Together we are Stronger:
Empirical Investigations & Personal Experiences for Successful Industry & Academia Collaboration

Michael Felderer

Industry (I) and Academia (A)

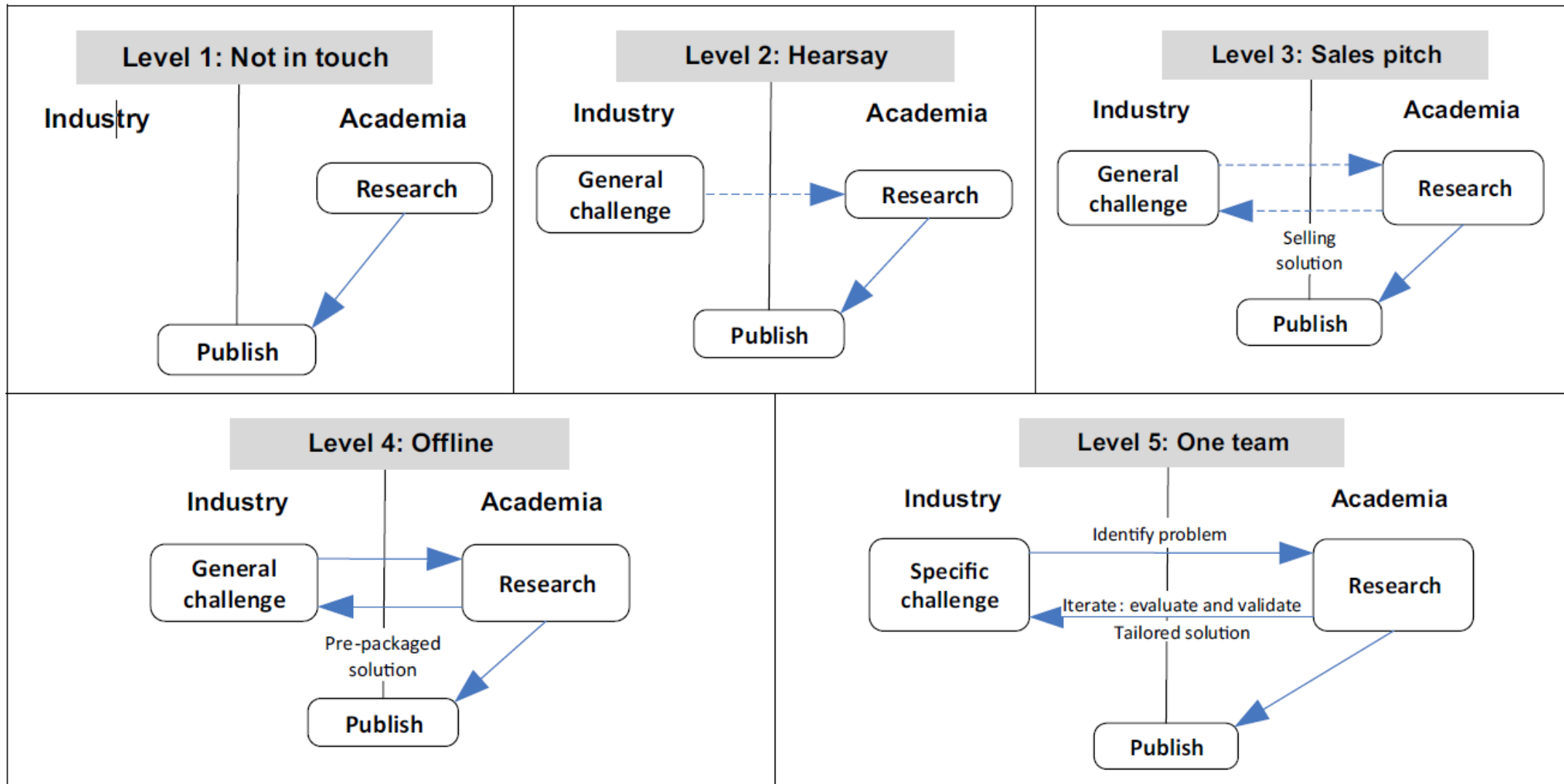Practical Solutions

Disruptive Innovation Cycles

Goal-driven

Publications

Fixed Innovation Cycles

Curiosity-driven

Maturity Levels of Closeness Between I and A

