

Putting Software Testing Terminology to the Test

M.A.Sc. Seminar

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- The Need for Standardized Terminology
- The Lack of Standardized Terminology

2 Project

- Research Questions
- Methodology

3 Results

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The Need for Standardized Terminology

- Engineering is applied science
- Scientific fields use precise terminology



SOFTWARE
ENGINEERING

The Need for Standardized Terminology

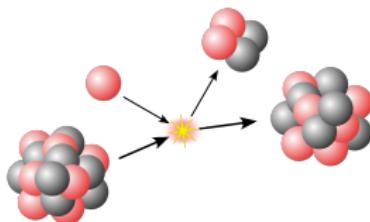
- Engineering is applied science
- Scientific fields use precise terminology



SOFTWARE
ENGINEERING



Penubag and Ramey (2010)



Kjerish (2016)



AzaToth (2008)

The Lack of Standardized Terminology

"The Problem"



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

The Lack of Standardized Terminology

"The Problem"



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

The Lack of Standardized Terminology

"The Problem"

ISO/IEC/IEEE 29119-4 describes the **experience-based test design technique** of error guessing. Other **experience-based test practices** include (but are not limited to) exploratory testing (see [4.4.3.3](#)), tours, attacks, and checklist-based testing.

Adapted from (ISO/IEC and IEEE, 2022, p. 34)

The Lack of Standardized Terminology

“The Problem” (cont.)

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



(Firesmith, 2015, p. 23)

The Lack of Standardized Terminology

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The Lack of Standardized Terminology

“The Problem” (cont.)



Adapted from (Hamburg and Mogyorodi, 2024)

What-Based Testing

OUT-Based Testing

System Testing

Subsystem Testing

System Integration Testing

System Testing

SoS Integration Testing

SoS Testing

Adapted from (Firesmith, 2015, p. 23)

The Lack of Standardized Terminology

“The Problem” (cont.)

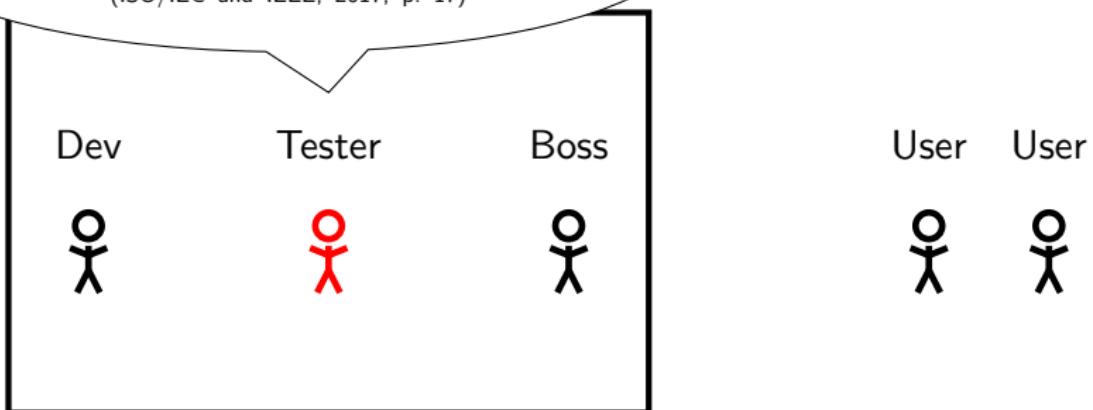


The Lack of Standardized Terminology

"The Problem" (cont.)

"Alpha testing is done by 'users within the organization developing the software'."

(ISO/IEC and IEEE, 2017, p. 17)



