

Sustainability and Waste in AI-Assisted Test Engineering: Patterns and Checklists

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Software Center/CoDig Sustainability Workshop

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Software Center 

TRACE

A Software Center
Project

Introduction

Edi

- PhD in Test Automation at MDU, 2016
- Docent in Embedded Systems (Industrial Quality Assurance), 2022
- AI and Society Fellow (2025-2026)
- Co-leading the Software Testing Laboratory
- Working at the intersection of:
 - engineering, empirical research, human factors, quality assurance, and embedded systems.
- Living in Västerås



What is AI-Assisted Test Engineering?

- Software Testing:

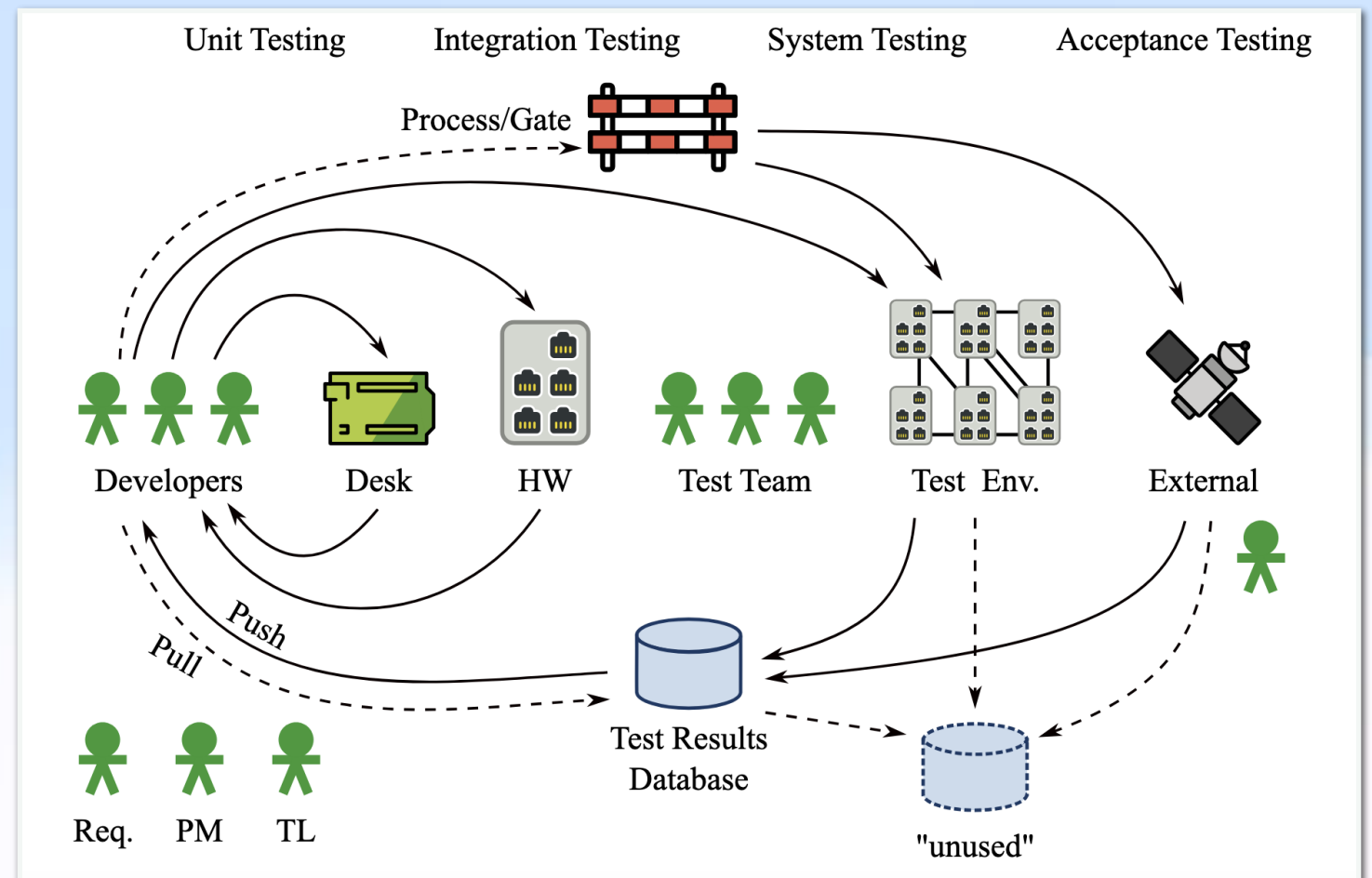
- “the act of manually or automatically inspecting or executing software with or without custom hardware in order to gather information for some purposes like feedback, quality control, finding issues, building trust.”

