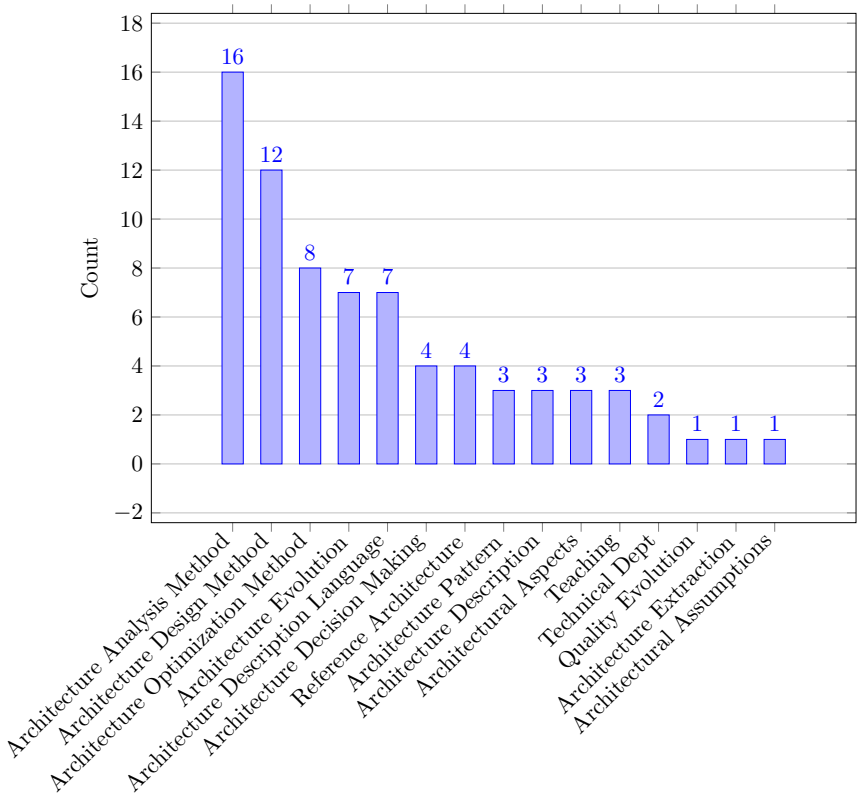
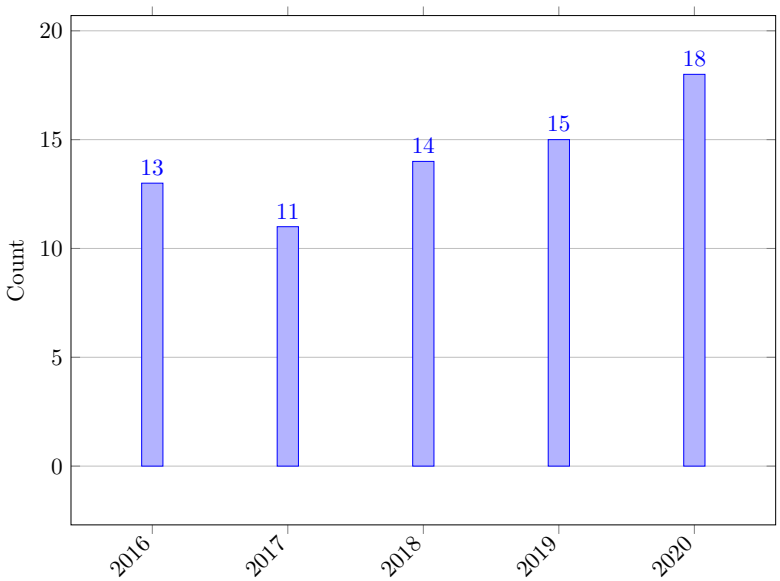
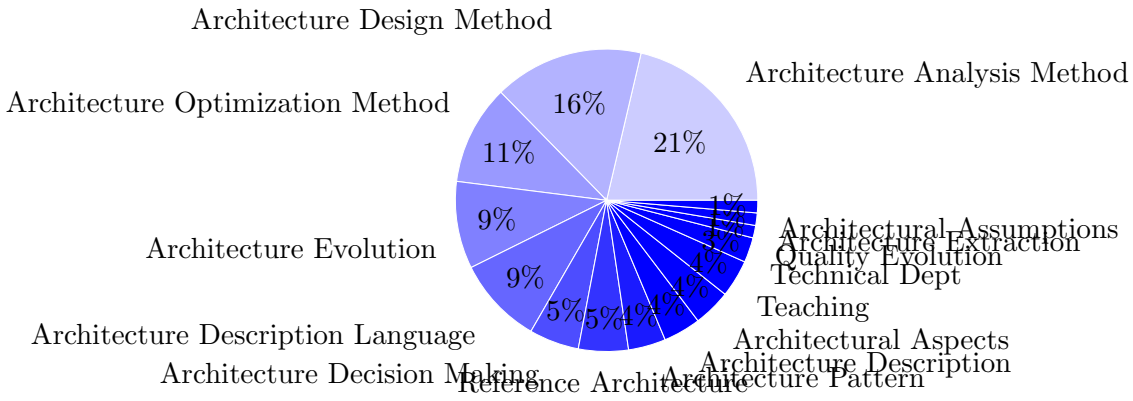
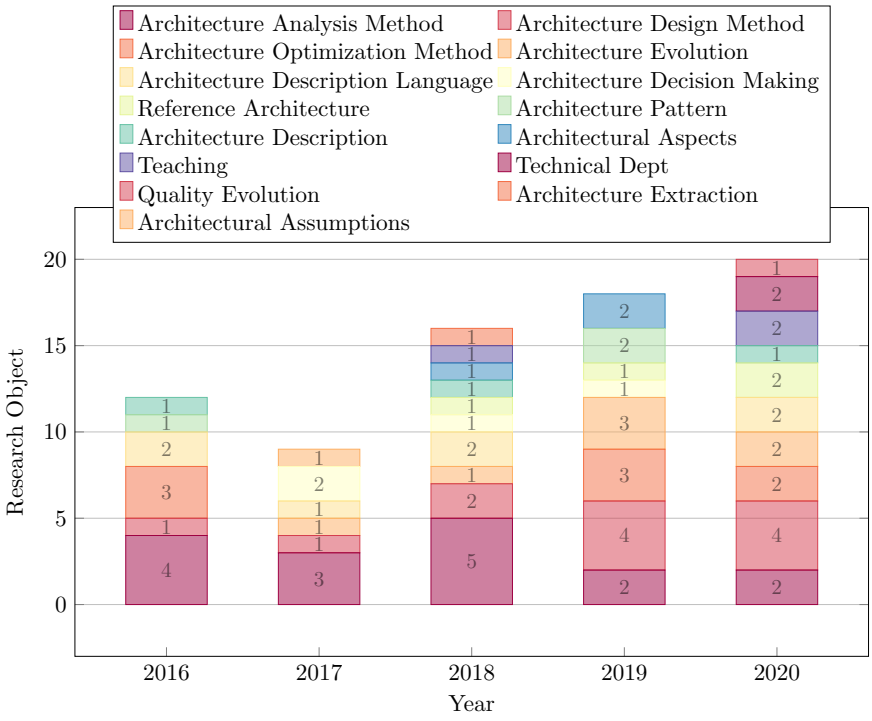
1 Research Objects



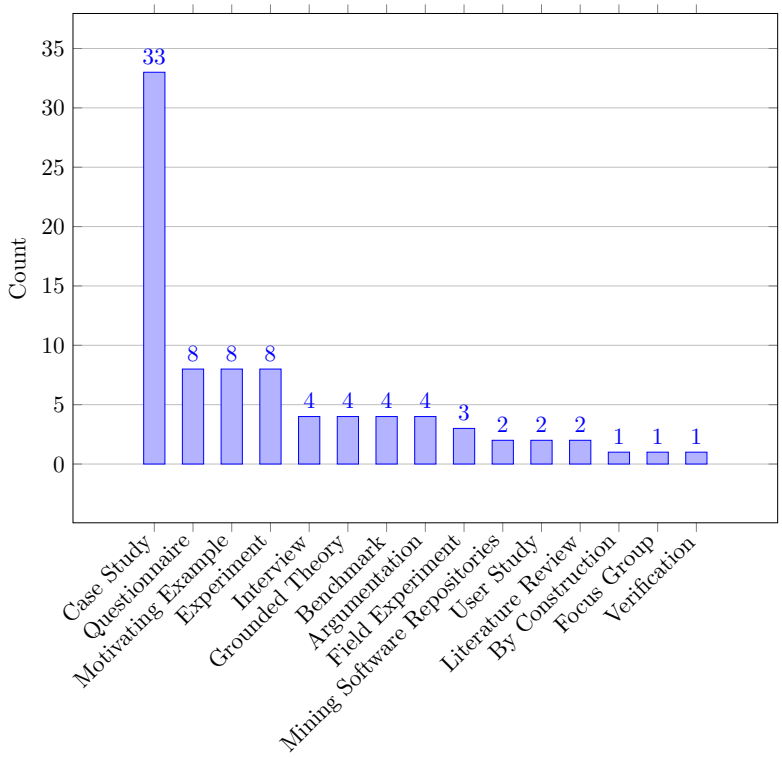


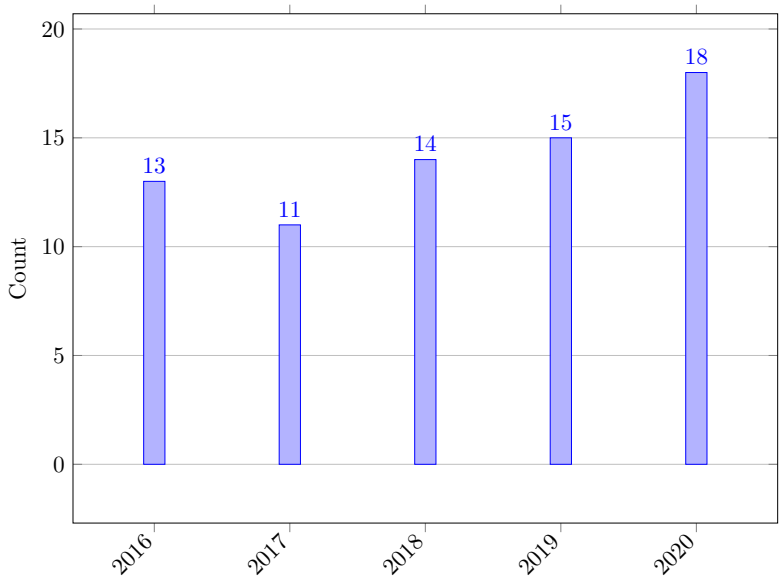


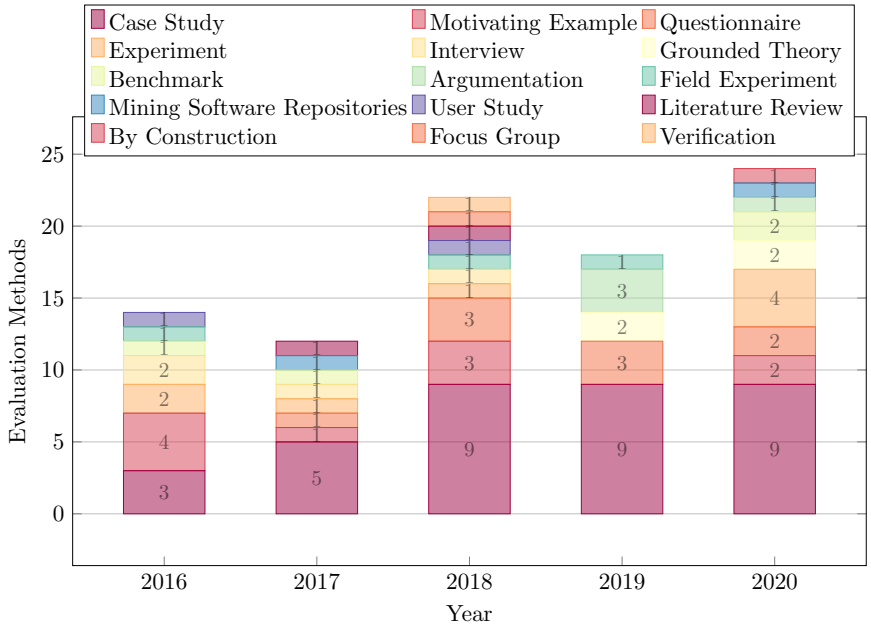
Pie chart for Research Object (75)