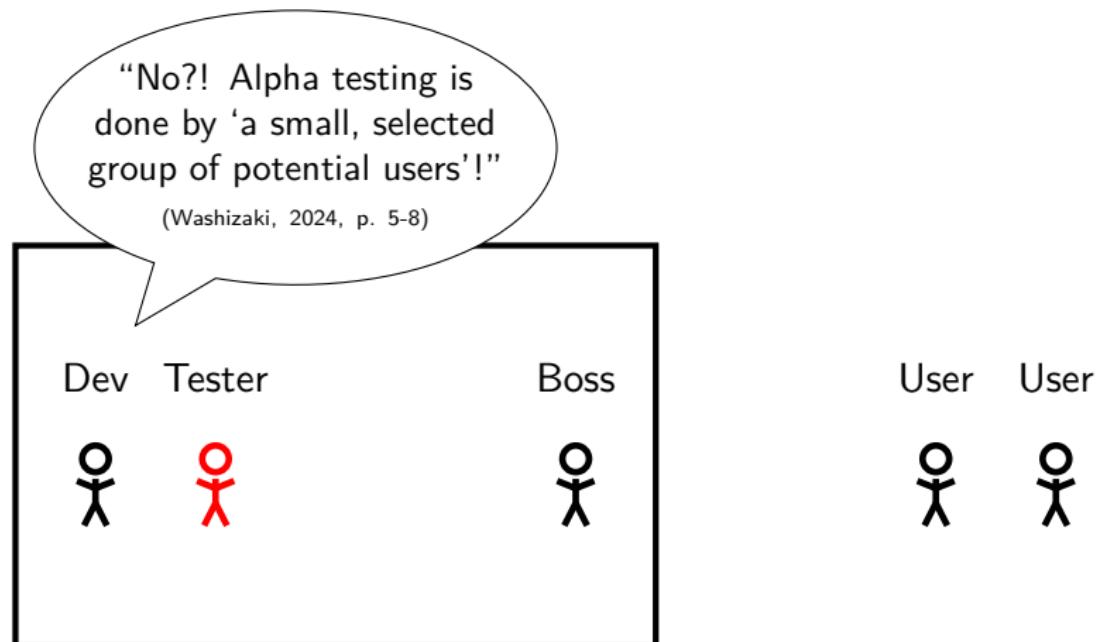
The Lack of Standardized Terminology

"The Problem" (cont.)



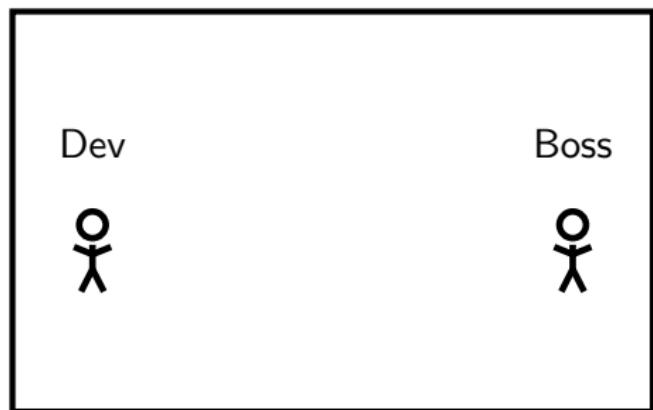
The Lack of Standardized Terminology

"The Problem" (cont.)



The Lack of Standardized Terminology

“The Problem” (cont.)



Tester User User



The Lack of Standardized Terminology

“The Problem” (cont.)

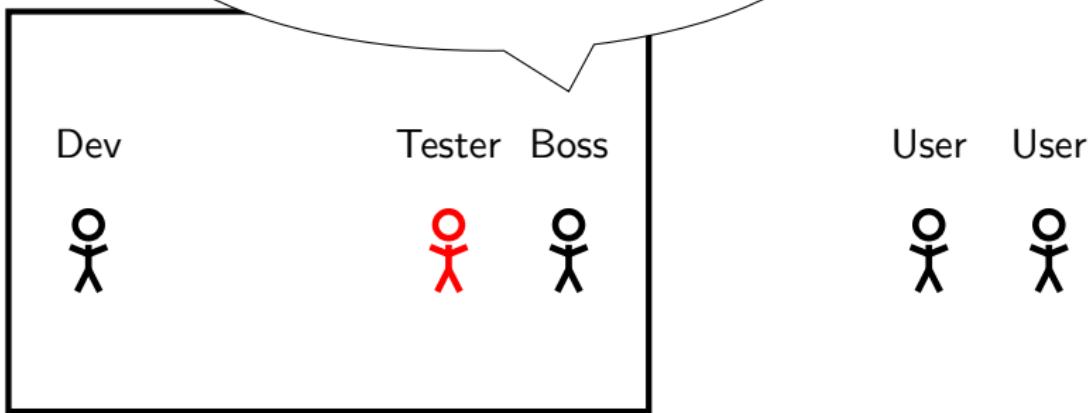


The Lack of Standardized Terminology

“The Problem” (cont.)

“How? Alpha testing is performed
‘in the developer’s test environment’,
but you didn’t bring anyone in.”

(Hamburg and Mogyorodi, 2024)



Barriers to Effective Communication

“The Problem” (cont.)

Interorganizational

Schools, companies, etc.



Barriers to Effective Communication

“The Problem” (cont.)

Interorganizational

Schools, companies, etc.



Intraorganizational

“Complete testing” could require the tester to:

- discover every bug,
- exhaust the time allocated,
- implement every planned test,
- . . . (Kaner et al., 2011, p. 7)

Taxonomies to the Rescue?

“The Problem” (cont.)

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

Taxonomies to the Rescue?

"The Problem" (cont.)

- Existing software testing taxonomies:

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Focus on:

The Testing Process
Organizing Terminology
Relations between Approaches
Traceability between Stages

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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?

Methodology

Overview

Research Question 1

What test approaches do the literature describe?

