

# Second Committee Meeting

## Updated Progress Report

Samuel Crawford

McMaster University

Fall 2025

# Table of Contents

## 1 Introduction

## 2 Project

- Research Questions
- Methodology

## 3 Results

# Table of Contents

## 1 Introduction

## 2 Project

- Research Questions
- Methodology

## 3 Results

# Where Were We?

## Introduction

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

# 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

# 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?

## Introduction

- Existing software testing taxonomies:

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

Focus on:

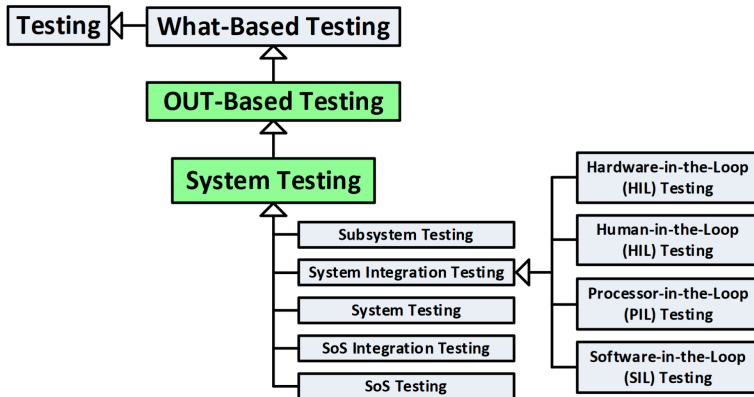
The Testing Process  
Organizing Terminology  
Relations between Approaches  
Traceability between Stages



# Existing Taxonomies?

## Introduction

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

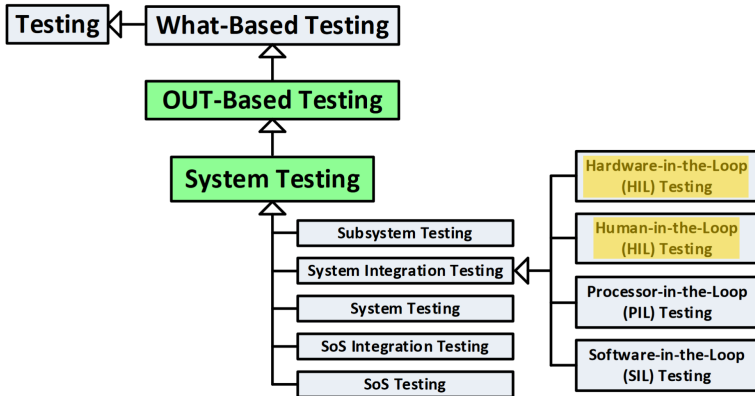


(Firesmith, 2015, p. 23)

# Existing Taxonomies?

## Introduction

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

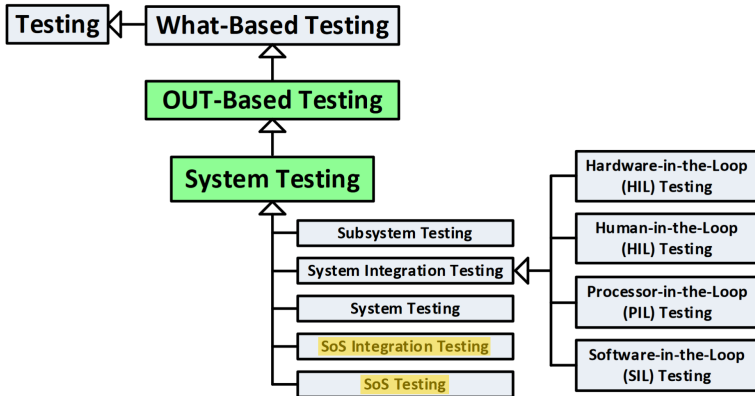


Adapted from (Firesmith, 2015, p. 23)

