

# Putting Software Testing Terminology to the Test

## M.A.Sc. Seminar

Samuel Crawford, B.Eng.

McMaster University  
Department of Computing and Software

Fall 2024

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## 1 Introduction

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

## 2 Project

- Research Questions
- Methodology

## 3 Results

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## 1 Introduction

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## 3 Results

# 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 Problem” (cont.)

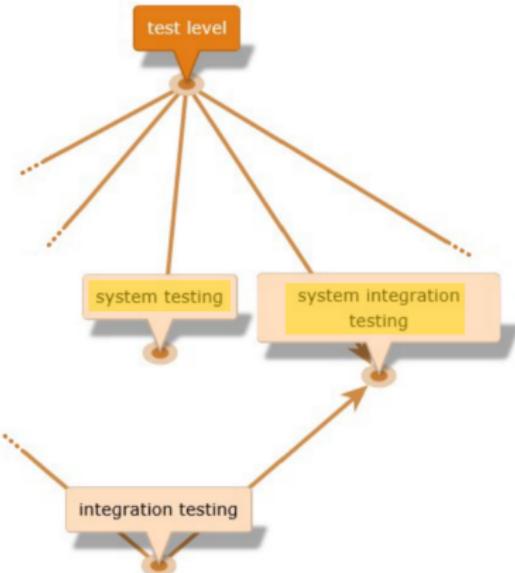
## What: by Object Under Test (OUT) – System Testing



Adapted from (Firesmith, 2015, p. 23)

# The Lack of Standardized Terminology

“The Problem” (cont.)



Adapted from (Hamburg and Mogyorodi, 2024)

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.)



# 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.)

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- Souza et al. (2017)
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- Unterkalmsteiner et al. (2014)

Focus on:

The Testing Process  
Organizing Terminology  
Relations between Approaches  
Traceability between Stages

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# Research Questions

## Research Question 1

What testing 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 testing approaches do the literature describe?

- ① Identifying authoritative sources on software testing and “snowballing” from them
- ② Identifying all test approaches and related testing terms that are used repeatedly and/or have complex definitions
- ③ Recording all relevant data, including implicit data, for each term identified in step 2; test approach data are comprised of:

① Names	③ Definitions	⑤ Parents
② Categories	④ Synonyms	⑥ Flaws
- ④ Repeating steps 1 to 3 for any missing or unclear terms until some stopping criteria

# Methodology

## Overview

### Research Question 2

Are these descriptions consistent?

- ⑤ Analyzing recorded test approach data for additional flaws
  - ① Generating relation graphs
  - ② Automatically detecting certain classes of flaws
  - ③ Automatically analyzing manually recorded flaws from step 3.6
- ⑥ Reporting results of flaw analysis

### Research Question 3

Can we systematically resolve any of these inconsistencies?

- ⑦ Providing examples of how to resolve these flaws

# Methodology

## Procedure

- A row is created 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

## Procedure

- A row is created for each test approach

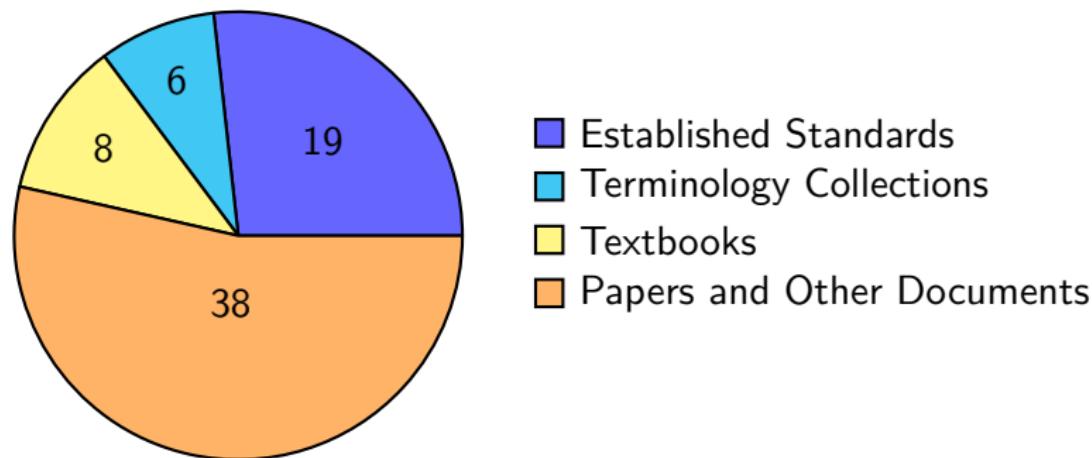
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Information from (ISO/IEC and IEEE, 2022)