C. Wohlin: Software Engineering Research under the Lamppost. IJCST 2013, 2013

Prof. Dr. Michael Felderer

> 120 Publications

Organisation of IAC Events

10 Best Paper Awards

> 30 Projects

> 10 Years Industrial Experience

> 50 Committees

Founder
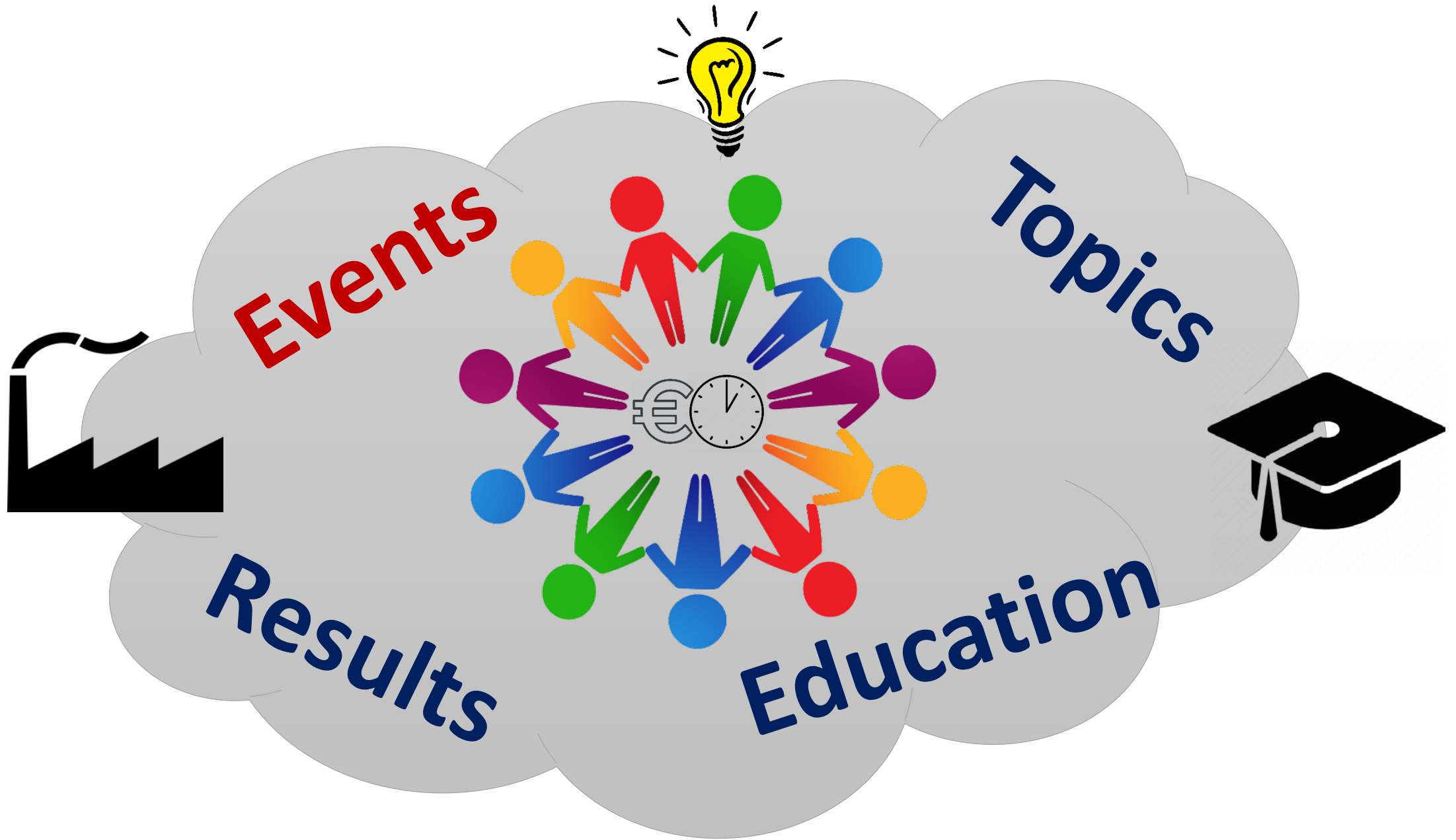
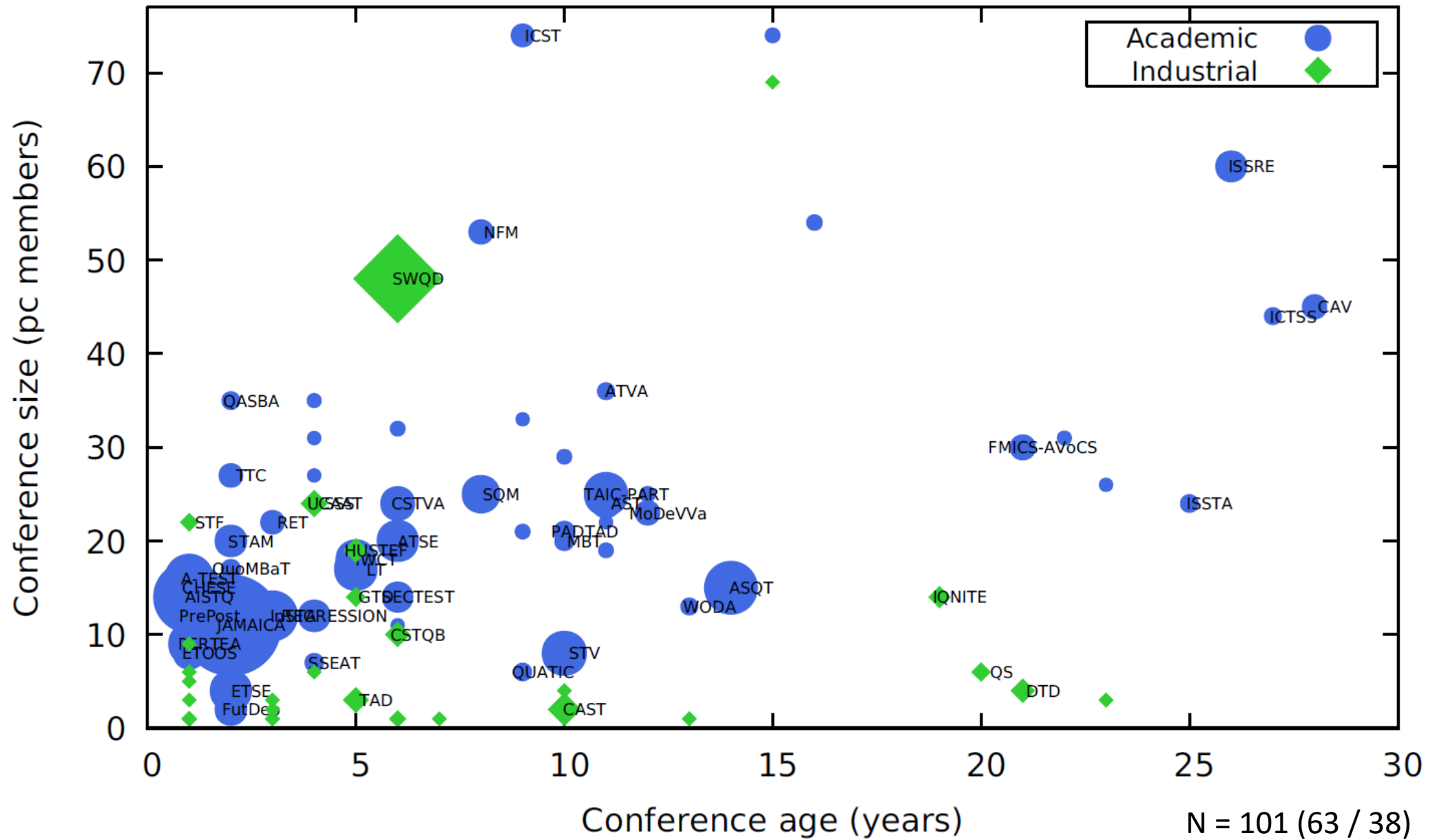**> 50 Companies Collaborated**