- ① Identify authoritative sources on software testing and “snowball” from them
- ② Identify all test approaches and testing-related terms described in these authoritative sources
- ③ Record all relevant data, including implicit data, for each term identified in step 2; test approach data are comprised of:

| | | |
|--|--|---|
| <ul style="list-style-type: none">① Names② Categories | <ul style="list-style-type: none">③ Definitions④ Synonyms | <ul style="list-style-type: none">⑤ Parents⑥ Flaws |
|--|--|---|
- ④ Repeat steps 1 to 3 for any missing or unclear terms until the stopping criteria is reached

Methodology

Overview

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

Methodology

Procedure

- 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)

Methodology

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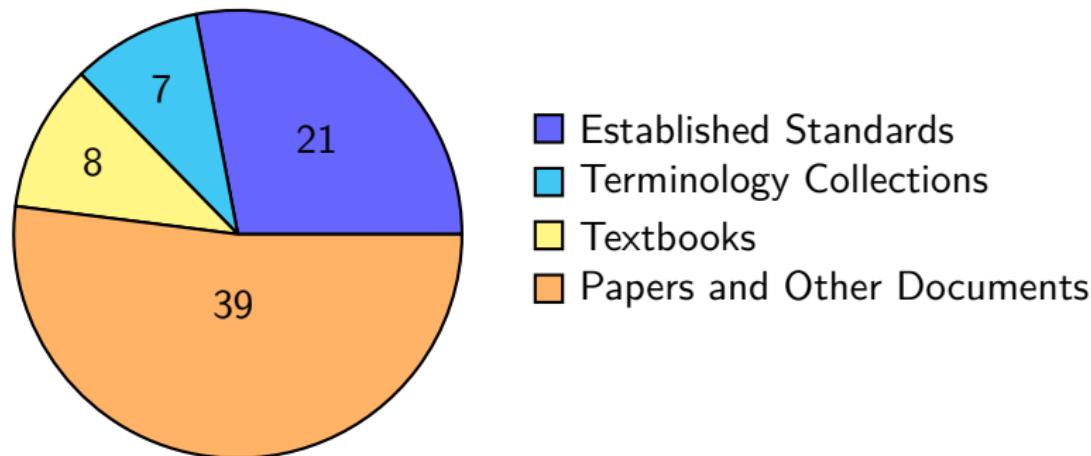
Information from (ISO/IEC and IEEE, 2022)

