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Landscaping Performance Research at the ICPE and its Predecessors: A Systematic Literature Review

Short Paper

International Conference on Performance Engineering (ICPE) 2015

Alexandru Danciu [1], Johannes Kroß [1], Andreas Brunnert [1], Felix Willnecker [1], Christian Vögele [1], Anand Kapadia [2], Helmut Krcmar [2]

[1]fortiss GmbH, [2]Technische Universität München

Agenda

- Methodology
- Results
  - Topics at the ICPE
  - Research and Contribution Facets
  - Evaluation Methods
  - Geographical and Organizational Perspective
- Conclusion

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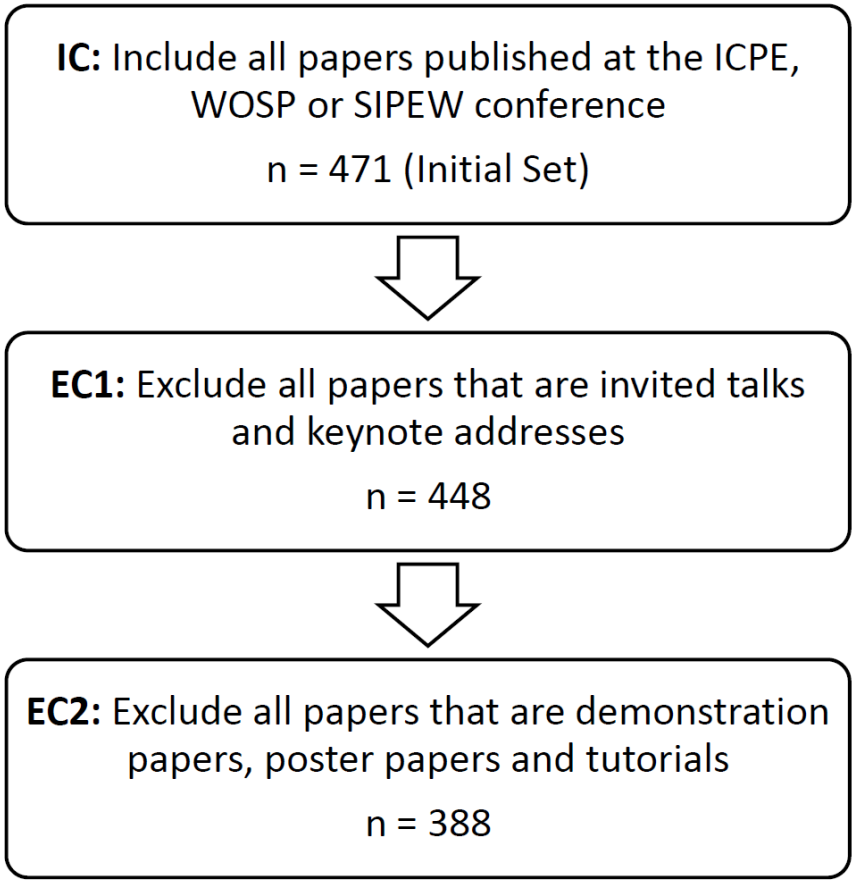
Methodology

Research Questions

- The systematic literature review in this work is conducted following the guidelines provided by Kitchenham/Charters (2007) and is guided by the following research questions (RQ):
  - **RQ 1:** Which topics have been addressed in the papers published at the ICPE (respectively at its predecessors) in the time period from 1998 to 2014?
  - **RQ 2:** Which research facets, contribution facets and evaluation methods have been used in papers published at the ICPE and its predecessors?
  - **RQ 3:** Who are the top ten countries and organizations in terms of the quantity of articles published at the ICPE and its predecessors?

Methodology

Data Sources and Paper Selection



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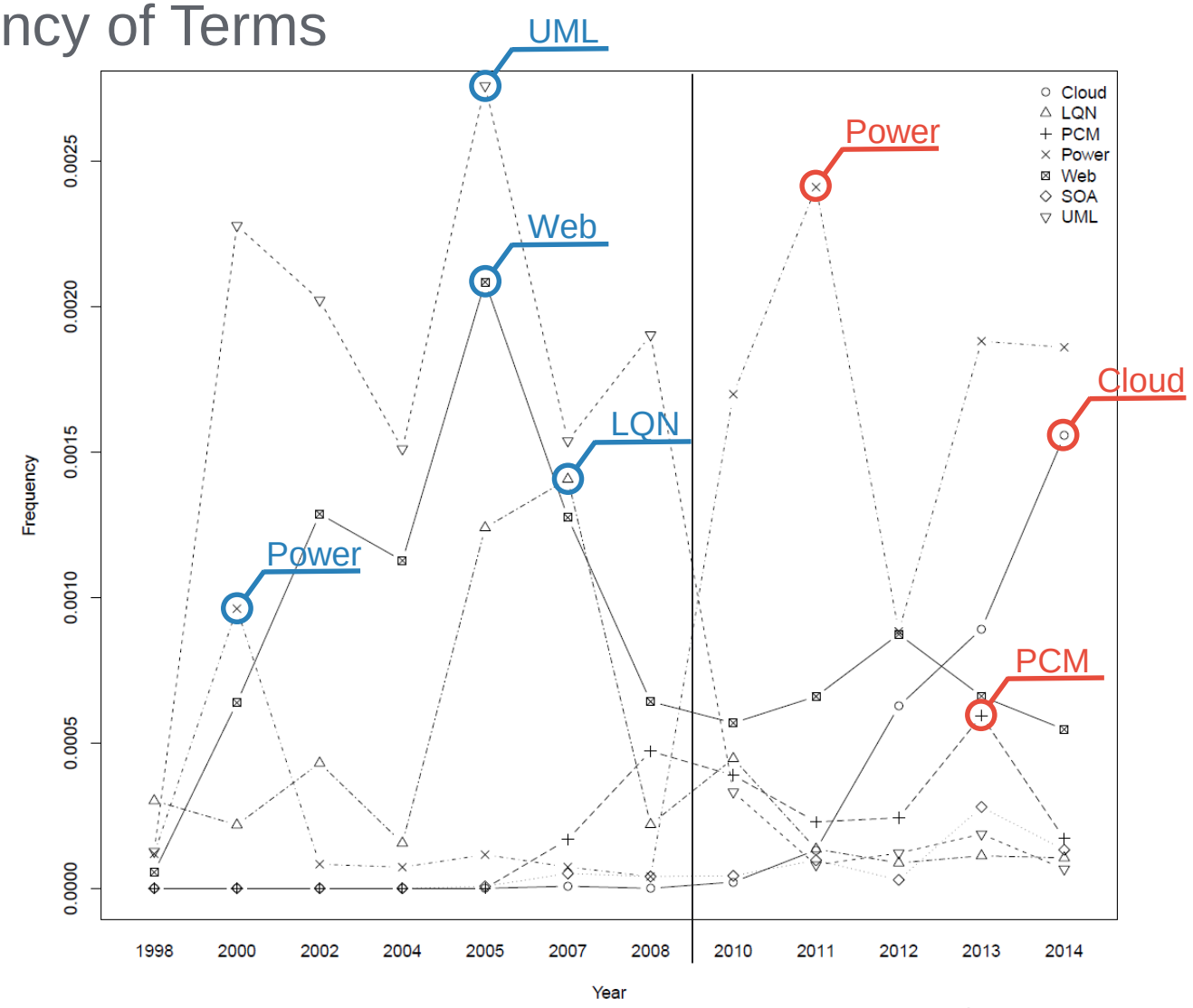
Results - RQ1: Topics at the ICPE

