

Architectural Technical Debt Identification: the Research Landscape

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Architectural Technical Debt

- **Sub-optimal decisions** resulting in **immature architectural artifacts**¹
- **ATD identification:** detecting ATDIs during or after architecting processes²
- Various researches investigated how to identify ATDIs
- **Still an open question**

¹“A Systematic Literature Review and a Unified Model of ATD.” IEEE, 2016, pp. 189-197.
T. Besker, A. Martini, and J. Bosch

²“Architectural Debt Management in Value-Oriented Architecting”. 2014. In Economics-Driven Software Architecture, pp. 183-204. Z. Li, P. Liang, and P. Avgeriou.



Secondary studies on TD

Secondary study title	Year	Focus	#Studies	Time frame
Tom et al. [26]	2013	TD	35	N/A
Li et al. [20]	2015	TD	94	1992-2013
Alves et al. [2]	2015	TD	100	2006-2014
Ampatzoglou et al. [4]	2015	TD (financial)	69	2009-2013
Besker et al. [9]	2016	ATD	26	2012-2015
Besker et al. [10]	2017	ATD	42	2011-2016



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- **Problem:** Difficult to have a clear overview of existing research solutions for **architectural technical debt identification**



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This study	2018	ATD identification	47	2009-2017



Research contributions(s)

1. **Map of the state of the art** in ATD identification;
2. **Classification framework** for ATD identification approaches;
3. Evaluation of **publication trends, specifics**, and **potential for industrial adoption**
4. Discussion of the research **trends** and **gaps** and their **implication on future research**
5. **Replication package**
 - a. <http://s2group.cs.vu.nl/techdebt-2018-replication-package/>



Results sneak peek

- Definition of **ATD categories** appears to be **missing**
- **Scarce tool support**
- **Time dimension** not always considered
- Numerous **ad-hoc analyses**
- Only **few** researches consider **ATD resolution**



Study design: RQs

- **RQ1:** What are the **publication trends** about techniques for ATD identification?



Study design: RQs

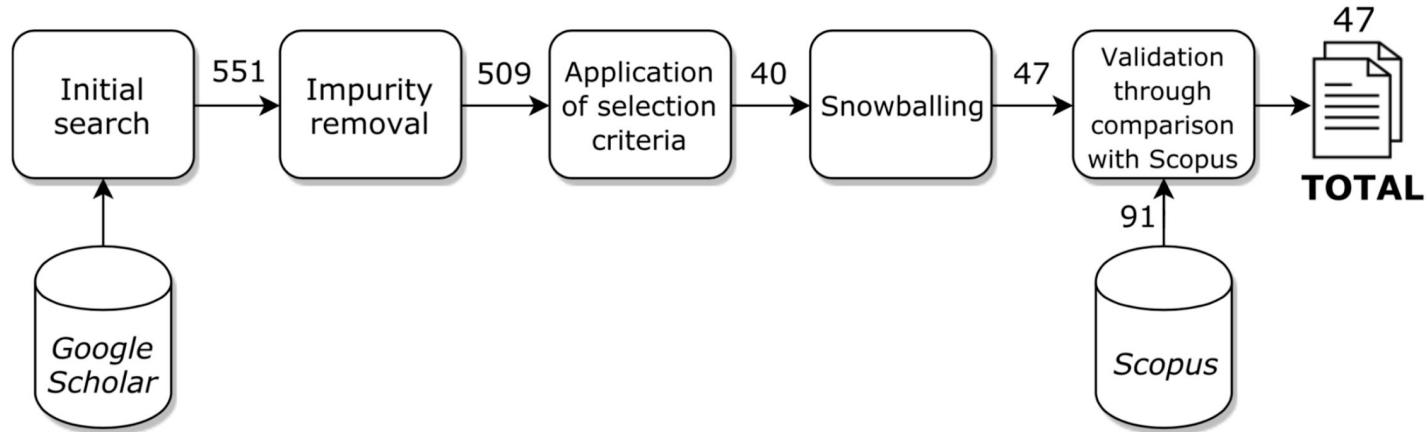
- **RQ1:** What are the **publication trends** about techniques for ATD identification?
- **RQ2:** What are the **characteristics** of existing techniques for ATD identification?



Study design: RQs

- **RQ1:** What are the **publication trends** about techniques for ATD identification?
- **RQ2:** What are the **characteristics** of existing techniques for ATD identification?
- **RQ3:** What is the **potential for industrial adoption** of existing techniques for ATD identification?

