

Introduction

- Existing software testing taxonomies:
 - Tebes et al. (2020)
 - Souza et al. (2017)
 - Firesmith (2015)
 - Unterkalmsteiner et al. (2014)

Existing Taxonomies?

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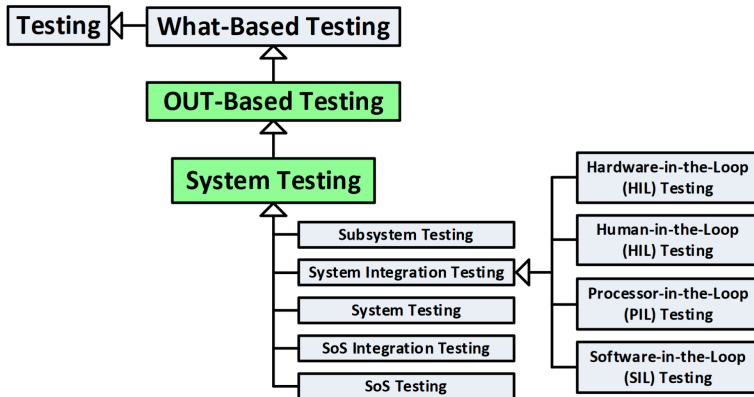
Focus on:

The Testing Process
Organizing Terminology
Relations between Approaches
Traceability between Stages

Existing Taxonomies?

Introduction

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

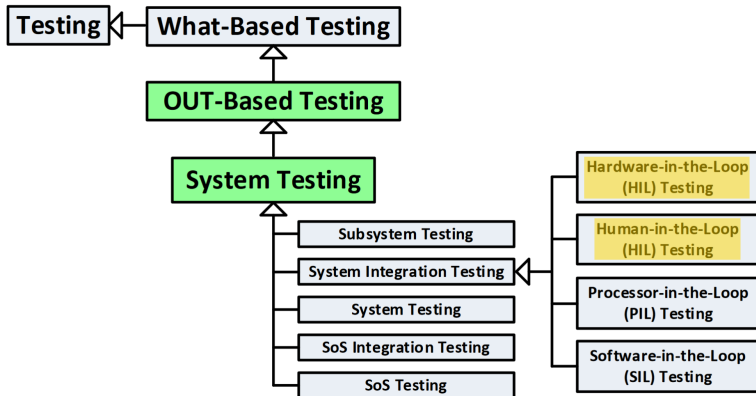


(Firesmith, 2015, p. 23)

Existing Taxonomies?

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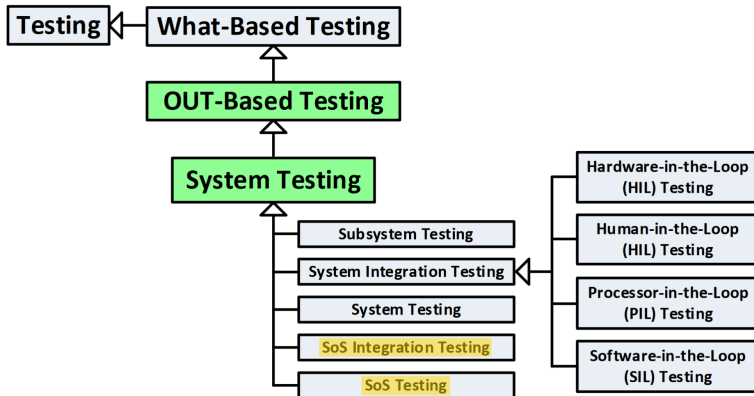