# Existing Taxonomies?

## Introduction

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

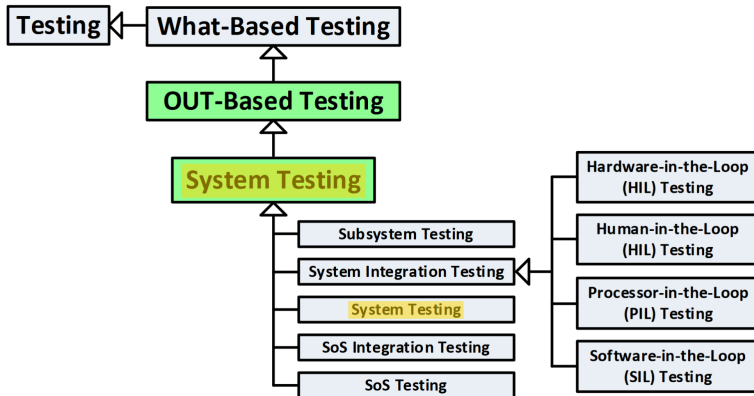


Adapted from (Firesmith, 2015, p. 23)

# Existing Taxonomies?

## Introduction

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

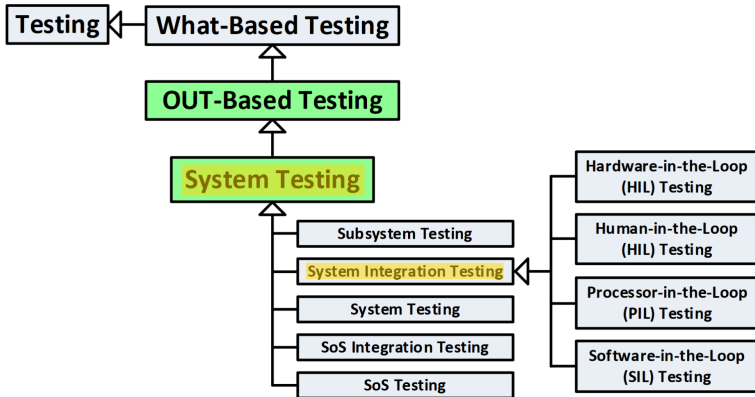


Adapted from (Firesmith, 2015, p. 23)

# Existing Taxonomies?

## Introduction

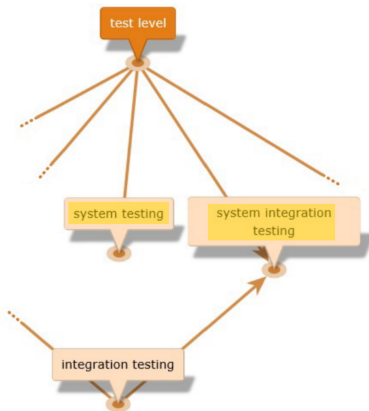
### What: by Object Under Test (OUT) – System Testing



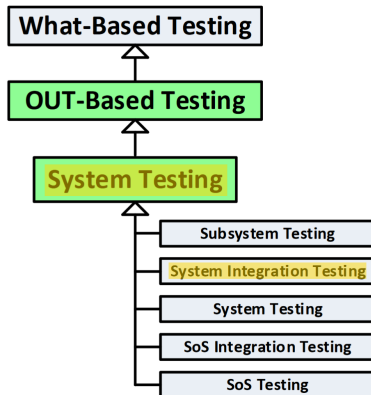
Adapted from (Firesmith, 2015, p. 23)

# Existing Taxonomies?

## Introduction



Adapted from (Hamburg and Mogyorodi, 2024)



Adapted from (Firesmith, 2015, p. 23)

# Table of Contents

## 1 Introduction

## 2 Project

- Research Questions
- Methodology

## 3 Results

# 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)

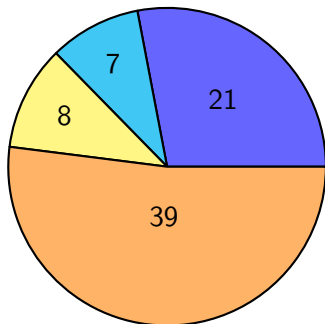
- We build a glossary with a row for each test approach

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

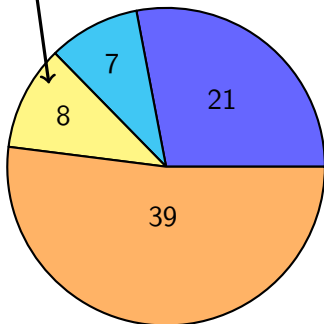
In total, we investigate 75 sources



- 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)