- Test Engineering

- practice of planning, designing, building, executing, and maintaining test(ing) (and test infrastructure).

- Automated Testing

- Automated Test Execution
- Automated Test Case Generation
- Automated Regression Test Selection
- Automated Test Log/Results Analysis



Automated System-Level Software Testing of Industrial Networked Embedded Systems
[Per Erik Strandberg](#)

Sustainability and Waste

AI-Assisted Test Automation

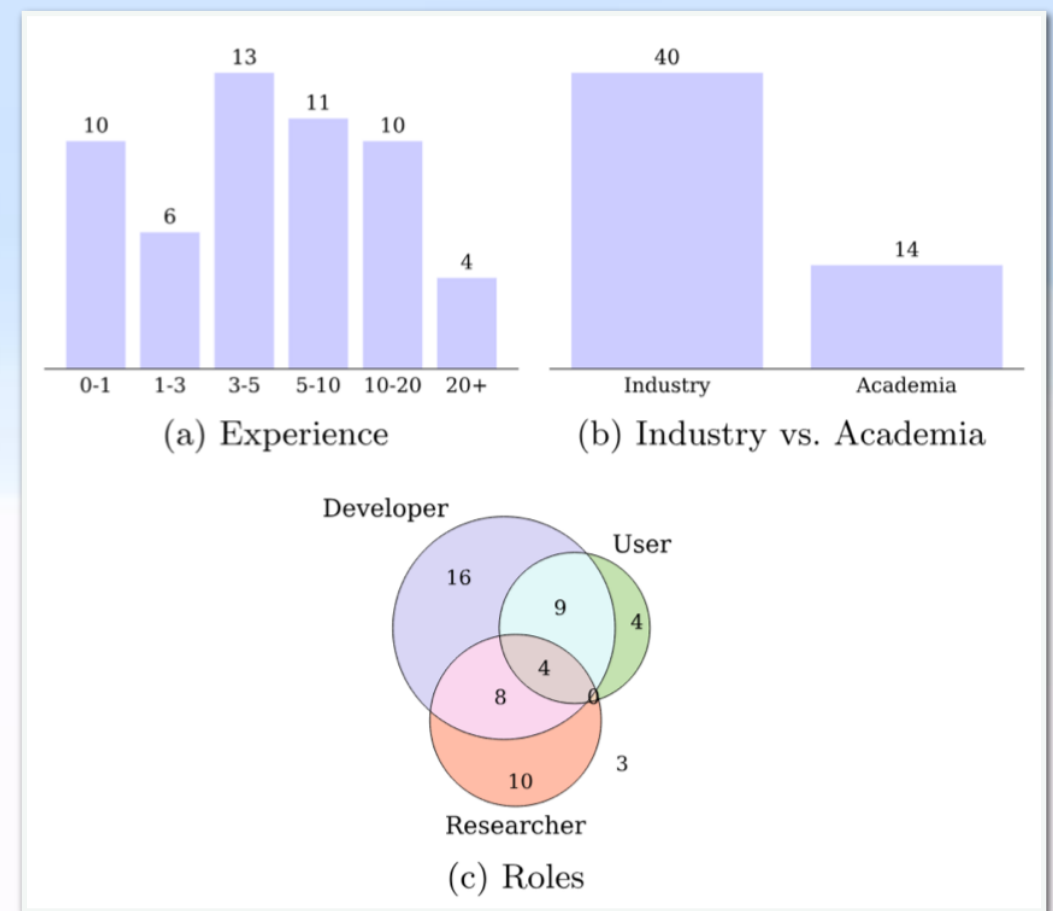
- Empirical Insights from Strandberg, Enoiu & Frasheri (2025)
 - What practitioners think about it and what this means for the present and future.
 - Part of a broader framework of 9 ethical challenges.