- 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

Methodology

Sources

In total, we investigate 75 sources

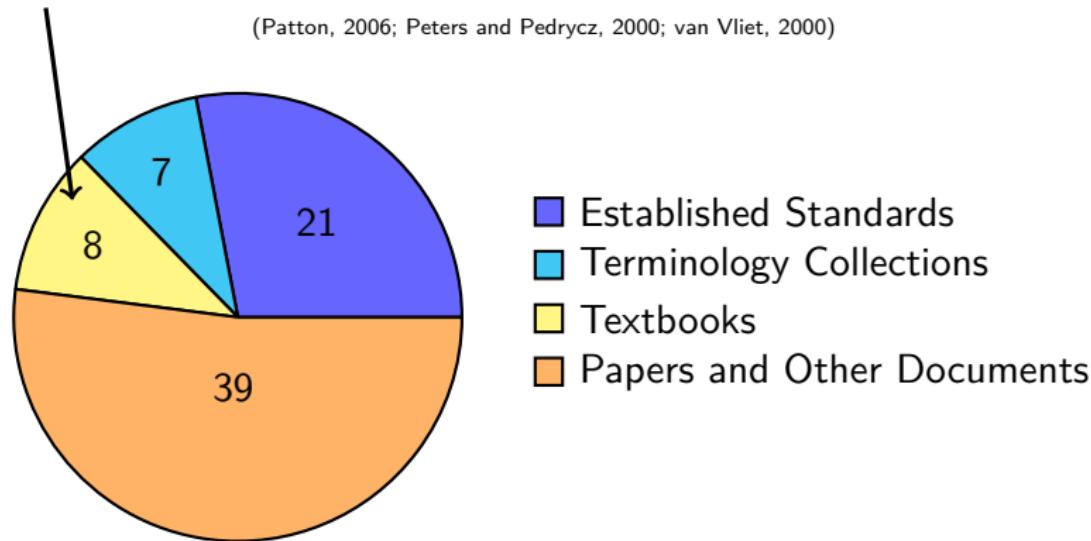


Methodology

Sources

Textbooks used at McMaster were our ad hoc starting points

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



Methodology

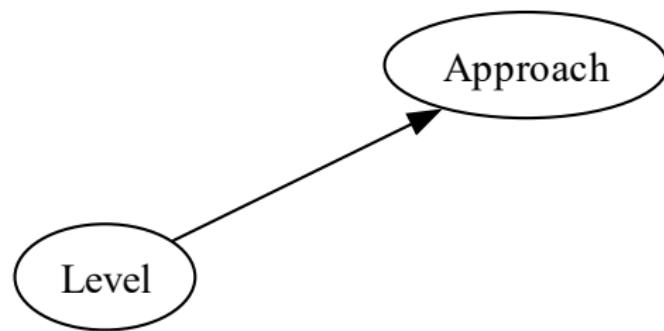
Categories

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

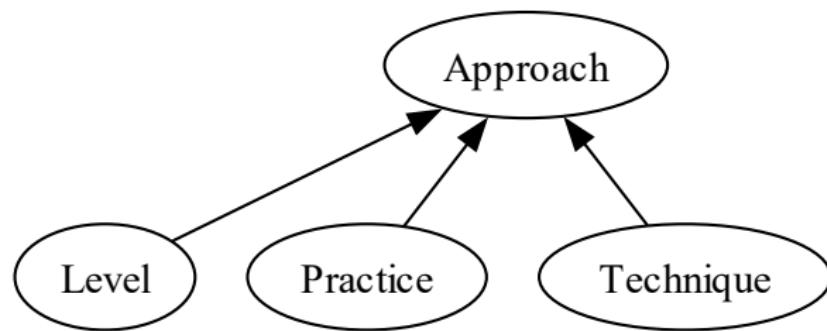
Categories



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

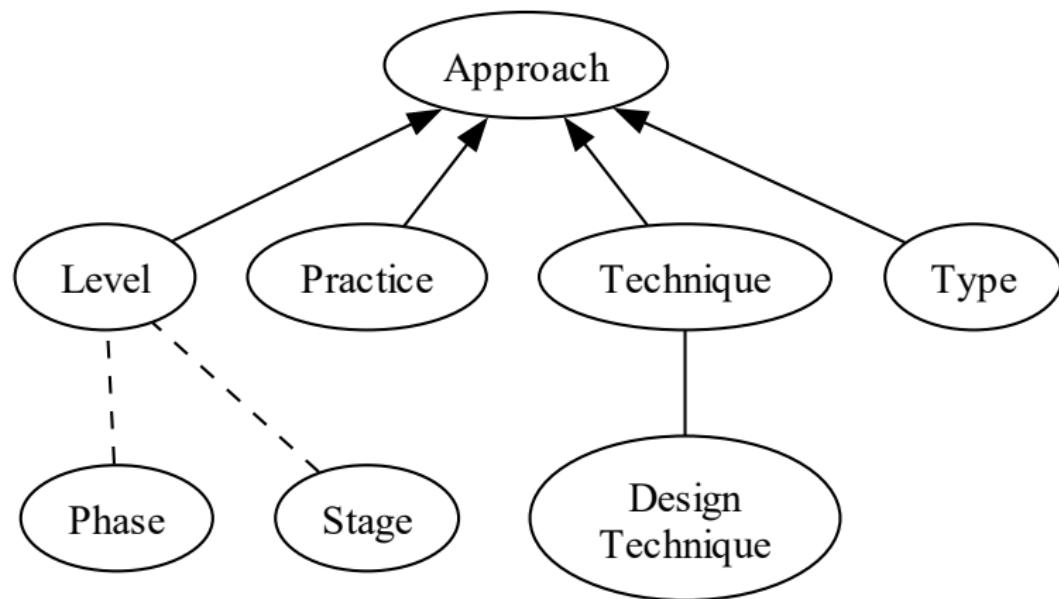
Visualization Notation



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*.

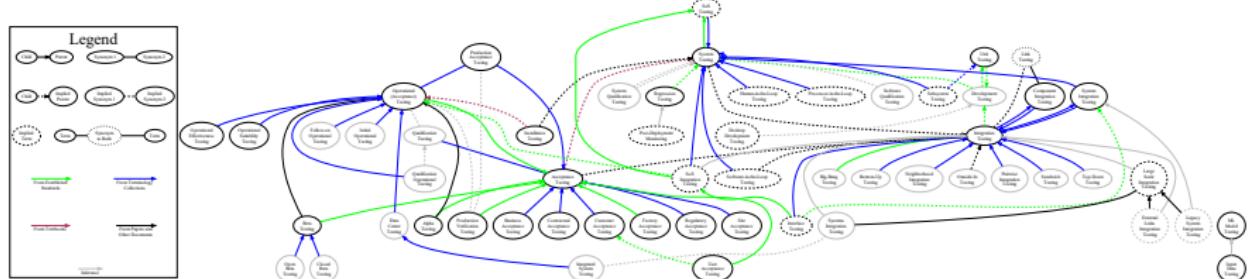
Dotted outlines indicate a term is a *synonym* to more than one term.