Frequency of Terms



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Results - RQ1: Topics at the ICPE

Most Frequent Keyword Combinations (WOSP/SIPEW)

WOSP 1998		WOSP 2000		WOSP 2002		WOSP 2004	
Queueing Network	0.619	Performance Model	0.792	Response Time	1.459	Response Time	0.644
Software Architecture	0.619	Software System	0.647	Performance Model	0.674	Web Service	0.452
Response Time	0.603	Execution Time	0.485	Autonomous Service	0.514	Performance Analysis	0.431
Task Graph	0.595	Software Architecture	0.477	Performance Analysis	0.409	Performance Model	0.369
Service Time	0.532	Performance Engineering	0.429	Real Time	0.393	Software Performance	0.333
Performance Requirements	0.453	Performance Analysis	0.38	Sequence Diagram	0.382	Operational Profile	0.322
Server Subsystem	0.373	Object Oriented	0.356	Use Case	0.382	Component based	0.312
Mean Service	0.357	Optimal Shutdown	0.356	Web Server	0.371	Class Diagram	0.307
Component Model	0.342	Response Time	0.356	Data Structure	0.321	Content Location	0.27
Use Case	0.334	Service Time	0.348	Data Flow	0.293	Software Component	0.265
WOSP 2005		**WOSP 2007**		**WOSP 2008**		**SIPEW 2008**	
Performance Model	1.308	Response Time	1.143	Performance Model	1	Response Time	1.444
Response Time	0.709	Web Service(s)	0.835	Performance Analysis	0.643	User Behavior	0.565
Software Performance	0.675	Performance Model	0.557	Execution Time	0.634	SPEC CPU	0.532
UML Model	0.579	Queueing Network	0.543	Case Study	0.569	Timing Behavior	0.532
Software System	0.552	LQN Model	0.543	Use Case	0.561	Calling Context	0.5
Redundant Computation	0.539	Performance Engineering	0.44	Software Performance	0.513	Resource Demands	0.424
Software Archtecture	0.396	Service Time	0.418	Performance Modeling	0.48	Context Analysis	0.413
Web Service	0.396	Business Process	0.403	Response Time	0.472	Composite Service	0.402
Acitivity Diagram	0.327	Performance Analysis	0.359	Meta Model	0.391	Trace Context	0.402
Covering Arrays	0.327	Execution Time	0.352	Model Transformation	0.358	Behavior Model	0.391

values need to be multiplied by 10^{-3}

Results - RQ1: Topics at the ICPE

Most Frequent Keyword Combinations (ICPE)

ICPE 2010		ICPE 2011		ICPE 2012	
Response Time	0.842	Response Time	0.66	Response Time	0.694
Non Determinsm	0.67	Power Consumption	0.512	File System	0.544
Page Coloring	0.54	Performance Model	0.403	Software Performance	0.326
Calling Context	0.439	Power Savings	0.367	Control Charts	0.306
Execution Time	0.425	Product Form	0.358	Web Server	0.292
Power Consumption	0.353	Execution Time	0.351	Software System	0.263
Workload Intensity	0.317	Data Center	0.348	Stack Distance	0.263
Data Item	0.288	Delay Tolerant	0.261	Access Control	0.258
Performance Model	0.26	Delay Sensitive	0.232	Monitoring Mechanism	0.238
Performance Signature	0.238	System Performance	0.229	Data Access	0.219

