CREST Workshop

Got Technical Debt? Surfacing Elusive Technical Debt in Issue Trackers

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Nov 28-29th, 2016

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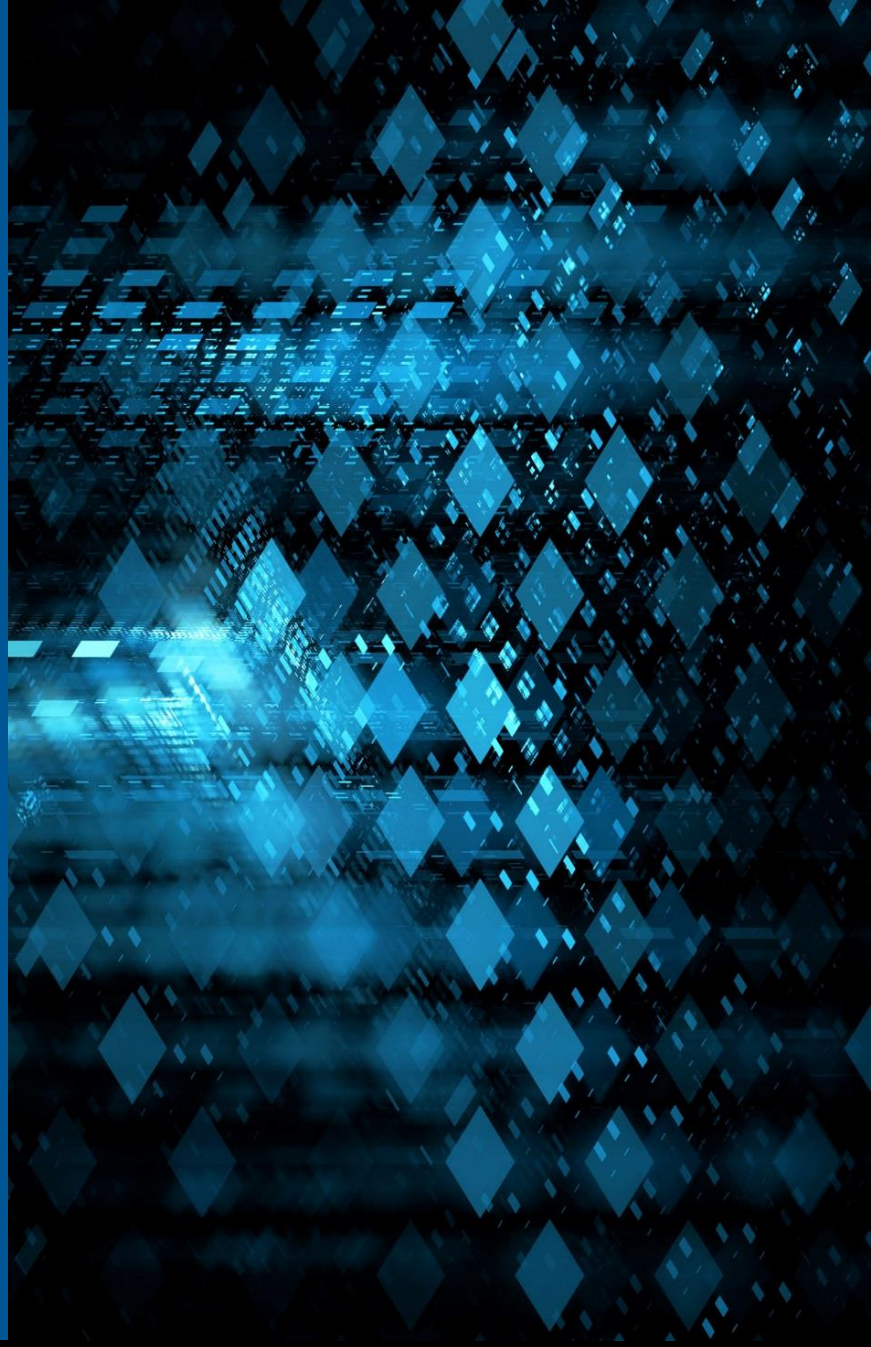


Distribution Statements

This material is based upon work funded and supported by the Department of Defense under Contract No. FA8721-05-C-0003 with Carnegie Mellon University for the operation of the Software Engineering Institute, a federally funded research and development center.

DM-0004232

Do issue trackers reveal technical debt?