- Topic: Ethical challenges and software test automation, by P E Strandberg, E P Enoiu, & M Frasheri. (2025). *AI and Ethics*, 1-22. <https://doi.org/10.1007/s43681-025-00804-7>

Motivation and Method

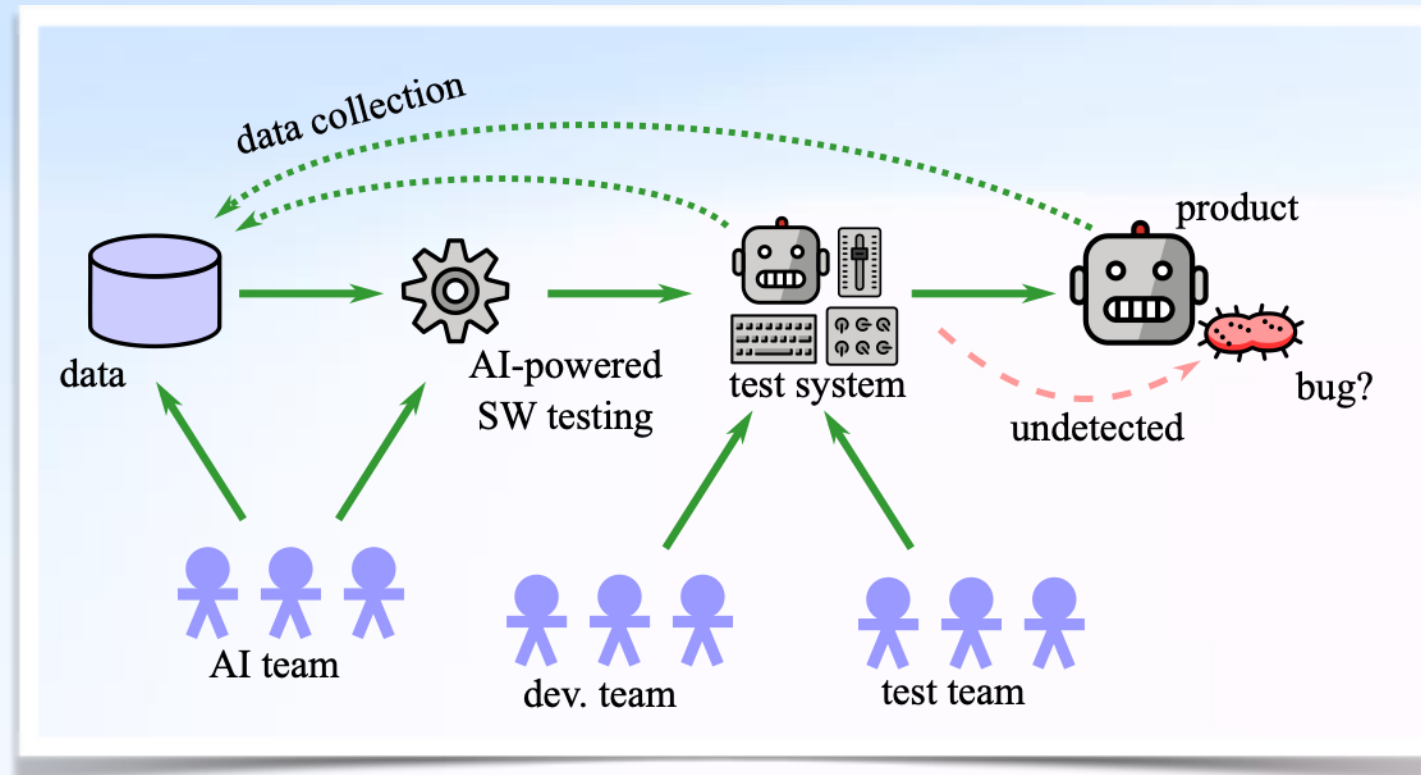
- Goal: What should we discuss about when we talk about ethical AI-assisted Test Engineering?
- Topics, Questions, and Human validation
- 2021 – 2025
- Theme: Sustainability and waste
- Example: What are the risks that the test automation will produce unreasonable amounts of waste, e.g. extreme power consumption, meaningless log files, etc.?



What Is Sustainability and Waste?

AI-Assisted Test Engineering

A frustrated test automation engineer at RRCO complained to a manager "We need a more powerful server with terabytes of disk for all logs and a ton of cores to train all these AI tools!"