Graph of Test Approaches

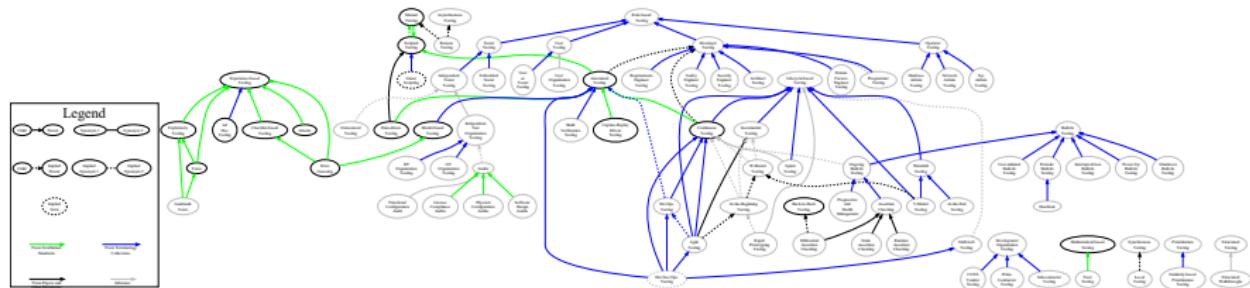
Graph of Test Approaches

! Dimension too large.