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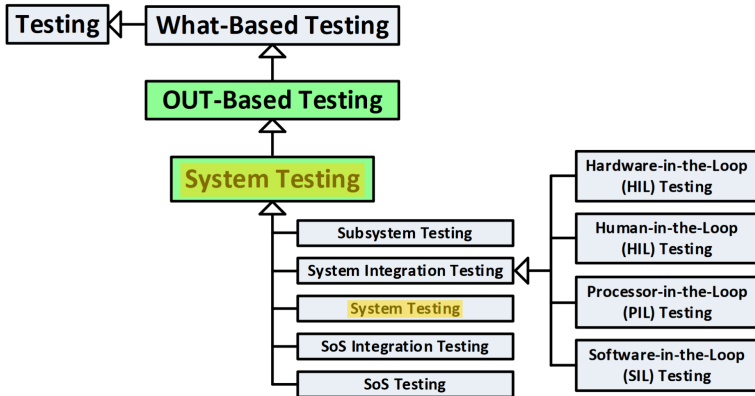


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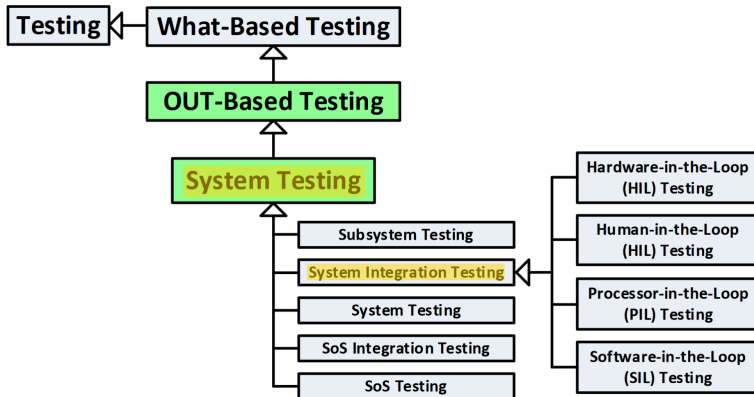


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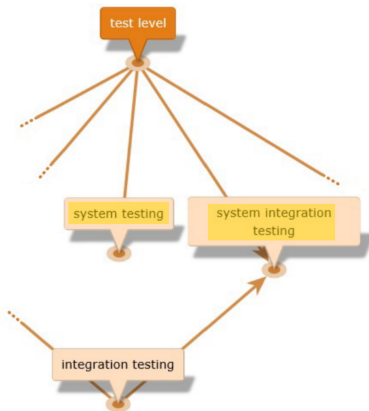
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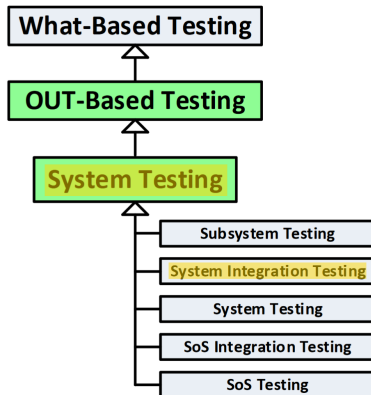
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Existing Taxonomies?

Introduction



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
 - ➌ Parents
 - ➍ 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)

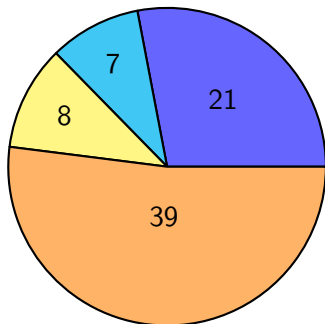
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Information from (ISO/IEC and IEEE, 2022)

- 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

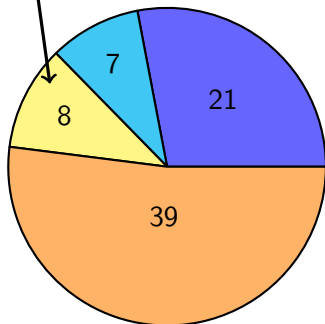
In total, we investigate 75 sources



- 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)