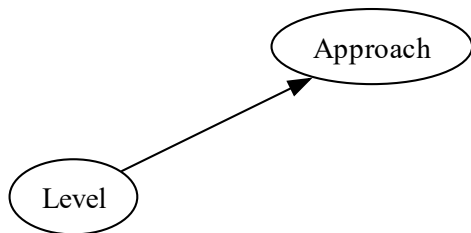
- Established Standards
- Terminology Collections
- Textbooks
- Papers and Other Documents

### 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

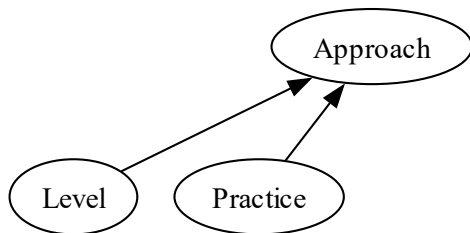


**Level:** a stage of testing with “particular objectives and ... risks”, each performed in sequence (ISO/IEC and IEEE, 2022, p. 12; 2021a, p. 6; 2021c, p. 6)



# Methodology

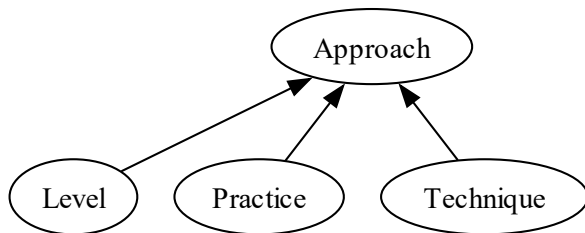
## Categories



**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

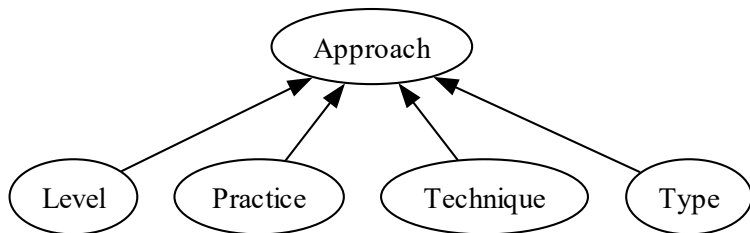
## Categories



**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

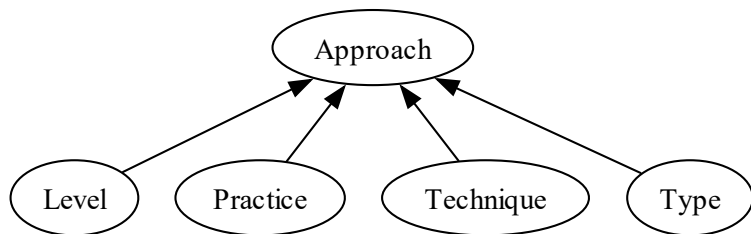
## Categories



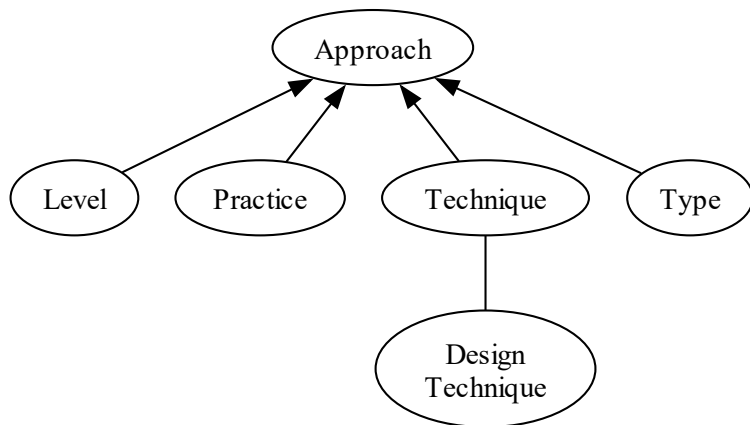
**Type:** “Testing that is focused on specific quality characteristics”  
(ISO/IEC and IEEE, 2022, p. 15; 2021c, p. 7; 2017, p. 473)

