VU VRIJE UNIVERSITEIT AMSTERDAM

Software Engineering Institute
Carnegie Mellon

ENASE 2020
5 May 2020

ATDx
Building an Architectural Technical Debt IndeX

*R. Verdecchia** r.verdecchia@vu.nl

*P. Lago** p.lago@vu.nl

*I. Malavolta** i.malavolta@vu.nl

I.Ozkaya† ozkaya@sei.cmu.edu

*Vrije Universiteit Amsterdam, The Netherlands †Software Engineering Institute, Carnegie Mellon, USA

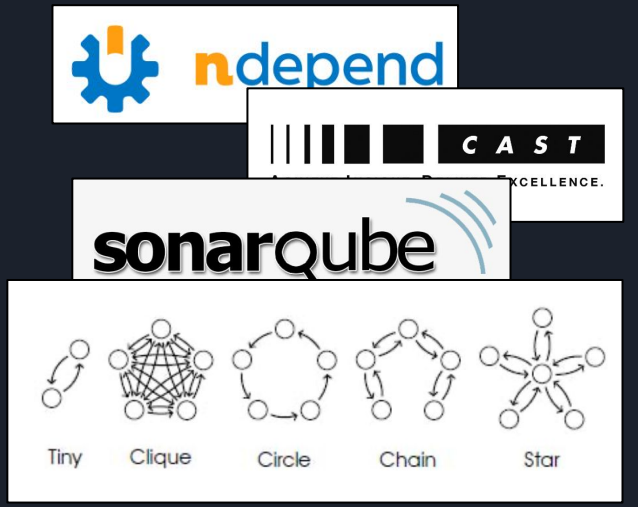
Architectural Technical Debt

- **Suboptimal decisions** resulting in **immature architectural artifacts**[1]
- Hinders long term **maintainability** and **evolvability**
- **Widespread** through code-bases, mostly **invisible**, and of **high remediation cost**[2]

[1] "A Systematic Literature Review and a Unified Model of ATD." IEEE, 2016, pp. 189-197. T. Besker, A. Martini, and J. Bosch
[2] "Technical debt: From metaphor to theory to practice". IEEE Software, 2012, pp. 18–21. P. Kruchten., R. L. Nord, and I. Ozkaya.

The problem

- **Numerous industrial and academic[1] source-code analysis tools**
- **Fine-grained techniques**
- **Ad-hoc definitions of ATD and analyses**
- **Heterogeneous, context-independent, results**
- The “bigger picture” gets easily lost



[1] “Towards an architectural debt index”. Roveda, R., Arcelli Fontana, F., Pigazzini, I., and Zanoni, M. (2018). In 44th Euromicro Conference on Software Engineering and Advanced Applications (SEAA), pages 408–416. IEEE.

The goal

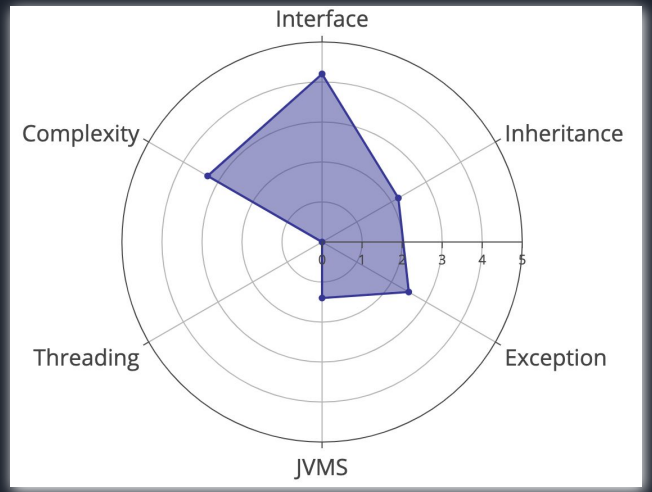
Gain an encompassing and intuitive overview of the architectural technical debt present in a software system