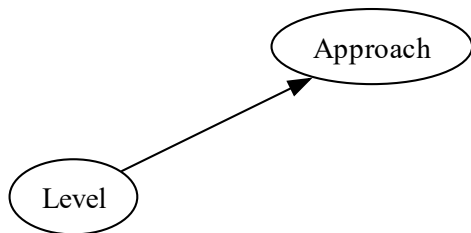
- Established Standards
- Terminology Collections
- Textbooks
- Papers and Other Documents

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

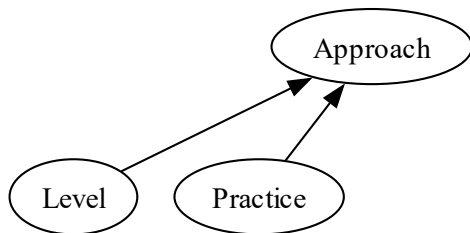
Categories



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

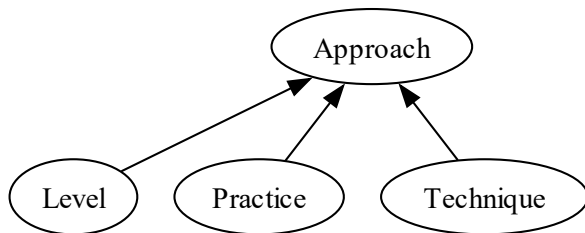
Categories



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

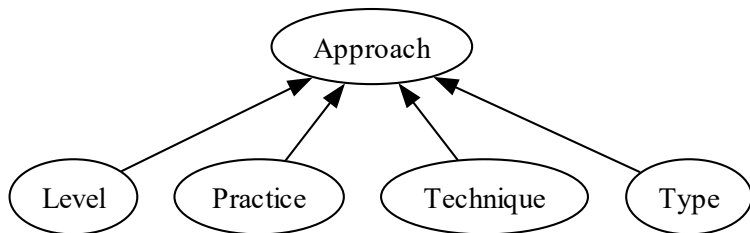
Categories



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

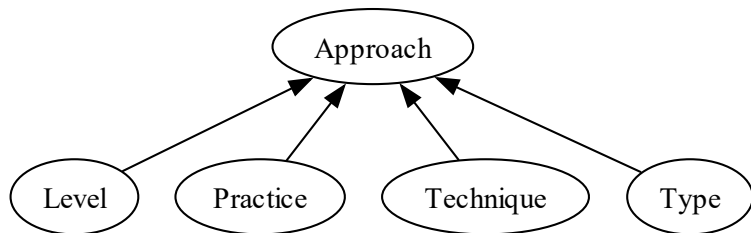
Categories



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

Methodology

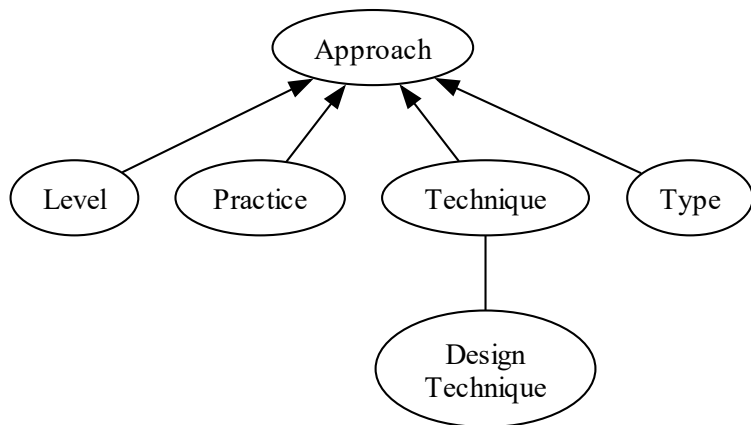