# Methodology

## Visualization Notation



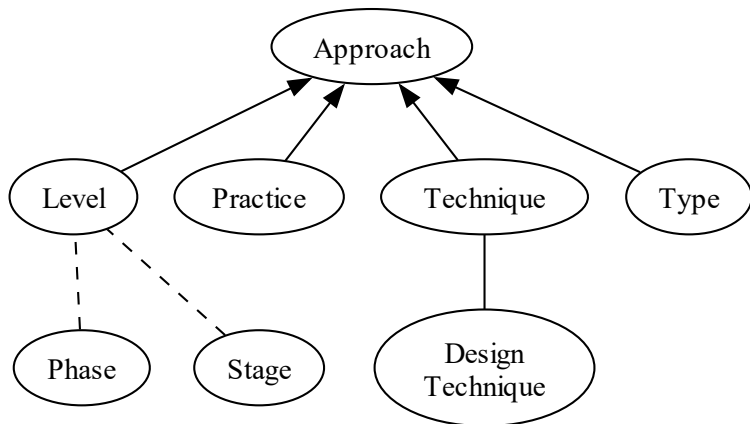
Arrows point from a *child* node to a *parent* node.



Lines without arrowheads connect *synonyms*.

# Methodology

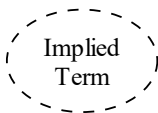
## Visualization Notation



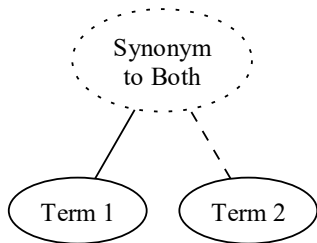
Dashed lines indicate a relationship is *implicit*.

# Methodology

## Visualization Notation



Dashed outlines indicate a term is *implicit*.



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

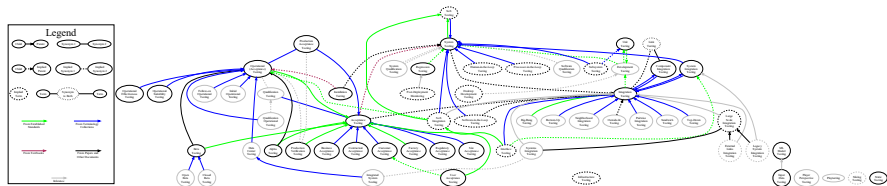
# Graph of Test Approaches



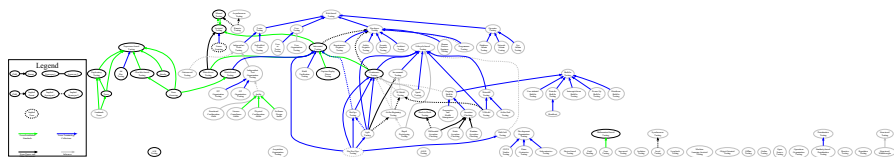
# Graph of Test Approaches

! Dimension too large.