Study design: *Search and selection*

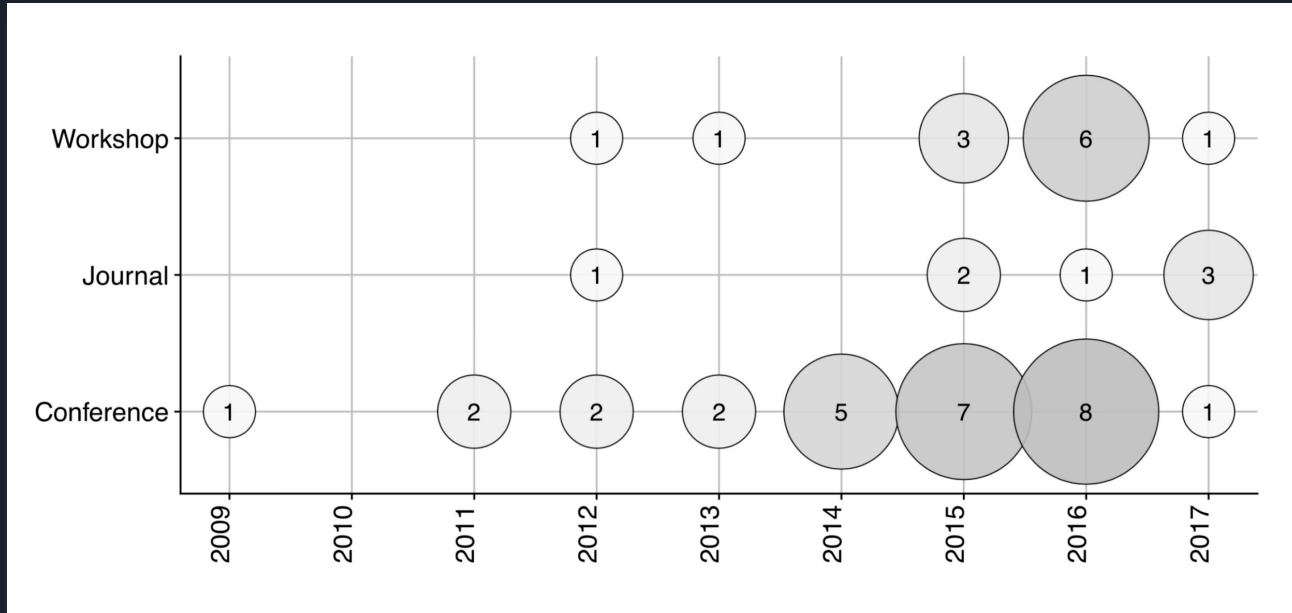




Systematic Mapping Study

- RQ1: What are the **publication trends** of techniques for ATD identification?
 - Scientific interest, contribution type, venues
- RQ2: What are the characteristics of existing techniques for ATD identification?
- RQ3: What is the potential for industrial adoption of existing techniques for ATD identification?

RQ1: Publication trends



Findings: Topic is attracting a growing scientific interest.
Conferences and workshops most targeted venues.

RQ1: Publication trends

Venues



Findings: Fragmented community



Systematic Mapping Study

- *RQ1: What are the publication trends about techniques for ATD identification?*
- RQ2: What are the **characteristics** of existing techniques for ATD identification?
 - Understanding current trends and gaps
 - Classification framework through keywording process
- *RQ3: What is the potential for industrial adoption of existing techniques for ATD identification?*



RQ2: Approach characteristics

RQ2: What are the **characteristics** of existing techniques for ATD identification?

- Architectural level
- ATDI definition
- Analysis type
- Input
- Temporal dimension
- ATD resolution
- Tool support