Austria & Sweden

Research on IAC

> 10 Project Assessments

> 50 Different Lectures and Trainings
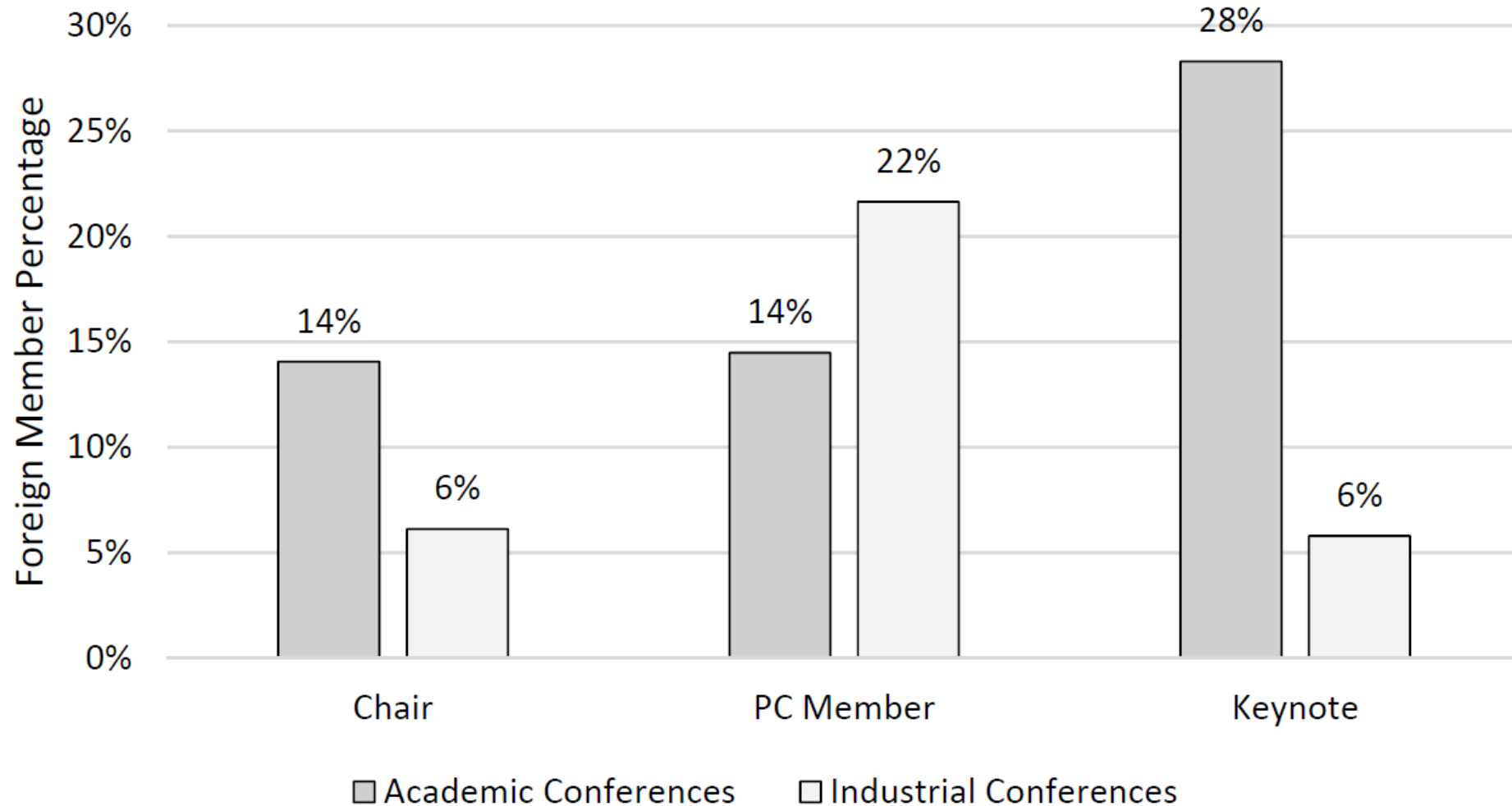
Industry Academia Collaboration Ecosystem
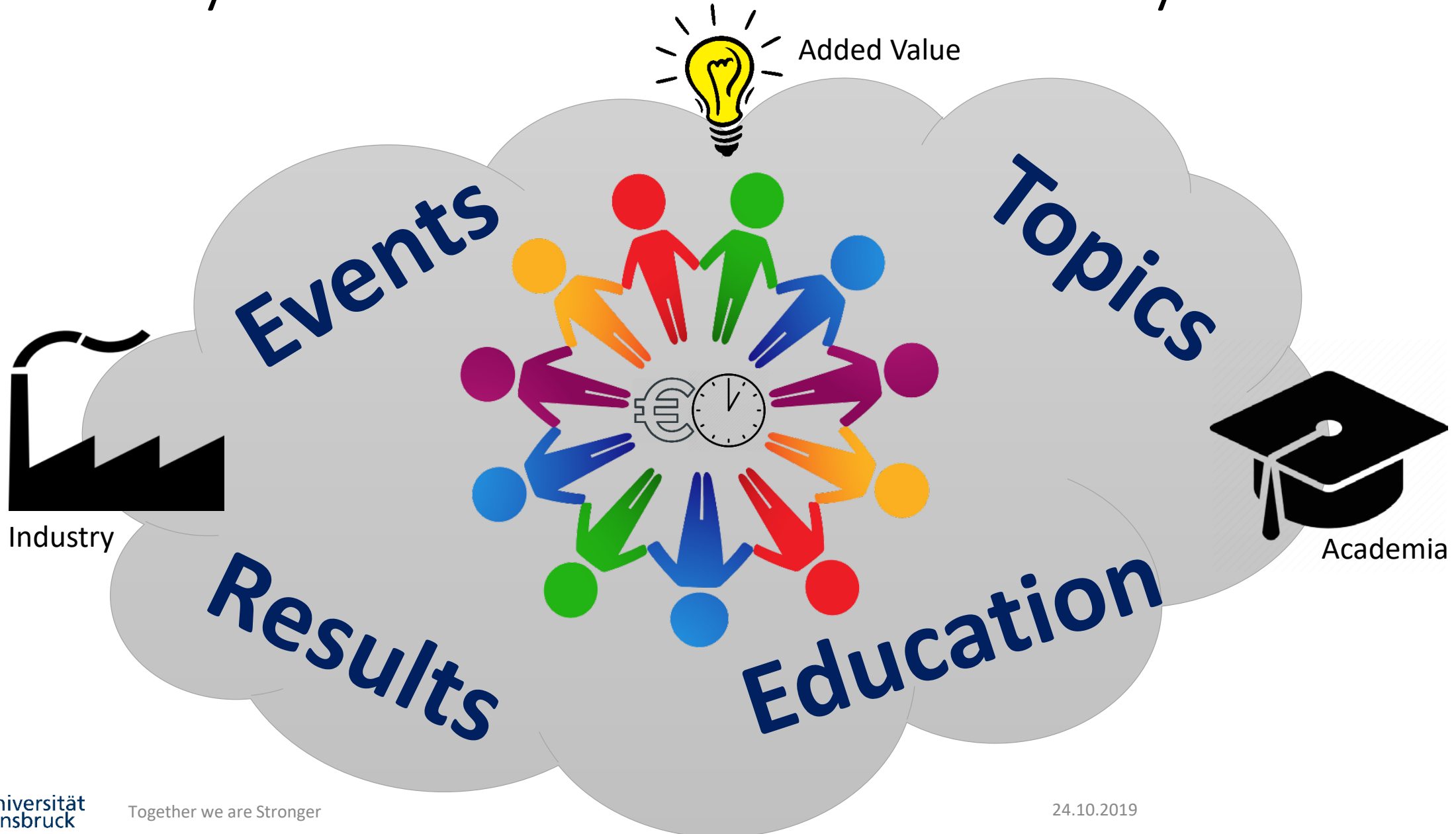
Á. Beszédes, L. Vidács: Academic and Industrial Software Testing Conferences: Survey and Synergies. TAICPART 2016, 2016