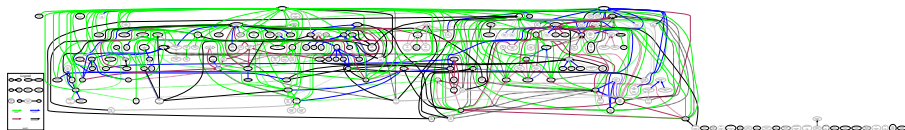
# Graph of Test Levels



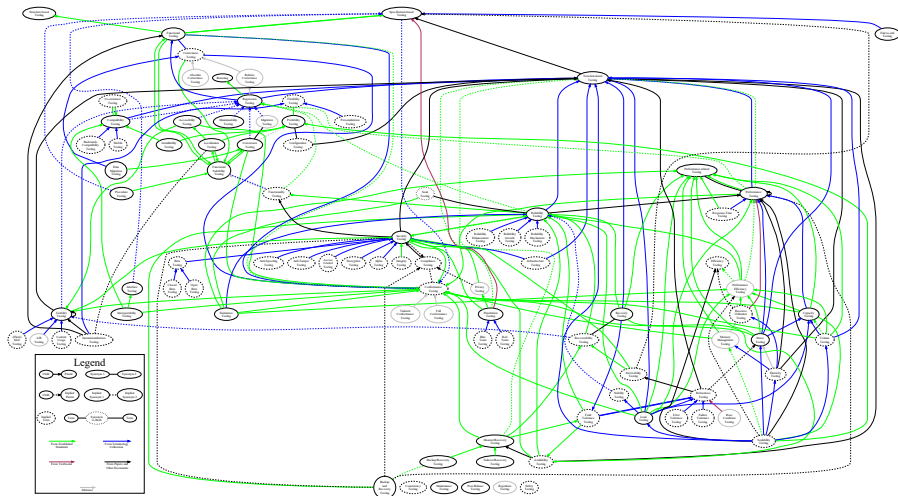
# Graph of Test Practices



# Graph of Test Techniques



# Graph of Test Types



# Table of Contents

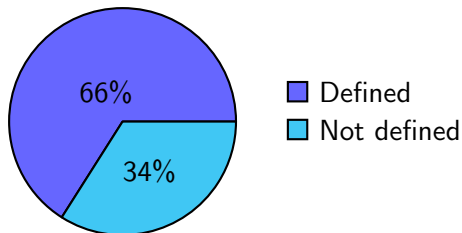
## 1 Introduction

## 2 Project

- Research Questions
- Methodology

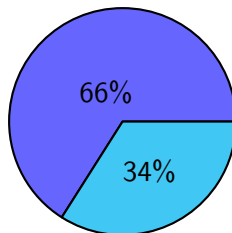
## 3 Results

- 561 test approaches →



# Overview

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

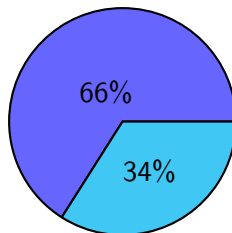


■ Defined  
■ Not defined



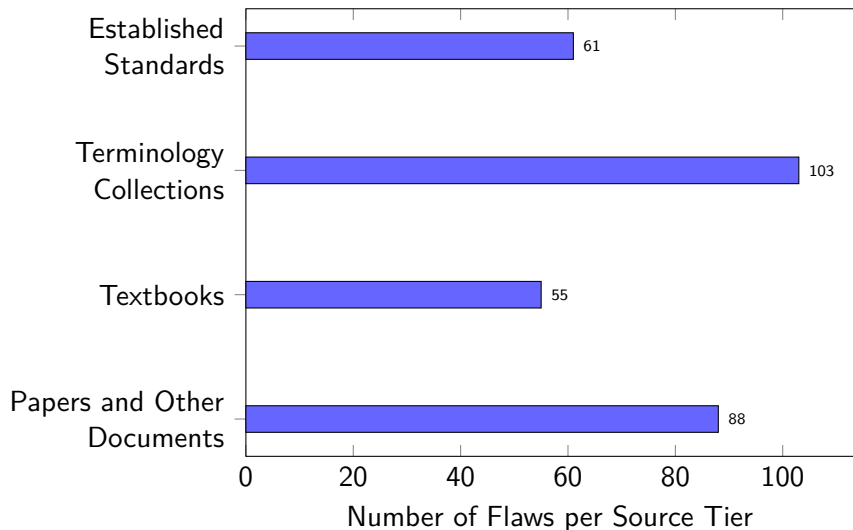
# Overview

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

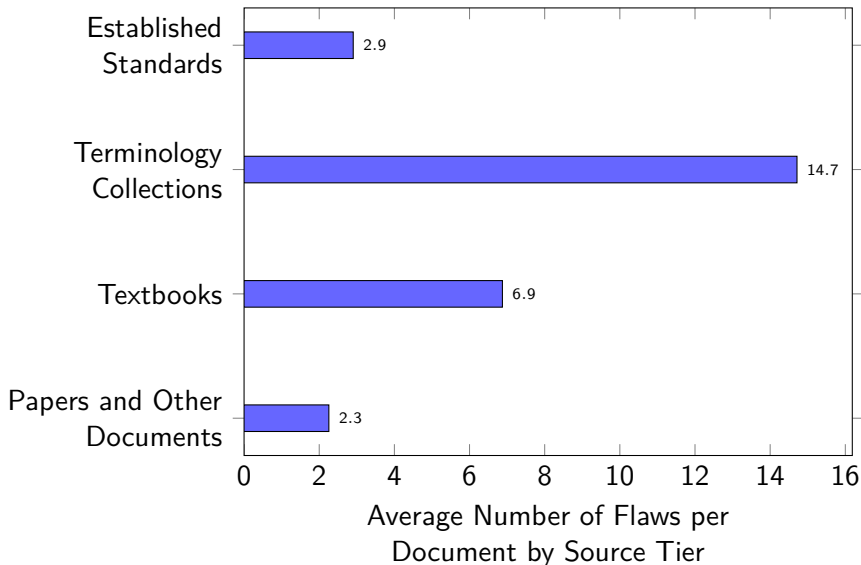


■ Defined  
■ Not defined

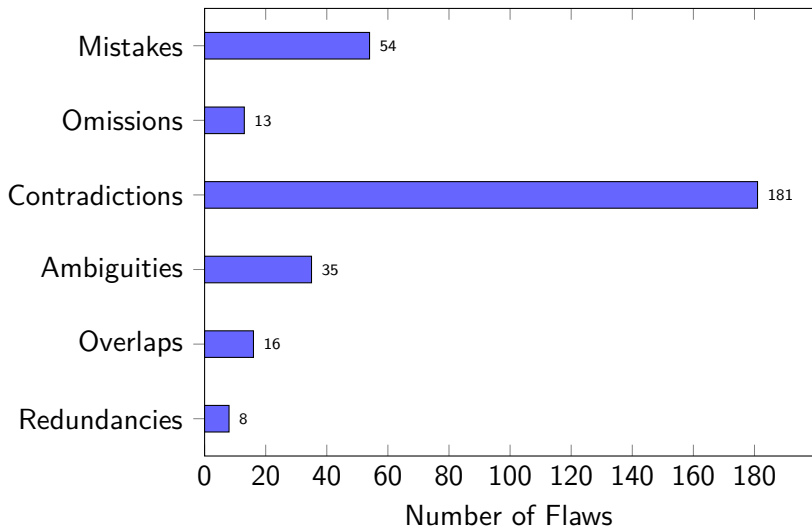