- This information is gathered from sources by looking for
  - Glossaries, taxonomies, hierarchies, etc.
  - Testing-related terms
  - Terms described *by* other approaches
  - Terms that *imply* other approaches

# Methodology

## Sources

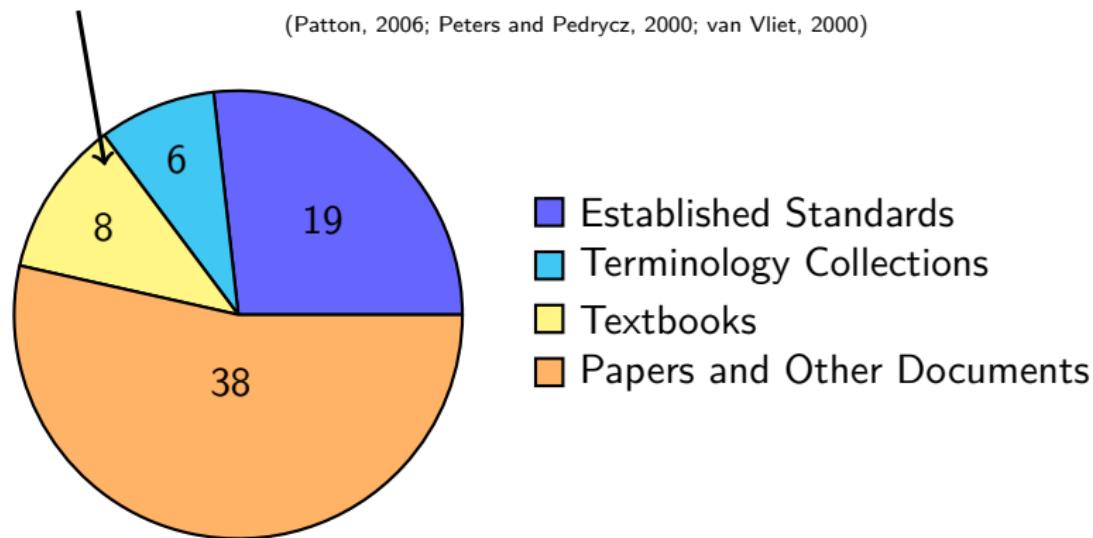


# Methodology

## Sources

Textbooks used at McMaster were our ad hoc starting points

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



# Methodology

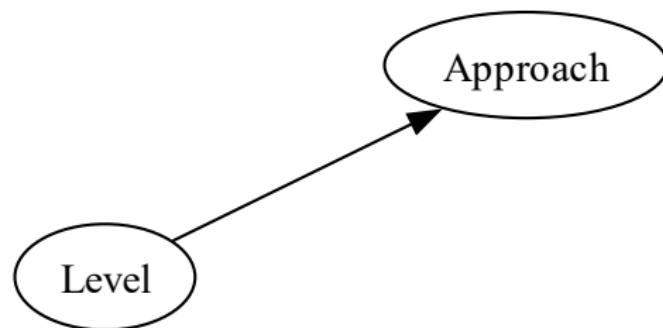
## Categories

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

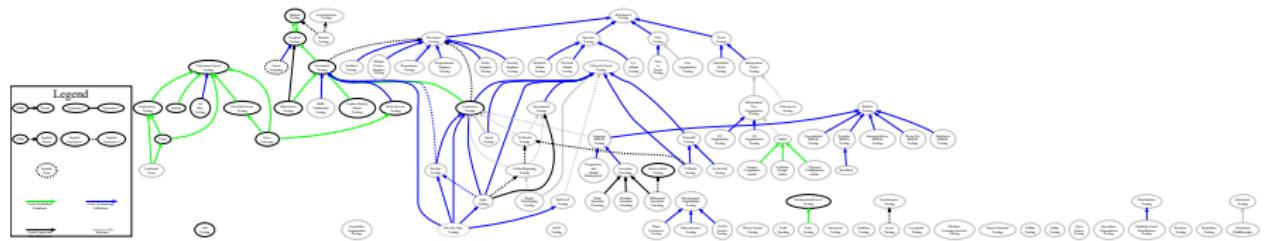
# Graph of Test Approaches

! Dimension too large.