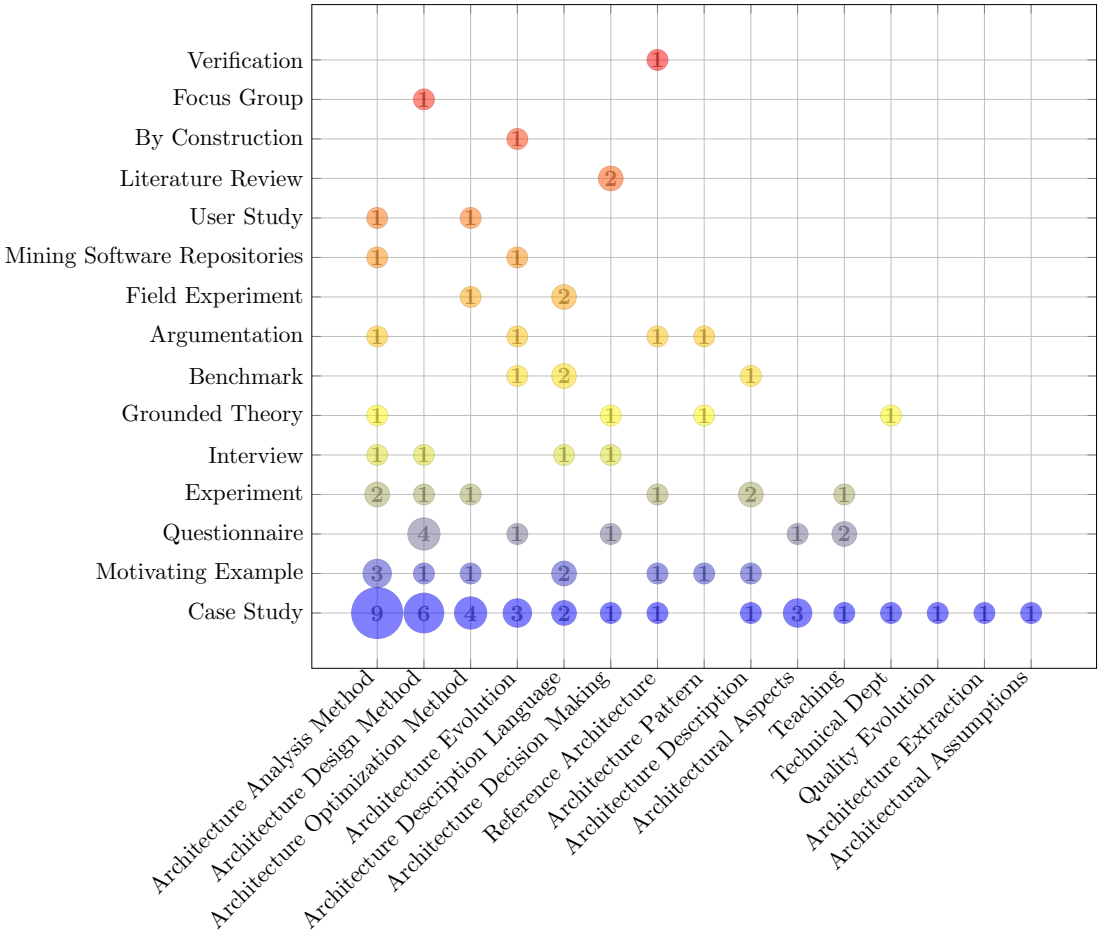


2 Evaluation Methods

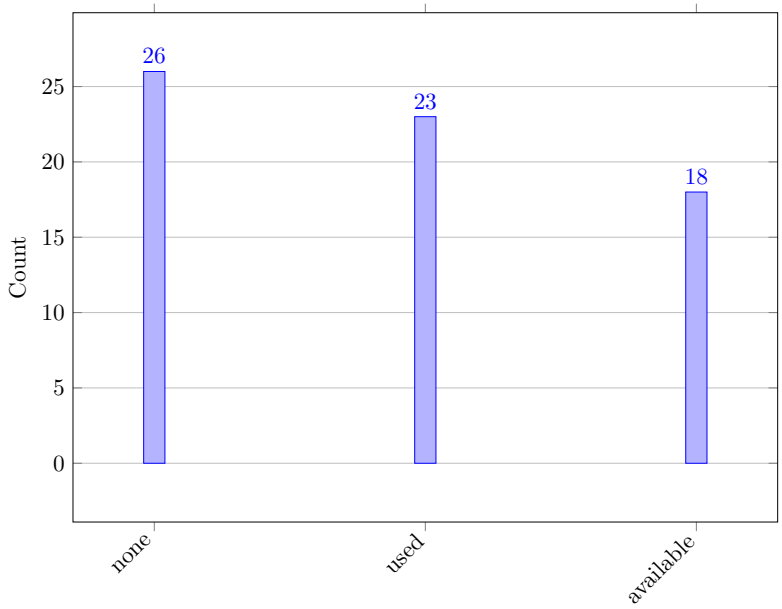


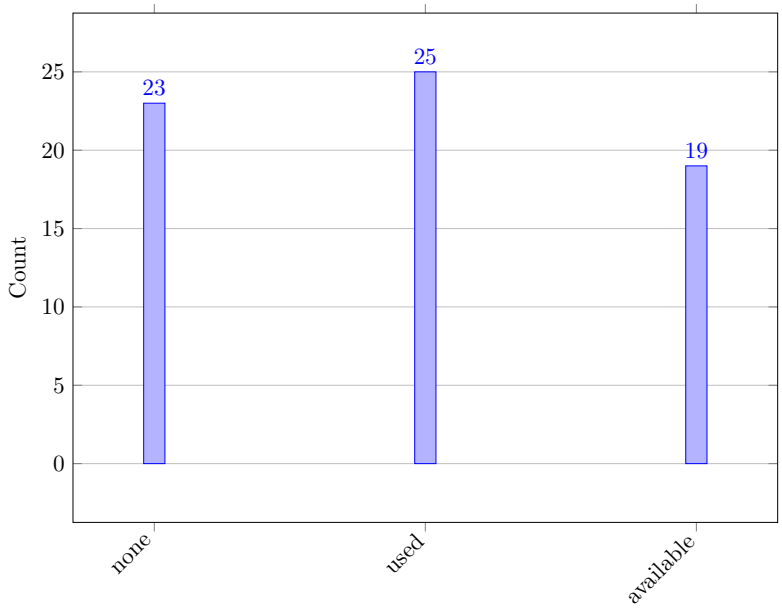


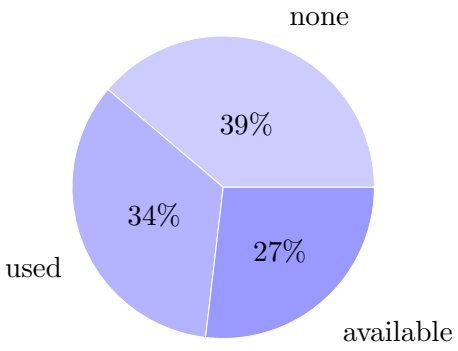

Case Study
Motivating Example
Questionnaire
Experiment
Interview
Grounded Theory
Benchmark
Argumentation
Field Experiment
Mining Software Repositories
User Study
Literature Review
By Construction
Focus Group
Verification
Evaluation Methods
Year
2016
2017
2018
2019
2020


Verification
Focus Group
By Construction
Literature Review
User Study
Mining Software Repositories
Field Experiment
Argumentation
Benchmark
Grounded Theory
Interview
Experiment
Questionnaire
Motivating Example
Case Study
Architecture Analysis Method
Architecture Design Method
Architecture Optimization Method
Architecture Evolution
Architecture Description Language
Architecture Decision Making
Reference Architecture
Architecture Pattern
Architecture Description
Architectural Aspects
Teaching
Technical Dept
Quality Evolution
Architecture Extraction
Architectural Assumptions

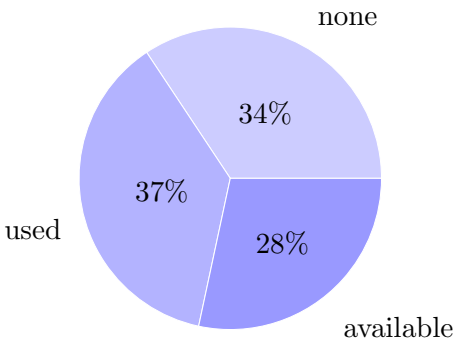
3 Replication Package



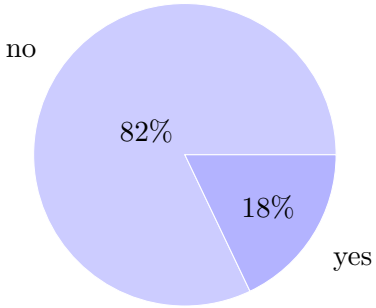




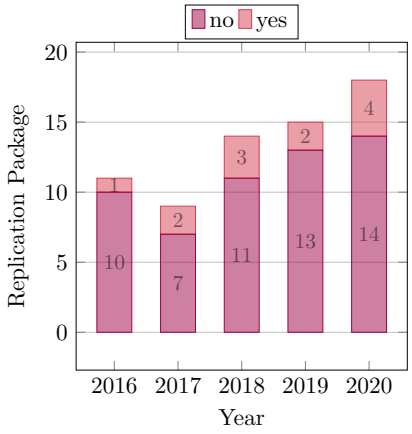
Pie chart for Tool Prototype (67)

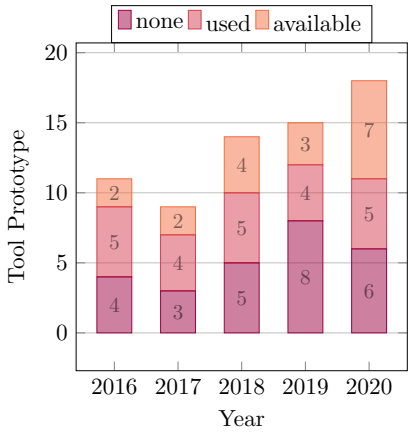


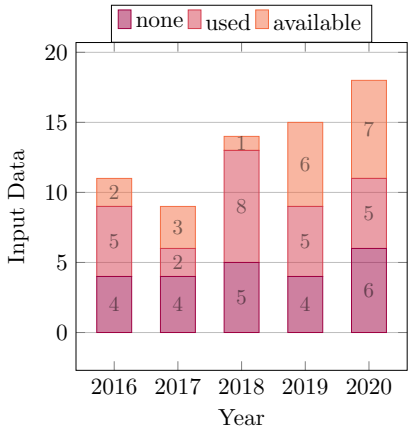
Pie chart for Input Data (67)



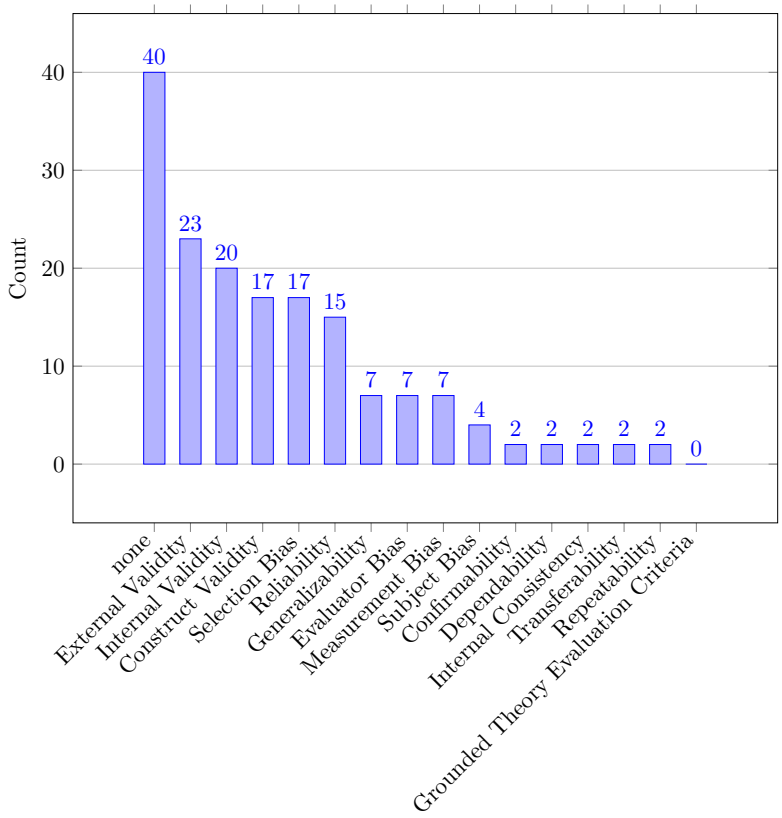
Pie chart for Replication Package (67)

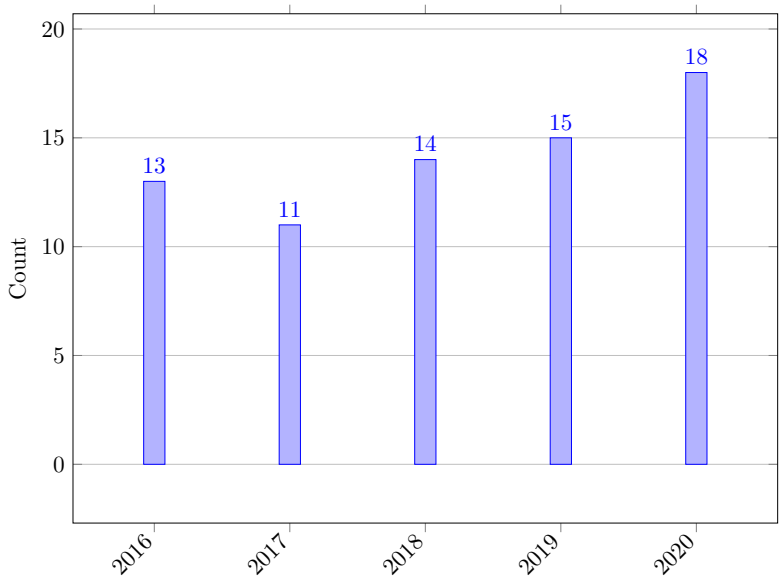

no
yes
Replication Package
20
15
10
5
0
1
10
2
7
3
11
2
13
4
14
2016
2017
2018
2019
2020
Year

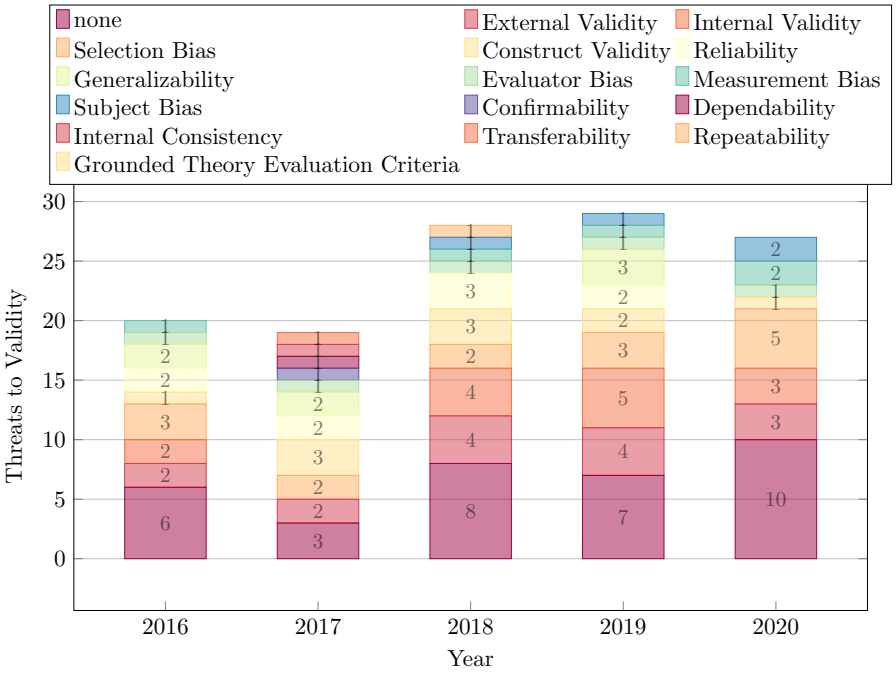

none
used
available
Tool Prototype
20
15
10
5
0
2
5
4
2
4
3
4
5
5
3
4
8
7
5
6
2016
2017
2018
2019
2020
Year


none
used
available
Input Data
20
15
10
5
0
2
5
4
3
2
4
1
8
5
6
5
4
7
5
6
2016
2017
2018
2019
2020
Year