Synergy Metrics Between Conferences
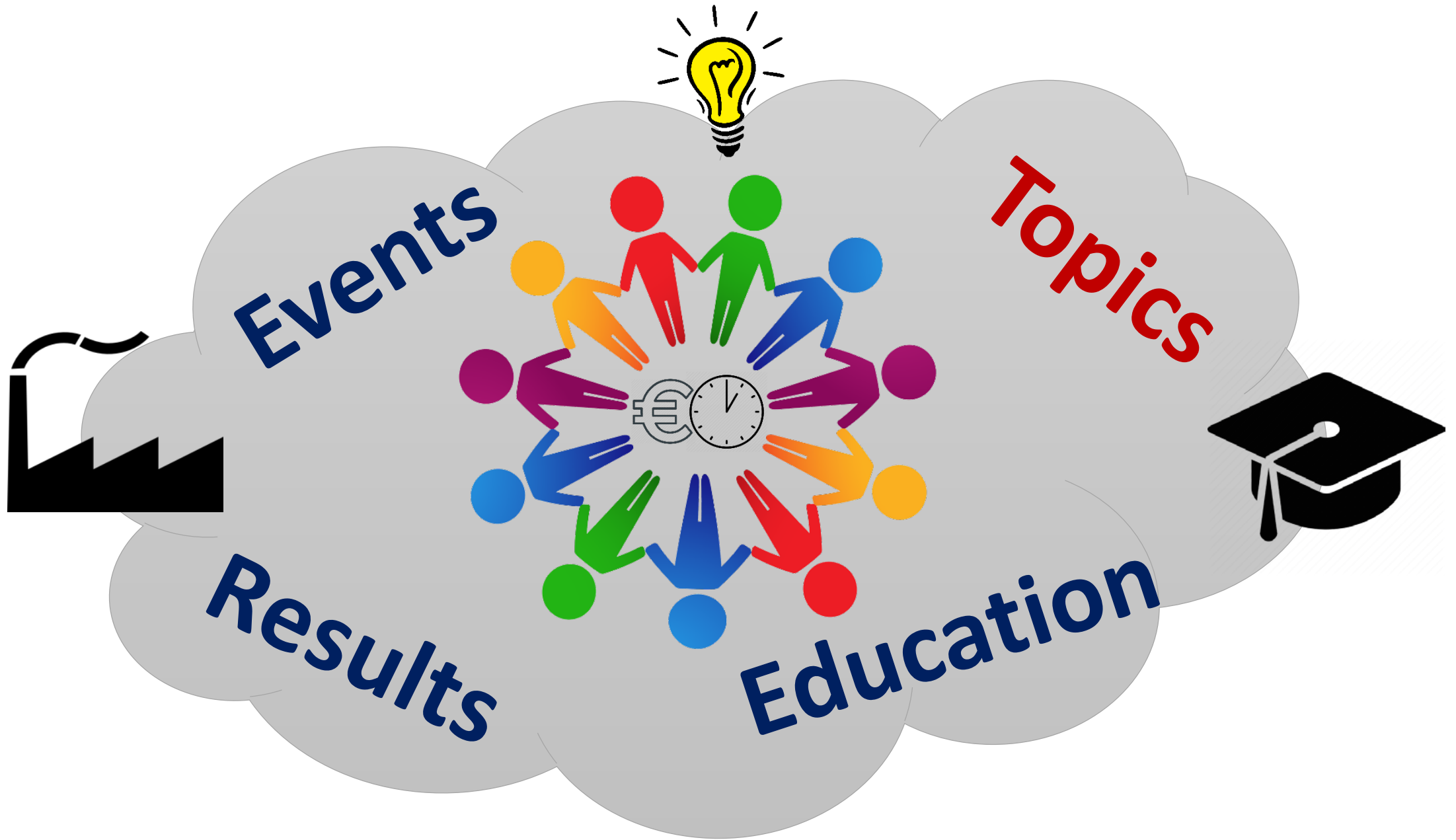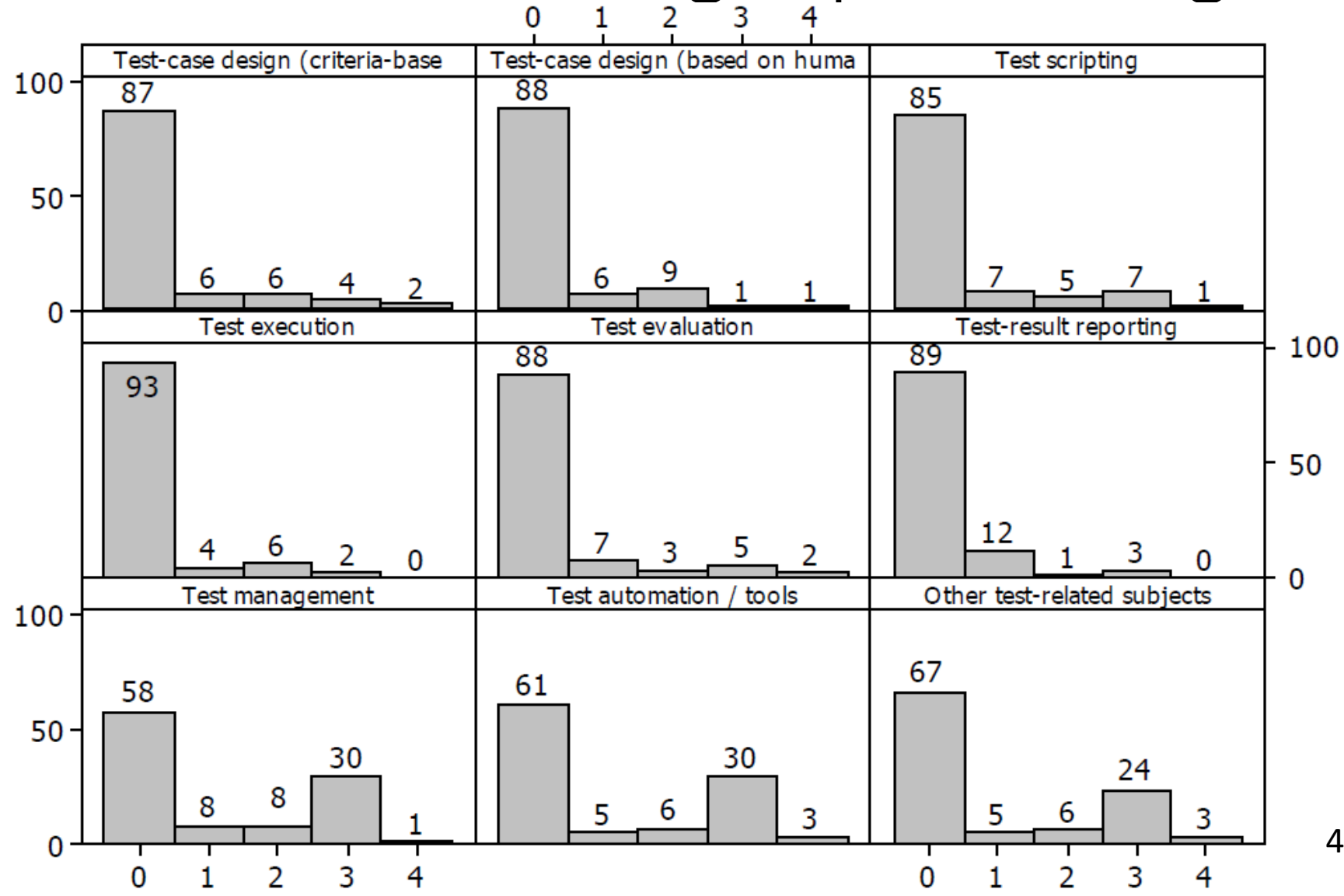