ICPE 2013		ICPE 2014	
Response Time	0.963	Energy Consumption	0.856
Energy Consumption	0.739	Performance Model	0.685
Live Migration	0.605	Load Test	0.619
Performance Model	0.534	Power Consumption	0.481
Performance Regression	0.437	Response Time	0.481
Power Consumption	0.355	Execution Time	0.436
Time Series	0.348	System Performance	0.381
Web Server	0.262	Performance Degradation	0.376
System Architect	0.239	Performance Metrics	0.359
System Performance	0.239	Garbage Collection	0.321

values need to be multiplied by 10^{-3}

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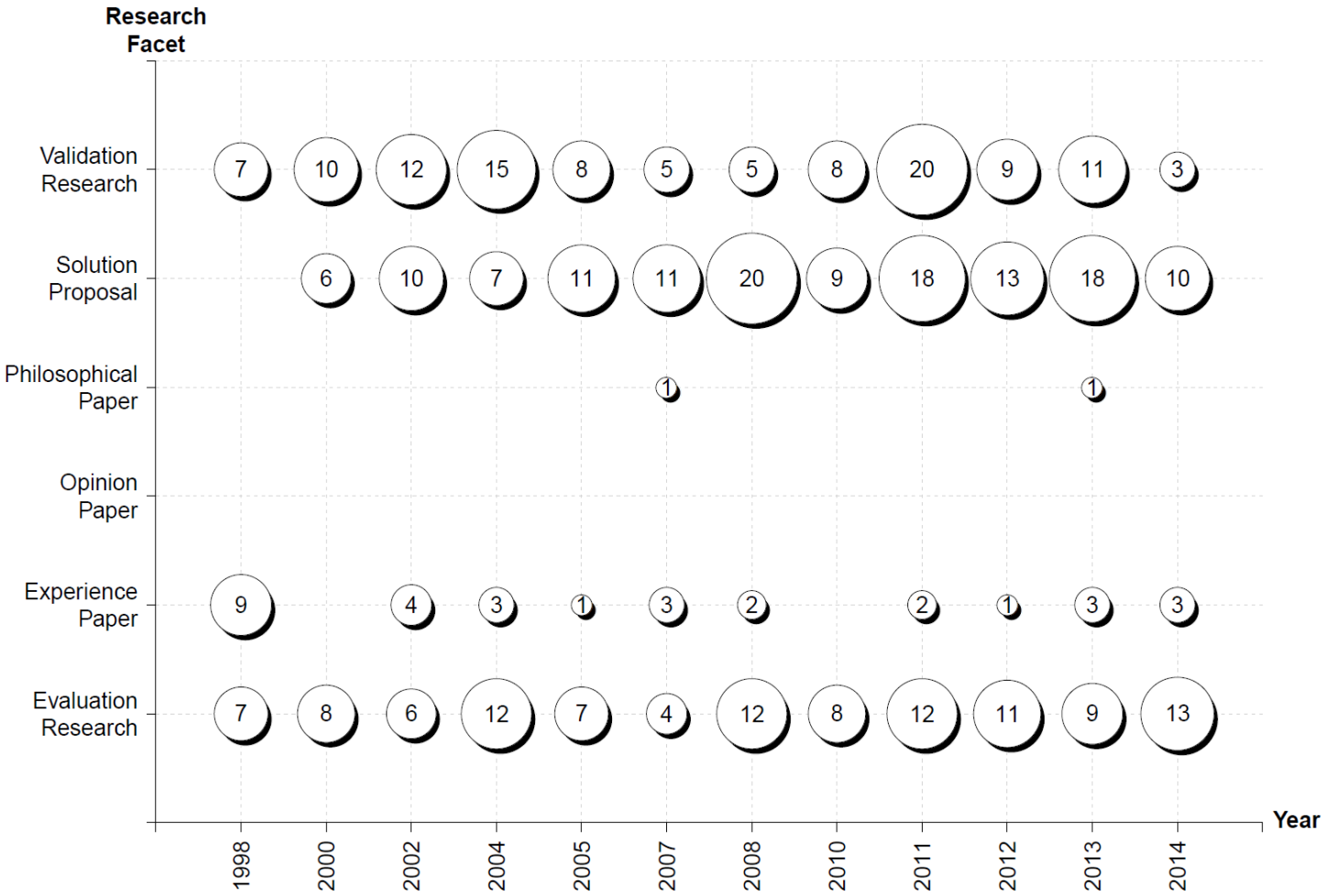
Results - RQ2: Research Facets

Distribution of Research Facets Over the Years



Research facets based on Petersen et al. (2008)

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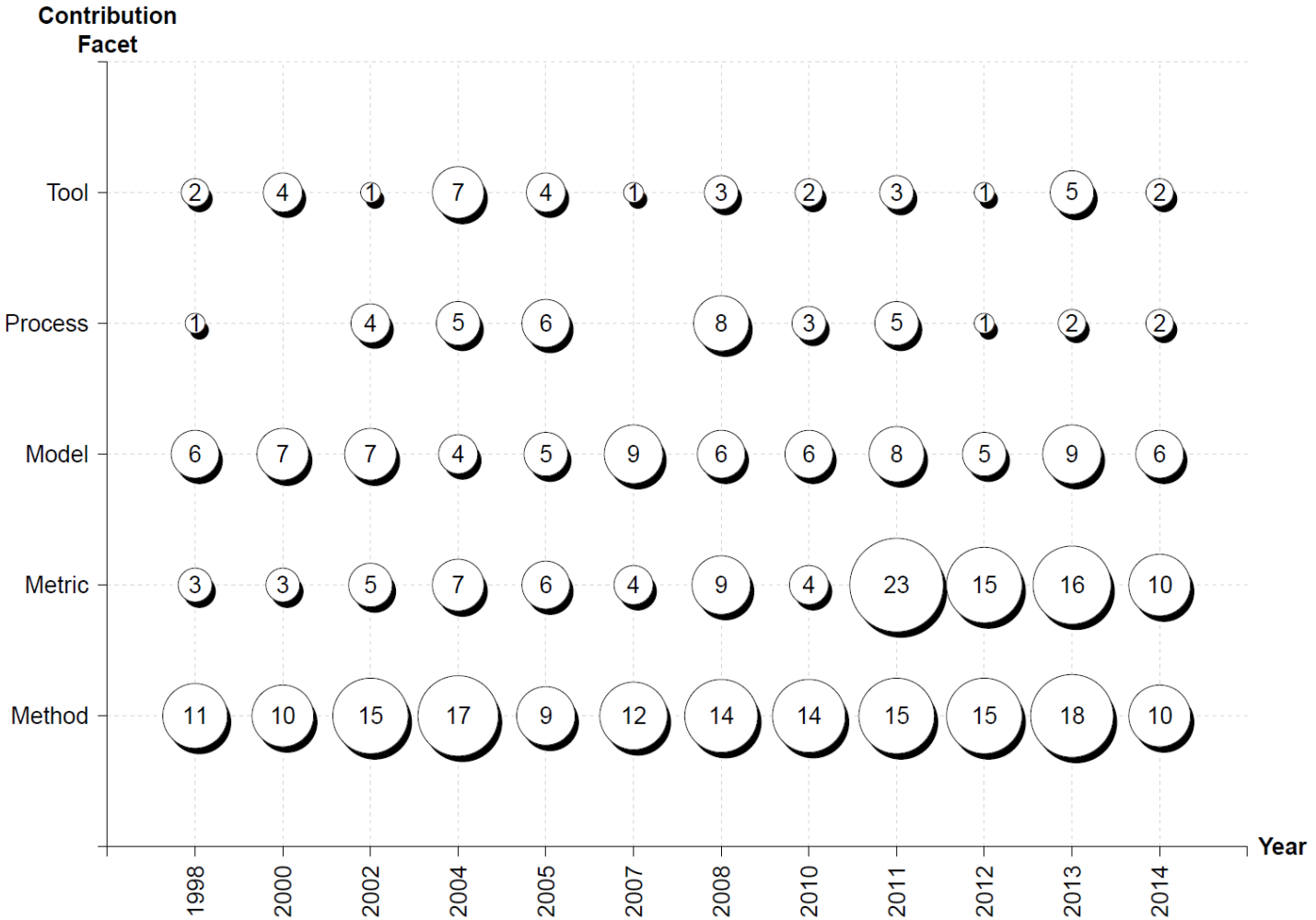
RQ2: Contribution Facet