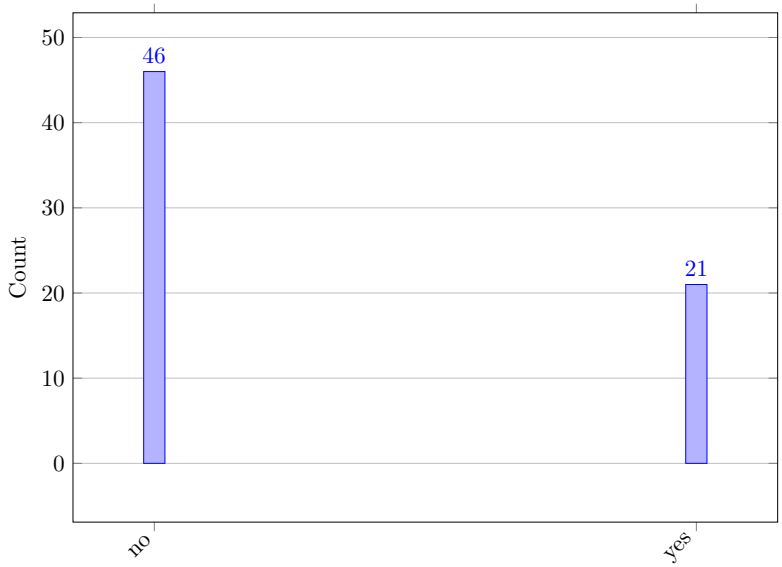
4 Threats to Validity

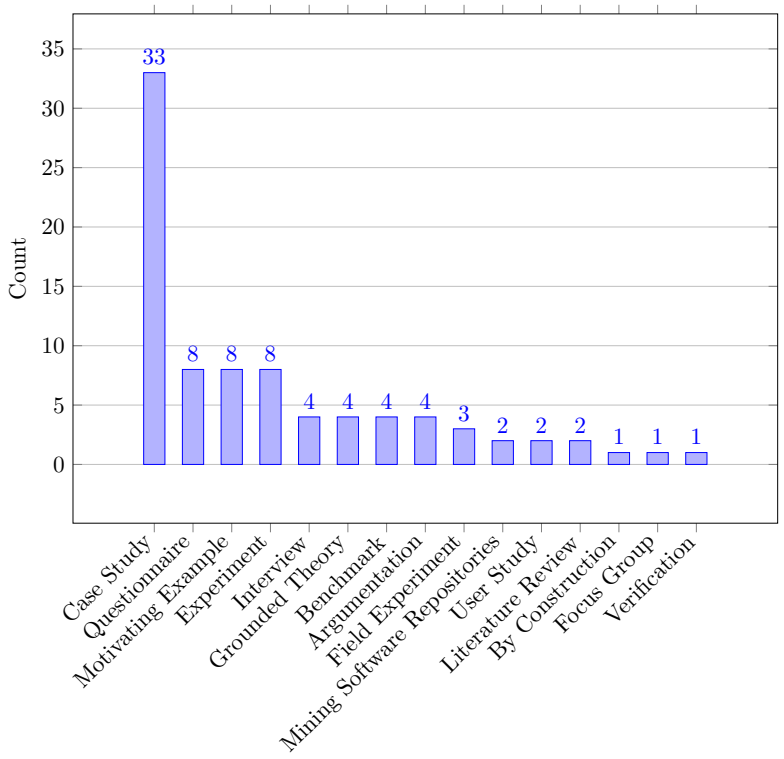


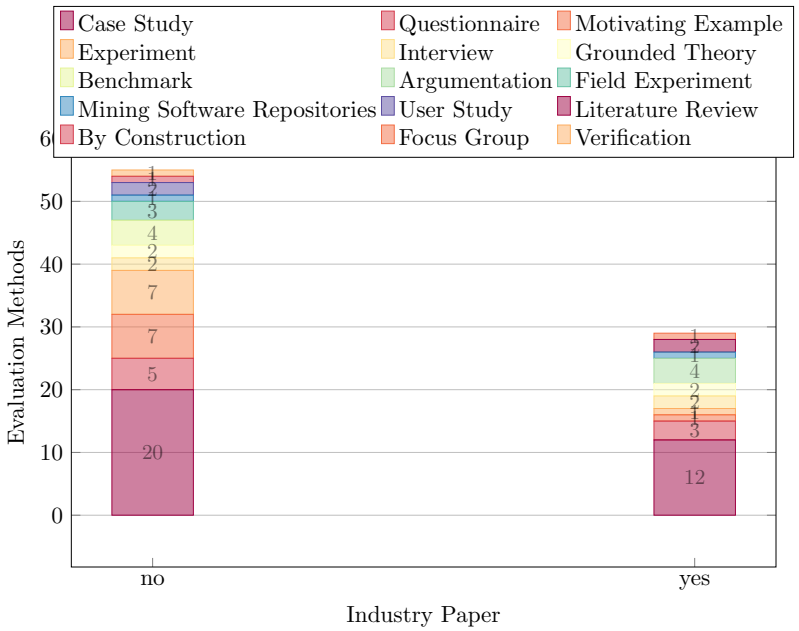


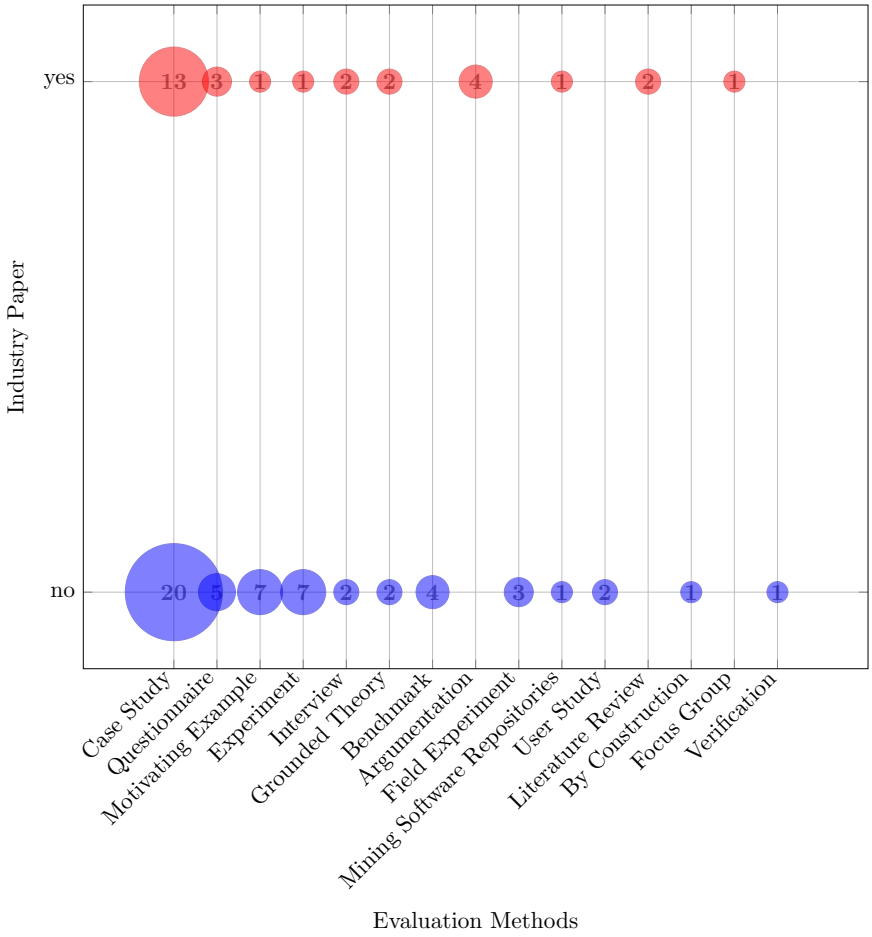


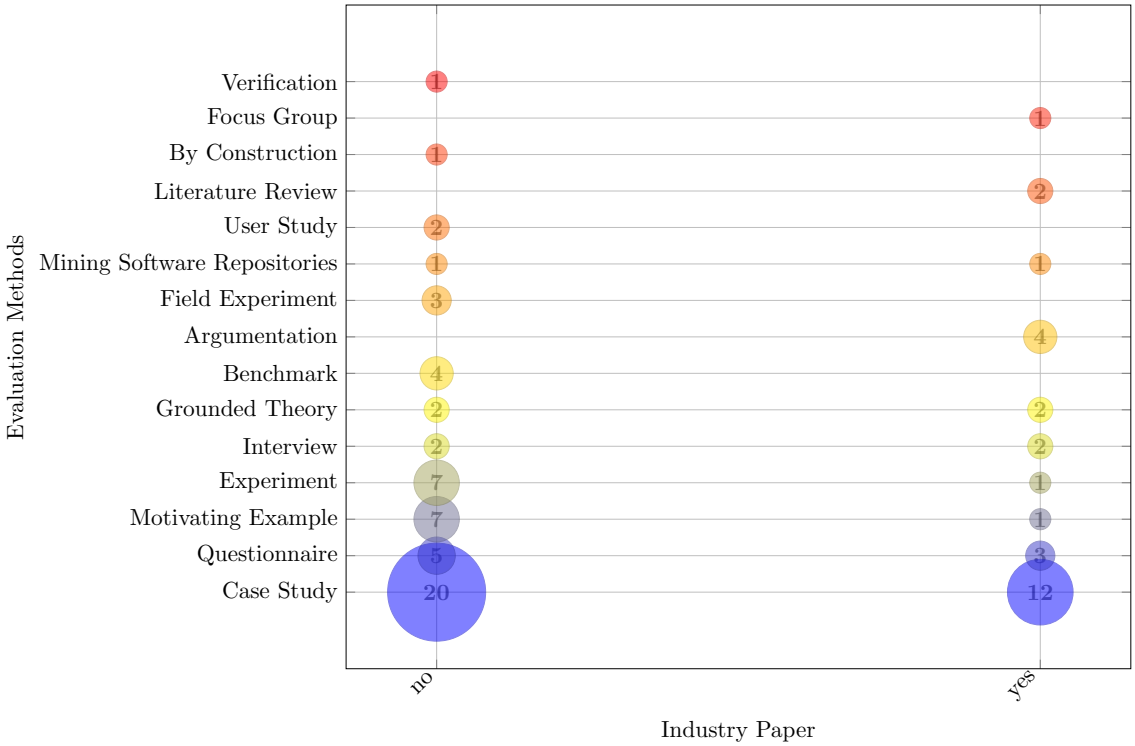
5 Kinds vs. Evaluation Methods



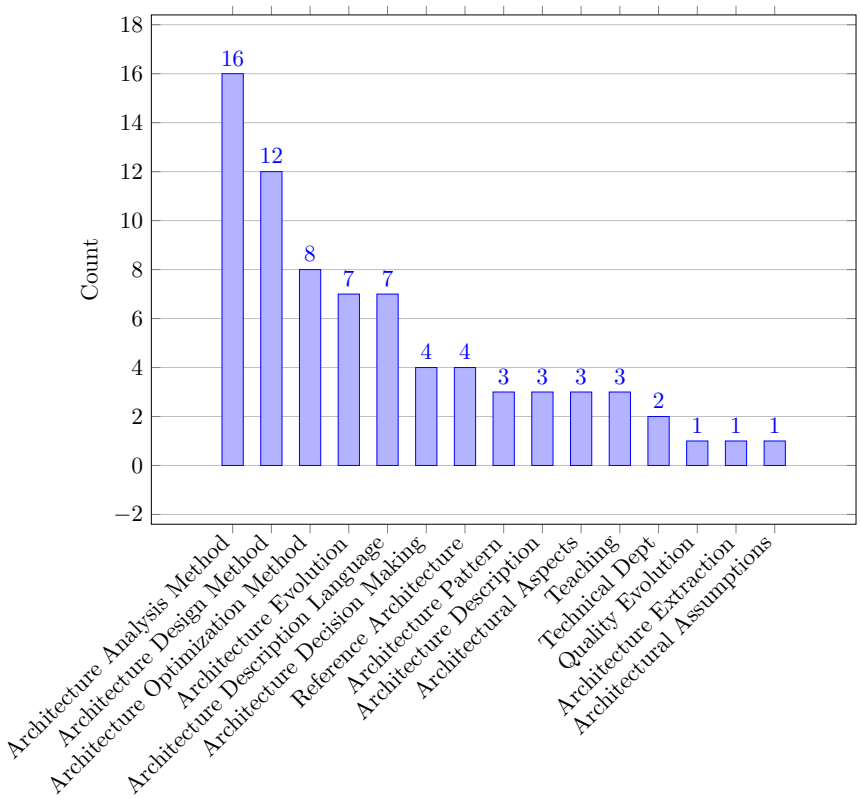

Count
35
30
25
20
15
10
5
0
33
8
8
8
4
4
4
4
3
2
2
2
1
1
1
Case Study
Questionnaire
Motivating Example
Experiment
Interview
Grounded Theory
Benchmark
Argumentation
Field Experiment
Mining Software Repositories
User Study
Literature Review
By Construction
Focus Group
Verification

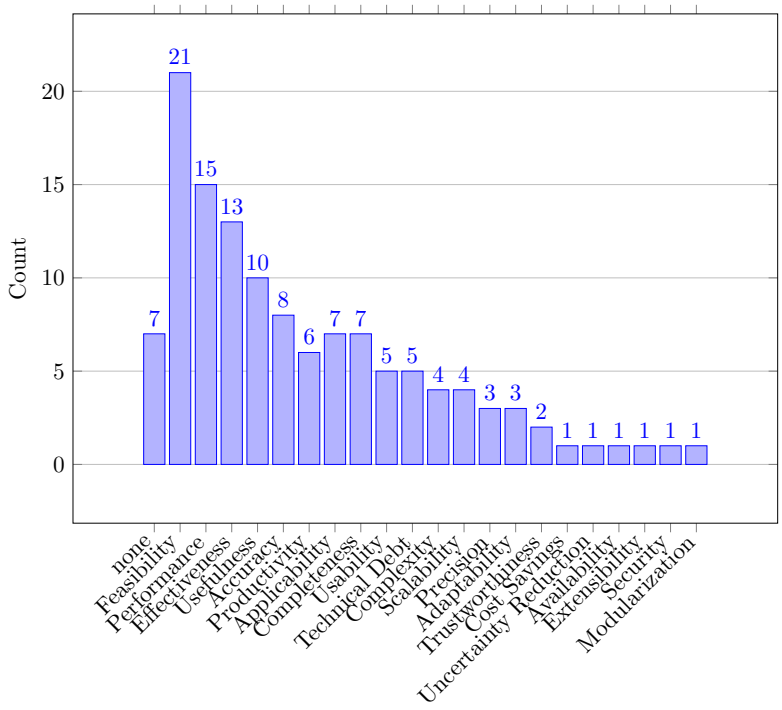

Case Study
Questionnaire
Motivating Example
Experiment
Interview
Grounded Theory
Benchmark
Argumentation
Field Experiment
Mining Software Repositories
User Study
Literature Review
By Construction
Focus Group
Verification
Evaluation Methods
60
50
40
30
20
10
0
20
5
7
7
2
4
3
1
2
1
1
12
3
1
1
2
4
1
2
1
no
yes
Industry Paper