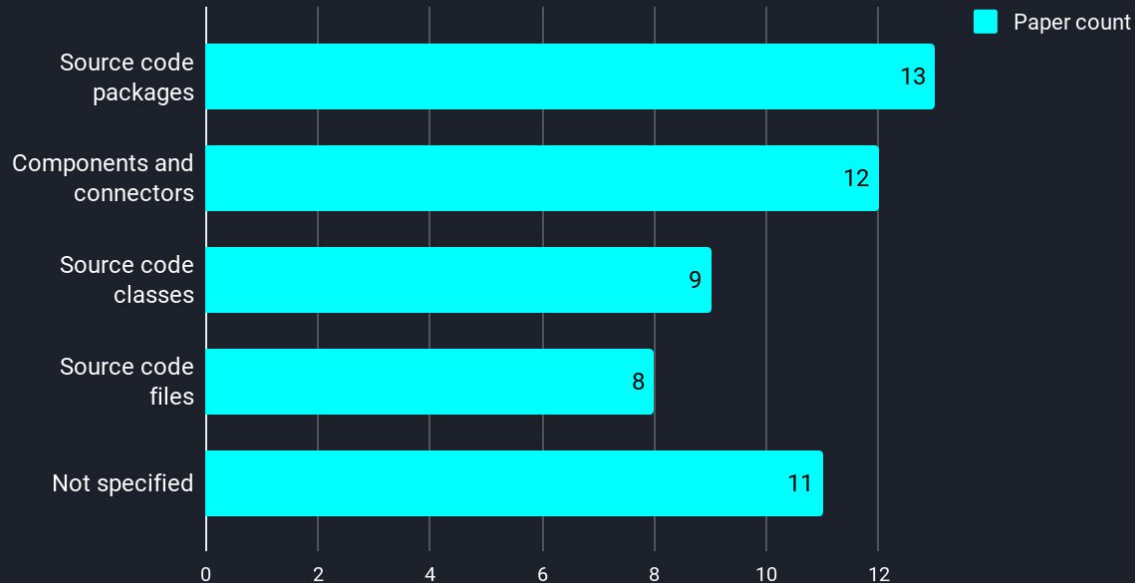
RQ2: Approach characteristics

RQ2: What are the characteristics of existing techniques for ATD identification?

- **Architectural level**
- ATDI definition
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RQ2: Approach characteristics

Architectural level



Findings: Different architectural levels considered
Many occurrences of *unspecified*



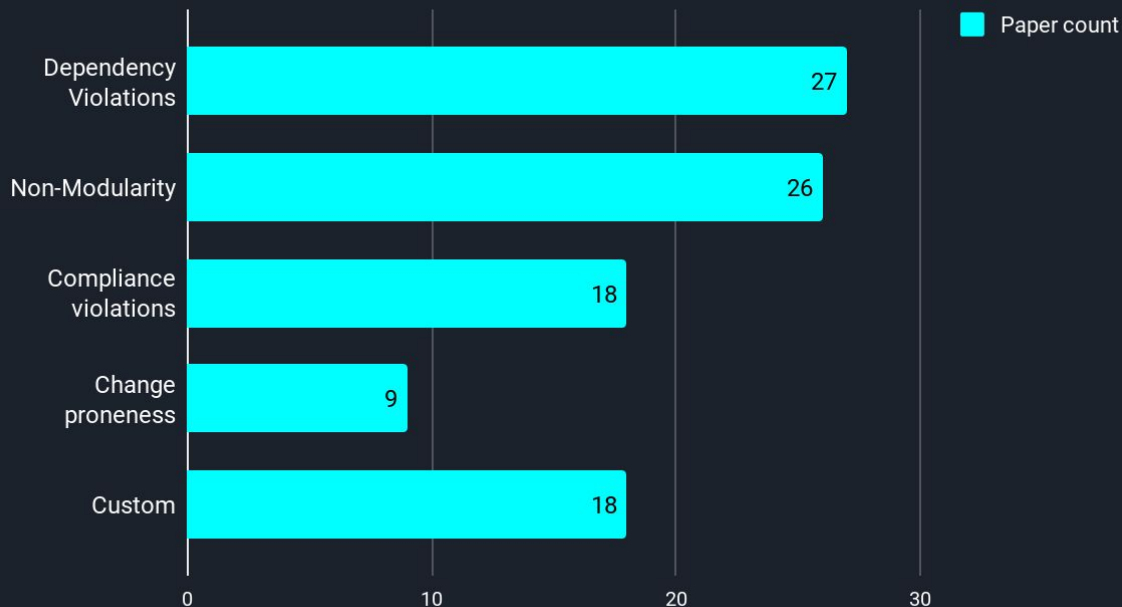
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RQ2: Approach characteristics

ATDI definition



Findings: Various ATDI definitions are considered
High number of custom definitions