Distribution of Contribution Facets Over the Years



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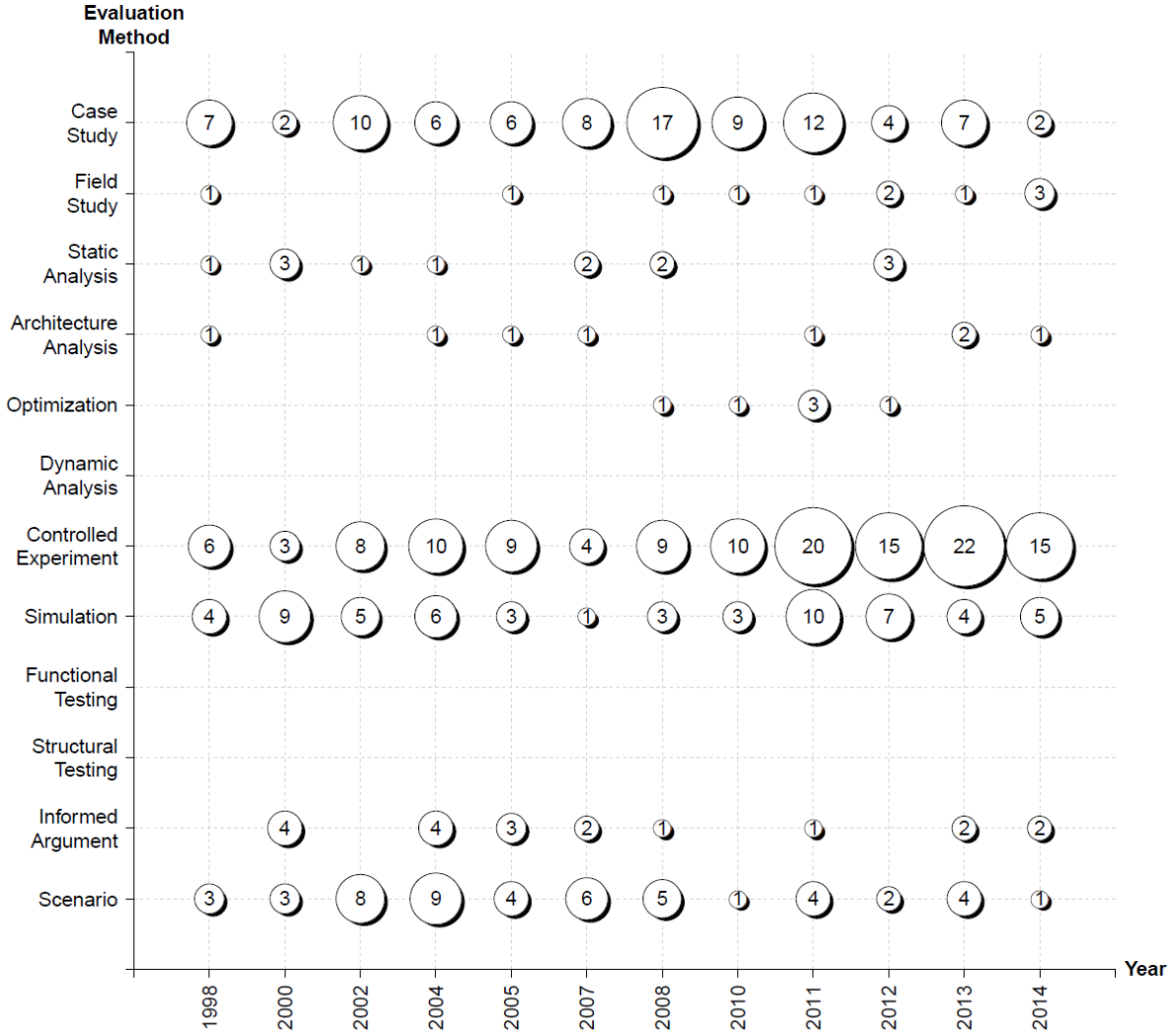
Results - RQ2: Evaluation Methods