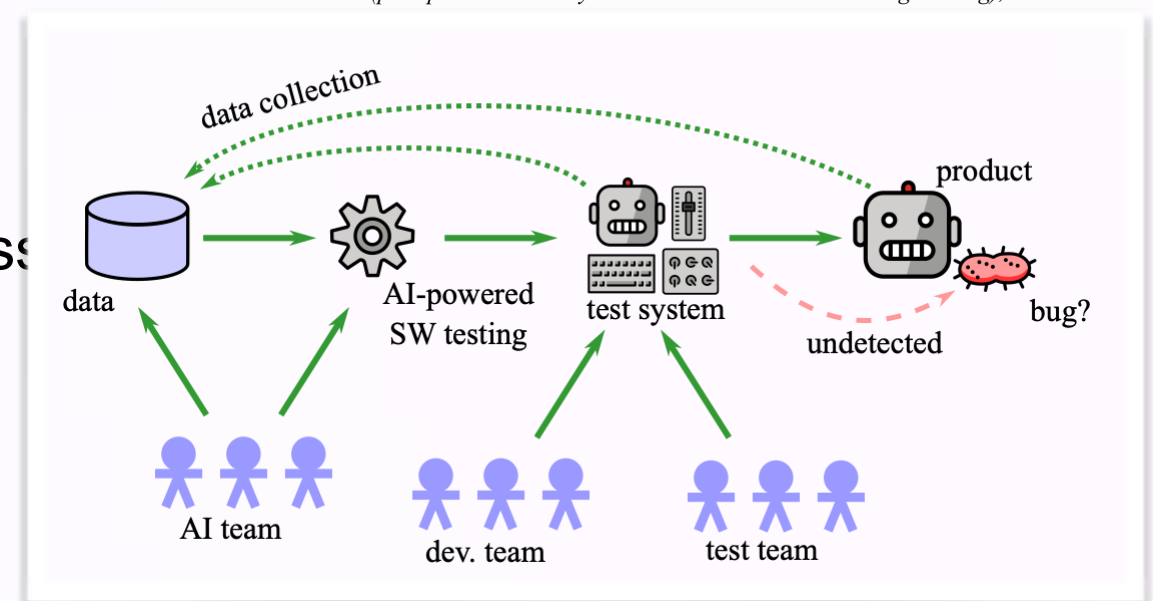
What Is Sustainability and Waste?

AI-Assisted Test Engineering

- Sustainability and Waste in AI-Assisted Test Engineering refers to (among others things):
 - **Resource efficiency**
 - Computing, storage, test infrastructure.
 - **Process efficiency**
 - Avoiding redundant tests, unnecessary execution, bloated pipelines.
 - **Human sustainability**
 - Avoiding overload, skill erosion, meaningless work.
 - **Long-term maintainability**
 - Not just short-term speed gains.