- **RQ1:** Do developers use the term *technical debt* **explicitly** when discussing problems in their issue trackers?
- **RQ2:** Can **implicit** technical debt items be discovered systematically within issue trackers?
- **RQ3:** What are the distinguishing **characteristics** of technical debt items discovered in issue trackers?

Overview of Data Sets

	Data set	Source	Filter criteria	# Records analyzed
Setup (instrument development)	Chromium	Google issue tracker	Text search “technical debt”	56
	Connect	Jira	Text search “technical debt”	15
	Technical debt survey	Examples (as text)	N/A	265
Phase 1 TD categorization	Connect	Jira	2012, first 200 records	200
Phases 2–4 TD classification, analysis, and evaluation Total: 727 issues	Connect	Jira	March 2012	286
	Project A	Jira	Defects/CRs Sep. 2010 to Dec. 2014	86
	Project B	FogBugz	All year 2013	193
	Chromium	Google issue tracker	Milestone 48 Stars (watchers) > 3	163
Total				1,264

Data sets are also published

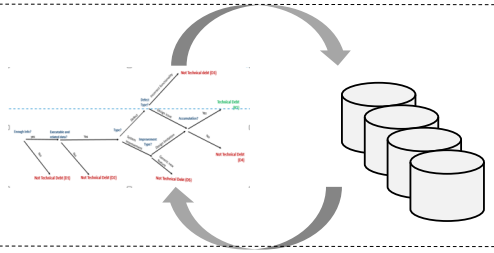
- Initial phased focused on exploring RQ1 (explicit declaration) and survey examples
- Core research phases 1-4
- Mix of open source and project data
- Created manageable sized data sets for manual analysis

Multi-phased analysis approach

1. Categorization: Extract reoccurring concepts from samples; create initial categorization

Output: Classification guidance

2. Classification: Systematically classify data sets using categorization



Outputs: Classified data set, refined classification guidance

3. Evaluation: Validate effectiveness of classification with project stakeholders

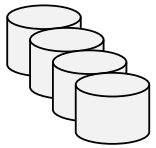
Are these really TD?

Does the classification make sense?