Distribution of Evaluation Methods Over the Years



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Results - RQ3: Geographical Perspective

Top 10 Contributing Countries

Rank	Country	Publications	Share	Cooperations
1	USA	130	33.51%	40
2	Germany	67	17.27%	23
3	Canada	61	15.72%	12
4	Italy	52	13.40%	23
5	UK	41	10.57%	14
6	Spain	20	5.15%	13
7	Australia	9	2.32%	2
	Netherlands	9	2.32%	5
	India	9	2.32%	2
	Switzerland	9	2.32%	5

Results - RQ3: Organizational Perspective

Top 10 Contributing Organizations

Rank	Organization	Country	Publications	Share	Cooperations
1	Carleton University	Canada	38	9.79%	12
2	Karlsruhe Institute of Technology	Germany	24	6.19%	18
3	University of L'Aquila	Italy	20	5.15%	14
4	Imperial College London	UK	16	4.12%	3
5	University of Rome Tor Vergata	Italy	12	3.09%	5
6	University of Zaragoza	Spain	9	2.32%	4
7	AT&T Labs	USA	8	2.06%	3
	Hewlett-Packard Laboratories USA	USA	8	2.06%	5
	University of the Balearic Islands	Spain	8	2.06%	8
10	George Mason University	USA	7	1.80%	3
	Oracle Corporation USA	USA	7	1.80%	6
	Performance Engineering Services	USA	7	1.80%	7
	SAP Research Karlsruhe	Germany	7	1.80%	5
	University of Oldenburg	Germany	7	1.80%	6

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Conclusion

- Most articles are focused on the system development phase.
- Since 2010, an increasing number of papers address the system operation phase which results in a well-balanced conference profile.
- Constant shift of the conference focus towards the latest technologies such as cloud computing.
- The community would greatly benefit from more research which provides taxonomies for the generated knowledge and summarizes existing findings.
- Positive influence of hosting a conference on the number of publications of this country.

Alexandru Danciu,
Andreas Brunnert
performancegroup@fortiss.org
pmw.fortiss.org

Motivation

- A general overview of prevailing topics and methods within the community does not exist.

- The principle conference that is focused on the performance of software systems and related questions is the International Conference on Performance Engineering (ICPE).

➢ Performance engineering research at the ICPE and its predecessors is analyzed in a systematic literature review.

Results - RQ1: Topics at the ICPE

N-Gram Analysis

- The N-Gram analysis is employed to reveal trends within the conference from 1998 to 2014 (Soper/Turel 2012, Demeyer et al. 2013):
  - An N-Gram is a sequence of n words extracted from a body of text.
  - For example, the phrase “software performance management” can be divided into:
    - three 1-Grams (“software", "performance", "management"),
    - two 2-Grams (“software performance", "performance management"), and
    - one 3-Gram (“software performance management").
  - In order to prevent distortion of results we removed in several post-processing steps any unnecessary data such as author information, keyword lists, the bibliography, the appendix, page numbers and citation references.