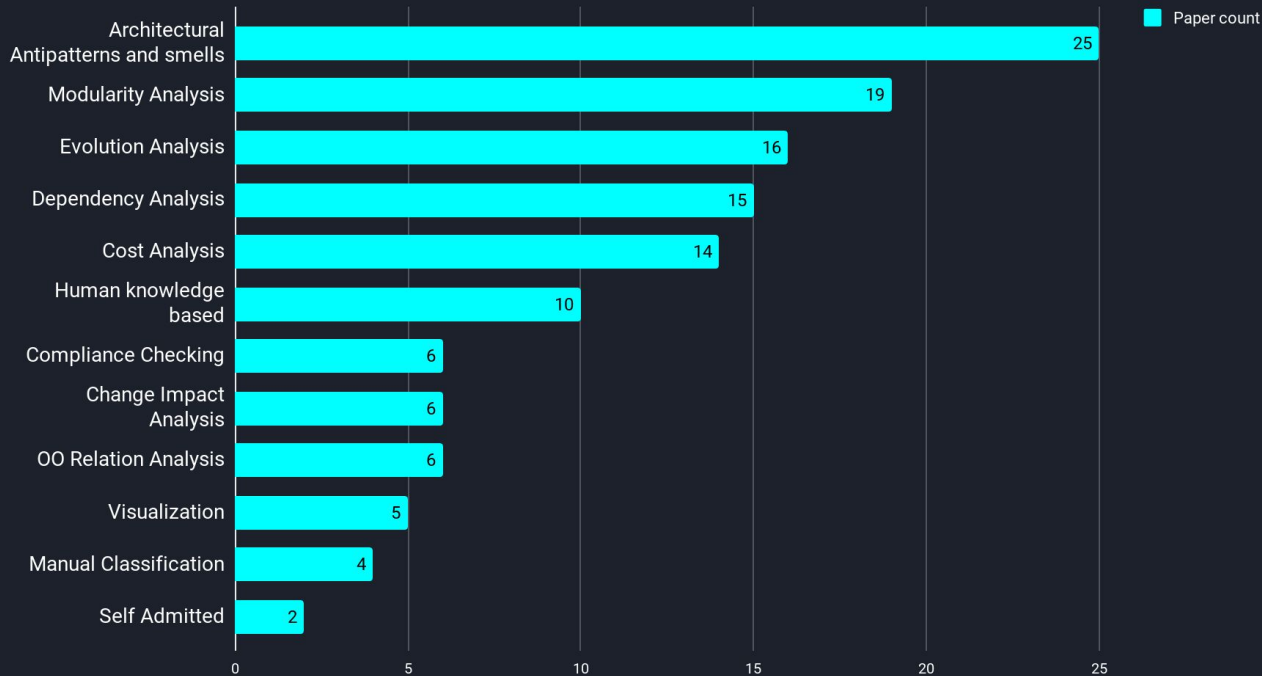
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RQ2: Approach characteristics

Analysis type



Findings: Heterogeneous types of analysis
Most analyses rooted in code
Some types only marginally explored



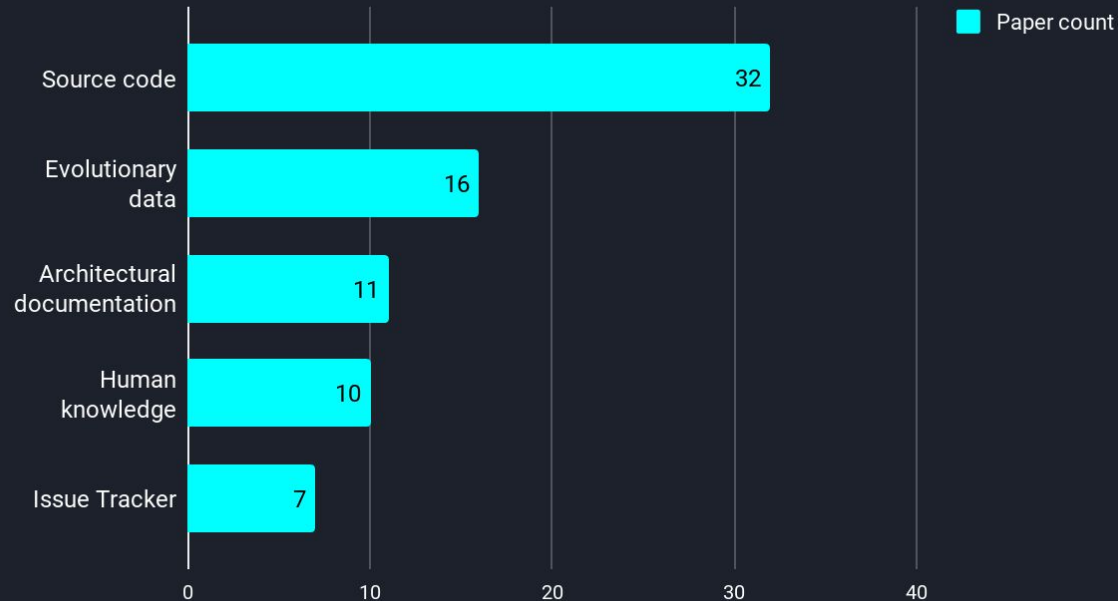
RQ2: Approach characteristics

RQ2: What are the characteristics of existing techniques for ATD identification?