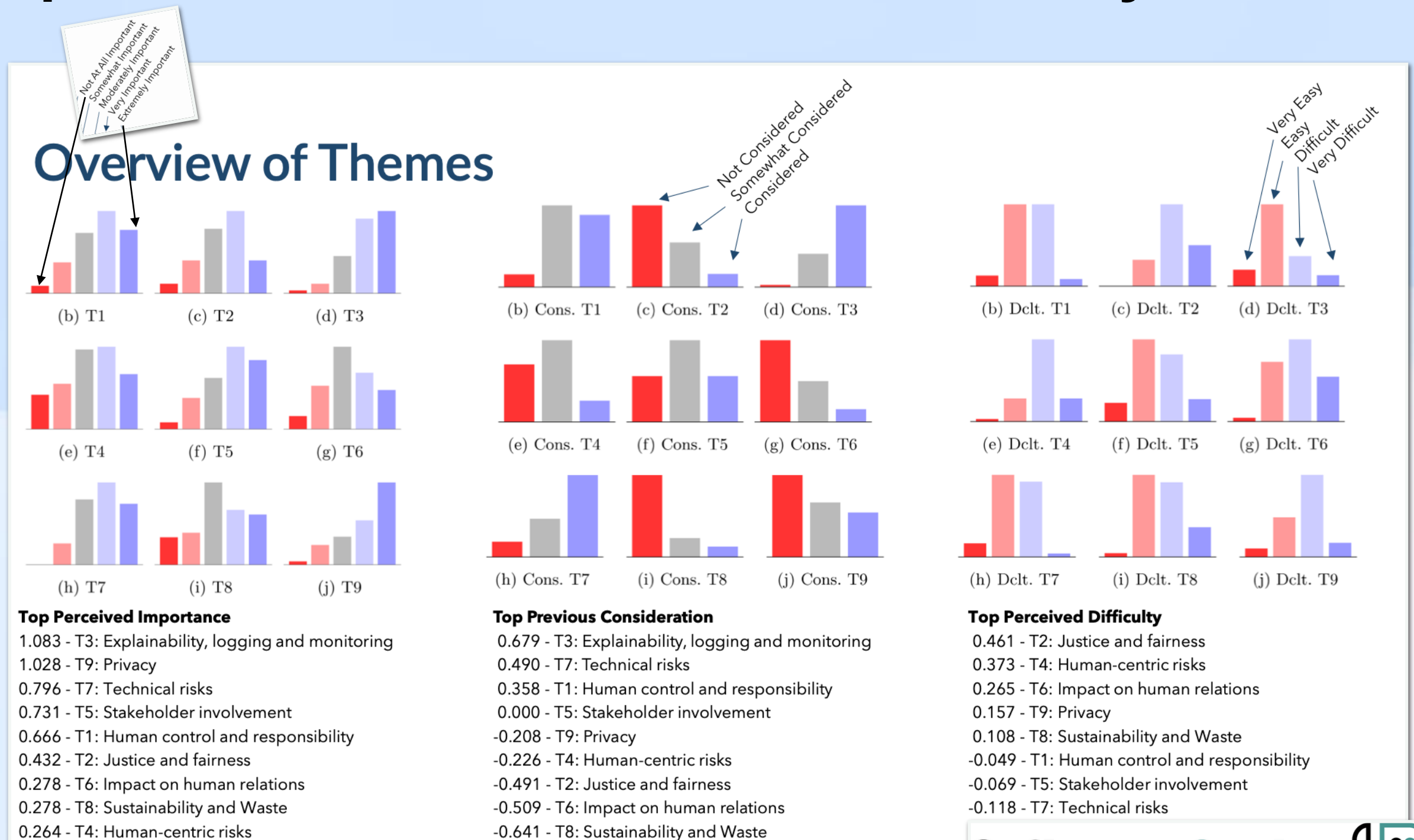


Generated illustration using an AI-based image generation model
(prompt: sustainability and waste in AI-assisted test engineering), 2025.