Á. Beszédes, L. Vidács: Academic and Industrial Software Testing Conferences: Survey and Synergies. TAICPART 2016, 2016

Topics: Level of Challenges per Testing Activity

V. Garousi, M. Felderer, M. Kuhrmann, K. Herkiloglu: What Industry wants from Academia in Software Testing. Hearing pracitioners' opinions. EASE 2017, 2017

N = 105

0 – no challenges
4 – lots of challenges

Presentation Titles at Conferences

N = 340
(2013/14)

Term	Frequency
Automation	34
Mobile	29
Agile	24
Quality	18
Cloud	13
Performance	12
World	11
Management	11
Data	10
Continuous	9

N = 354
(2013/14)

Term	Frequency
Model	18
Combinatorial	13
Automated	10
Web	8
Analysis	8
Applications	7
Empirical	6
Product	6
Mutation	6
Data	6

V. Garousi, M. Felderer: Worlds Apart.
Industrial and Academic Focus Areas in
Software Testing. IEEE Software, 2017
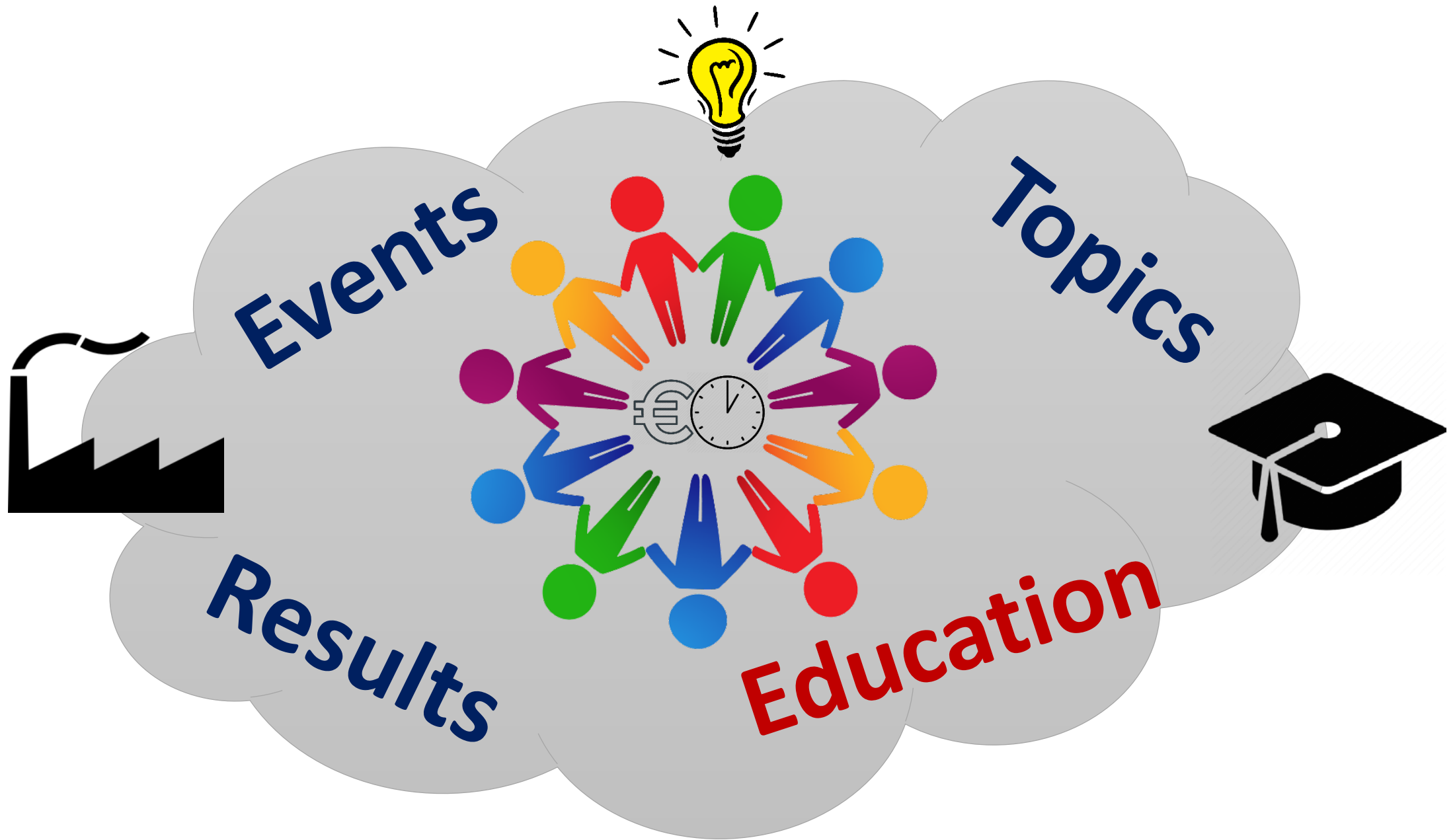
Importance of SE Knowledge Areas