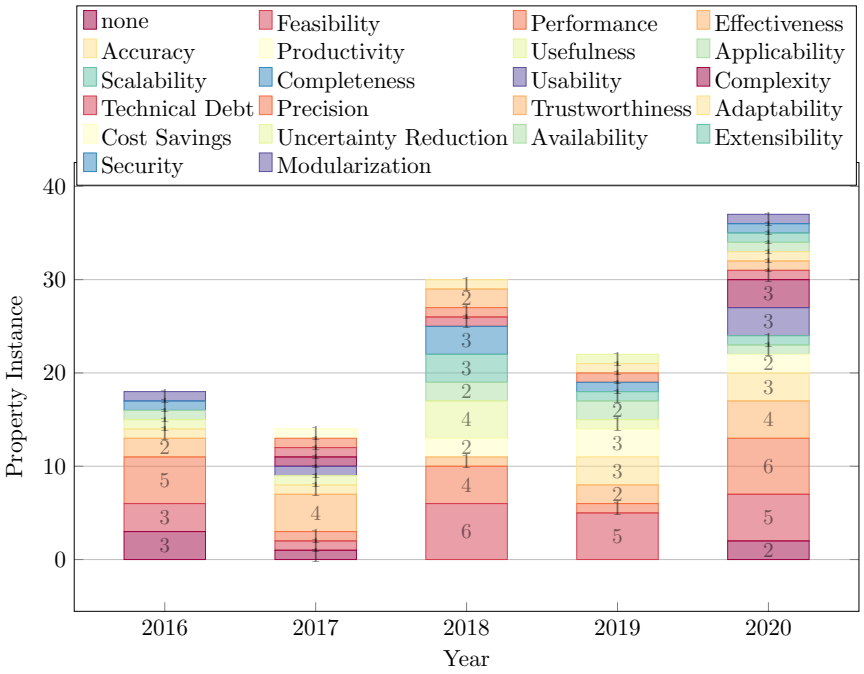

Industry Paper
yes
no
13
3
1
1
2
2
4
1
2
1
20
5
7
7
2
2
4
3
1
2
1
1
Case Study
Questionnaire
Motivating Example
Experiment
Interview
Grounded Theory
Benchmark
Argumentation
Field Experiment
Mining Software Repositories
User Study
Literature Review
By Construction
Focus Group
Verification
Evaluation Methods

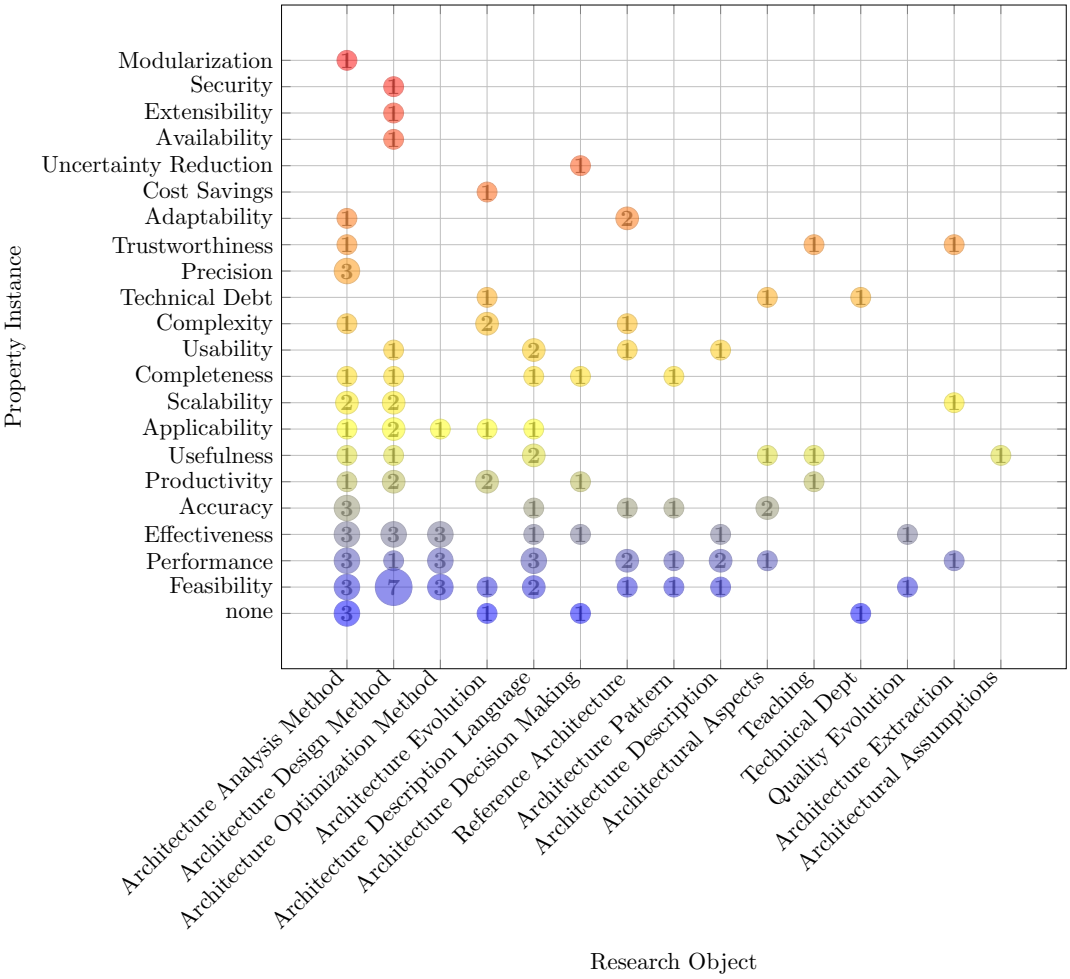

Evaluation Methods
Verification
Focus Group
By Construction
Literature Review
User Study
Mining Software Repositories
Field Experiment
Argumentation
Benchmark
Grounded Theory
Interview
Experiment
Motivating Example
Questionnaire
Case Study
1
1
1
2
2
1
1
3
4
4
2
2
2
2
7
1
7
1
5
3
20
12
no
yes
Industry Paper

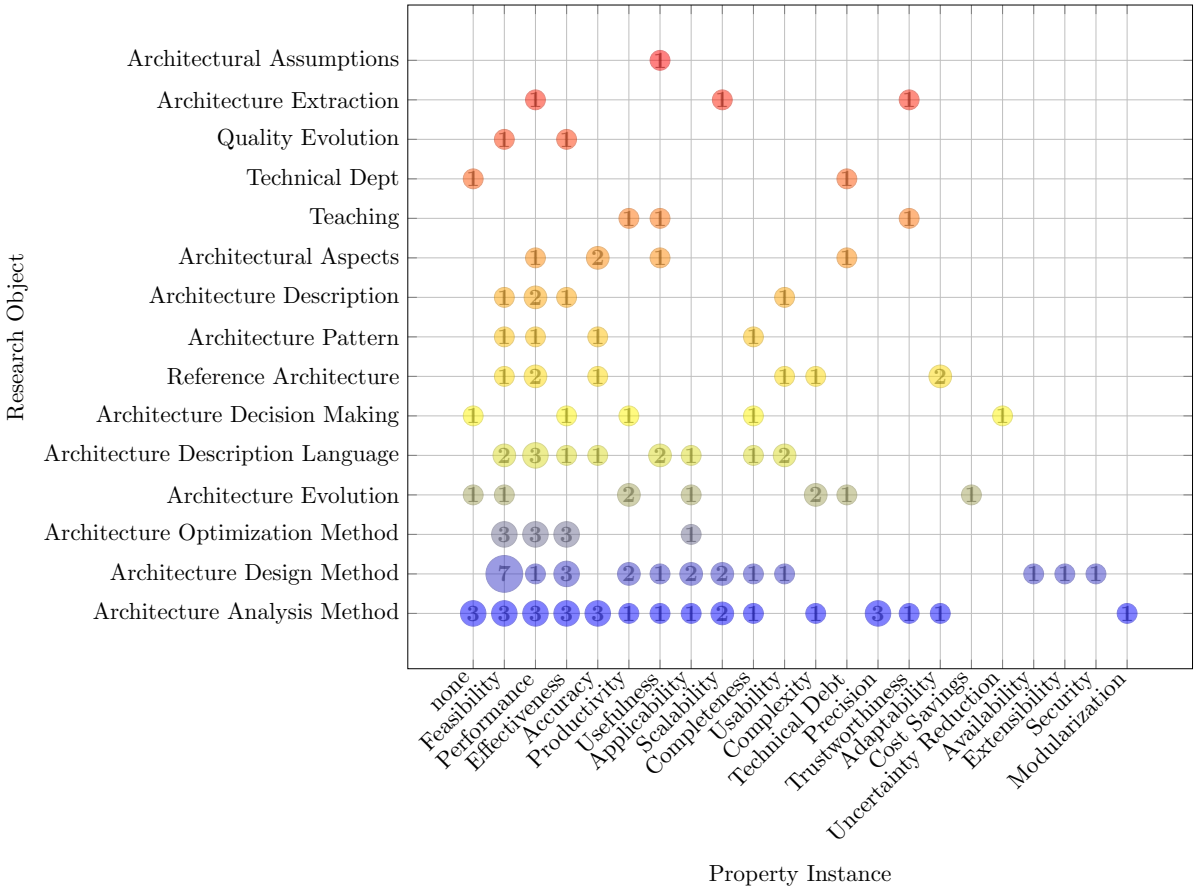
6 Research Object vs. Property



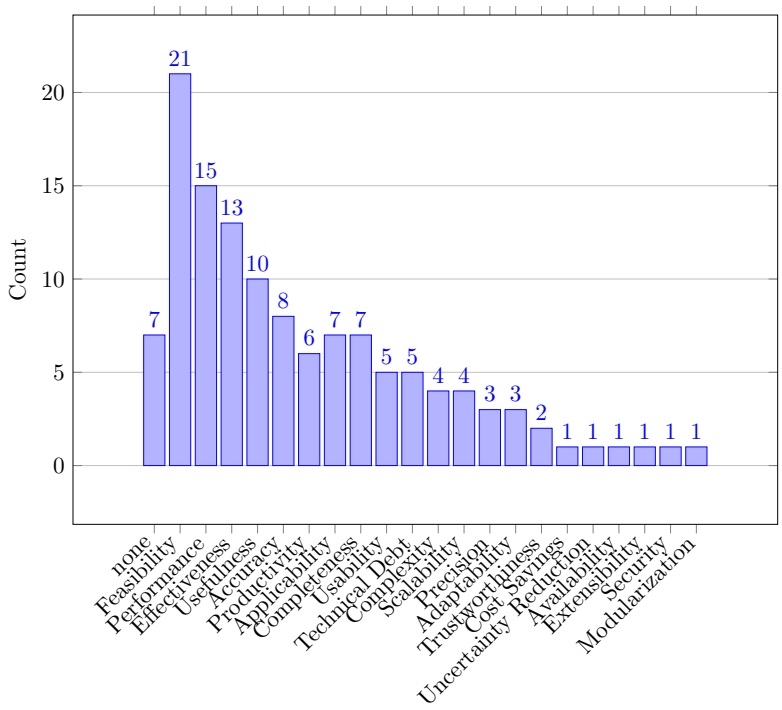

Count
0
5
10
15
20
7
21
15
13
10
8
6
7
7
5
5
4
4
3
3
2
1
1
1
1
1
1
none
Feasibility
Performance
Effectiveness
Usefulness
Accuracy
Productivity
Applicability
Completeness
Usability
Technical Debt
Complexity
Scalability
Precision
Adaptability
Trustworthiness
Cost Savings
Uncertainty Reduction
Availability
Extensibility
Security
Modularization

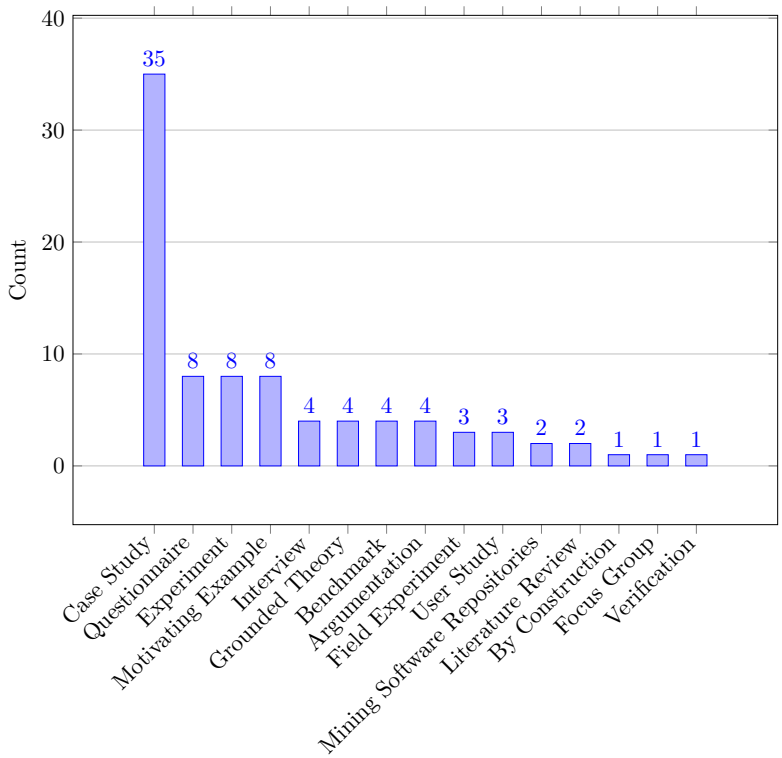

none
Feasibility
Performance
Effectiveness
Accuracy
Productivity
Usefulness
Applicability
Scalability
Completeness
Usability
Complexity
Technical Debt
Precision
Trustworthiness
Adaptability
Cost Savings
Uncertainty Reduction
Availability
Extensibility
Security
Modularization
Property Instance
0
10
20
30
40
2016
2017
2018
2019
2020
Year

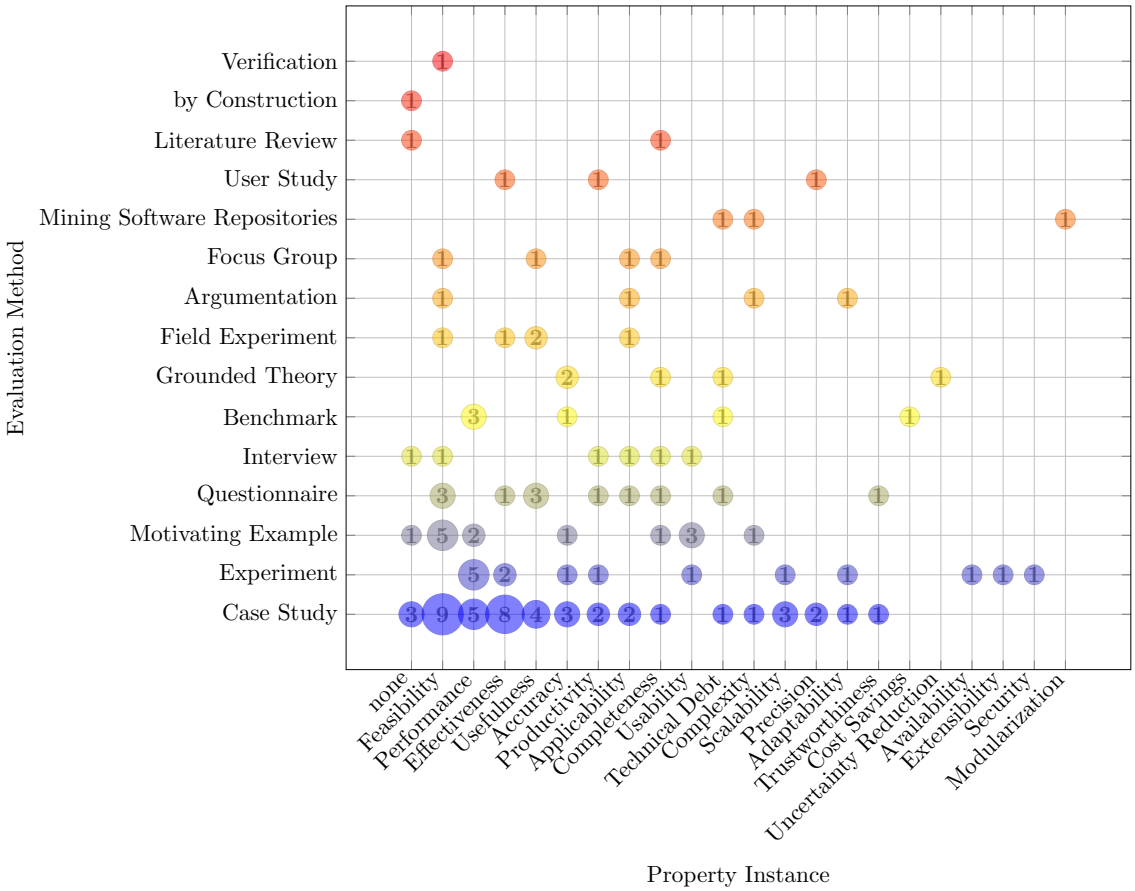

Property Instance
Modularization
Security
Extensibility
Availability
Uncertainty Reduction
Cost Savings
Adaptability
Trustworthiness
Precision
Technical Debt
Complexity
Usability
Completeness
Scalability
Applicability
Usefulness
Productivity
Accuracy
Effectiveness
Performance
Feasibility
none
Architecture Analysis Method
Architecture Design Method
Architecture Optimization Method
Architecture Evolution
Architecture Description Language
Architecture Decision Making
Reference Architecture
Architecture Pattern
Architecture Description
Architectural Aspects
Teaching
Technical Dept
Quality Evolution
Architecture Extraction
Architectural Assumptions
Research Object