# Flaw Summary by Source Tier



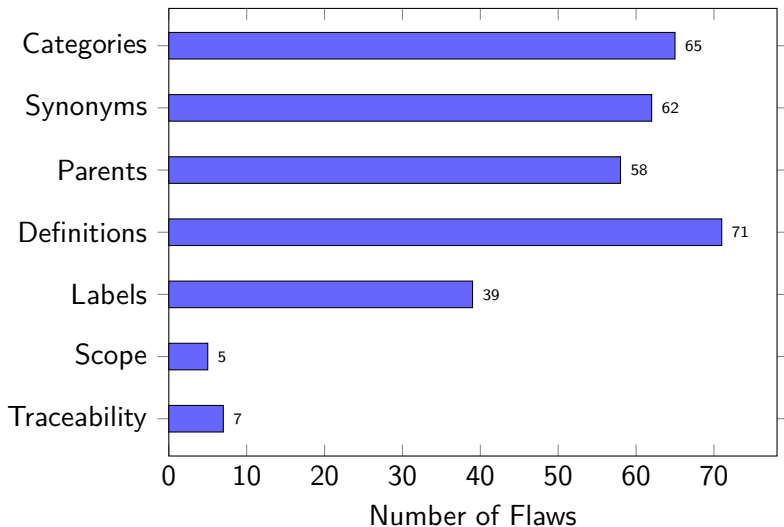
# Normalized Flaw Summary



# Flaw Summary by Manifestation



# Flaw Summary by Domain



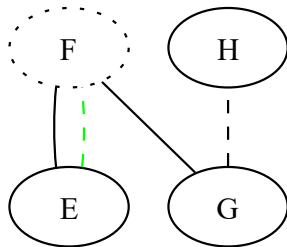
# Automated Flaws

- 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)



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)



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)

## 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; ...)

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)

## 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; ...)

## 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
  - They have helped me refine the scope of this project
  - Dr. Smith first suggested generating test cases back in 2020!