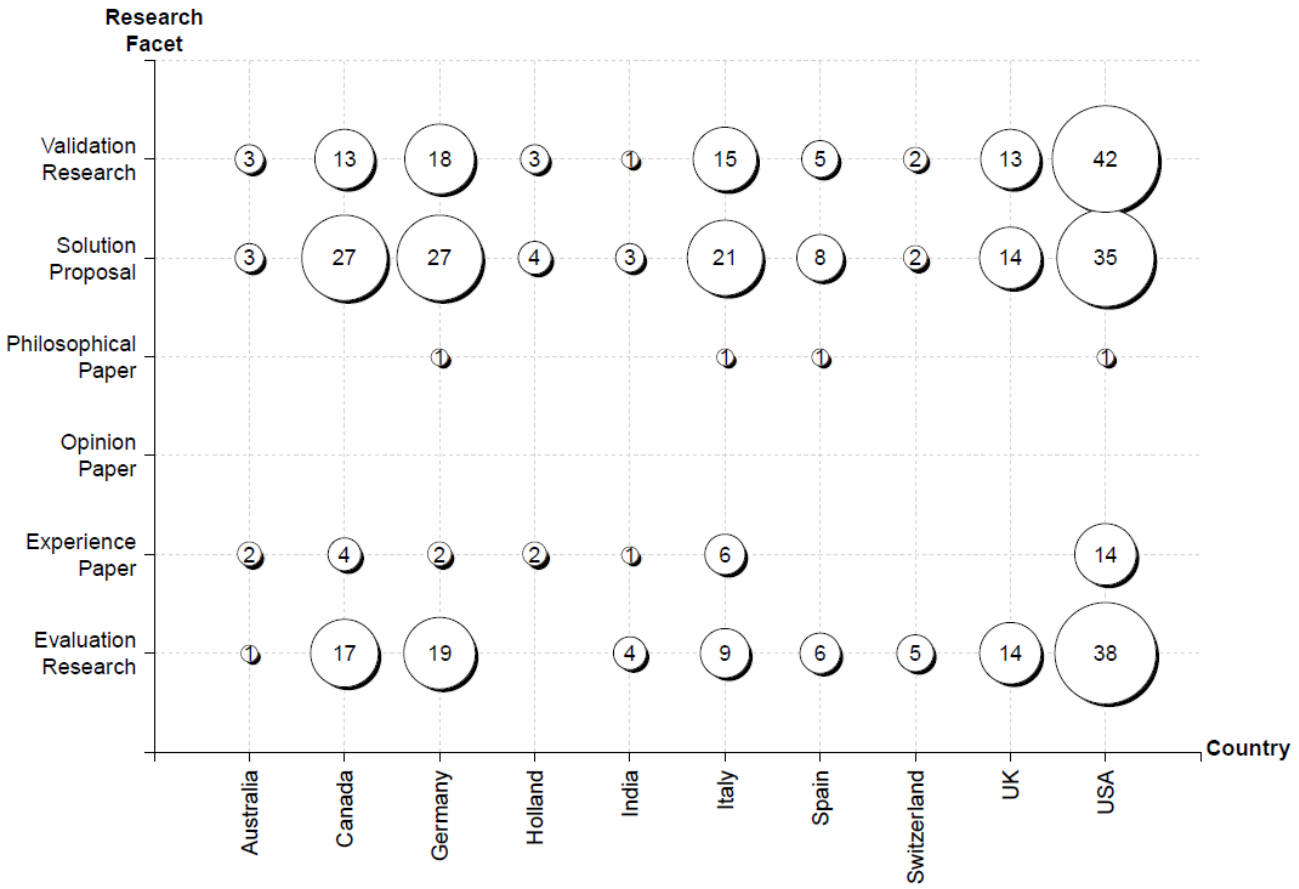
Results - RQ2: Evaluation Methods

Method descriptions (Hevner et al. 2004)

Category	Method	Paper
1. Observational	**Case Study:** Study artifact in depth in business environment	90
	Field Study: Monitor use of artifact in multiple projects	11
2. Analytical	**Static Analysis:** Examine structure of artifact for static qualities (e.g., complexity)	13
	Architecture Analysis: Study fit of artifact into technical information system architecture	8
	Optimization: Demonstrate inherent optimal properties of artifact or provide optimality bounds on artifact behavior	6
	Dynamic Analysis: Study artifact in use for dynamic qualities (e.g., performance)	0
3. Experimental	**Controlled Experiment:** Study artifact in controlled environment for qualities (e.g., usability)	131
	Simulation: Execute artifact with artificial data	60
4. Testing	**Functional (Black Box) Testing:** Execute artifact interfaces to discover failures and identify defects	0
	Structural (White Box) Testing: Perform coverage testing of some metric (e.g., execution paths) in the artifact implementation	0
5. Descriptive	**Informed Argument:** Use information from the knowledge base (e.g., relevant research) to build a convincing argument for the artifact's utility	19
	Scenarios: Construct detailed scenarios around the artifact to demonstrate its utility	50

Results - RQ3: Geographical Perspective

Distribution of Research Facets Over Countries



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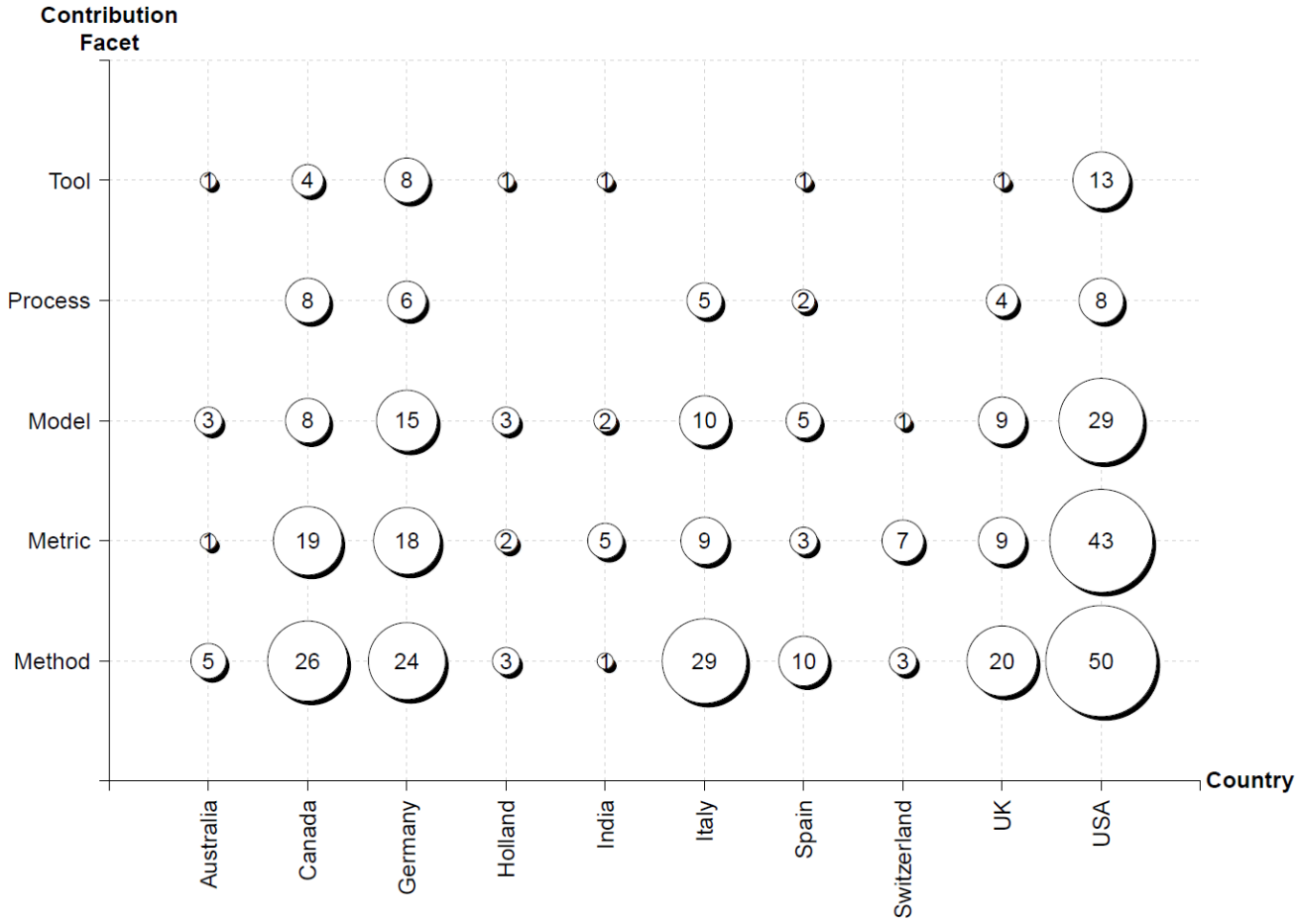
Results - RQ3: Geographical Perspective