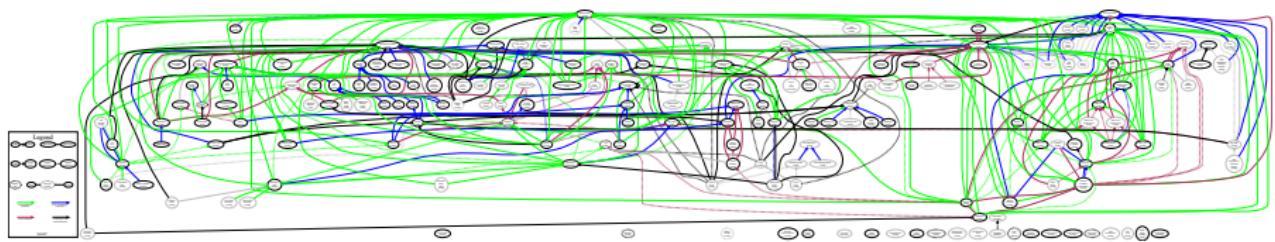
# Graph of Test Levels



# Graph of Test Practices



# Graph of Test Techniques



# Graph of Test Types



# Methodology

## Visualization Notation



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

# Methodology

## Visualization Notation



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

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## Visualization Notation

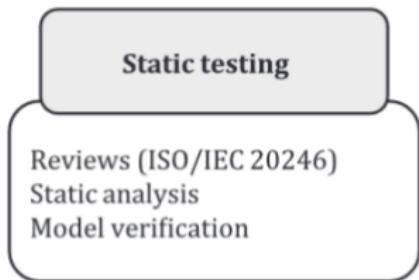


- Quite distinct but not necessarily orthogonal

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

# Methodology

## Visualization Notation

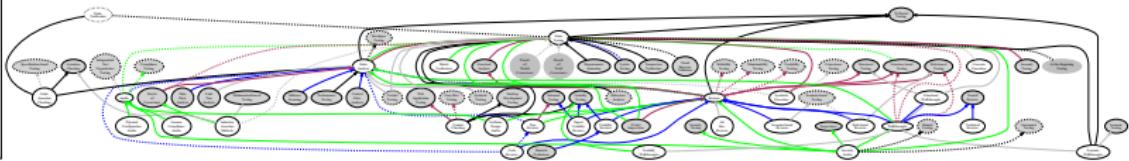
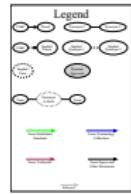


- Quite distinct but not necessarily orthogonal
- When considering static testing in isolation, related *dynamic approaches* have grey backgrounds



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

# Graph of *Static* Test Approaches



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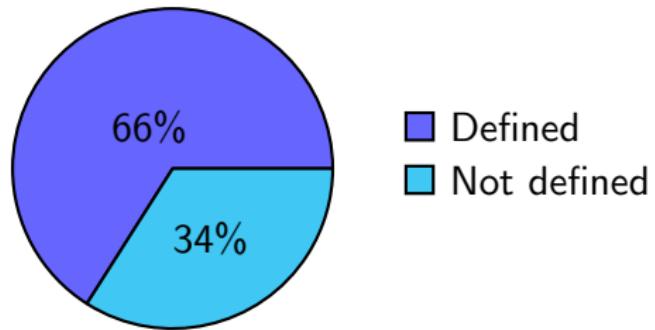
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## 3 Results