Papers published between 2013-2018 (n=17)
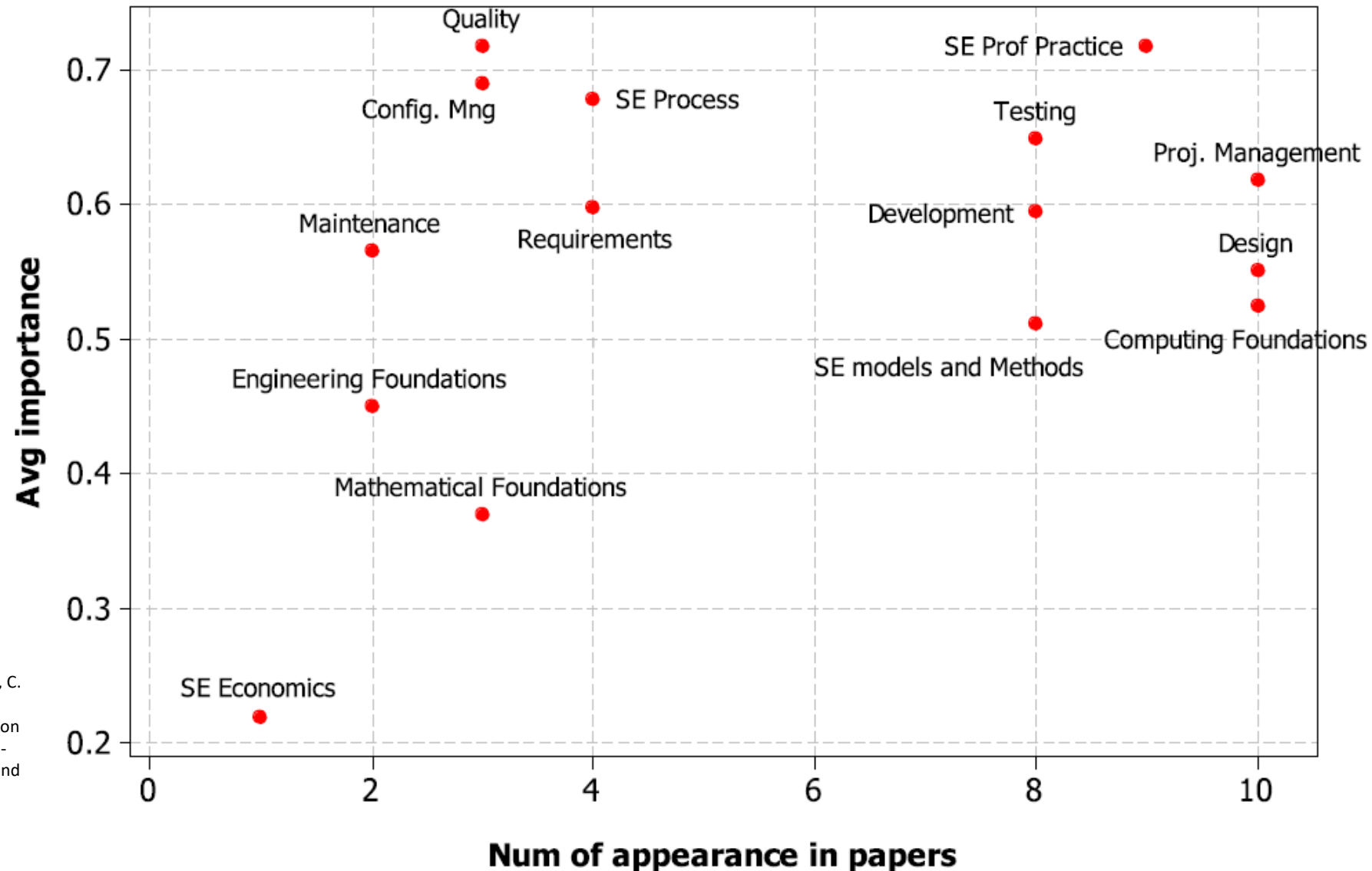
V. Garousi, G. Giray, E. Tüzün, C. Catal, M. Felderer: Aligning software engineering education with industrial needs: A meta-analysis. Journal of Systems and Software, 2019

N = 17

Top Ten Job Skills to Thrive "4th Industrial Revolution"

in 2020

1. Complex Problem Solving
2. Critical Thinking
3. Creativity
4. People Management
5. Coordinating with Others
6. Emotional Intelligence
7. Judgment and Decision Making
8. Service Orientation
9. Negotiation
10. Cognitive Flexibility

in 2015

1. Complex Problem Solving
2. Coordinating with Others
3. People Management
4. Critical Thinking
5. Negotiation
6. Quality Control
7. Service Orientation
8. Judgment and Decision Making
9. Active Listening
10. Creativity