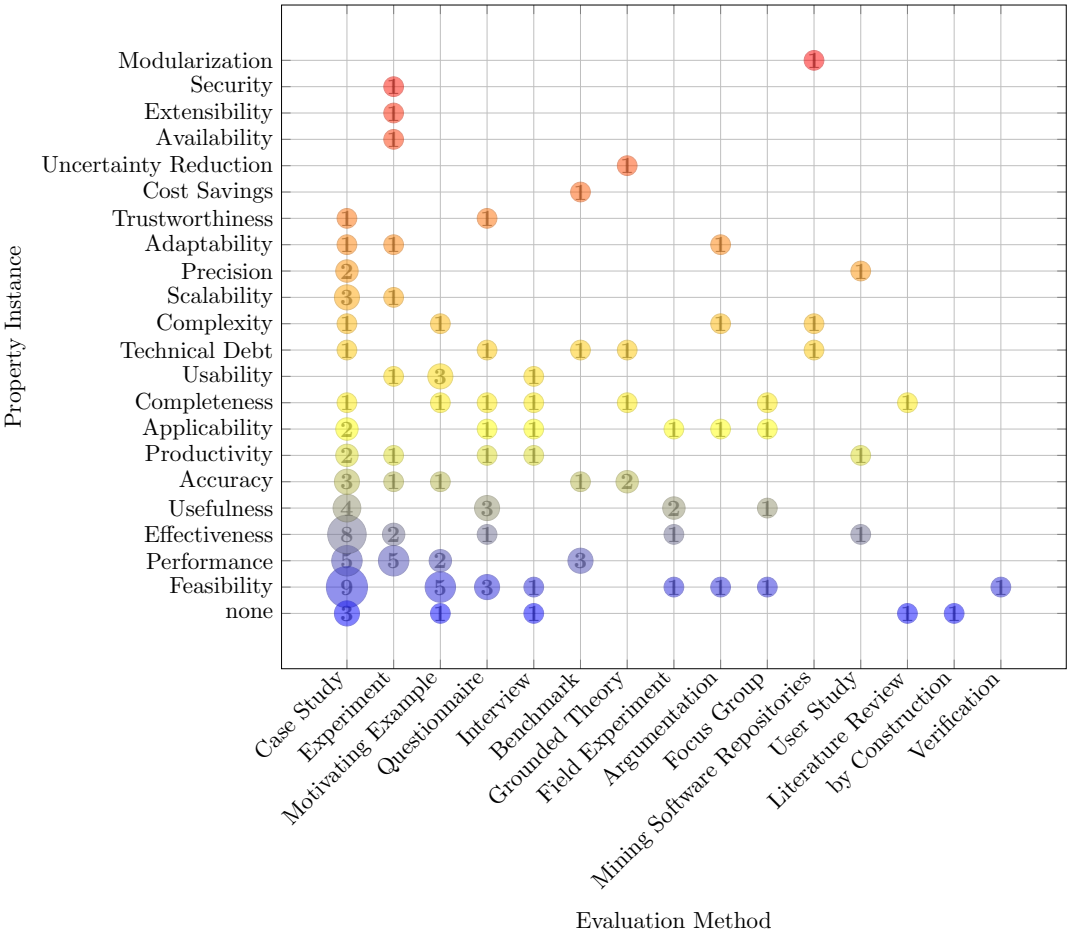

Research Object
Architectural Assumptions
Architecture Extraction
Quality Evolution
Technical Dept
Teaching
Architectural Aspects
Architecture Description
Architecture Pattern
Reference Architecture
Architecture Decision Making
Architecture Description Language
Architecture Evolution
Architecture Optimization Method
Architecture Design Method
Architecture Analysis Method
none
Feasibility
Performance
Effectiveness
Accuracy
Productivity
Usefulness
Applicability
Scalability
Completeness
Usability
Complexity
Technical Debt
Precision
Trustworthiness
Adaptability
Cost Savings
Uncertainty Reduction
Availability
Extensibility
Security
Modularization
Property Instance

7 Property vs. Evaluation Methods

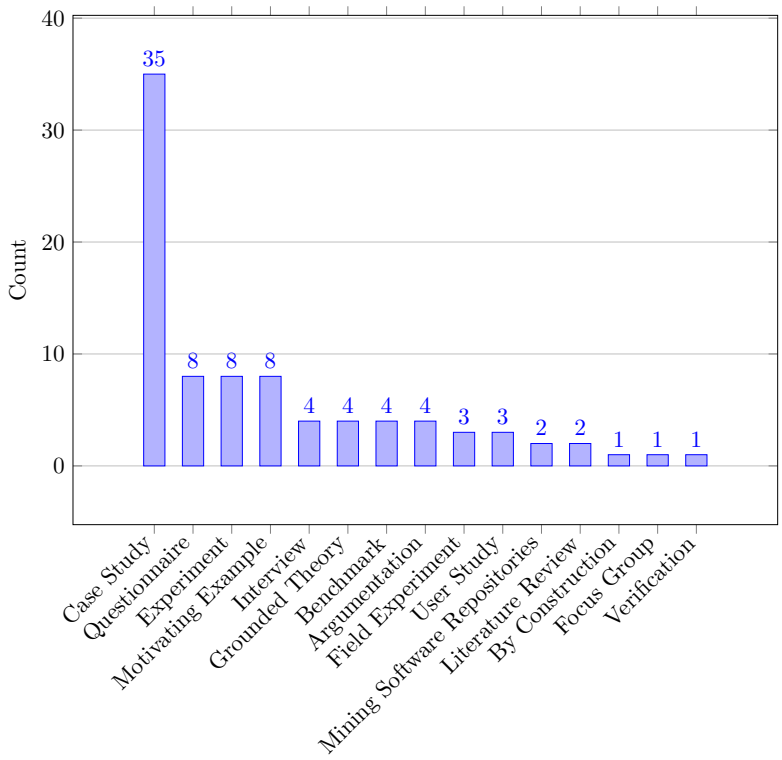


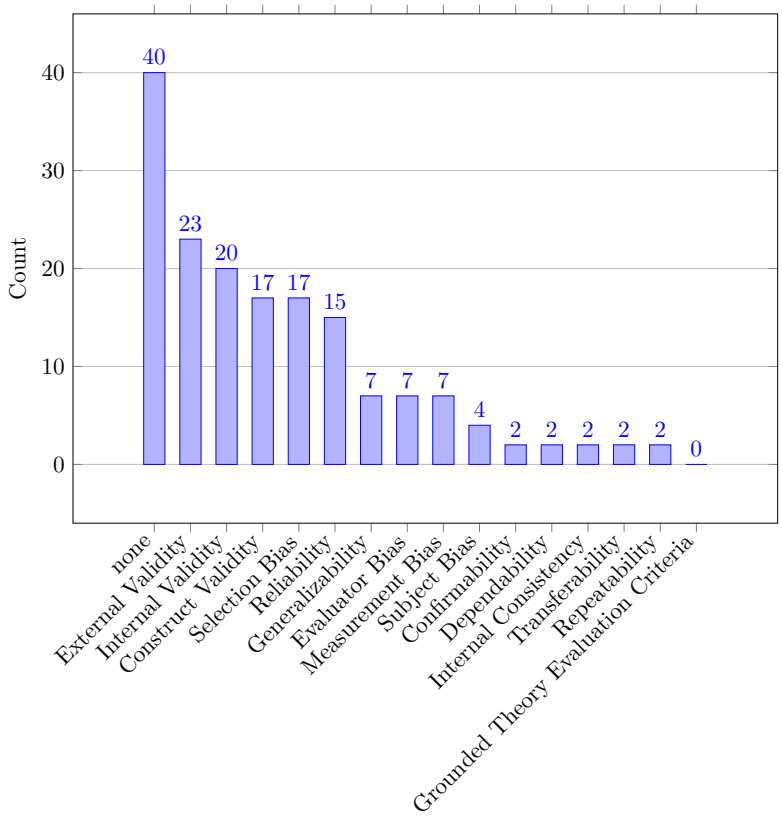


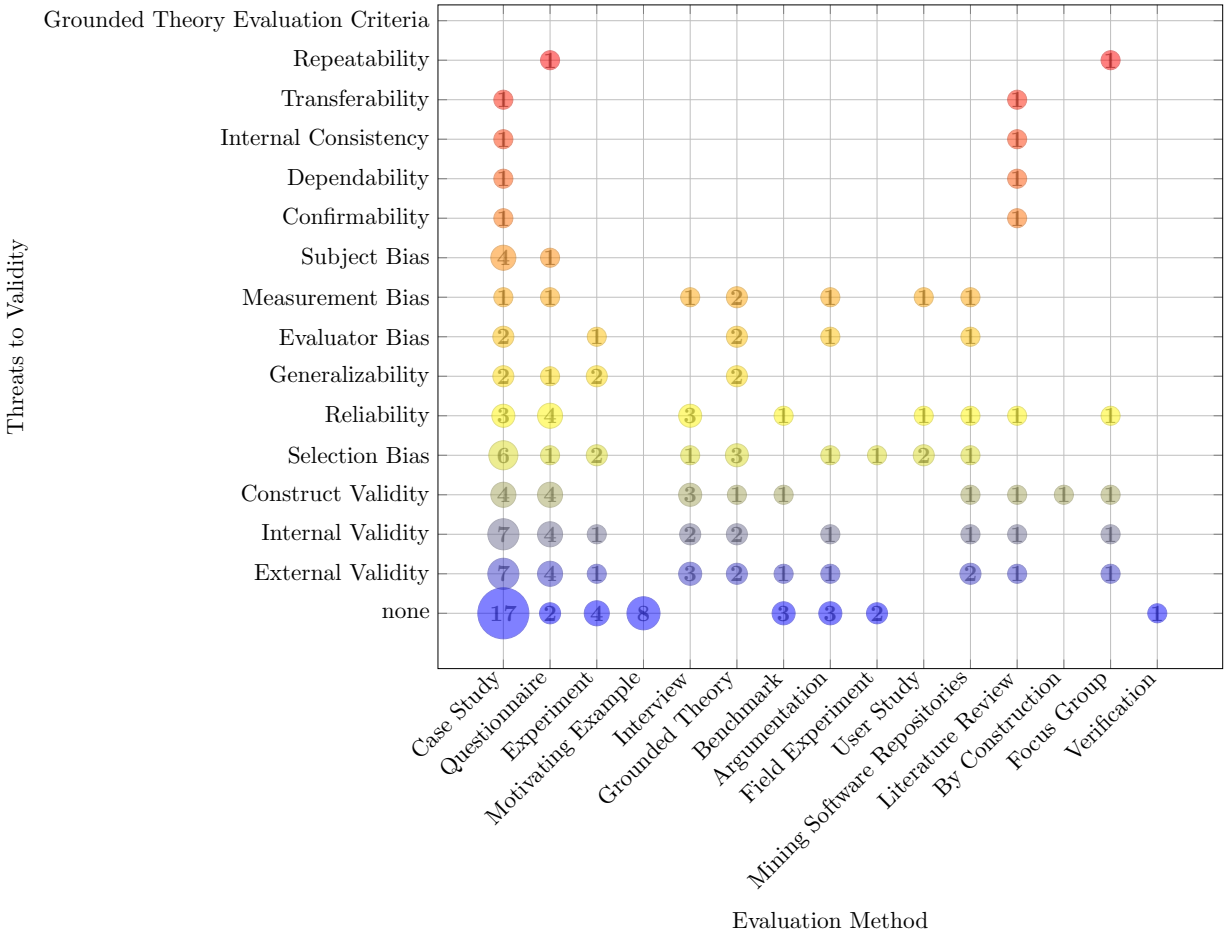

Evaluation Method
Verification
by Construction
Literature Review
User Study
Mining Software Repositories
Focus Group
Argumentation
Field Experiment
Grounded Theory
Benchmark
Interview
Questionnaire
Motivating Example
Experiment
Case Study
none
Feasibility
Performance
Effectiveness
Usefulness
Accuracy
Productivity
Applicability
Completeness
Usability
Technical Debt
Complexity
Scalability
Precision
Adaptability
Trustworthiness
Cost Savings
Uncertainty Reduction
Availability
Extensibility
Security
Modularization
Property Instance