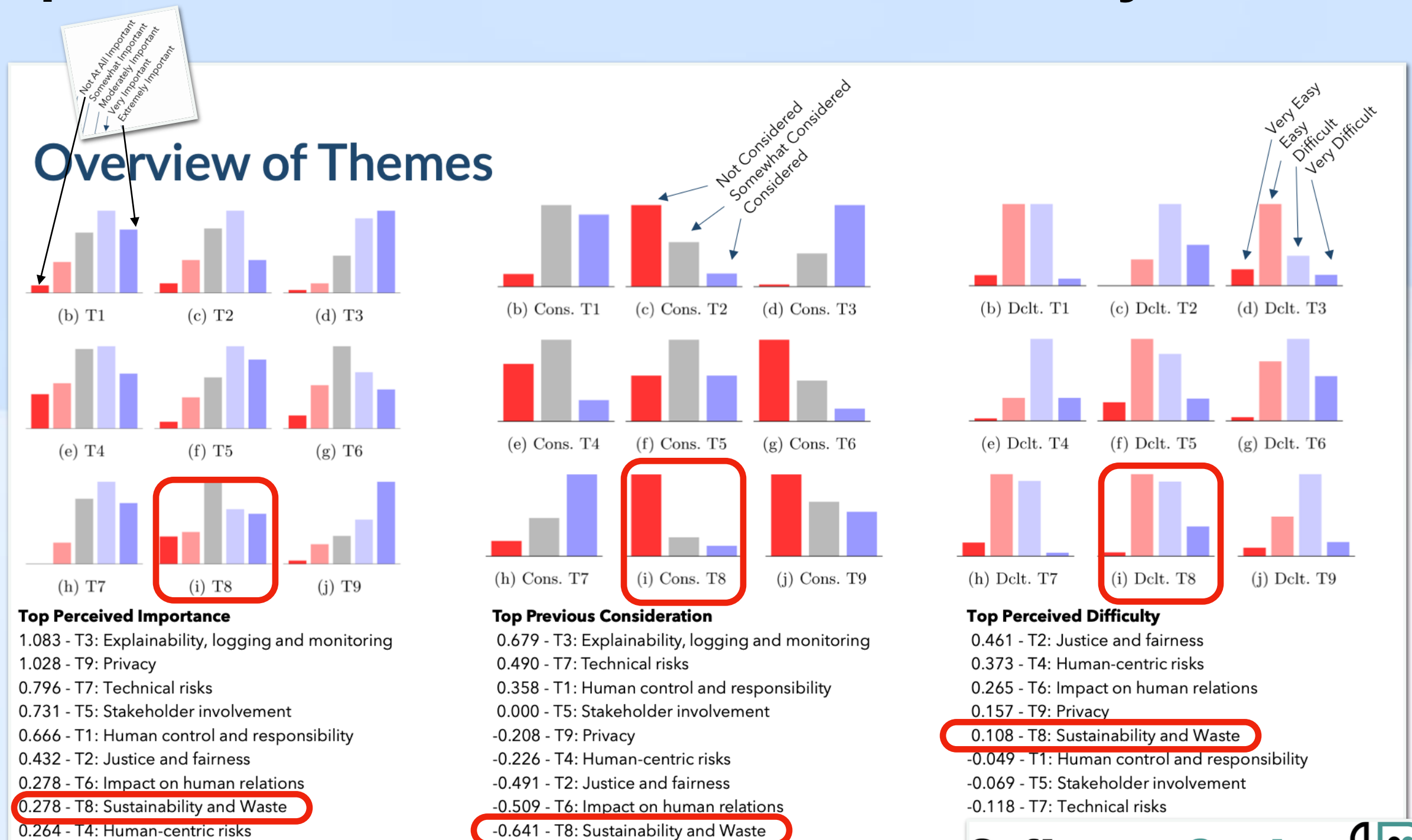
Sustainability and Waste

Importance vs Consideration vs Difficulty



Sustainability and Waste

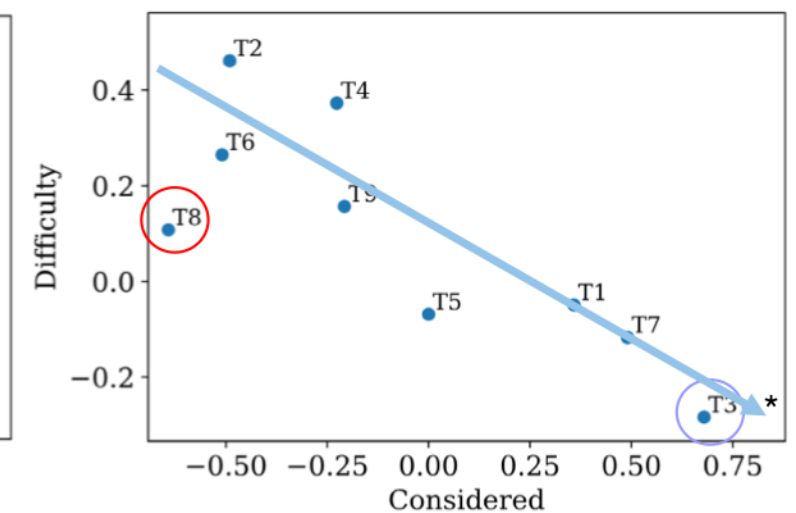
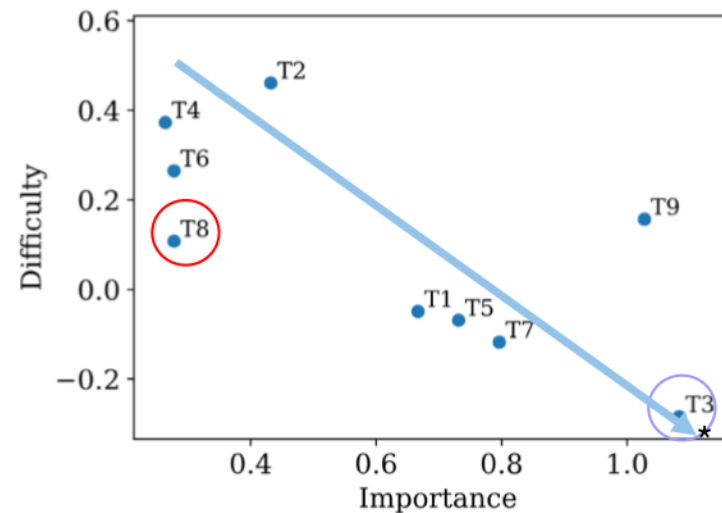
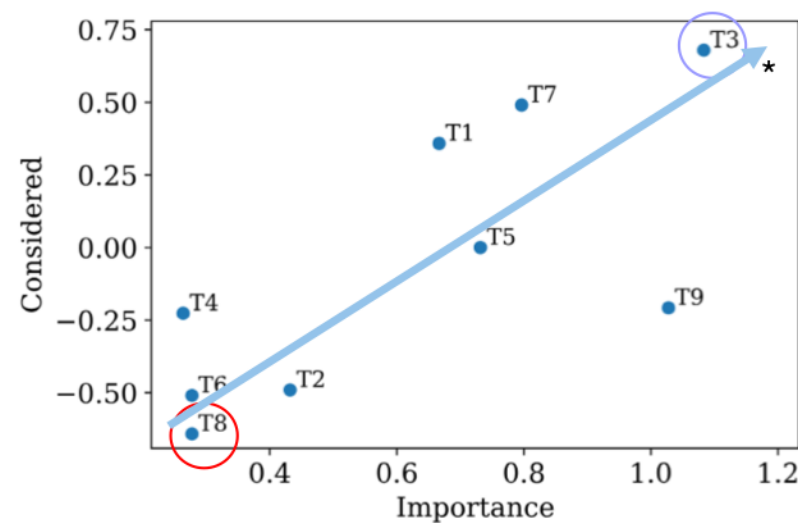
Importance vs Consideration vs Difficulty



Sustainability and Waste

Least considered, perceived as moderately difficult if it would be to implement...