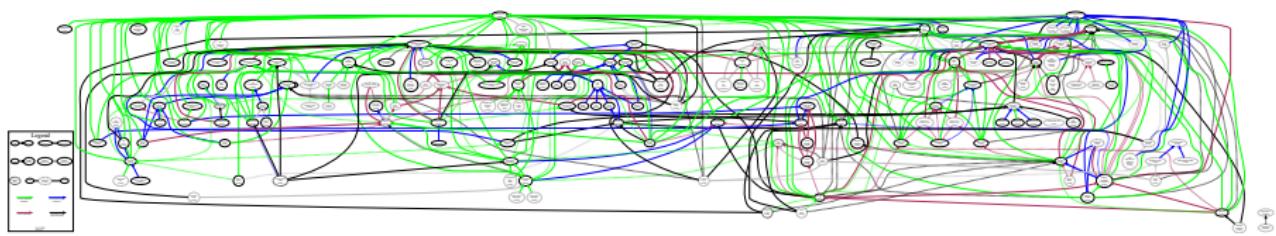
Graph of Test Levels



Graph of Test Practices



Graph of Test Techniques



Graph of Test Types

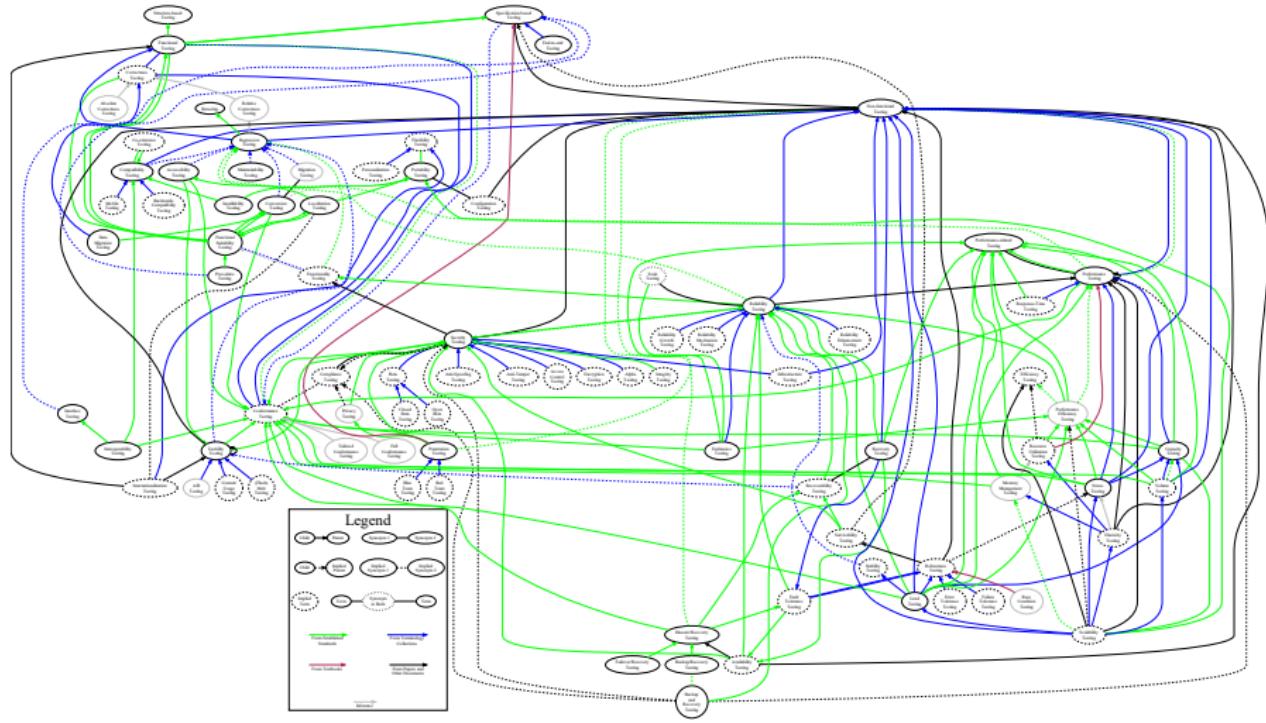


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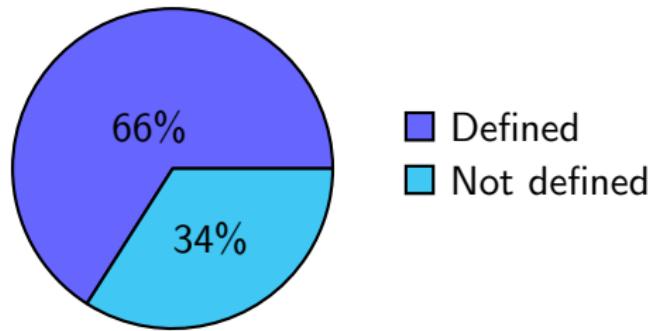
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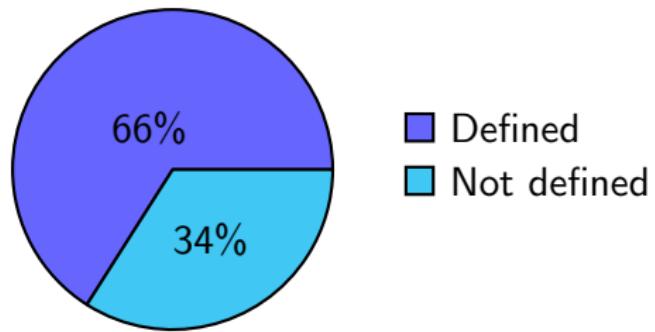
Overview