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- Analysis type
- **Input**
- Temporal dimension
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- Tool support

RQ2: Approach characteristics

Analysis input



Findings: Identification strongly rooted in source code



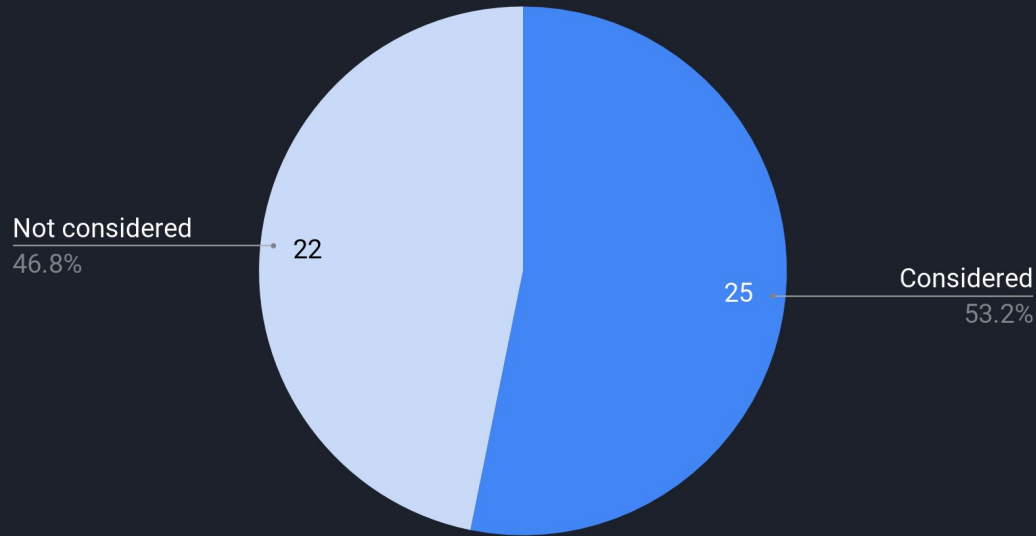
RQ2: Approach characteristics

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- Architectural level
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- Input
- **Temporal dimension**
- ATD resolution
- Tool support

RQ2: Approach characteristics

Temporal dimension



Findings: Almost half of the studies do not consider temporal aspects



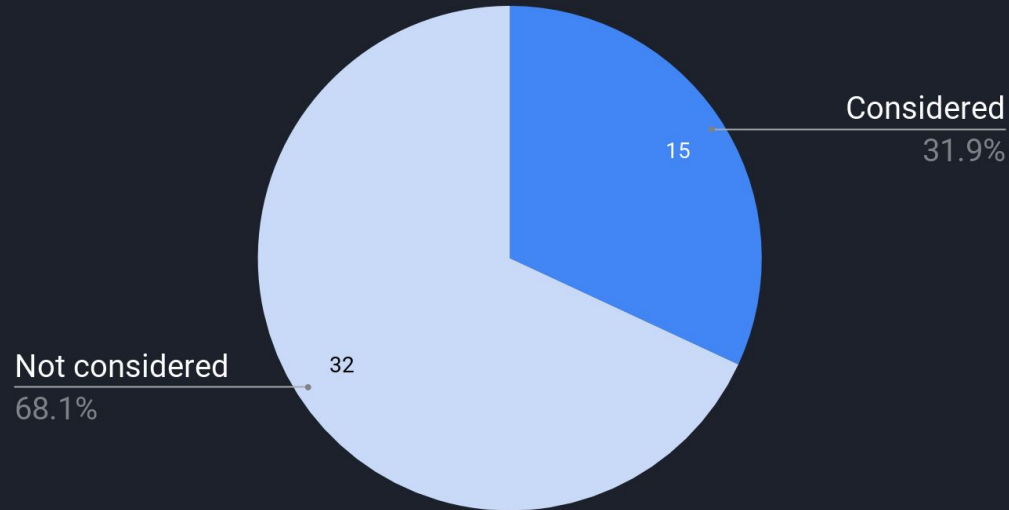
RQ2: Approach characteristics

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- Architectural level
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- Temporal dimension
- **ATD resolution**
- Tool support