Distribution of Contribution Facets Over Countries



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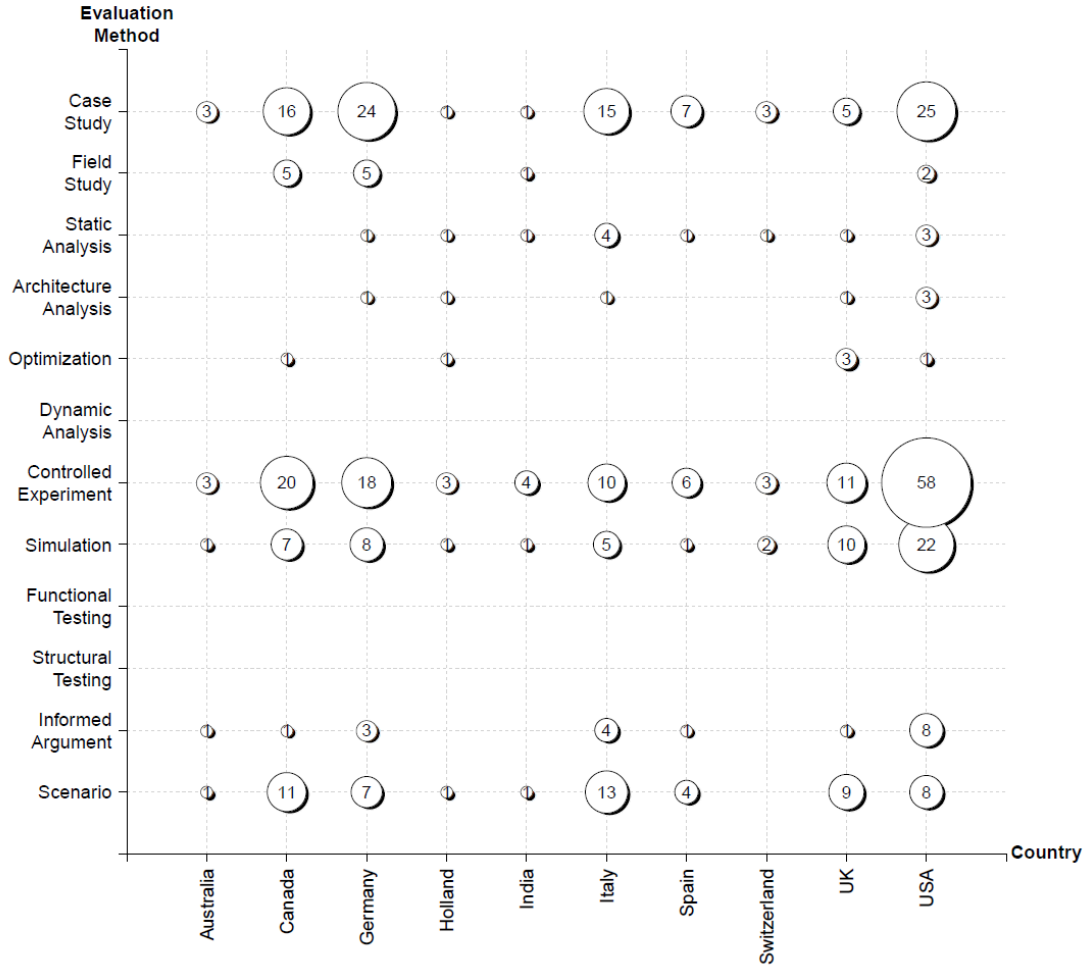
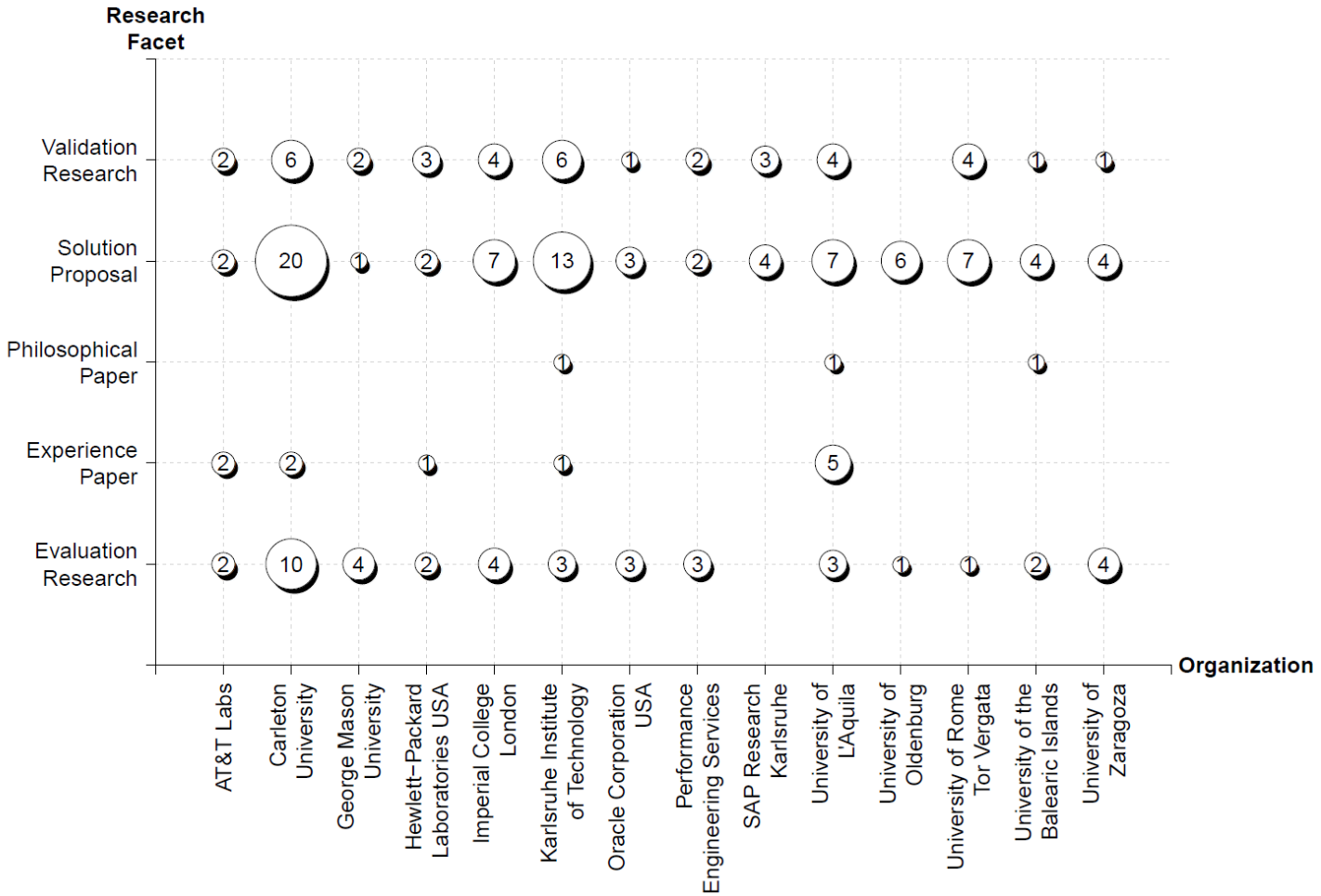
Results - RQ3: Geographical Perspective