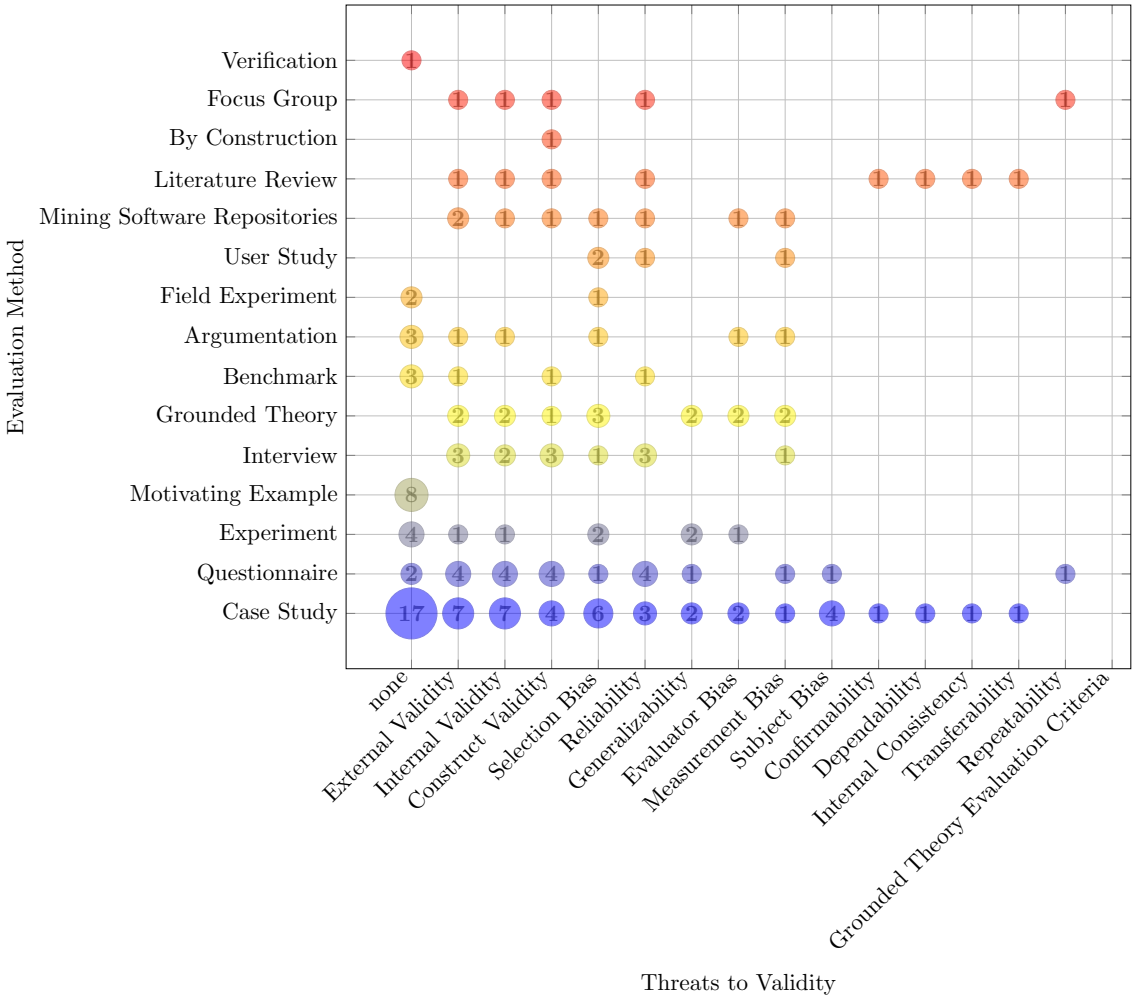

Property Instance
Modularization
Security
Extensibility
Availability
Uncertainty Reduction
Cost Savings
Trustworthiness
Adaptability
Precision
Scalability
Complexity
Technical Debt
Usability
Completeness
Applicability
Productivity
Accuracy
Usefulness
Effectiveness
Performance
Feasibility
none
Case Study
Experiment
Motivating Example
Questionnaire
Interview
Benchmark
Grounded Theory
Field Experiment
Argumentation
Focus Group
Mining Software Repositories
User Study
Literature Review
by Construction
Verification
Evaluation Method

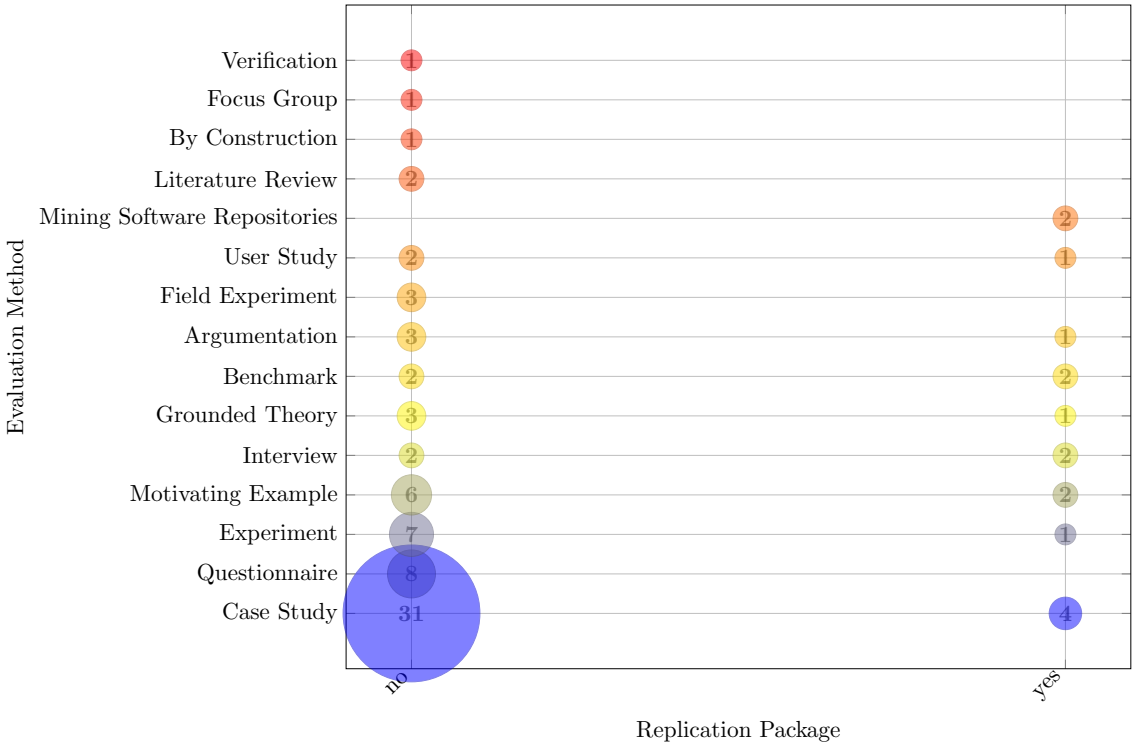
8 Evaluation Method vs Threats to Validity



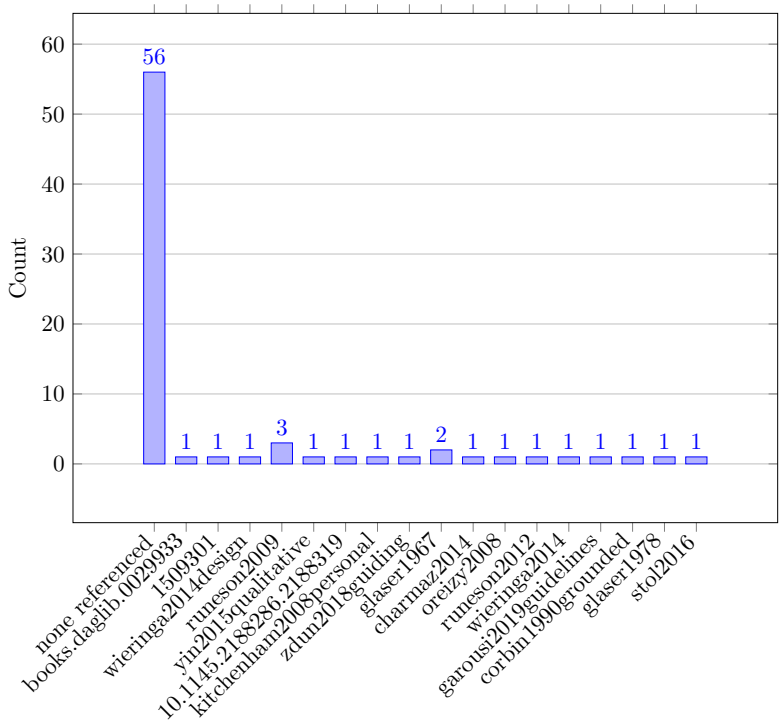

Count
0
10
20
30
40
40
23
20
17
17
15
7
7
7
4
2
2
2
2
2
0
none
External Validity
Internal Validity
Construct Validity
Selection Bias
Reliability
Generalizability
Evaluator Bias
Measurement Bias
Subject Bias
Confirmability
Dependability
Internal Consistency
Transferability
Repeatability
Grounded Theory Evaluation Criteria

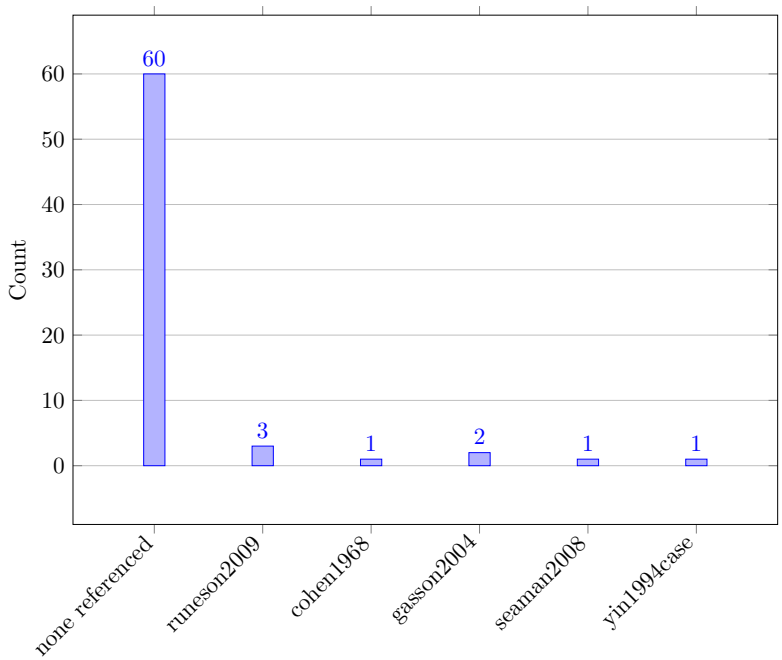

Grounded Theory Evaluation Criteria
Repeatability
Transferability
Internal Consistency
Dependability
Confirmability
Subject Bias
Measurement Bias
Evaluator Bias
Generalizability
Reliability
Selection Bias
Construct Validity
Internal Validity
External Validity
none
Threats to Validity
Case Study
Questionnaire
Experiment
Motivating Example
Interview
Grounded Theory
Benchmark
Argumentation
Field Experiment
User Study
Mining Software Repositories
Literature Review
By Construction
Focus Group
Verification
Evaluation Method

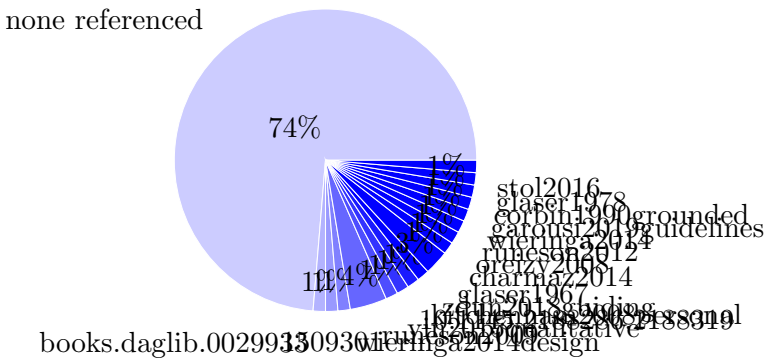

Evaluation Method
Verification
Focus Group
By Construction
Literature Review
Mining Software Repositories
User Study
Field Experiment
Argumentation
Benchmark
Grounded Theory
Interview
Motivating Example
Experiment
Questionnaire
Case Study
none
External Validity
Internal Validity
Construct Validity
Selection Bias
Reliability
Generalizability
Evaluator Bias
Measurement Bias
Subject Bias
Confirmability
Dependability
Internal Consistency
Transferability
Repeatability
Grounded Theory Evaluation Criteria
Threats to Validity


Evaluation Method
Verification
Focus Group
By Construction
Literature Review
Mining Software Repositories
User Study
Field Experiment
Argumentation
Benchmark
Grounded Theory
Interview
Motivating Example
Experiment
Questionnaire
Case Study
1
1
1
2
2
1
2
3
3
1
2
2
3
1
2
2
6
2
7
1
8
31
4
no
yes
Replication Package

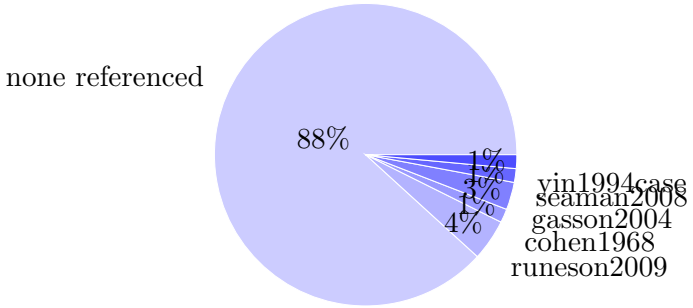
9 Guidelines for Evaluation Methods and Threats to Validity