RQ2: Approach characteristics

ATD Resolution



Findings: ATD resolution only marginally considered



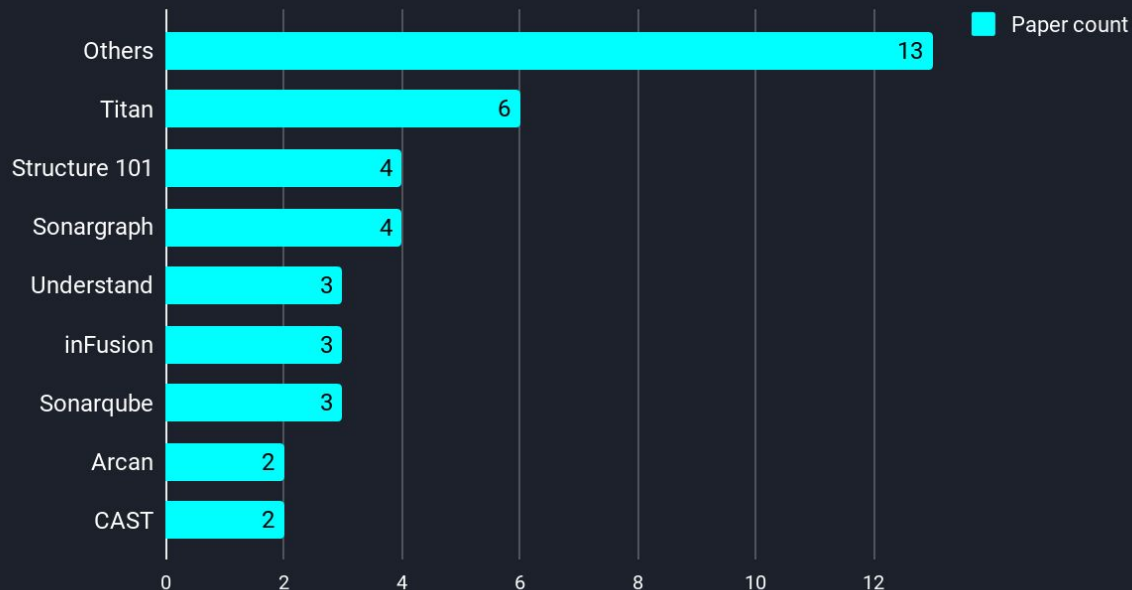
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RQ2: What are the characteristics of existing techniques for ATD identification?

- Architectural level
- ATDI definition
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- Temporal dimension
- ATD resolution
- **Tool support**

RQ2: Approach characteristics

Tool support



Findings: Heterogeneous toolset

Scope ranges from *general purpose* to *ad-hoc* solutions

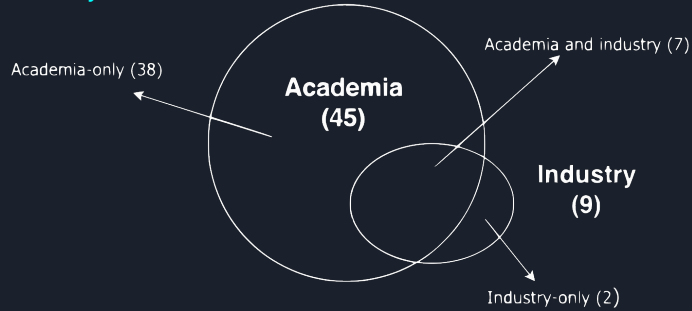


Systematic Mapping Study

- RQ1: *What are the publication trends about techniques for ATD identification?*
- RQ2: *What are the characteristics of existing techniques for ATD identification?*
- RQ3: *What is the **potential for industrial adoption** of existing techniques for ATD identification?*
 - *Are we ready to transfer knowledge to industry?*