# Overview

- 561 test approaches →



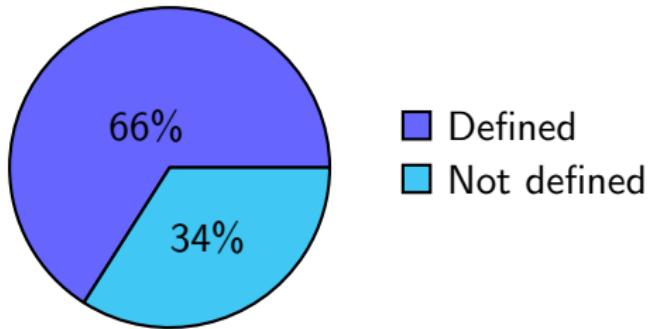
# Overview

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

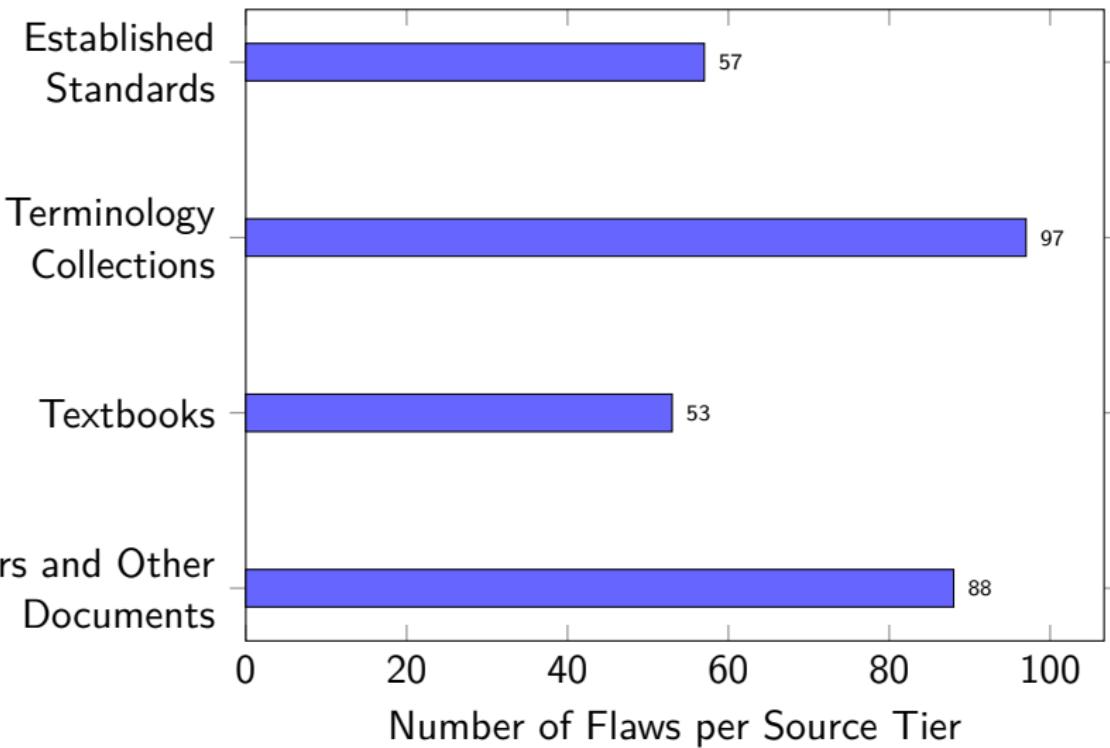