WORLD ECONOMIC FORUM

Future of Jobs Report
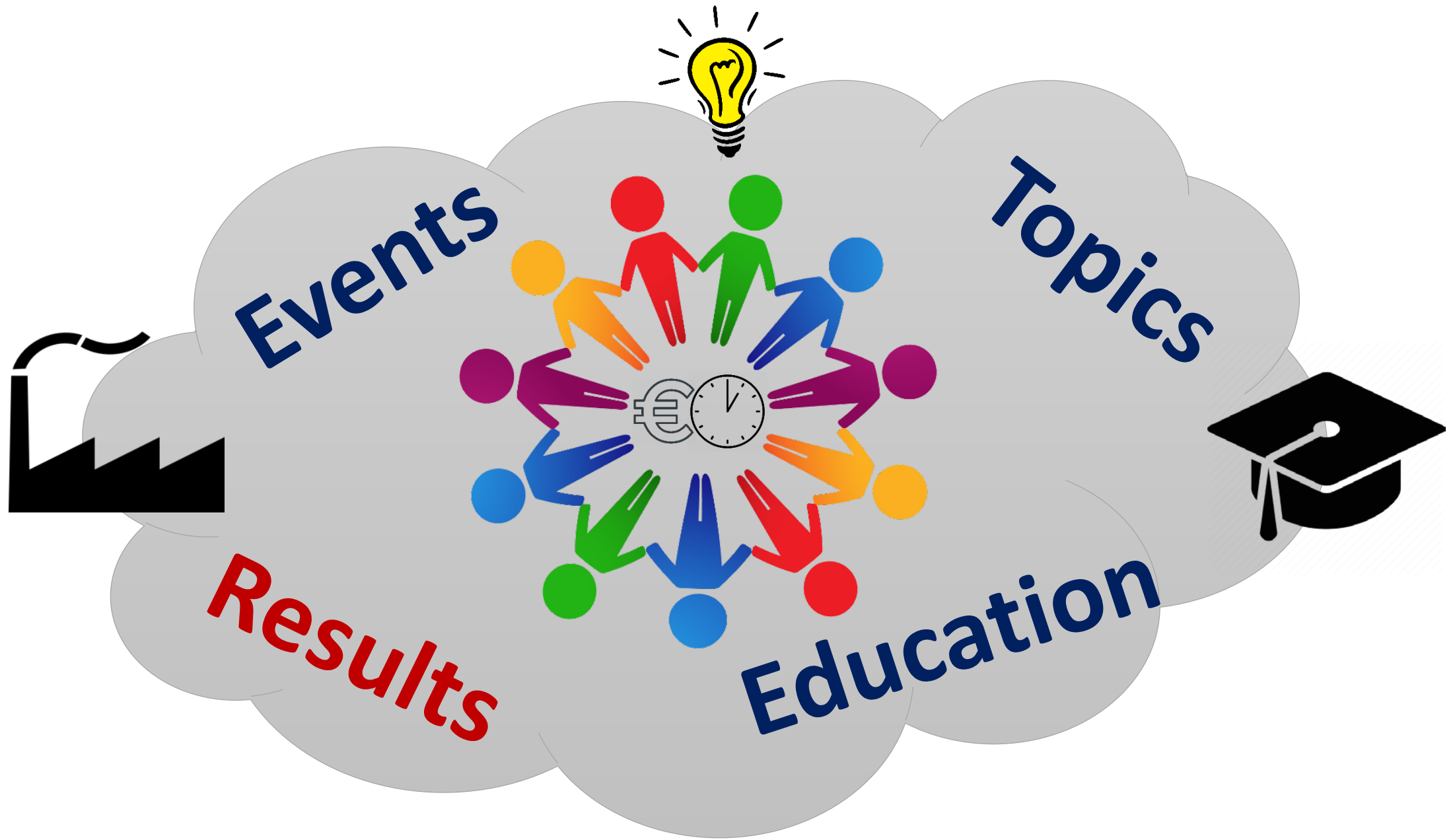
Grey Literature
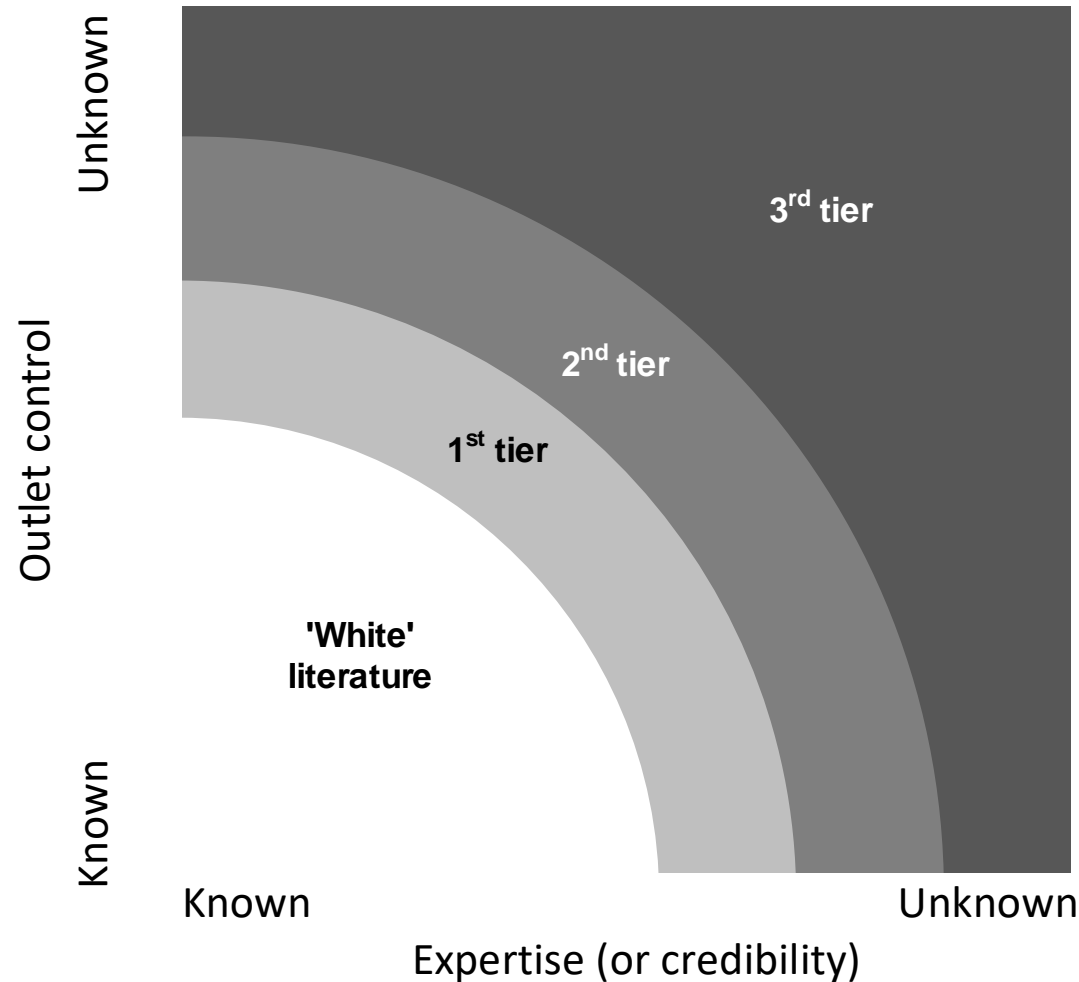
3rd tier GL: Low outlet control/ Low credibility: such as blogs, emails, tweets