Visualization Notation



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

Methodology

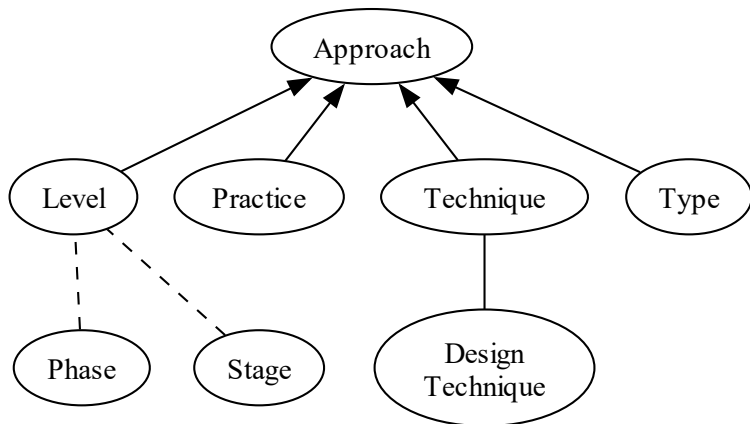
Visualization Notation



Lines without arrowheads connect *synonyms*.

Methodology

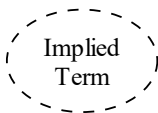
Visualization Notation



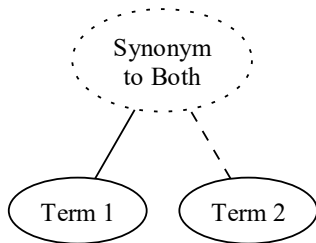
Dashed lines indicate a relationship is *implicit*.

Methodology

Visualization Notation



Dashed outlines indicate a term is *implicit*.



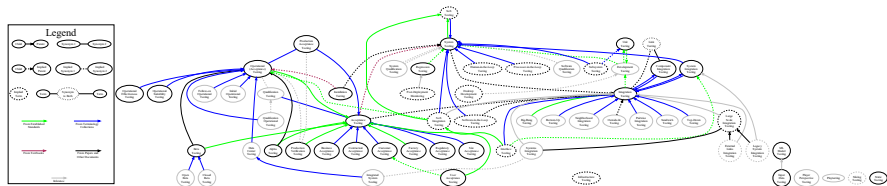
Dotted outlines indicate a term is a *synonym* to more than one term.

Graph of Test Approaches

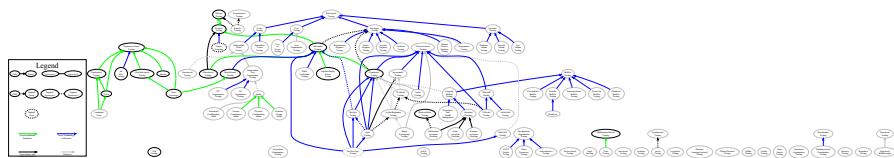
Graph of Test Approaches

! Dimension too large.