Considered vs. Importance vs. Difficulty



(*Not real trend lines)

Weak tendencies:

- Importance → Considered (or More Considered → more Important?)
- Importance → Less difficult (or Less difficult → more Important?)
- Considered → Less difficult (or Less difficult → more Considered?)
- (T9: Privacy seems to be an outlier)

T1: Human control and responsibility

T2: Justice and fairness

T3: Explainability, logging and monitoring

T4: Human-centric risks

T5: Stakeholder involvement

T6: Impact on human relations

T7: Technical risks

T8: Sustainability and Waste

T9: Privacy

Sustainability and Waste

Qualitative Perceptions - Patterns

Sustainability is “Relevant”, “Important in principle”
nut “Not a primary concern today”...

“The efficiency and cost benefits of automation outweigh its waste.”

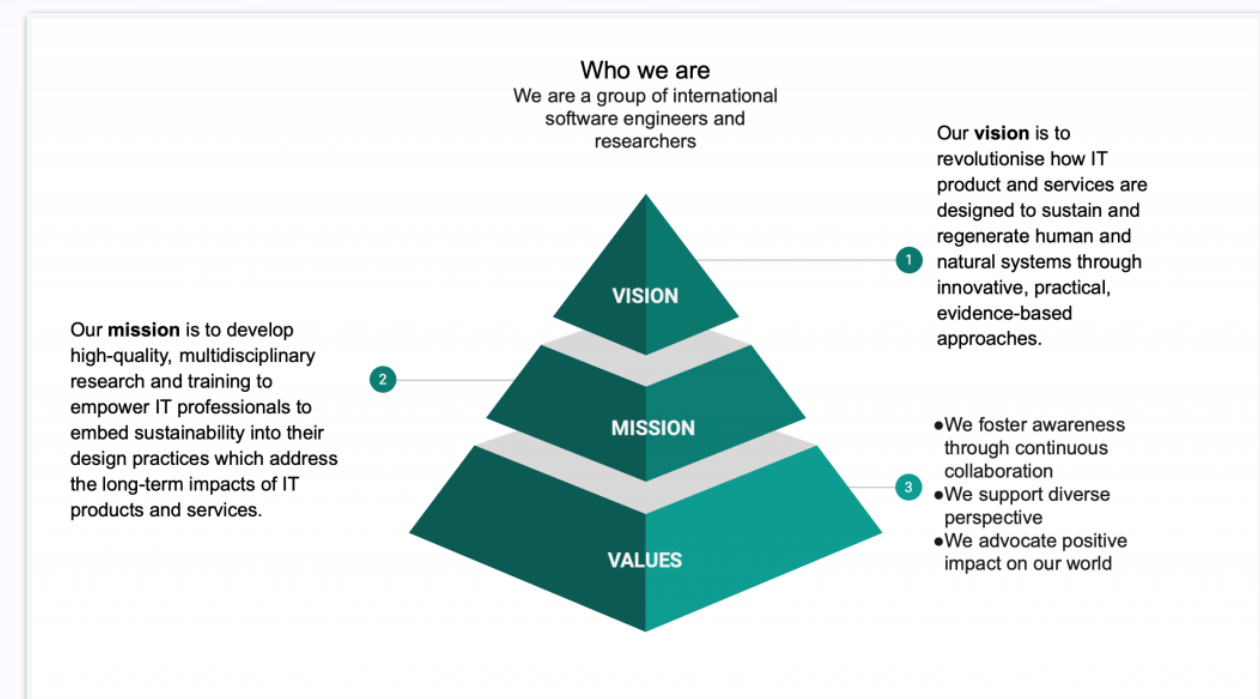
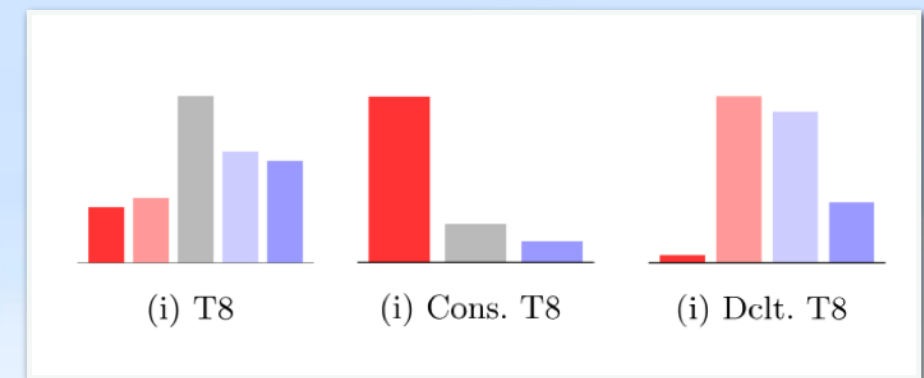
Waste must be evaluated relative to the alternative