Output: Stakeholder confirmation of findings

4. Analysis: Analyze the technical debt items for characteristics

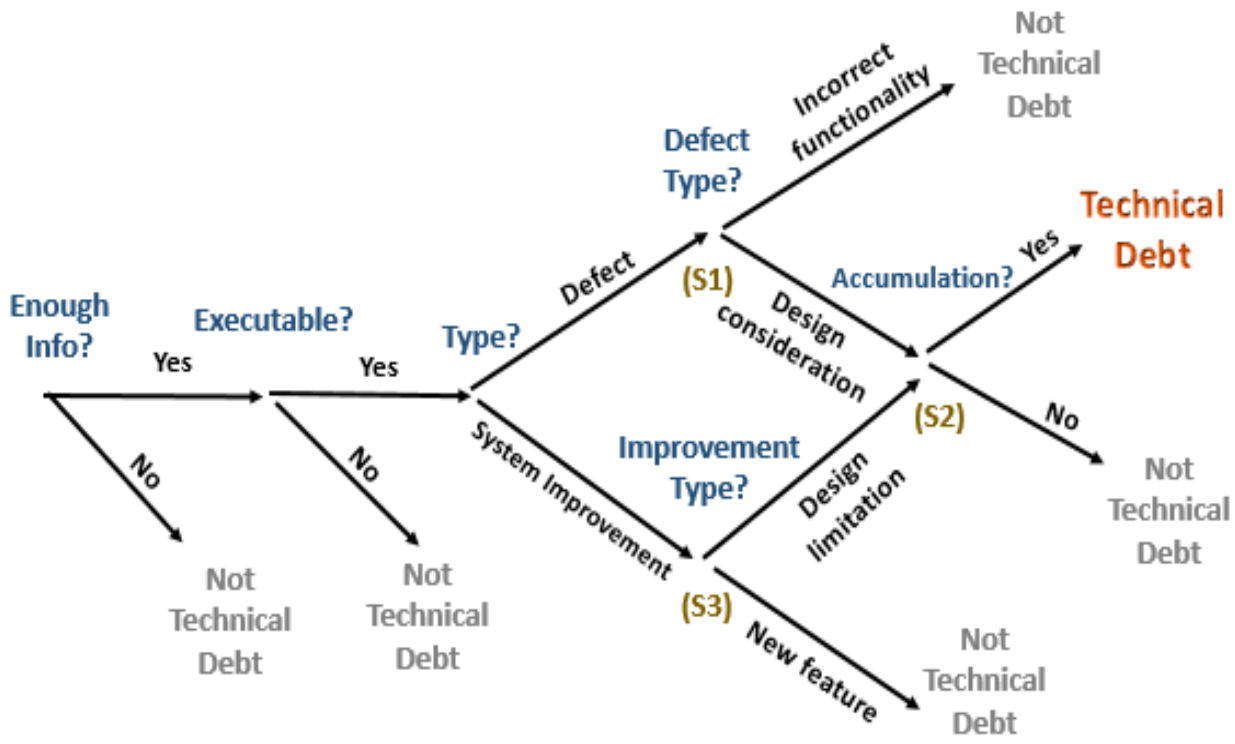
Categorized data sets



Analyze

Outputs: Demographic statistical analysis; unstructured data affinity grouping and analysis

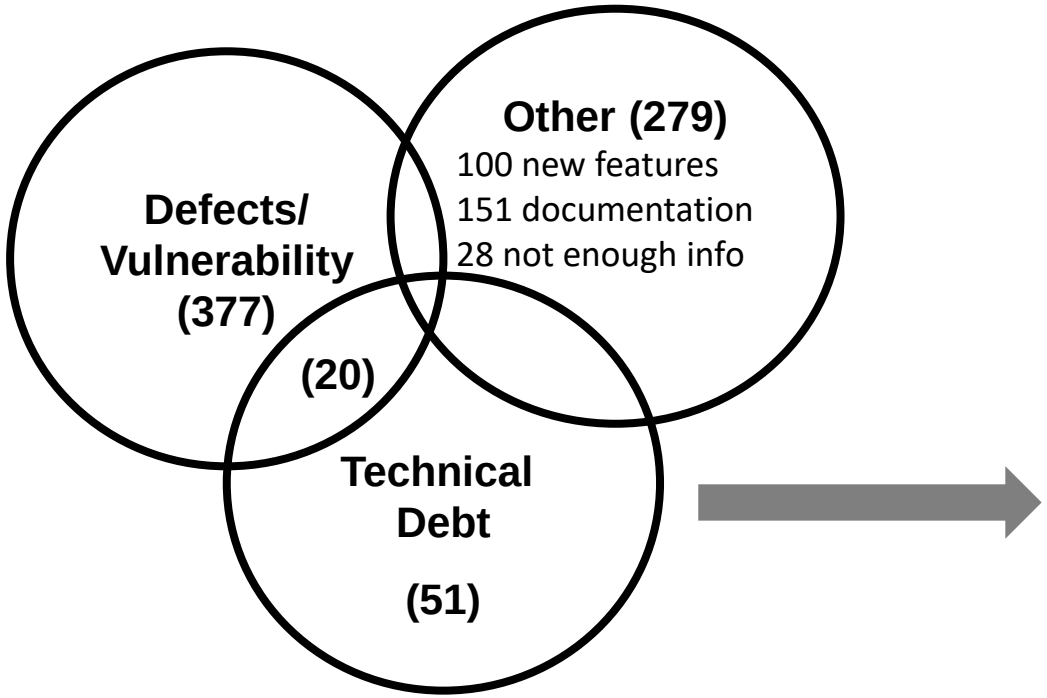
Technical Debt Classification Rules (Described as a Decision Tree)



Project	TD	Not TD	Stuck	No agreement	Total
Connect	12	265	1	7	285
Project A	10	74	1	1	86
Project B	13	171	9	0	193
Chromium	16	146	1	0	163
Total	51	656	12	8	727

- In current project, we are using method with larger datasets and machine learning

Technical Debt Breakout



Deployment & Build	Out-of-sync build dependencies	3	CN
	Version conflict	1	CN
	Dead code in build scripts	1	CN
Code Structure	Event handling	5	2CH, 3PB
	API/Interfaces	5	2CH, 1CN, 2PB
	Unreliable output or behavior	5	4CH, 1PA
	Type conformance issue	3	CN
	UI design	3	PB
	Throttling	2	1CH, 1PB
	Dead code	2	CN
	Large file processing or rendering	2	CH
	Memory limitation	2	CH
	Poor error handling	1	PA
	Performance appending nodes	1	CH
	Encapsulation	1	PB
	Caching issues	1	CN
Data Model	Data integrity	6	PA
	Data persistence	3	PB
	Duplicate data	2	PA
Regression Tests	Test execution	1	CH
	Overly complex tests	1	CH