RQ3: Potential for industrial adoption

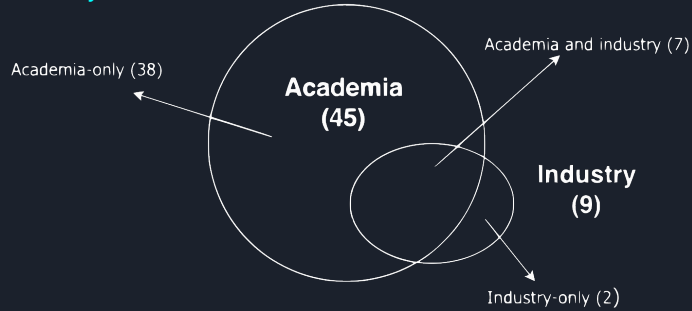
Industry involvement



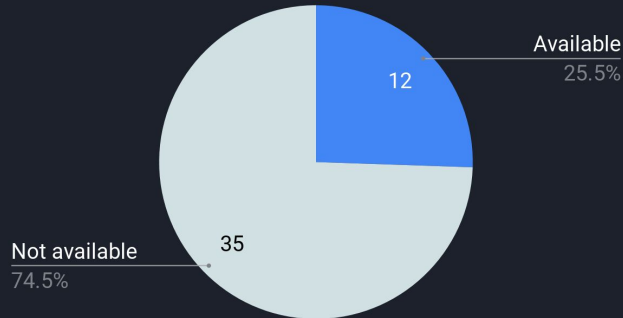
Findings: Mostly academic research,

RQ3: Potential for industrial adoption

Industry involvement



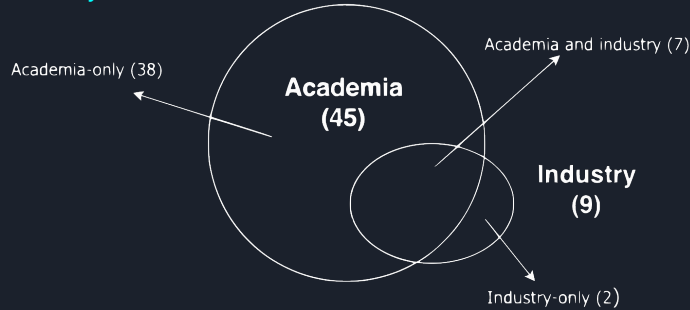
Tool availability



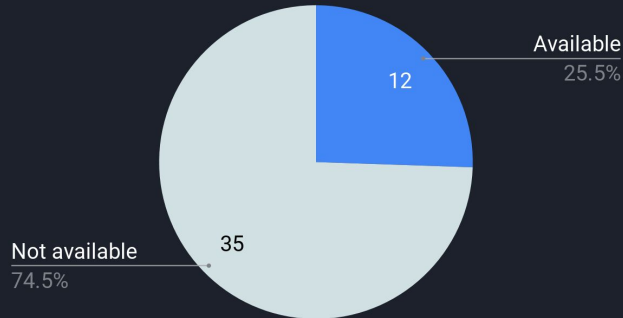
Findings: Mostly academic research, scarce tool support,

RQ3: Potential for industrial adoption

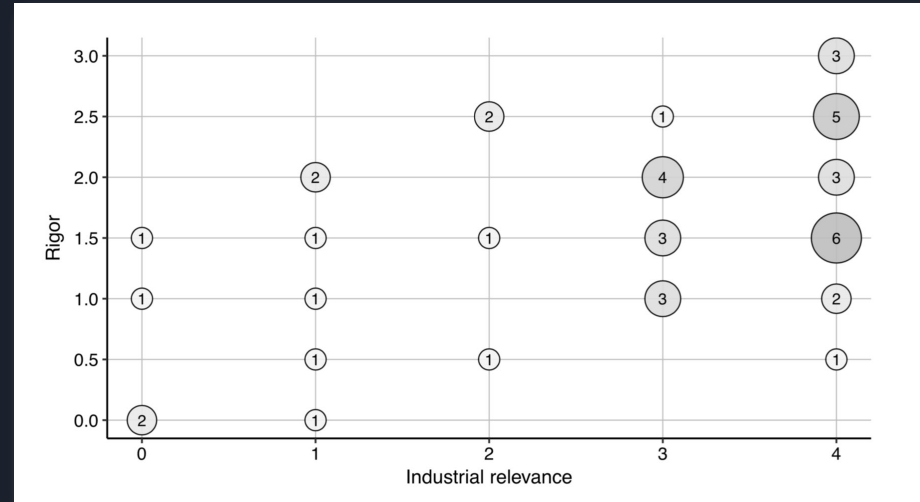
Industry involvement



Tool availability



Rigor and industrial relevance



Findings: Mostly academic research, scarce tool support, scattered rigor and medium/high relevance.



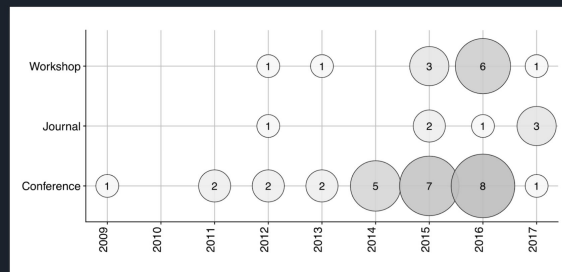
Take aways

- Definition of **ATD categories** appears to be **missing**
- **Scarce tool support**
- **Time dimension** not always considered
- Numerous ***ad-hoc analyses***
- ATD identification is **strongly rooted** into TD techniques working at the source code level
- **ATD resolution** only marginally explored