ATDx: an Architectural TD IndeX

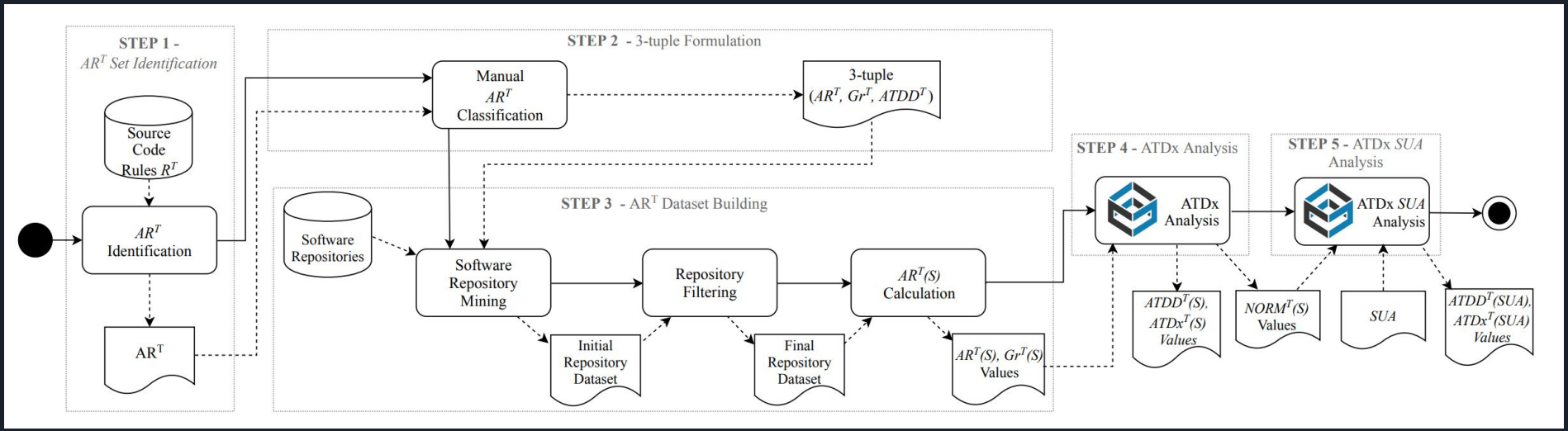
- **Data-driven** approach
- **Tool-**, and **language-independent**
- Supports **tool composability**
- **Multi-level granularity results**
- Designed with **extensibility** in mind

ATDx in a nutshell

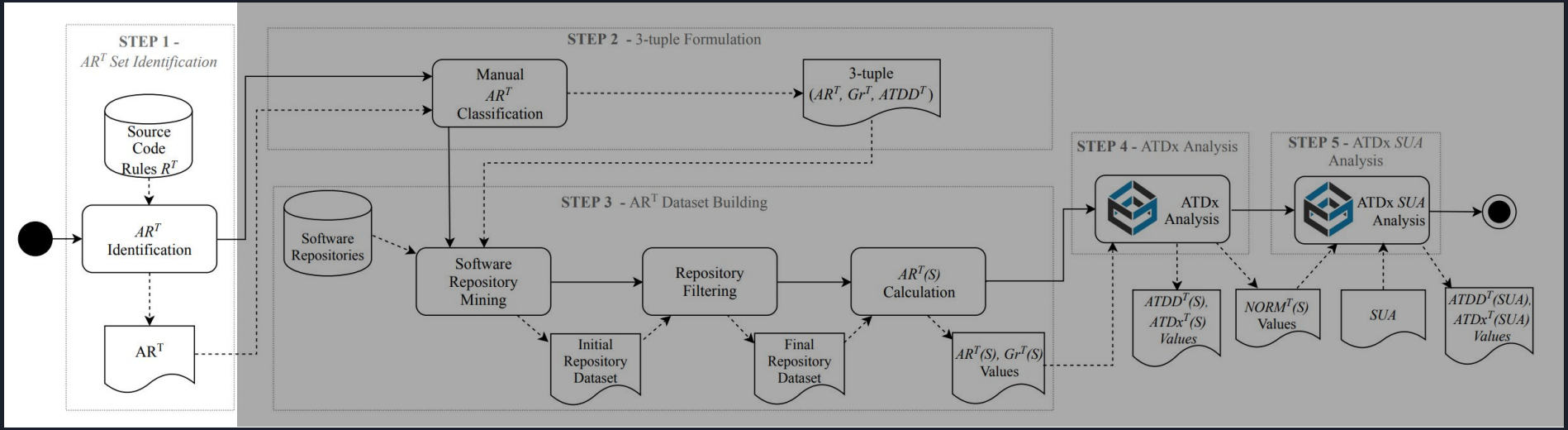
- Leverage **pre-computed metrics** of analysis tools
- **Qualitative** and **quantitative metric aggregation**
- Consider different **ATD dimensions**
- **Intra-project normalization** of metric values
- **Inter-project** large-scale statistical analysis