- 561 test approaches →



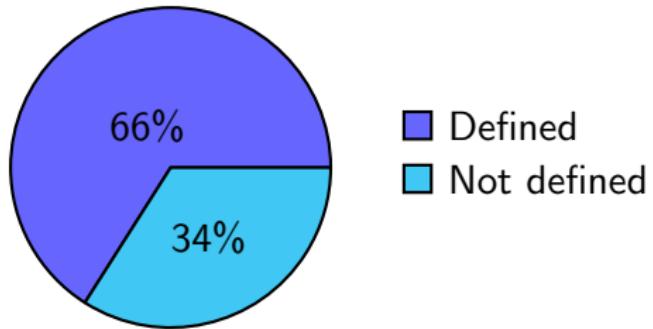
Overview

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

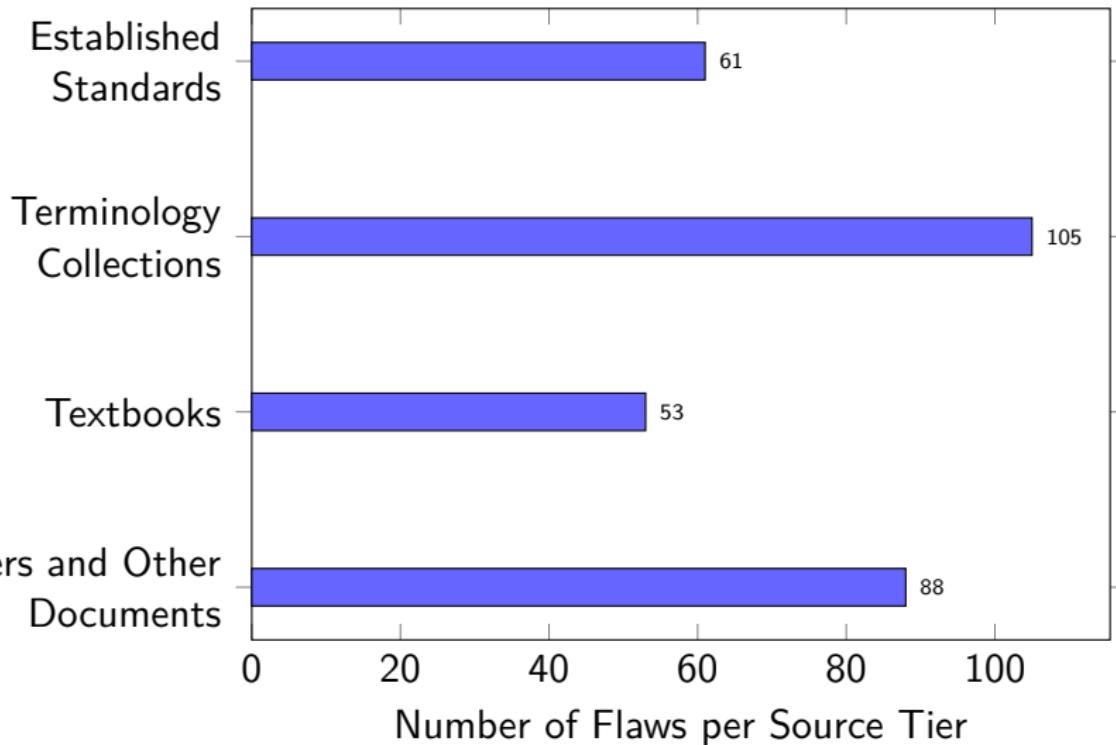


Overview

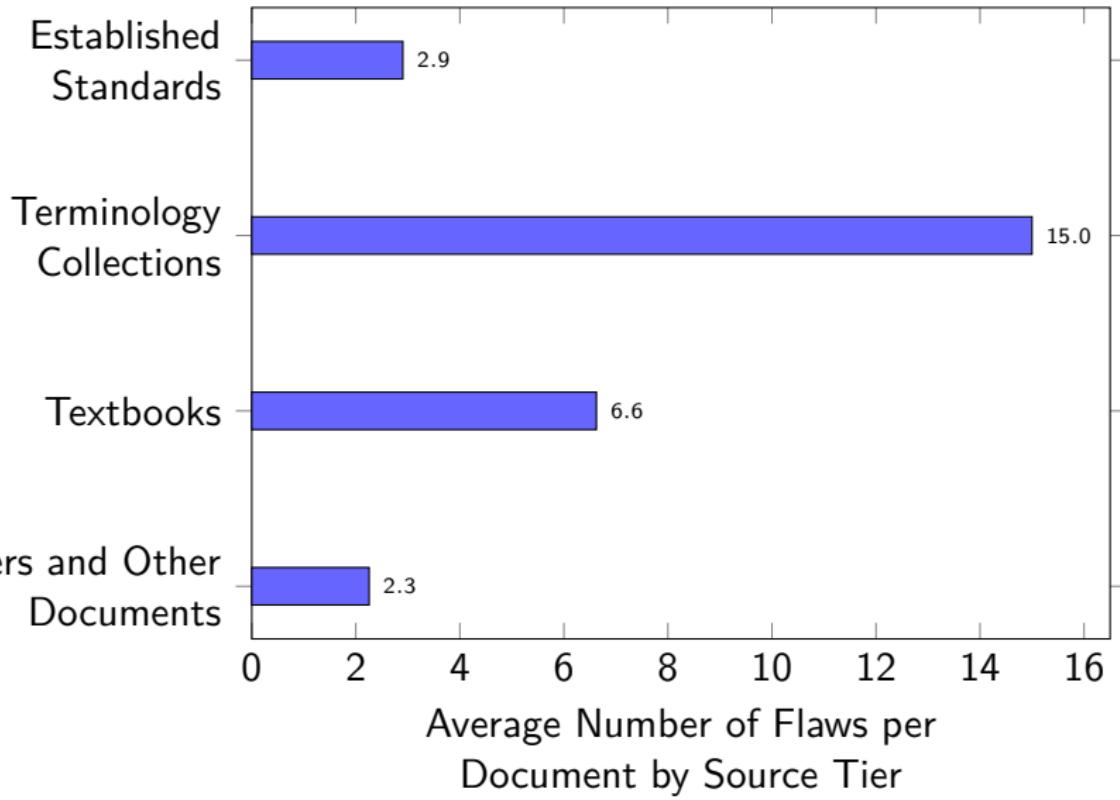
- 561 test approaches →
- 77 software qualities
(may imply test approaches)
- 307 flaws in the software testing literature