# Overview

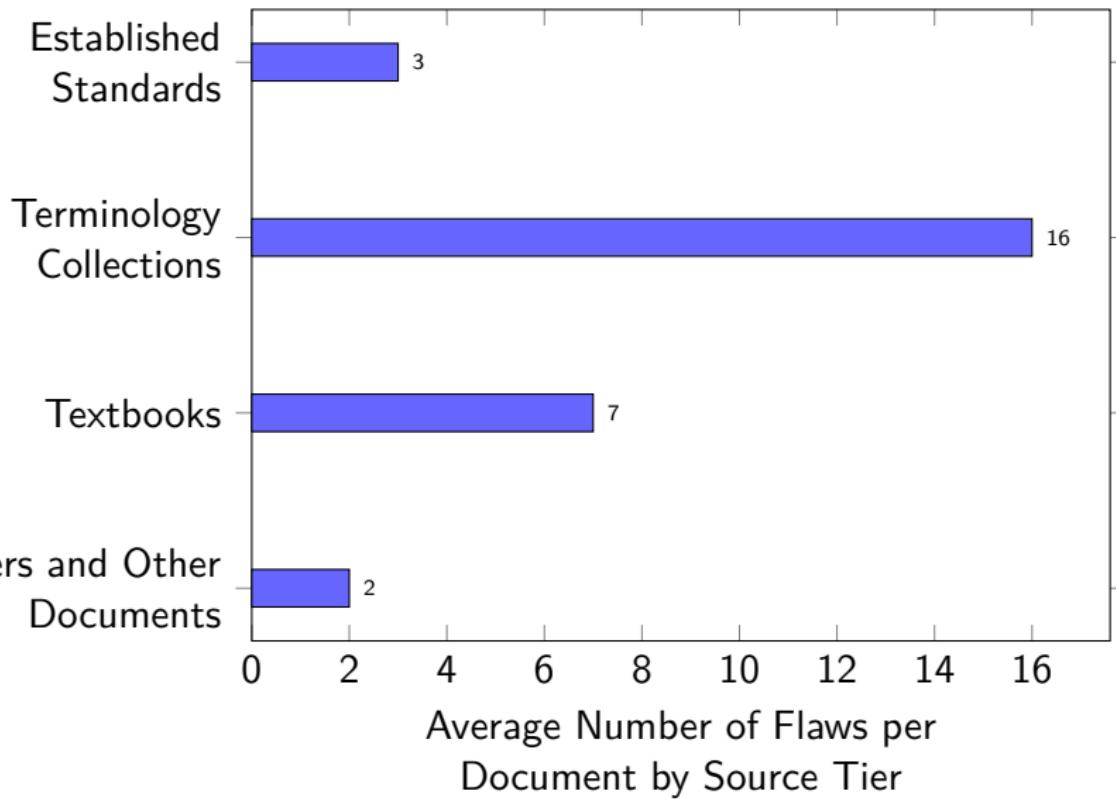
- 561 test approaches →
- 77 software qualities  
(may imply test approaches)
- 295 flaws in the software testing literature