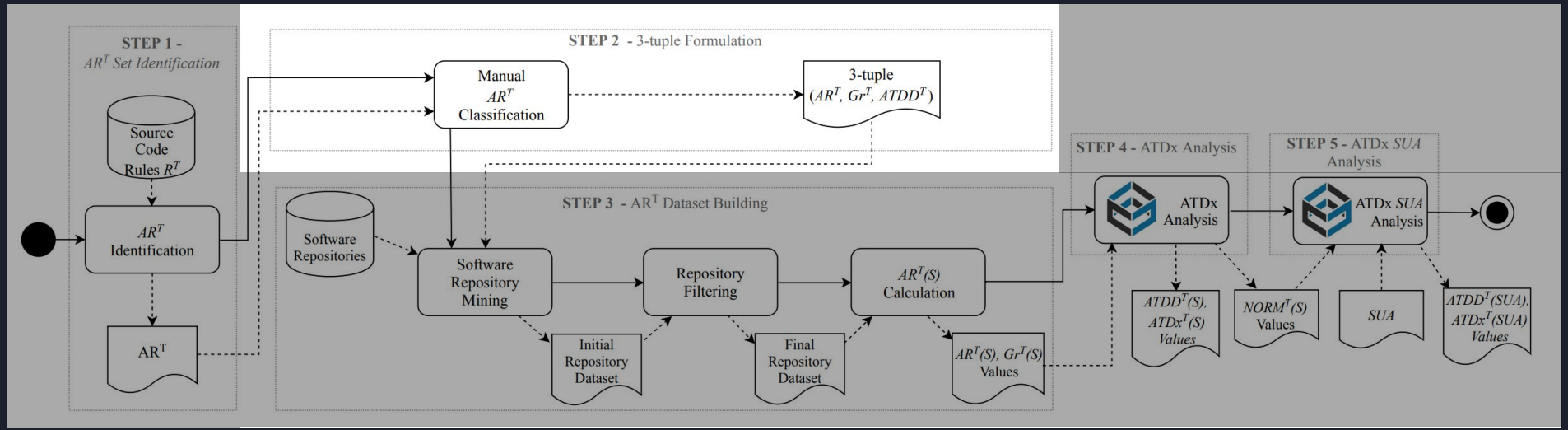
ATDx overview



ATDx, STEP 1
Architectural rules identification



ATDx, STEP 2
3-tuple formulation



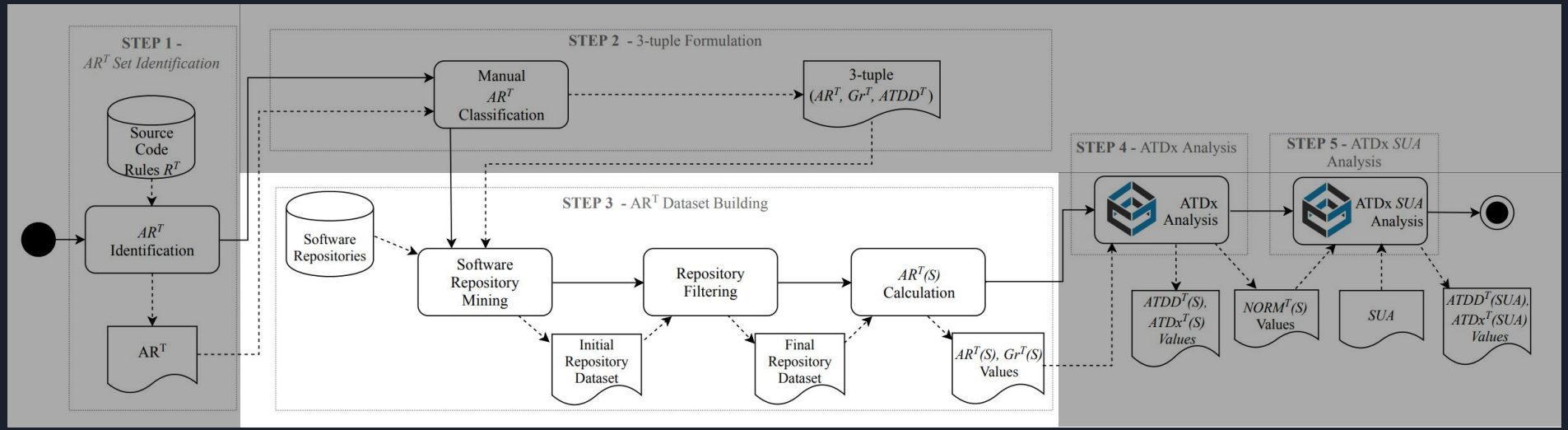
ATDx, STEP 2
3-tuple formulation: Example