# Acknowledgment

- Dr. Spencer Smith and Dr. Jacques Carette have been great supervisors and valuable sources of guidance and feedback
  - They have helped me refine the scope of this project
  - Dr. Smith first suggested generating test cases back in 2020!
- The format of this presentation was *heavily* based on a previous presentation by Jason Balaci, who also provided a great thesis template

# Acknowledgment

- Dr. Spencer Smith and Dr. Jacques Carette have been great supervisors and valuable sources of guidance and feedback
  - They have helped me refine the scope of this project
  - Dr. Smith first suggested generating test cases back in 2020!
- The format of this presentation was *heavily* based on a previous presentation by Jason Balaci, who also provided a great thesis template
- The past and current Drasil team have created a truly amazing framework!

Thank you!  
Questions?

# References I

- Donald G. Firesmith. A Taxonomy of Testing Types, 2015. URL <https://apps.dtic.mil/sti/pdfs/AD1147163.pdf>.
- Paul Gerrard. Risk-based E-business Testing - Part 1: Risks and Test Strategy. Technical report, Systeme Evolutif, London, UK, 2000a. URL [https://www.agileconnection.com/sites/default/files/article/file/2013/XUS129342file1\\_0.pdf](https://www.agileconnection.com/sites/default/files/article/file/2013/XUS129342file1_0.pdf).
- Paul Gerrard. Risk-based E-business Testing - Part 2: Test Techniques and Tools. Technical report, Systeme Evolutif, London, UK, 2000b. URL [wenku.uml.com.cn/document/test/EBTestingPart2.pdf](http://wenku.uml.com.cn/document/test/EBTestingPart2.pdf).
- Matthias Hamburg and Gary Mogyorodi, editors. ISTQB Glossary, v4.3, 2024. URL [https://glossary.istqb.org/en\\_US/search](https://glossary.istqb.org/en_US/search).
- ISO/IEC and IEEE. ISO/IEC/IEEE International Standard - Systems and software engineering—Vocabulary. *ISO/IEC/IEEE 24765:2017(E)*, September 2017. doi: 10.1109/IEEESTD.2017.8016712.

# References II

ISO/IEC and IEEE. ISO/IEC/IEEE International Standard - Software and systems engineering –Software testing –Part 2: Test processes.

*ISO/IEC/IEEE 29119-2:2021(E)*, October 2021a. doi:

10.1109/IEEESTD.2021.9591508.

ISO/IEC and IEEE. ISO/IEC/IEEE International Standard - Software and systems engineering –Software testing –Part 4: Test techniques.

*ISO/IEC/IEEE 29119-4:2021(E)*, October 2021c. doi:

10.1109/IEEESTD.2021.9591574.

ISO/IEC and IEEE. ISO/IEC/IEEE International Standard - Systems and software engineering –Software testing –Part 1: General concepts.

*ISO/IEC/IEEE 29119-1:2022(E)*, January 2022. doi:

10.1109/IEEESTD.2022.9698145.

Ben Kam. Web Applications Testing. Technical Report 2008-550, Queen's University, Kingston, ON, Canada, October 2008. URL <https://research.cs.queensu.ca/TechReports/Reports/2008-550.pdf>.



# References III

Ron Patton. *Software Testing*. Sams Publishing, Indianapolis, IN, USA, 2nd edition, 2006. ISBN 0-672-32798-8.

J.F. Peters and W. Pedrycz. *Software Engineering: An Engineering Approach*. Worldwide series in computer science. John Wiley & Sons, Ltd., 2000. ISBN 978-0-471-18964-0.

Erica Souza, Ricardo Falbo, and Nandamudi Vijaykumar. ROoST: Reference Ontology on Software Testing. *Applied Ontology*, 12:1–32, March 2017. doi: 10.3233/AO-170177.

Guido Tebes, Luis Olsina, Denis Peppino, and Pablo Becker. TestTDO: A Top-Domain Software Testing Ontology. pages 364–377, Curitiba, Brazil, May 2020. ISBN 978-1-71381-853-3.

# References IV

- 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].
- Hans van Vliet. *Software Engineering: Principles and Practice*. John Wiley & Sons, Ltd., Chichester, England, 2nd edition, 2000. ISBN 0-471-97508-7.
- Hironori Washizaki, editor. *Guide to the Software Engineering Body of Knowledge, Version 4.0*. January 2024.