Sustainability is:
Acknowledged 
Rarely operationalised 

Sustainability and Waste

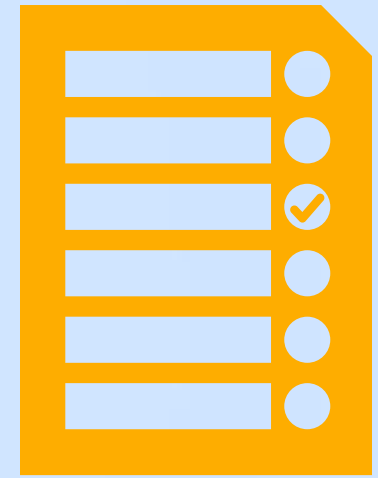
Discussion

- Not very interesting according to practitioners (!?!)
- Importance: 2nd from bottom
- Least considered
- Difficulty: so-so (perceived)
- In related work (e.g. Jobin et al.) also not well covered
- The Karlskrona Manifesto for Sustainability Design
 - <https://sustainabilitydesign.org/>

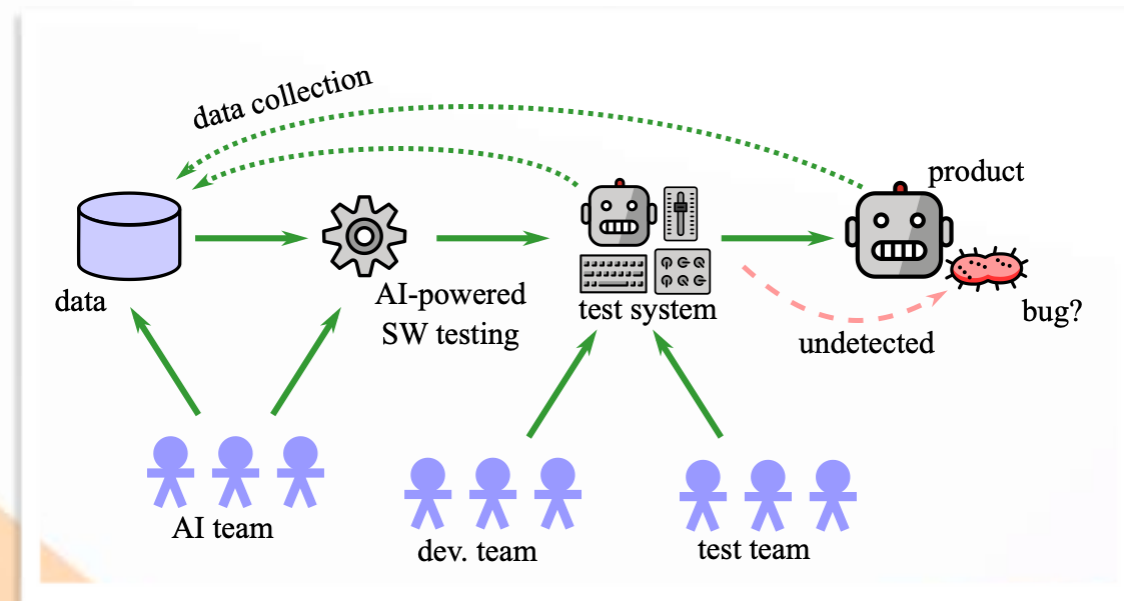


Sustainability and Waste

In AI-Assisted Test Engineering



- **Framing and Priority**
 - Do we treat sustainability and waste as an ethical concern in its own right?
 - Have we defined, in our context, what counts as “unreasonable waste” for AI-assisted testing?
- **Comparative View: Automation vs Non-Automation**
 - When we claim that waste from AI-assisted testing is “minor or major”, what is our reference, manual testing, non-AI automation, or something else?
- **Human Effort as a Sustainability Resource**
 - Do we treat human time and cognitive load as part of “waste”?
- **Organizational Alignment and Future Orientation**
 - How do our test automation choices align with our organization’s broader sustainability commitments?



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