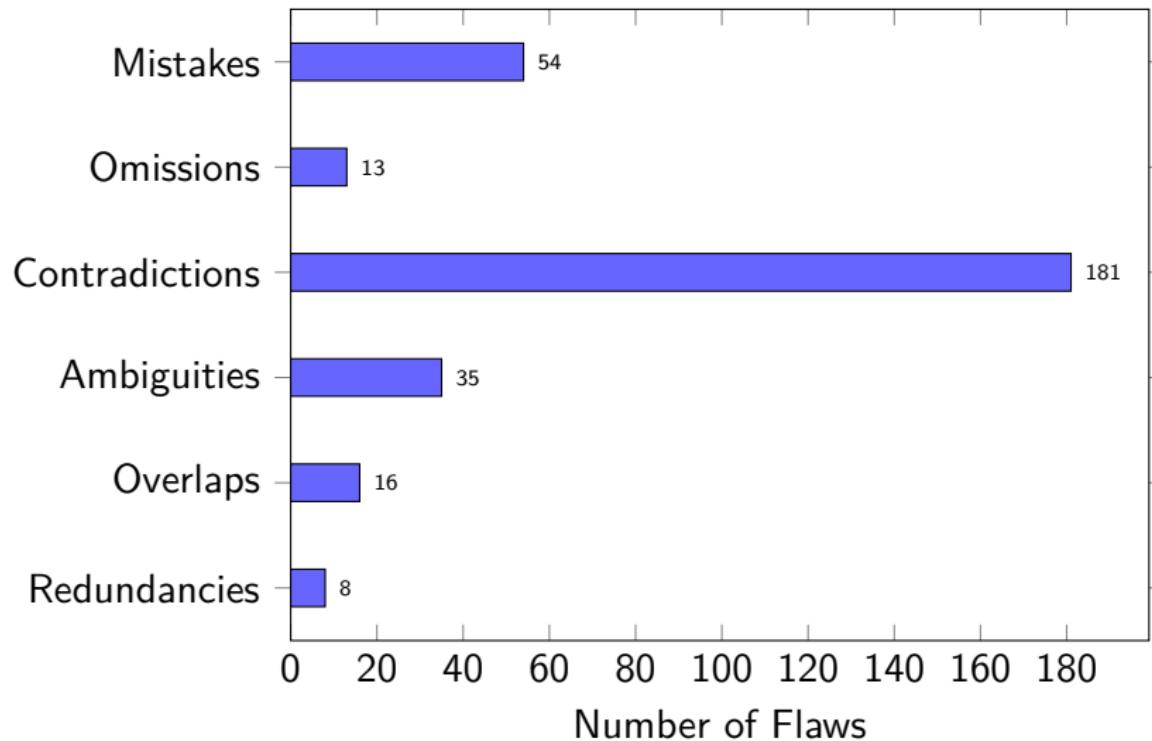
Flaw Summary by Source Tier



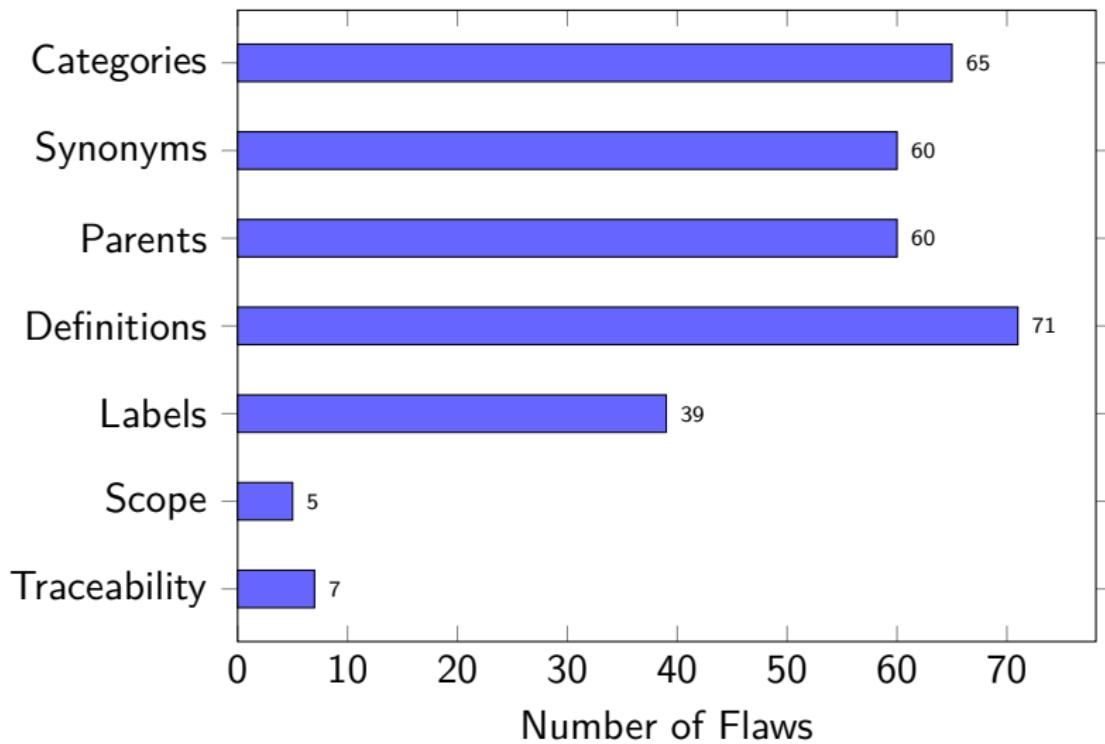
Normalized Flaw Summary



Flaw Summary by Manifestation



Flaw Summary by Domain



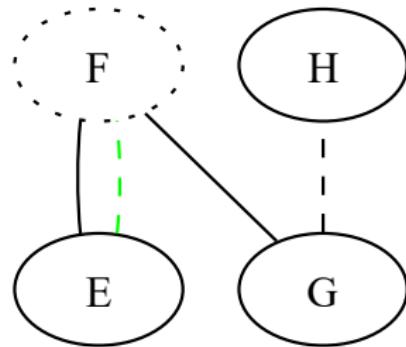
Automated Flaws

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

Automated Flaws

- 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) |



Automated Flaws

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)

Automated Flaws

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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; ...)

Automated Flaws

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(Kam, 2008, p. 45)

(Washizaki, 2024, p. 5-7)

(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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 - 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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