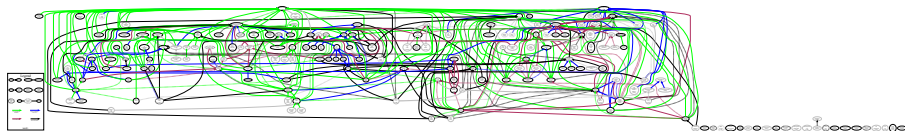
Graph of Test Levels



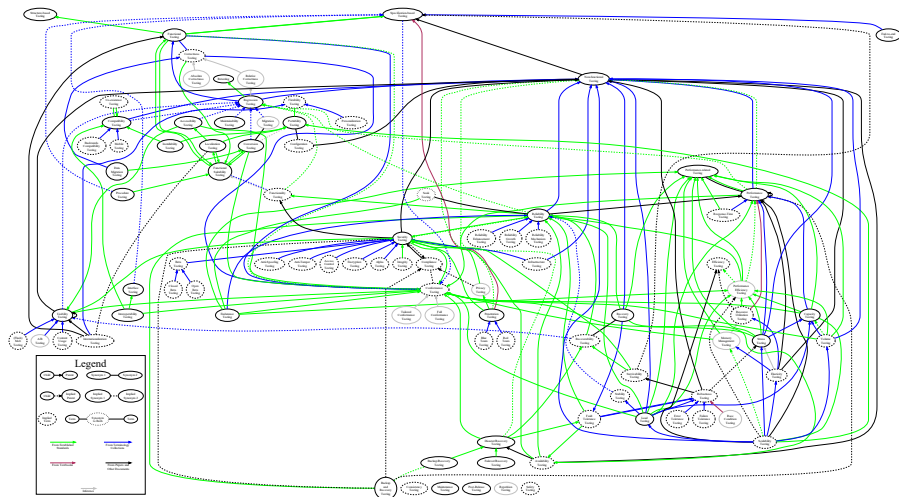
Graph of Test Practices



Graph of Test Techniques

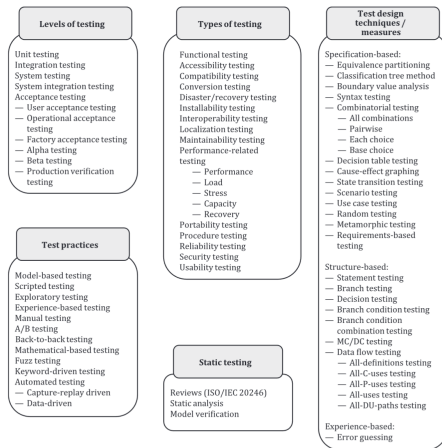


Graph of Test Types



Methodology

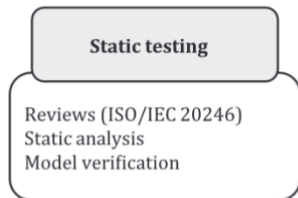
Visualization Notation



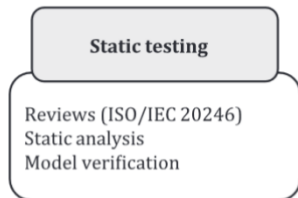
(ISO/IEC and IEEE, 2022, Fig. 2)

Methodology

Visualization Notation



Adapted from (ISO/IEC and IEEE, 2022, Fig. 2)

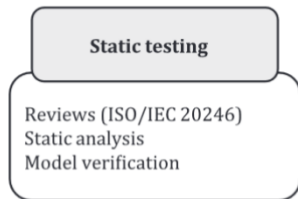


- Quite distinct but not necessarily orthogonal

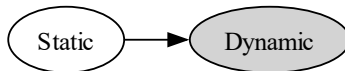
Adapted from (ISO/IEC and IEEE, 2022, Fig. 2)

Methodology

Visualization Notation



- Quite distinct but not necessarily orthogonal
- When considering static testing in isolation, related *dynamic approaches* have grey backgrounds



Adapted from (ISO/IEC and IEEE, 2022, Fig. 2)

Graph of *Static* Test Approaches

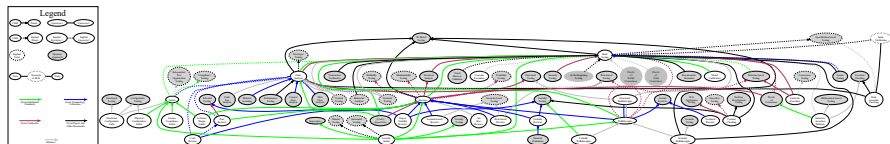


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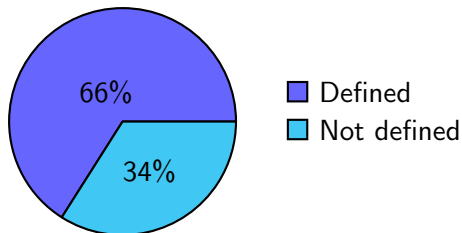
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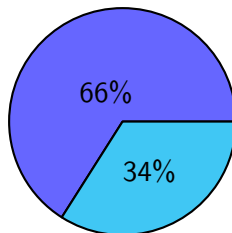
3 Results