"Abstract classes without fields should be converted to interfaces"[1]

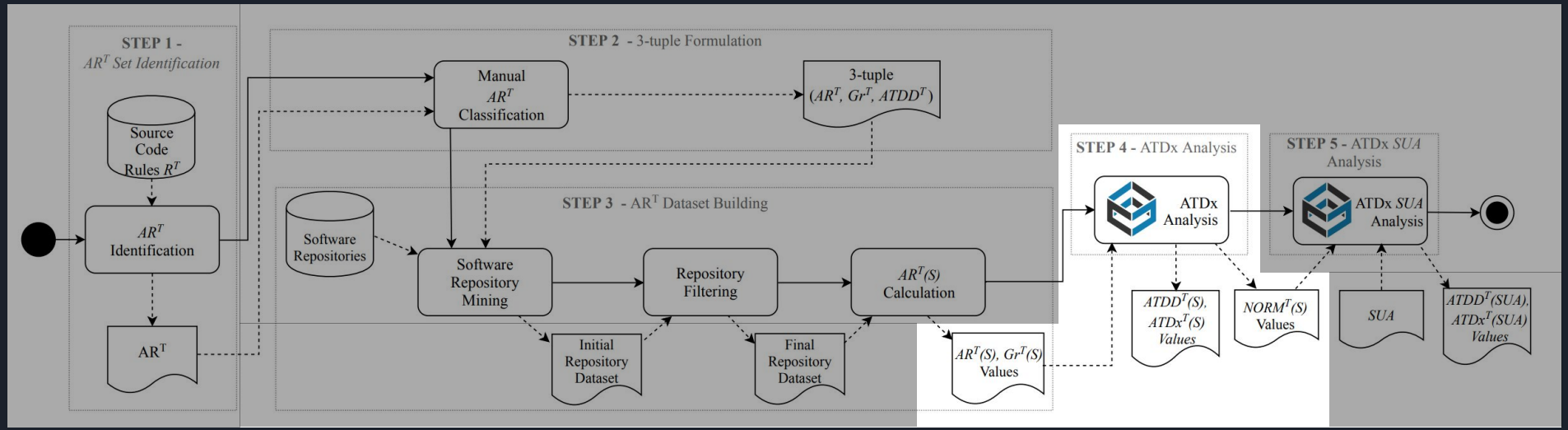
1. **Architectural Technical Debt rule**
   ✓Architectural, TD relevant
2. **Granularity:** ***Class level***
3. **ATD Dimension:** ***Interface***