Study design: RQs

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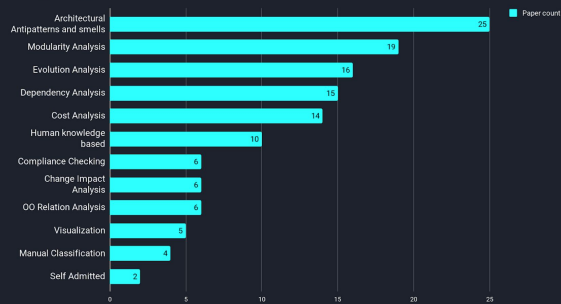
RQ1: Publication trends



Findings: Topic is attracting a growing scientific interest.
Conferences and workshops most targeted venues.

RQ2: Approach characteristics

Analysis type



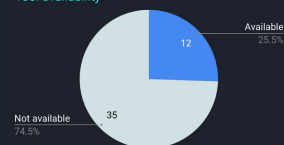
Findings: Heterogeneous types of analysis
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RQ3: Potential for industrial adoption

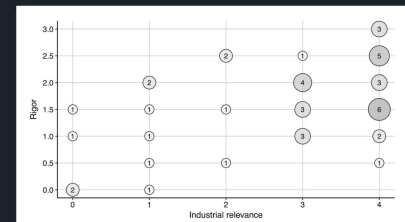
Industry involvement



Tool availability



Rigor and industrial relevance



Findings: Mostly academic research, scarce tool support, high rigor and medium relevance

Architectural Technical Debt Identification: the Research Landscape

Backup slides

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Search Query

```
TITLE:(architecture OR architectural OR architect OR  
architecting OR TD OR "technical debt" OR ATD)  
AND (architecture OR architectural OR architect  
OR architecting) AND ("technical debt")
```



Inclusion criteria

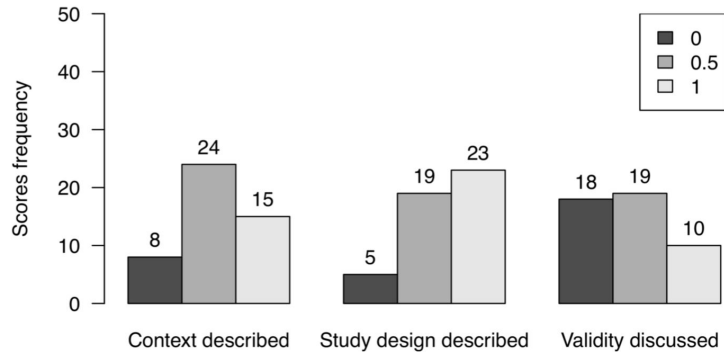
1. Studies focusing on **TD identification** in software-intensive systems.
2. Studies focusing on the **architecture** of software-intensive systems.
3. Studies presenting or using a **technique aimed to the identification of ATD** in software-intensive systems.



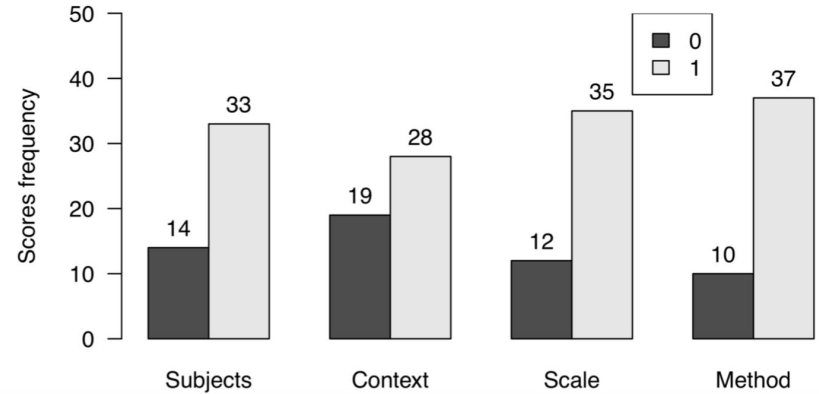
Exclusion criteria

1. **Secondary** or **tertiary studies** (e.g., systematic literature reviews, surveys, etc.).
2. Studies in the form of **editorials** and **tutorial, short papers**, and **poster**.
3. Studies that have **not** been published **in English** language.
4. Studies that have **not** been **peer reviewed**.
5. **Duplicate papers or extensions** of already included papers.
6. Papers that are **not available**.

Rigor and relevance



Rigor of primary studies



Industrial relevance of primary studies