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 processes\(^2\)
- Various researches investigated how to identify ATDIs
- **Still an open question**

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   T. Besker, A. Martini, and J. Bosch
### Secondary studies on TD

<table>
<thead>
<tr>
<th>Secondary study title</th>
<th>Year</th>
<th>Focus</th>
<th>#Studies</th>
<th>Time frame</th>
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- **Problem:** Difficult to have a clear overview of existing research solutions for **architectural technical debt identification**
Secondary studies on TD

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<td><strong>This study</strong></td>
<td>2018</td>
<td>ATD identification</td>
<td><strong>47</strong></td>
<td><strong>2009-2017</strong></td>
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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
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?
Findings: Topic is attracting a growing scientific interest. Conferences and workshops most targeted venues.
RQ1: Publication trends

Venues

Findings: Fragmented community
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: What are the characteristics of existing techniques for ATD identification?

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

Findings: Different architectural levels considered
Many occurrences of unspecified
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

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

Verdecchia et al., ATD Identification: The research landscape
RQ2: Approach characteristics

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

Findings: Identification strongly rooted in source code
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

Verdecchia et al., ATD Identification: The research landscape
Findings: Almost half of the studies do not consider temporal aspects
RQ2: What are the characteristics of existing techniques for ATD identification?

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

Verdecchia et al., *ATD Identification: The research landscape*
RQ2: Approach characteristics

Findings: ATD resolution only marginally considered
RQ2: Approach characteristics

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

- Architectural level
- ATDI definition
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- Input
- Temporal dimension
- ATD resolution
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Verdecchia et al., ATD Identification: The research landscape
Findings:
Heterogeneous toolset
Scope ranges from general purpose to ad-hoc solutions
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?
Findings: Mostly academic research,
Findings: Mostly academic research, scarce tool support,
RQ3: Potential for industrial adoption

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

Verdecchia et al., *ATD Identification: The research landscape*
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?

### RQ1: Publication trends

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

### RQ2: Approach characteristics

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<tr>
<td>Architectural analysis and metrics</td>
<td>20</td>
</tr>
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<td>Modularity analysis</td>
<td>15</td>
</tr>
<tr>
<td>Evolution analysis</td>
<td>10</td>
</tr>
<tr>
<td>Dependency analysis</td>
<td>10</td>
</tr>
<tr>
<td>Cost Analysis</td>
<td>8</td>
</tr>
<tr>
<td>Human knowledge support</td>
<td>6</td>
</tr>
<tr>
<td>Complexity checking</td>
<td>5</td>
</tr>
<tr>
<td>Change impact analysis</td>
<td>5</td>
</tr>
<tr>
<td>Design related metrics</td>
<td>3</td>
</tr>
<tr>
<td>Visualization</td>
<td>3</td>
</tr>
<tr>
<td>Manual classification</td>
<td>2</td>
</tr>
<tr>
<td>Self-adaptation</td>
<td>1</td>
</tr>
</tbody>
</table>

**Findings**: Heterogeneous types of analysis.
Most analyses rooted in code. Some types only marginally exploited.

### RQ3: Potential for industrial adoption

- **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")
```
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.
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

![Bar chart showing scores frequency for context described, study design described, and validity discussed.

Scores frequency:
- Context described: 8, 24, 15
- Study design described: 5, 19, 23
- Validity discussed: 18, 19, 10

Industrial relevance of primary studies

![Bar chart showing scores frequency for subjects, context, scale, and method.

Scores frequency:
- Subjects: 14, 33
- Context: 19, 28
- Scale: 12, 35
- Method: 10, 37]