CH = Chromium, PA = Project A, PB = Project B, CN = CONNECT

Examples

Not Technical Debt

[Project A #25] Correct the values for subsystem A to reflect the subsystem B values

[Project B #265] Update alert authoring UI – ‘event window’ should be close to ‘any rule’ checkbox

[Project B #1513] Refactor onclicks in nodes.html into query events

Technical Debt

[Project A #18] approximately 340 records exist in the database twice … so much time had elapsed in some cases the duplicate was endorsed.

[Chromium #367158] Currently, we have a lot of duplicate/boilerplate code in this test. We should try to simplify this test so that it’s easier to maintain and read.

Example of a Technical Debt Item

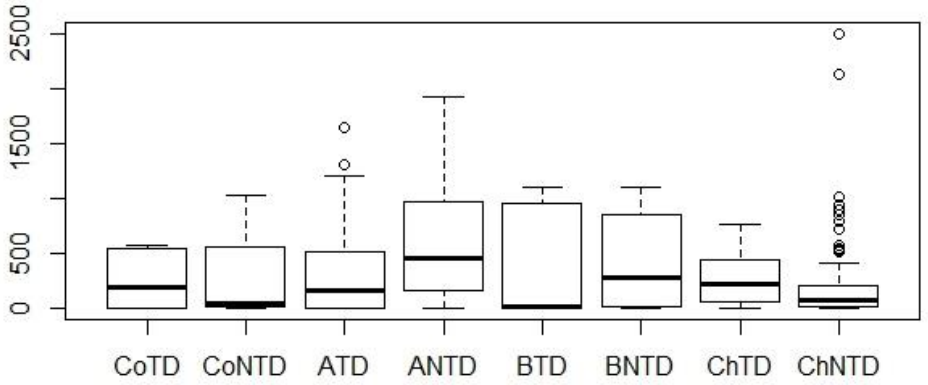
Name	Connect #Gateway-1631: Empty Java package (dead code)
Development artifact	The re-architecture of the source code to support multiple NwHIN specifications has introduced a new Java packaging scheme.
Symptoms	Numerous empty Java package folders present across multiple projects.
Consequences	No impact to functionality; however, may lead to confusion for users implementing enhancements or modifications to the source code.
Analysis	New and existing classes have been moved into these new package folders; however, the previous package folders have been left in place with no class files.

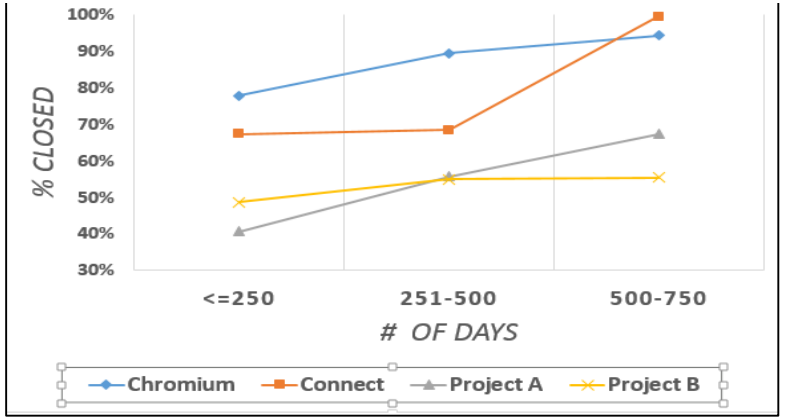
Suggested template for capturing Technical Debt Item

Our Assertion: Technical debt can be made **visible earlier** when tracked similarly to defects, consequently managed more effectively and strategically

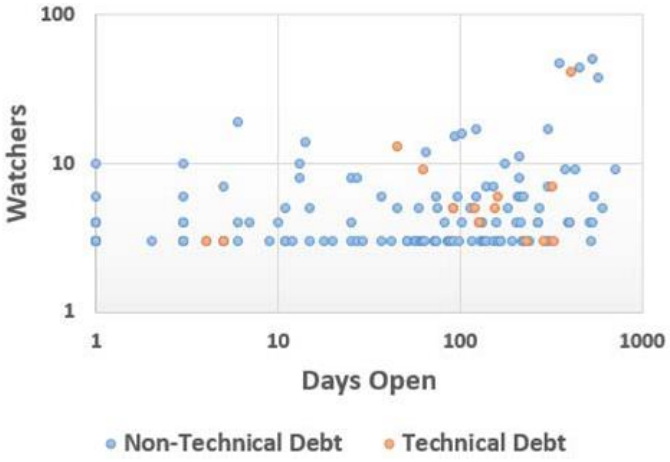
RQ3: Are there any quantifiable characteristics

Are TD issues open longer?