Distribution of Evaluation Methods Over Countries



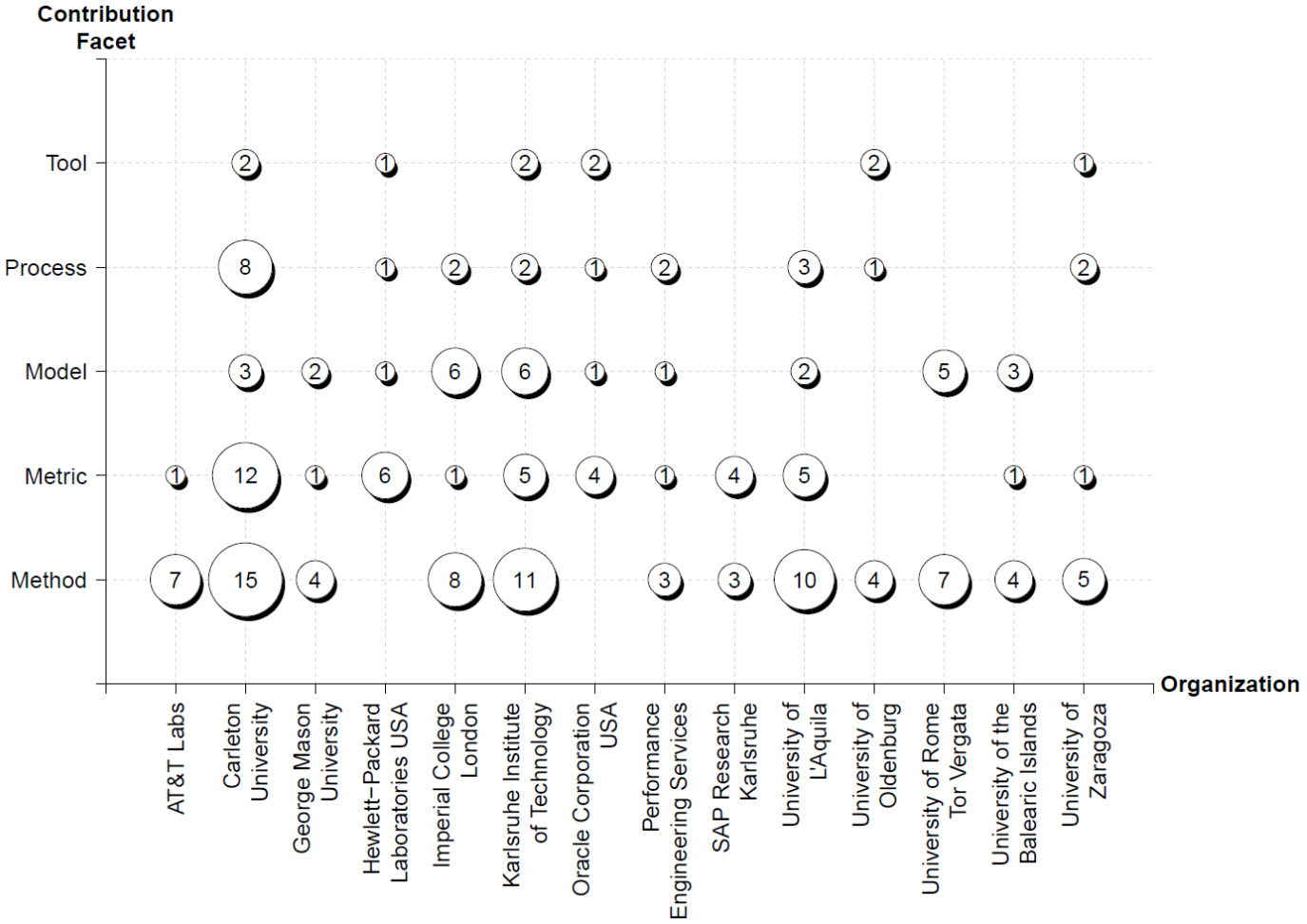
Results - RQ3: Organizational Perspective

Distribution of Research Facets Over Countries



Results - RQ3: Organizational Perspective

Distribution of Contribution Facets Over Organizations



Results - RQ3: Organizational Perspective

Distribution of Evaluation Methods Over Countries