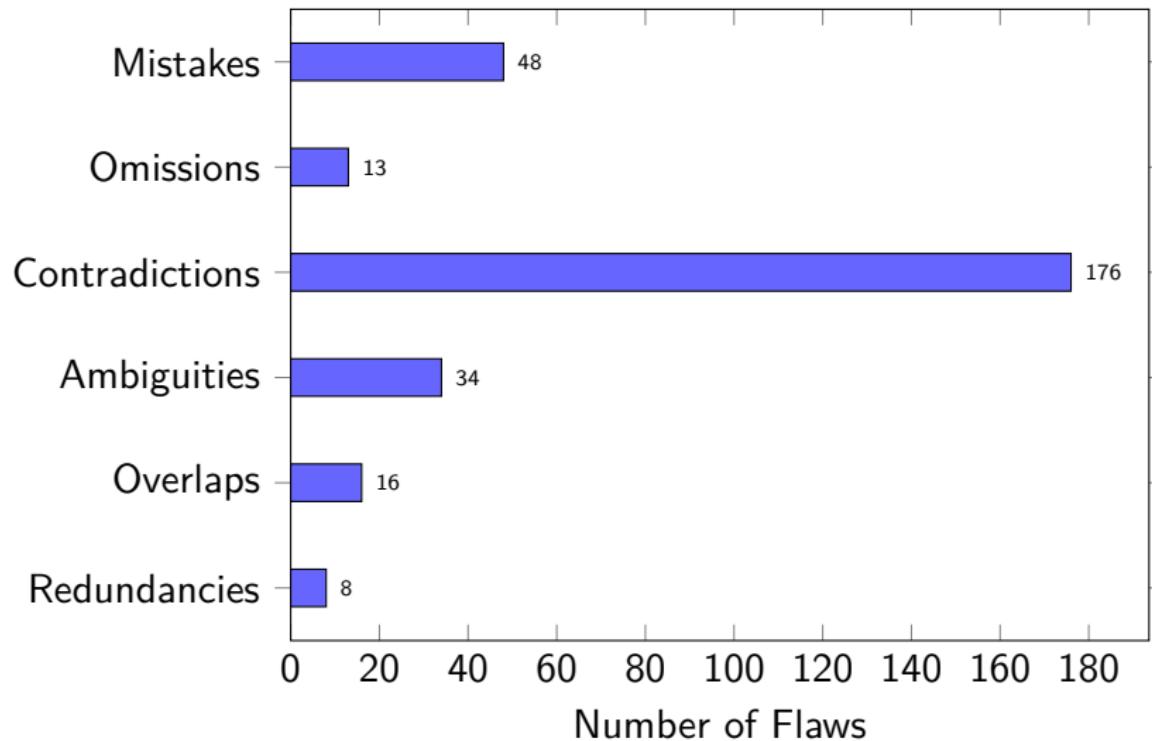
## Flaw Summary by Source Tier



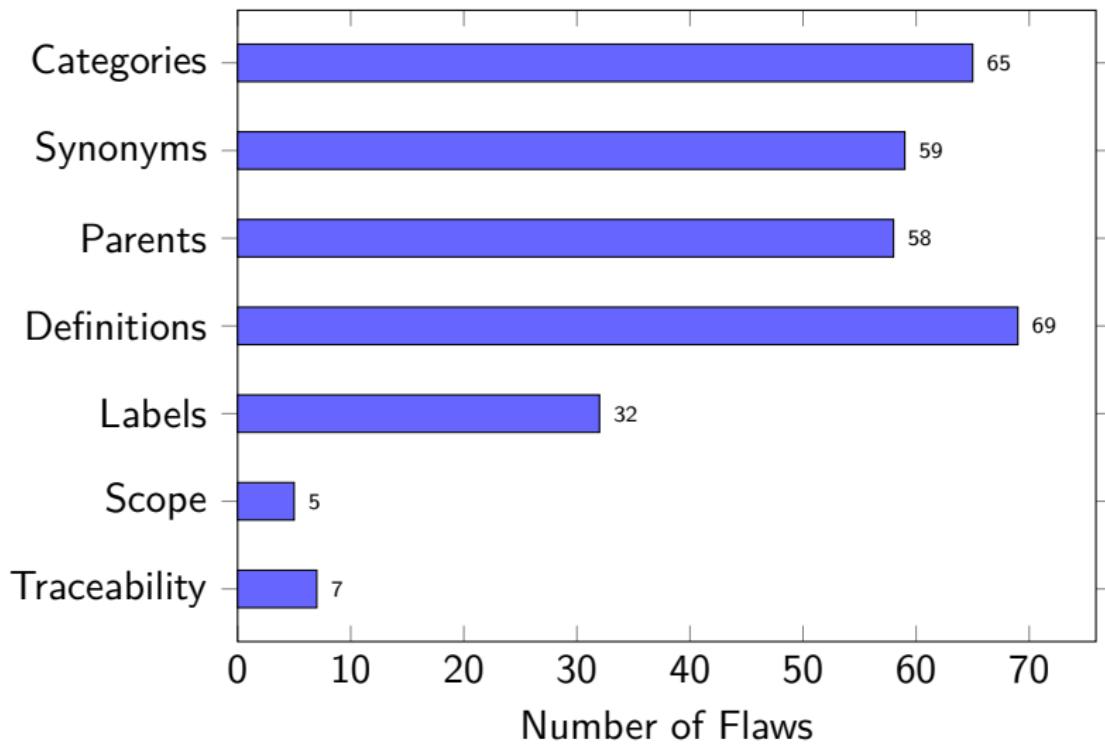
# Normalized Flaw Summary



# Flaw Summary by Manifestation



# Flaw Summary by Domain



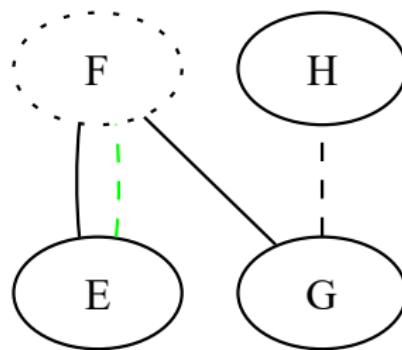
# Automated Flaws

- 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)



# 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

Prominent examples of these “multi-synonyms”:

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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

- Dr. Spencer Smith and Dr. Jacques Carette have been great supervisors and valuable sources of guidance and feedback
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- The past and current Drasil team have created a truly amazing framework!

Thank you!  
Questions?

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