[1] https://jira.sonarsource.com/browse/RSPEC-1610

ATDx, STEP 3
Dataset building

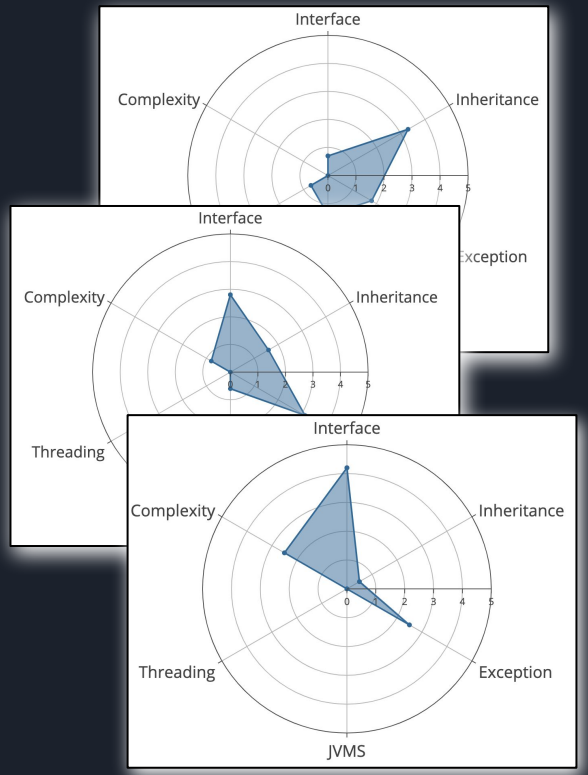


ATDx, STEP 4
Statistical Analysis



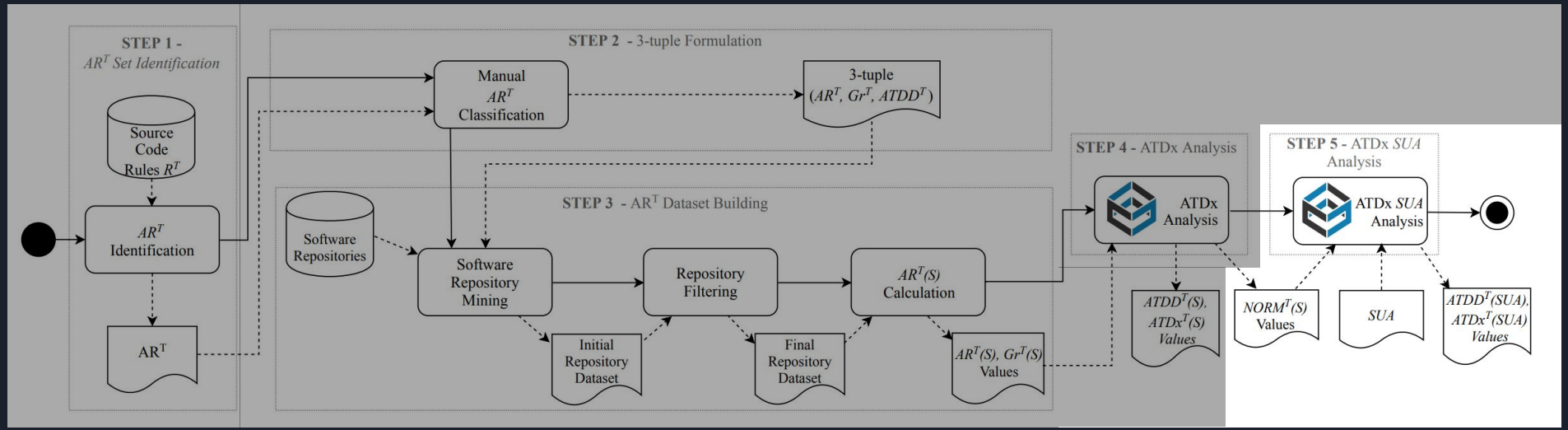
ATDx, STEP 4
Statistical Analysis

1. **Normalize** cumulative AR violations **at system level**
2. Establish **cross-project dataset** of normalized values
3. Identify projects with **outlier violation values**
4. Summarize per-project results into **ATD dimensions**
5. Calculate per-project summary **ATDx value**