Do TD issues generate more developer discussion?



Do TD issues have higher priority?

	Priority 1	Priority 2	Priority 3
Technical Debt Issues	22%	56%	22%
Not Technical Debt Issues	24%	50%	26%

Our Emerging Definition of Technical Debt

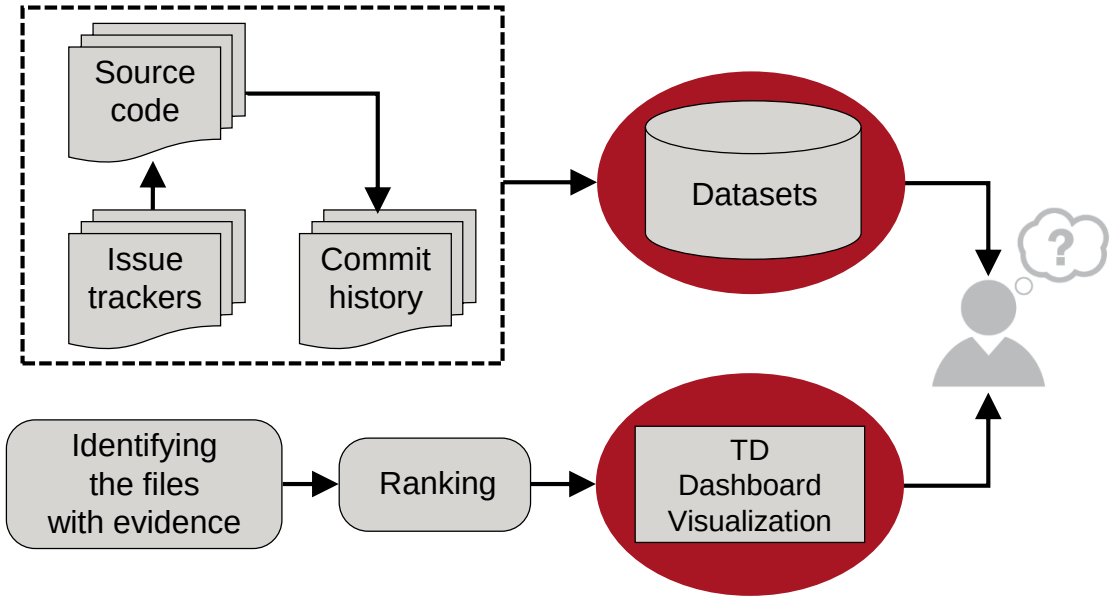
Technical debt is design work relating to **software units** that have evidence of present or anticipated accumulation of extra work.

- Exists in an **executable system artifact**, such as code, build scripts, automated test suites;
- Is traced to **several locations** in the system, implying ripple effects of impact of change;
- Has a **quantifiable** effect on system attributes of interest to developers, such as increasing number of defects, negative change in maintainability and code quality indicators are symptoms of technical debt.

Summary of Findings

- Using this method we manually identified 51 examples of technical debt records in several issue tracker datasets.
- Existing definitions focus on the explicit shortcuts, however, the issues we found are mostly implicit **- result of unintentional design choices.**
  - We presented an emerging definition from our work.
- We found no searchable characteristics when we analyzed the technical debt records.
  - Consequently, text analysis is necessary.
- We observed developers **do not identify the consequences** of technical debt in issue trackers
  - Suggested a template for improving this.

Future Vision: Towards Technical Debt Analytics



Problem: Managing the consequences of technical debt relies on an ability to (1) identify unintentional decisions and (2) quantify the consequences of such decisions.

Solution: Develop tools that integrate data from multiple, commonly available sources to surface problematic decisions and quantify consequences

Approach: Combine techniques from machine learning, code analysis, and data mining to identify problematic design issues.