- 561 test approaches →



Overview

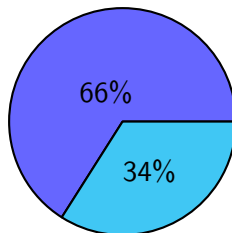
- 561 test approaches →
- 77 software qualities
(may imply test approaches)



■ Defined
■ Not defined

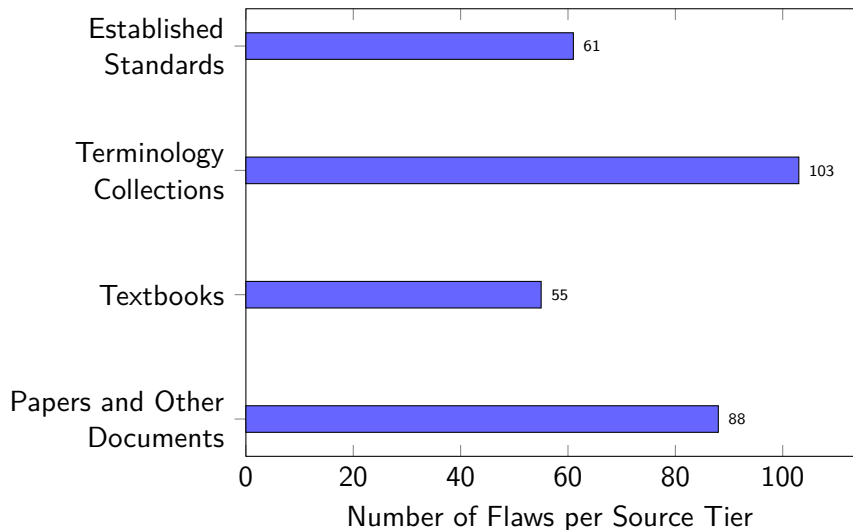
Overview

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

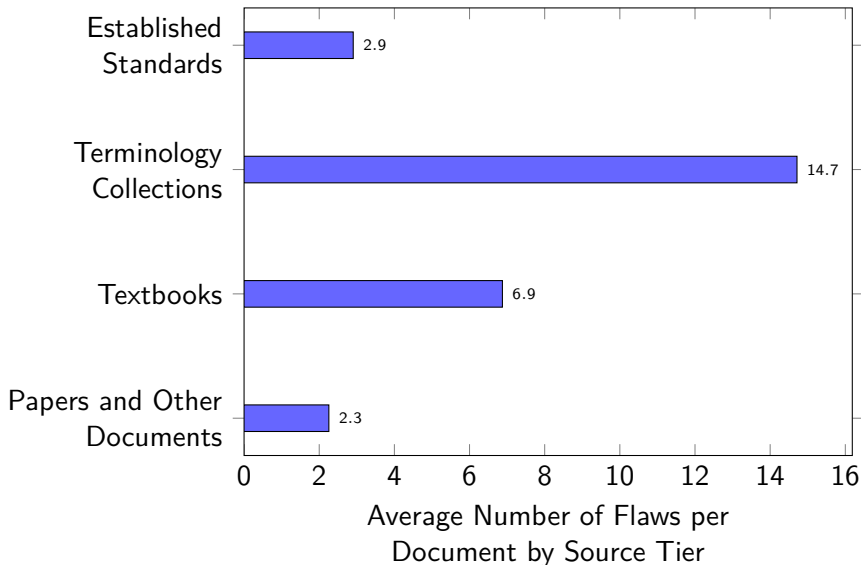


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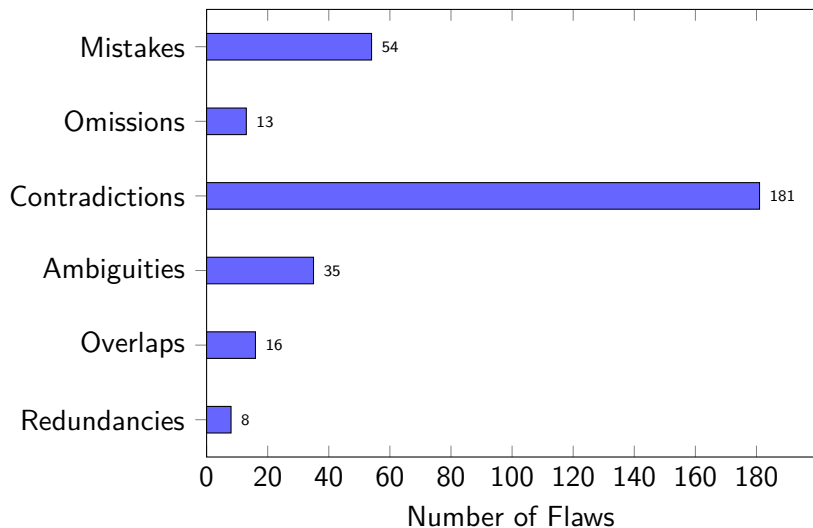
Flaw Summary by Source Tier



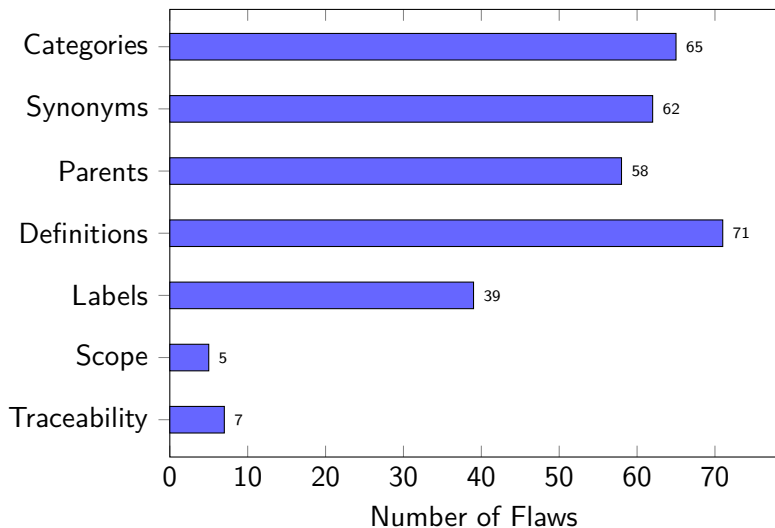
Normalized Flaw Summary



Flaw Summary by Manifestation



Flaw Summary by Domain



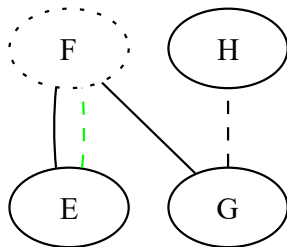
Automated Flaws

- Some terms are given as a synonym to two (or more) disjoint, unrelated terms, making the relation between the given synonyms ambiguous

Automated Flaws

- Some terms are given as a synonym to two (or more) disjoint, unrelated terms, making the relation between the given synonyms ambiguous
- These are included in generated visualizations automatically

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



Prominent examples of these “multi-synonyms”:

① Soak Testing:

- Endurance Testing
- Reliability Testing

Source(s)

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

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

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② Functional Testing:

- Behavioural Testing
- Correctness Testing
- Specification-based Testing

(Kam, 2008, p. 45)

(Washizaki, 2024, p. 5-7)

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

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

③ Link Testing:

- Branch Testing
- Component Integration Testing
- Integration Testing

(implied by ISO/IEC and IEEE, 2021c, p. 24)

(Kam, 2008, p. 45)

(implied by Gerrard, 2000a, p. 13)

Acknowledgment

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- The past and current Drasil team have created a truly amazing framework!

Thank you!
Questions?

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- Donald G. Firesmith. A Taxonomy of Testing Types, 2015. URL <https://apps.dtic.mil/sti/pdfs/AD1147163.pdf>.
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