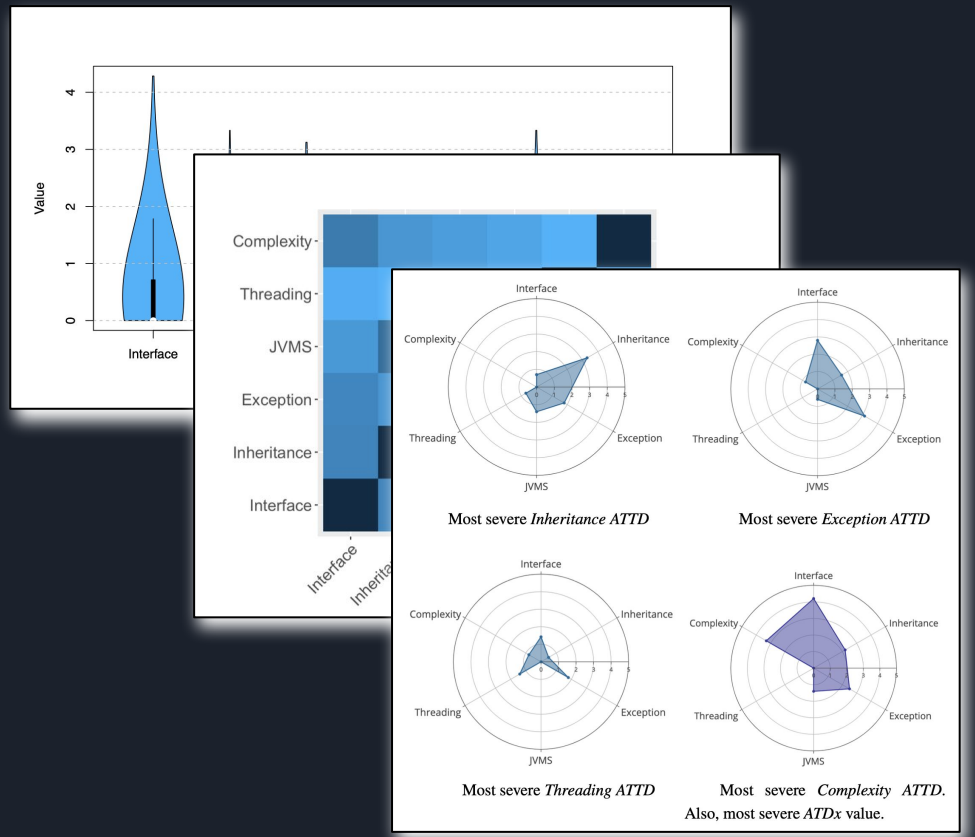
ATDx, STEP 5

Analysis of a specific project



ATDx Prototyping

- **Technical Report[1]**
- **SonarQube-based**
- **6,706** software **projects**
- **~90M SLOC**
- **6 ATD dimensions**



[1] https://github.com/ATDindeX/ATDx

Takeaways

- **Source-code** Architectural Technical Debt index
- Based on **inter-project metric analysis**
- Ideal for:
  - **Comprehensive and intuitive overview** of ATD
  - Software **portfolio management**
- Currently working on:
  - Approach **refinement**
  - Experimentation in **industrial context**

The goal

Gain an encompassing and intuitive overview of the architectural technical debt present in a software system

ATDx: an Architectural TD IndeX

- **Data-driven** approach
- **Tool-**, and **language-independent**
- Supports **tool composability**
- **Multi-level granularity results**
- Designed with **extensibility** in mind

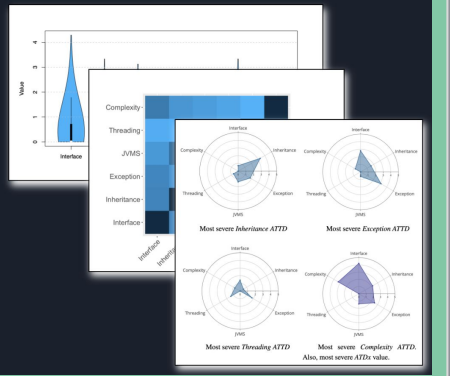
ATDx

ATDx in a nutshell

- Leverage **pre-computed metrics** of analysis tools
- **Qualitative** and **quantitative metric aggregation**
- Consider different **ATD dimensions**
- **Intra-project normalization** of metric values
- **Inter-project** large-scale statistical analysis

ATDx Prototyping

- **Technical Report**[1]
- **SonarQube-based**
- **6,706** software **projects**
- **~90M SLOC**
- **6 ATD dimensions**



[1] https://github.com/ATDindeX/ATDx