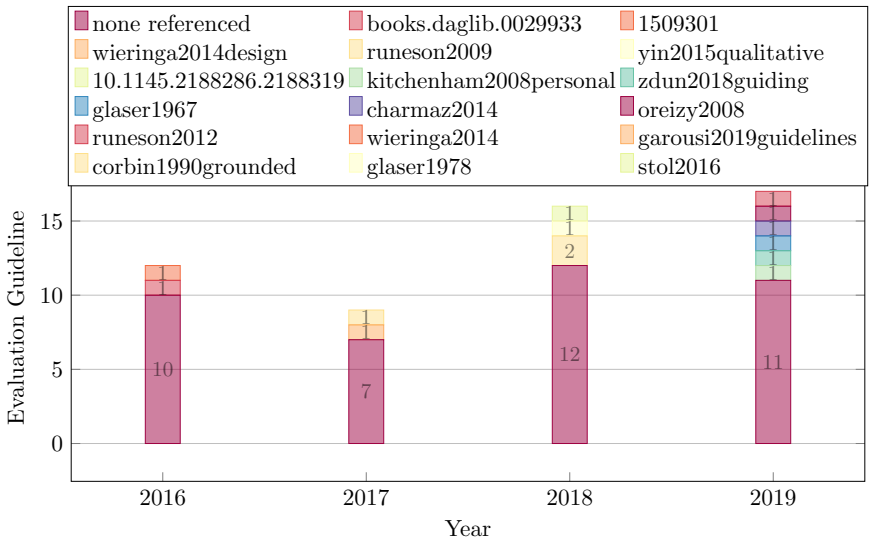


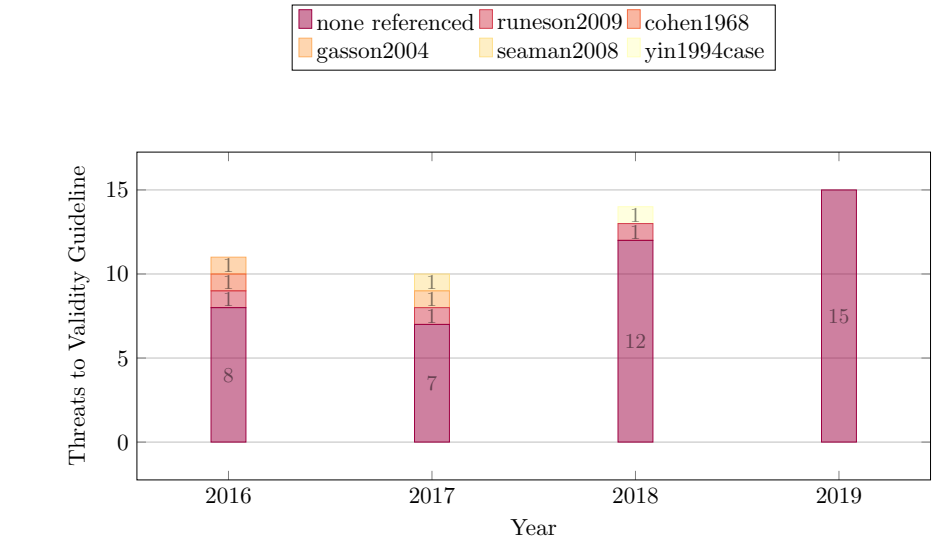


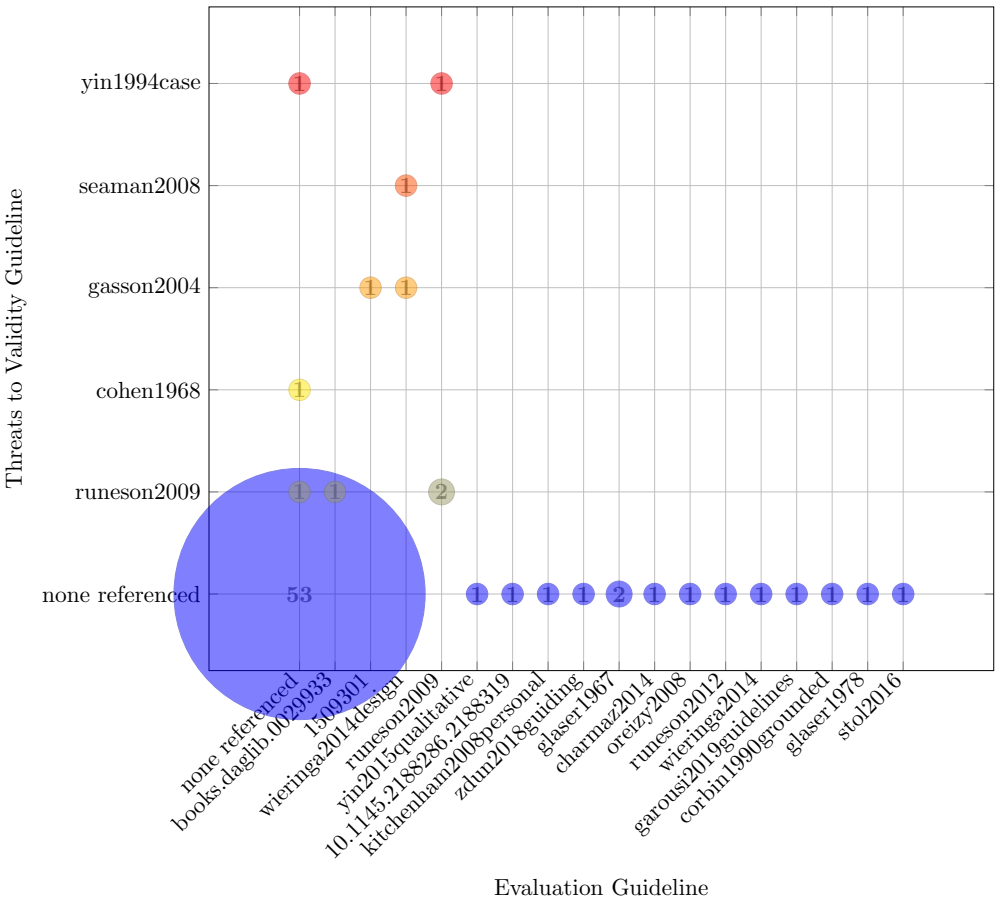
Pie chart for Evaluation Guideline (76)



Pie chart for Threats to Validity Guideline (68)




none referenced
runeson2009
cohen1968
gasson2004
seaman2008
yin1994case
Threats to Validity Guideline
0
5
10
15
2016
2017
2018
2019
Year
8
7
12
15


Threats to Validity Guideline
yin1994case
seaman2008
gasson2004
cohen1968
runeson2009
none referenced
53
none referenced
books.daglib.0029933
1509301
wieringa2014design
runeson2009
yin2015qualitative
10.1145.2188286.2188319
kitchenham2008personal
zdun2018guiding
glaser1967
charmaz2014
oreizy2008
runeson2012
wieringa2014
garousi2019guidelines
corbin1990grounded
glaser1978
stol2016
Evaluation Guideline

Year	Paper	Research Objects	Evaluation Methods	Properties
2016	[1]	Architecture Analysis Method	Experiment	Accuracy
2016	[2]	Architecture pattern, Architecture Optimization Method	Motivating Example	Performance, Feasibility
2016	[3]	Architecture Analysis Method	Motivating Example	none
2016	[4]	Architecture Description Language	Case Study	Performance
2016	[5]	Architecture Optimization Method	Experiment	Performance
2016	[6]	Architecture Analysis Method	Case Study	Effectiveness, none
2016	[7]	Architecture Analysis Method	Interview, Case Study	none, Completeness
2016	[8]	Architecture Description Language	Field Experiment	Usefulness, Feasibility
2016	[9]	Architecture Description	Benchmark, Motivating Example	Performance, Usability
2016	[10]	Architecture Optimization Method	User Study	Effectiveness
2016	[11]	Architecture Design Method	Interview	Applicability, Feasibility
2017	[12]	Architecture Analysis Method	Case Study	Accuracy, Precision
2017	[13]	Architecture Analysis Method	Experiment	Effectiveness, Performance
2017	[14]	Architecture Evolution	Mining Software Repositories, Benchmark	Complexity, Technical Debt, Cost savings
2017	[15]	Architecture Description Language	Interview, Case Study	Usability, Effectiveness
2017	[16]	Architecture Decision Making	Case Study, Literature Review	none
2017	[17]	Architecture Analysis Method	Motivating Example	Feasibility
2017	[18]	Architecture Design Method	Case Study	Effectiveness
2017	[19]	Architectural Assumptions	Case Study	Usefulness
2017	[20]	Architecture Decision Making	Questionnaire	Effectiveness
2018	[21]	Architecture Description	Experiment , Case Study	Performance, Feasibility
2018	[22]	Architecture Design Method	Motivating Example	Feasibility
2018	[23]	Architecture Analysis Method, Architecture Description Language	Motivating Example	Completeness, Feasibility
2018	[24]	Architecture Analysis Method	Case Study	Scalability
2018	[25]	Architecture Extraction, Architecture Analysis Method	Case Study	Performance, Scalability, Trustworthiness
2018	[26]	Teaching	Case Study, Questionnaire	Usefulness
2018	[27]	Architecture Decision Making	Literature Review, Interview	Completeness, Productivity
2018	[28]	Architectural Aspects	Case Study, Questionnaire	Technical Debt, Usefulness
2018	[29]	Architecture Description Language	Field Experiment	Applicability, Usefulness
2018	[30]	Architecture Design Method	Focus Group, Questionnaire	Completeness, Usefulness, Feasibility, Applicability
2018	[31]	Architecture Evolution	Case Study	Feasibility
2018	[32]	Reference Architecture	Case Study, Verification	Feasibility
2018	[33]	Architecture Analysis Method	User Study	Productivity, Precision
2018	[34]	Architecture Analysis Method	Case Study	Adaptability, Performance , Effectiveness
2019	[35]	Architecture Evolution, Architecture Design Method	Questionnaire	Productivity
2019	[36]	Architecture pattern	Argumentation	Feasibility
2019	[37]	Architecture Decision Making	Grounded Theory	Uncertainty Reduction
2019	[38]	Architecture Optimization Method	Field Experiment	Effectiveness
2019	[39]	Reference architecture	Argumentation	Adaptability
2019	[40]	Architecture Analysis Method	Case Study	Applicability, Usefulness
2019	[41]	Architecture pattern	Grounded Theory	Accuracy, Completeness
2019	[42]	Architectural Aspects	Case Study	Accuracy
2019	[43]	Architecture Analysis Method, Architecture Evolution	Argumentation, Case Study	Precision, Applicability
2019	[44]	Architecture Design Method	Questionnaire	Feasibility
2019	[45]	Architecture Design Method	Case Study	Scalability, Effectiveness
2019	[46]	Architectural Aspects	Case Study	Accuracy, Performance
2019	[47]	Architecture Optimization Method, Architecture Design Method	Case Study	Feasibility
2019	[48]	Architecture Evolution	Case Study	Productivity
2019	[49]	Architecture Optimization Method	Case Study	Feasibility
2020	[50]	Teaching	Questionnaire	Trustworthiness
2020	[51]	Architecture Optimization Method, Architecture Evolution	Case Study	Complexity, Effectiveness, Applicability
2020	[52]	Teaching	Experiment	Productivity
2020	[53]	Architecture Description	Experiment	Effectiveness
2020	[54]	Architecture Design Method	Case Study	Effectiveness, Productivity
2020	[55]	Architecture Description Language	Benchmark	Accuracy, Performance
2020	[56]	Architecture Analysis Method	Case Study	Feasibility
2020	[57]	Architecture Description Language	Benchmark, Motivating Example	Performance, Feasibility, Usability
2020	[58]	Quality Evolution	Case Study	Feasibility, Effectiveness
2020	[59]	Reference Architecture	Motivating Example	Complexity, Usability, Accuracy, Performance
2020	[60]	Architecture Design Method	Experiment	Usability, Availability, Scalability, Extensibility, Security, Performance
2020	[61]	Technical Dept	Case Study	none
2020	[62]	Architecture Design Method	Case Study,Questionnaire	Feasibility
2020	[63]	Architecture Optimization Method	Case Study	Performance
2020	[64]	Architecture Analysis Method	Grounded Theory, Mining Software Repositories, Argumentation	Complexity, Accuracy, Modularization
2020	[65]	Reference Architecture	Experiment	Performance, Adaptability
2020	[66]	Architecture Evolution, Technical Dept	Grounded Theory, By construction	none, Technical Debt
2020	[67]	Architecture Design Method	Case Study	Feasibility

Table 1: Overview

10 Table

References

[1] Hadil Abukwaik, Mohammed Abujayyab, and H. Dieter Rombach. Towards seamless analysis of software interoperability: Automatic identification of conceptual constraints in API documentation. In Bedir Tekinerdogan, Uwe Zdun, and Muhammad Ali Babar, editors, *Software Architecture - 10th European Conference, ECSA 2016, Copenhagen, Denmark, November 28 - December 2, 2016, Proceedings*, volume 9839 of *Lecture Notes in Computer Science*, pages 67–83, 2016.

[2] Ashish Agrawal and T. V. Prabhakar. Towards a framework for building saas applications operating in diverse and dynamic environments. In Bedir Tekinerdogan, Uwe Zdun, and Muhammad Ali Babar, editors, *Software Architecture - 10th European Conference, ECSA 2016, Copenhagen, Denmark, November 28 - December 2, 2016, Proceedings*, volume 9839 of *Lecture Notes in Computer Science*, pages 291–306, 2016.

[3] Zakarea Alshara, Abdelhak-Djamel Seriai, Chouki Tibermacine, Hinde-Lilia Bouziane, Christophe Dony, and Anas Shatnawi. Materializing architecture recovered from object-oriented source code in component-based languages. In Bedir Tekinerdogan, Uwe Zdun, and Muhammad Ali Babar, editors, *Software Architecture - 10th European Conference, ECSA 2016, Copenhagen, Denmark, November 28 - December 2, 2016, Proceedings*, volume 9839 of *Lecture Notes in Computer Science*, pages 309–325, 2016.

[4] Everton Cavalcante, Jean Quilbeuf, Louis-Marie Traonouez, Flávio Oquendo, Thaís Batista, and Axel Legay. Statistical model checking of dynamic software architectures. In Bedir Tekinerdogan, Uwe Zdun, and Muhammad Ali Babar, editors, *Software Architecture - 10th European Conference, ECSA 2016, Copenhagen, Denmark, November 28 - December 2, 2016, Proceedings*, volume 9839 of *Lecture Notes in Computer Science*, pages 185–200, 2016.

[5] Ilias Gerostathopoulos, Dominik Skoda, Frantisek Plasil, Tomás Bures, and Alessia Knauss. Architectural homeostasis in self-adaptive software-intensive cyber-physical systems. In Bedir Tekinerdogan, Uwe Zdun, and Muhammad Ali Babar, editors, *Software Architecture - 10th European Conference, ECSA 2016, Copenhagen, Denmark, November 28 - December 2, 2016, Proceedings*, volume 9839 of *Lecture Notes in Computer Science*, pages 113–128, 2016.

[6] Christel Kapto, Ghizlane El-Boussaidi, Segla Kpodjedo, and Chouki Tibermacine. Inferring architectural evolution from source code analysis - A tool-supported approach for the detection of architectural tactics. In Bedir Tekinerdogan, Uwe Zdun, and Muhammad Ali Babar, editors, *Software Architecture - 10th European Conference, ECSA 2016, Copenhagen, Denmark, November 28 - December 2, 2016,*

Proceedings, volume 9839 of *Lecture Notes in Computer Science*, pages 149–165, 2016.

[7] Soraya Mesli-Kesraoui, Djamal Kesraoui, Flávio Oquendo, Alain Bignon, Armand Toguyéni, and Pascal Berruet. Formal verification of software-intensive systems architectures described with piping and instrumentation diagrams. In Bedir Tekinerdogan, Uwe Zdun, and Muhammad Ali Babar, editors, *Software Architecture - 10th European Conference, ECSA 2016, Copenhagen, Denmark, November 28 - December 2, 2016, Proceedings*, volume 9839 of *Lecture Notes in Computer Science*, pages 210–226, 2016.

[8] Flávio Oquendo. Software architecture challenges and emerging research in software-intensive systems-of-systems. In Bedir Tekinerdogan, Uwe Zdun, and Muhammad Ali Babar, editors, *Software Architecture - 10th European Conference, ECSA 2016, Copenhagen, Denmark, November 28 - December 2, 2016, Proceedings*, volume 9839 of *Lecture Notes in Computer Science*, pages 3–21, 2016.

[9] Bradley R. Schmerl, Jeff Gennari, Alireza Sadeghi, Hamid Bagheri, Sam Malek, Javier Cámara, and David Garlan. Architecture modeling and analysis of security in android systems. In Bedir Tekinerdogan, Uwe Zdun, and Muhammad Ali Babar, editors, *Software Architecture - 10th European Conference, ECSA 2016, Copenhagen, Denmark, November 28 - December 2, 2016, Proceedings*, volume 9839 of *Lecture Notes in Computer Science*, pages 274–290, 2016.

[10] Courtney Schriek, Jan Martijn E. M. van der Werf, Antony Tang, and Floris Bex. Software architecture design reasoning: A card game to help novice designers. In Bedir Tekinerdogan, Uwe Zdun, and Muhammad Ali Babar, editors, *Software Architecture - 10th European Conference, ECSA 2016, Copenhagen, Denmark, November 28 - December 2, 2016, Proceedings*, volume 9839 of *Lecture Notes in Computer Science*, pages 22–38, 2016.

[11] Sandra Schröder, Matthias Riebisch, and Mohamed Soliman. Architecture enforcement concerns and activities - an expert study. In Bedir Tekinerdogan, Uwe Zdun, and Muhammad Ali Babar, editors, *Software Architecture - 10th European Conference, ECSA 2016, Copenhagen, Denmark, November 28 - December 2, 2016, Proceedings*, volume 9839 of *Lecture Notes in Computer Science*, pages 247–262, 2016.

[12] Manoj Bhat, Klym Shumaiev, Andreas Biesdorf, Uwe Hohenstein, and Florian Matthes. Automatic extraction of design decisions from issue management systems: A machine learning based approach. In Antónia Lopes and Rogério de Lemos, editors, *Software Architecture - 11th European Conference, ECSA 2017, Canterbury, UK, September 11-15, 2017, Proceedings*, volume 10475 of *Lecture Notes in Computer Science*, pages 138–154. Springer, 2017.

[13] Javier Cámara, David Garlan, and Bradley R. Schmerl. Synthesis and quantitative verification of tradeoff spaces for families of software systems. In Antónia Lopes

and Rogério de Lemos, editors, *Software Architecture - 11th European Conference, ECSA 2017, Canterbury, UK, September 11-15, 2017, Proceedings*, volume 10475 of *Lecture Notes in Computer Science*, pages 3–21. Springer, 2017.

[14] Georgios Digkas, Mircea Lungu, Alexander Chatzigeorgiou, and Paris Avgeriou. The evolution of technical debt in the apache ecosystem. In Antónia Lopes and Rogério de Lemos, editors, *Software Architecture - 11th European Conference, ECSA 2017, Canterbury, UK, September 11-15, 2017, Proceedings*, volume 10475 of *Lecture Notes in Computer Science*, pages 51–66. Springer, 2017.

[15] Juarez L. M. Filho, Lincoln S. Rocha, Rossana M. C. Andrade, and Ricardo Britto. Preventing erosion in exception handling design using static-architecture conformance checking. In Antónia Lopes and Rogério de Lemos, editors, *Software Architecture - 11th European Conference, ECSA 2017, Canterbury, UK, September 11-15, 2017, Proceedings*, volume 10475 of *Lecture Notes in Computer Science*, pages 67–83. Springer, 2017.

[16] Stefan Haselböck, Rainer Weinreich, and Georg Buchgeher. Decision models for microservices: Design areas, stakeholders, use cases, and requirements. In Antónia Lopes and Rogério de Lemos, editors, *Software Architecture - 11th European Conference, ECSA 2017, Canterbury, UK, September 11-15, 2017, Proceedings*, volume 10475 of *Lecture Notes in Computer Science*, pages 155–170. Springer, 2017.

[17] Thanh-Dat Nguyen, Yassine Ouhammou, and Emmanuel Grolleau. PARAD repository: On the capitalization of the performance analysis process for AADL designs. In Antónia Lopes and Rogério de Lemos, editors, *Software Architecture - 11th European Conference, ECSA 2017, Canterbury, UK, September 11-15, 2017, Proceedings*, volume 10475 of *Lecture Notes in Computer Science*, pages 22–39. Springer, 2017.

[18] Mohammad Sharaf, Moamin Abughazala, Henry Muccini, and Mai Abusair. An architecture framework for modelling and simulation of situational-aware cyber-physical systems. In Antónia Lopes and Rogério de Lemos, editors, *Software Architecture - 11th European Conference, ECSA 2017, Canterbury, UK, September 11-15, 2017, Proceedings*, volume 10475 of *Lecture Notes in Computer Science*, pages 95–111. Springer, 2017.

[19] Chen Yang, Peng Liang, Paris Avgeriou, Ulf Eliasson, Rogardt Heldal, and Patrizio Pelliccione. Architectural assumptions and their management in industry - an exploratory study. In Antónia Lopes and Rogério de Lemos, editors, *Software Architecture - 11th European Conference, ECSA 2017, Canterbury, UK, September 11-15, 2017, Proceedings*, volume 10475 of *Lecture Notes in Computer Science*, pages 191–207. Springer, 2017.

[20] Andrzej Zalewski, Klara Borowa, and Andrzej Ratkowski. On cognitive biases in architecture decision making. In Antónia Lopes and Rogério de Lemos, editors,

Software Architecture - 11th European Conference, ECSA 2017, Canterbury, UK, September 11-15, 2017, Proceedings, volume 10475 of *Lecture Notes in Computer Science*, pages 123–137. Springer, 2017.

[21] Fahed Alkhabbas, Romina Spalazzese, and Paul Davidsson. Eco-iot: An architectural approach for realizing emergent configurations in the internet of things. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 86–102. Springer, 2018.

[22] Pablo Oliveira Antonino, Matthias Jung, Andreas Morgenstern, Florian Faßnacht, Thomas Bauer, Adam Bachorek, Thomas Kuhn, and Elisa Yumi Nakagawa. Enabling continuous software engineering for embedded systems architectures with virtual prototypes. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 115–130. Springer, 2018.

[23] Paolo Arcaini, Raffaela Mirandola, Elvinia Riccobene, and Patrizia Scandurra. A DSL for MAPE patterns representation in self-adapting systems. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 3–19. Springer, 2018.

[24] Alberto Avritzer, Vincenzo Ferme, Andrea Janes, Barbara Russo, Henning Schulz, and André van Hoorn. A quantitative approach for the assessment of microservice architecture deployment alternatives by automated performance testing. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 159–174. Springer, 2018.

[25] Georg Buchgeher, Rainer Weinreich, and Heinz Huber. A platform for the automated provisioning of architecture information for large-scale service-oriented software systems. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 203–218. Springer, 2018.

[26] Henrik Bærbak Christensen. Crunch: Automated assessment of microservice architecture assignments with formative feedback. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceed-*

ings, volume 11048 of *Lecture Notes in Computer Science*, pages 175–190. Springer, 2018.

[27] Femke Heijenk, Martin van den Berg, Henrik Leopold, Hans van Vliet, and Raymond Slot. Empirical insights into the evolving role of architects in decision-making in an agile context. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 247–264. Springer, 2018.

[28] Antonio Martini, Francesca Arcelli Fontana, Andrea Biaggi, and Riccardo Roveda. Identifying and prioritizing architectural debt through architectural smells: A case study in a large software company. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 320–335. Springer, 2018.

[29] Flávio Oquendo. Formally describing self-organizing architectures for systems-of-systems on the internet-of-things. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 20–36. Springer, 2018.

[30] Ken Power and Rebecca Wirfs-Brock. Understanding architecture decisions in context - an industry case study of architects' decision-making context. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 284–299. Springer, 2018.

[31] Yves Schneider, Axel Busch, and Anne Koziolek. Using informal knowledge for improving software quality trade-off decisions. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 265–283. Springer, 2018.

[32] John Spray and Roopak Sinha. Abstraction layered architecture: Writing maintainable embedded code. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 131–146. Springer, 2018.

[33] Katja Tuma and Riccardo Scandariato. Two architectural threat analysis techniques compared. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018,*

Madrid, Spain, September 24-28, 2018, Proceedings, volume 11048 of *Lecture Notes in Computer Science*, pages 347–363. Springer, 2018.

[34] Danny Weyns, M. Usman Iftikhar, Danny Hughes, and Nelson Matthys. Applying architecture-based adaptation to automate the management of internet-of-things. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 49–67. Springer, 2018.

[35] Camilo Castellanos, Boris Pérez, Carlos A. Varela, María-Del-Pilar Villamil, and Darío Correal. A survey on big data analytics solutions deployment. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 195–210. Springer, 2019.

[36] Somayeh Malakuti, Johannes Schmitt, Marie Platenius-Mohr, Sten Grüner, Ralf Gitzel, and Prerna Bihani. A four-layer architecture pattern for constructing and managing digital twins. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 231–246. Springer, 2019.

[37] Amine El Malki and Uwe Zdun. Guiding architectural decision making on service mesh based microservice architectures. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 3–19. Springer, 2019.

[38] David Issa Mattos, Jan Bosch, and Helena Holmström Olsson. ACE: easy deployment of field optimization experiments. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 264–279. Springer, 2019.

[39] Michael Mayrhofer, Christoph Mayr-Dorn, Alois Zoitl, Ouijdane Guiza, Georg Weichhart, and Alexander Egyed. Assessing adaptability of software architectures for cyber physical production systems. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 143–158. Springer, 2019.

[40] Angelika Musil, Juergen Musil, Danny Weyns, and Stefan Biffl. Continuous adaptation management in collective intelligence systems. In Tomás Bures, Laurence

Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 109–125. Springer, 2019.

[41] Evangelos Ntentos, Uwe Zdun, Konstantinos Plakidas, Daniel Schall, Fei Li, and Sebastian Meixner. Supporting architectural decision making on data management in microservice architectures. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 20–36. Springer, 2019.

[42] Luís Nunes, Nuno Santos, and António Rito Silva. From a monolith to a microservices architecture: An approach based on transactional contexts. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 37–52. Springer, 2019.

[43] Ilaria Pigazzini, Francesca Arcelli Fontana, and Andrea Maggioni. Tool support for the migration to microservice architecture: An industrial case study. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 247–263. Springer, 2019.

[44] Ken Power and Rebecca Wirfs-Brock. An exploratory study of naturalistic decision making in complex software architecture environments. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 55–70. Springer, 2019.

[45] Martina De Sanctis, Romina Spalazzese, and Catia Trubiani. Qos-based formation of software architectures in the internet of things. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 178–194. Springer, 2019.

[46] Hasan Sözer. Evaluating the effectiveness of multi-level greedy modularity clustering for software architecture recovery. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 71–87. Springer, 2019.

[47] Tobias Wägemann, Ramin Tavakoli Kolagari, and Klaus Schmid. ADOOPLA - combining product-line- and product-level criteria in multi-objective optimization of product line architectures. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019,*

Paris, France, September 9-13, 2019, Proceedings, volume 11681 of *Lecture Notes in Computer Science*, pages 126–142. Springer, 2019.

[48] Wensheng Wu, Yuanfang Cai, Rick Kazman, Ran Mo, Zhipeng Liu, Rongbiao Chen, Yingan Ge, Weicai Liu, and Junhui Zhang. Software architecture measurement - experiences from a multinational company. In Carlos E. Cuesta, David Garlan, and Jennifer Pérez, editors, *Software Architecture - 12th European Conference on Software Architecture, ECSA 2018, Madrid, Spain, September 24-28, 2018, Proceedings*, volume 11048 of *Lecture Notes in Computer Science*, pages 303–319. Springer, 2018.

[49] Rajitha Yasaweerasinghelage, Mark Staples, Hye-Young Paik, and Ingo Weber. Optimising architectures for performance, cost, and security. In Tomás Bures, Laurence Duchien, and Paola Inverardi, editors, *Software Architecture - 13th European Conference, ECSA 2019, Paris, France, September 9-13, 2019, Proceedings*, volume 11681 of *Lecture Notes in Computer Science*, pages 161–177. Springer, 2019.

[50] A. T. M. Aerts and Yanja Dajsuren. The pdeng program on software technology - experience report on a doctorate level architecture training program. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 247–262. Springer, 2020.

[51] João Franscisco Almeida and António Rito Silva. Monolith migration complexity tuning through the application of microservices patterns. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 39–54. Springer, 2020.

[52] Rafael Capilla, Olaf Zimmermann, Carlos Carrillo, and Hernán Astudillo. Teaching students software architecture decision making. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 231–246. Springer, 2020.

[53] Mauro Caporuscio, Mirko D'Angelo, Vincenzo Grassi, and Raffaela Mirandola. Decentralized architecture for energy-aware service assembly. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 57–72. Springer, 2020.

[54] Mauro Caporuscio, Farid Edrisi, Margrethe Hallberg, Anton Johannesson, Claudia Kopf, and Diego Perez-Palacin. Architectural concerns for digital twin of the organization. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf

Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 265–280. Springer, 2020.

[55] Nacha Chondamrongkul, Jing Sun, and Ian Warren. Formal software architectural migration towards emerging architectural styles. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 21–38. Springer, 2020.

[56] Pablo Cruz, Luis Salinas, and Hernán Astudillo. Quick evaluation of a software architecture using the decision-centric architecture review method: An experience report. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 281–295. Springer, 2020.

[57] Fagner Dias, Marcel Oliveira, Thaís Vasconcelos Batista, Everton Cavalcante, Jair C. Leite, Flávio Oquendo, and Camila Araújo. Empowering sysml-based software architecture description with formal verification: From sysadl to CSP. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 101–117. Springer, 2020.

[58] Federico Giaimo and Christian Berger. Continuous experimentation for automotive software on the example of a heavy commercial vehicle in daily operation. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 73–88. Springer, 2020.

[59] Chadni Islam, Muhammad Ali Babar, and Surya Nepal. Architecture-centric support for integrating security tools in a security orchestration platform. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 165–181. Springer, 2020.

[60] Heiko Koziolek, Sten Grüner, and Julius Rückert. A comparison of MQTT brokers for distributed iot edge computing. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 352–368. Springer, 2020.

[61] Somayeh Malakuti and Sergey Ostroumov. The quest for introducing technical debt management in a large-scale industrial company. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 296–311. Springer, 2020.

[62] Tiago Matias, Filipe Figueiredo Correia, Jonas Fritzsch, Justus Bogner, Hugo Sereno Ferreira, and André Restivo. Determining microservice boundaries: A case study using static and dynamic software analysis. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 315–332. Springer, 2020.

[63] Mahyar Tourchi Moghaddam, Éric Rutten, Philippe Lalanda, and Guillaume Giraud. IAS: an iot architectural self-adaptation framework. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 333–351. Springer, 2020.

[64] Evangelos Ntentos, Uwe Zdun, Konstantinos Plakidas, Sebastian Meixner, and Sebastian Geiger. Assessing architecture conformance to coupling-related patterns and practices in microservices. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 3–20. Springer, 2020.

[65] Martina De Sanctis, Ludovico Iovino, Maria Teresa Rossi, and Manuel Wimmer. A flexible architecture for key performance indicators assessment in smart cities. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 118–135. Springer, 2020.

[66] Roberto Verdecchia, Philippe Kruchten, and Patricia Lago. Architectural technical debt: A grounded theory. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy, September 14-18, 2020, Proceedings*, volume 12292 of *Lecture Notes in Computer Science*, pages 202–219. Springer, 2020.

[67] Dominik Werle, Stephan Seifermann, and Anne Koziolek. Data stream operations as first-class entities in component-based performance models. In Anton Jansen, Ivano Malavolta, Henry Muccini, Ipek Ozkaya, and Olaf Zimmermann, editors, *Software Architecture - 14th European Conference, ECSA 2020, L'Aquila, Italy,*

September 14-18, 2020, Proceedings, volume 12292 of *Lecture Notes in Computer Science*, pages 148–164. Springer, 2020.