2nd tier GL: Moderate outlet control/ Moderate credibility: such as annual reports, news articles, presentations, videos, Q/A sites (such as StackOverflow), Wiki articles

1st tier GL: High outlet control/ High credibility: such as books, magazines, government reports, white papers

Literature Study on Test Process Models
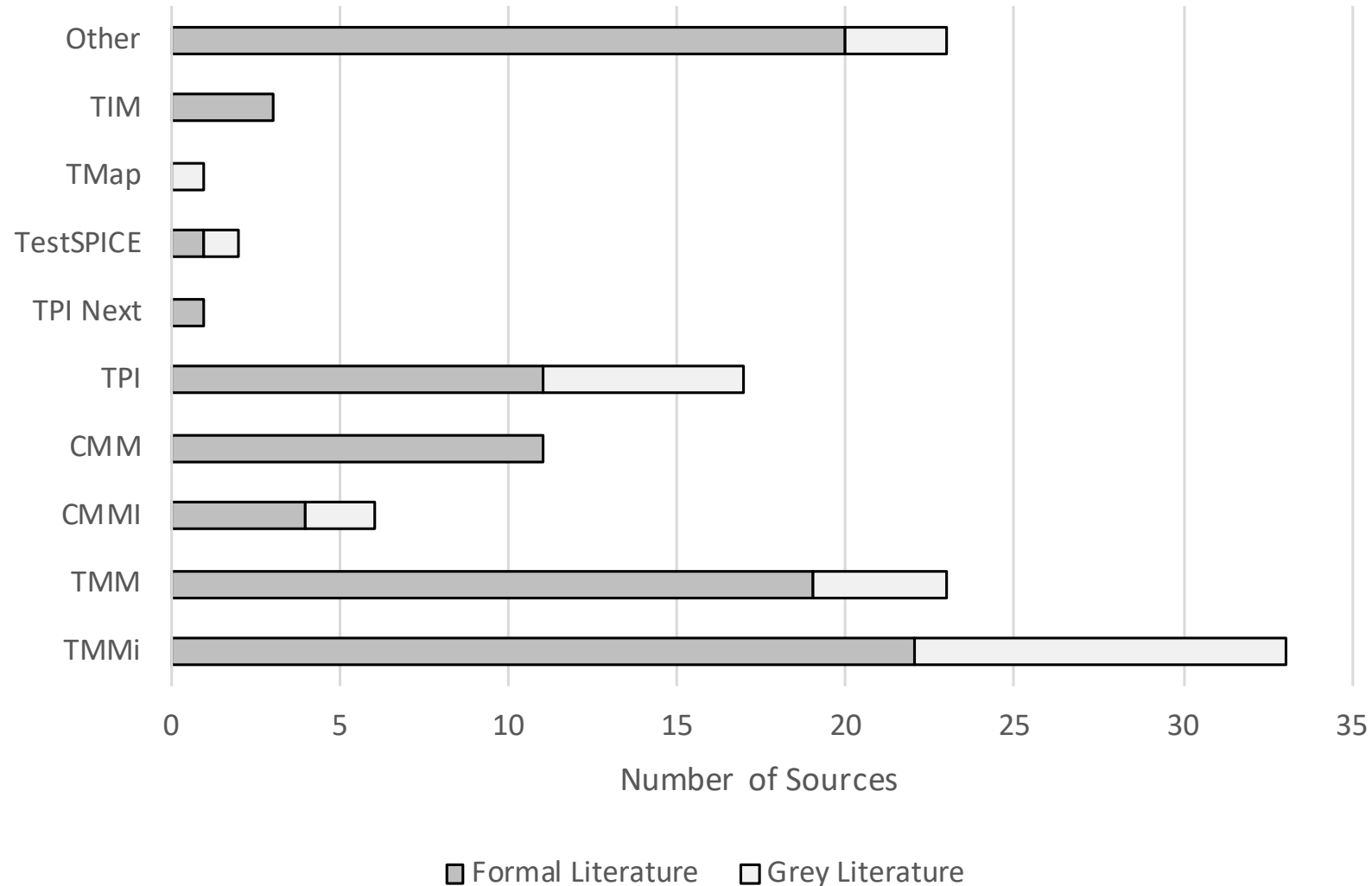
V. Garousi, M. Felderer, T. Hacaloğlu: Software test maturity assessment and test process improvement: A multivocal literature review. Information and Software Technology, 2017

N = 181

Impact of Patterns and Anti-Patterns on IAC Projects

Chart values (left to right):

Code	Value
WTI	1.39
HMRU	1.37
CUIN	1.28
ROSP	1.29
PTS	1.18
ENMC	1.17
TPS	1.15
UCCL	1.07
FPRM	1.01
PAKM	0.94
BA	0.94
CMA	0.89
ERPM	0.82
CMRL	0.64
MFRP	0.56
UDS	-0.56
PCM	-0.66
IPOP	-0.89
FSCA	-0.94

Patterns:
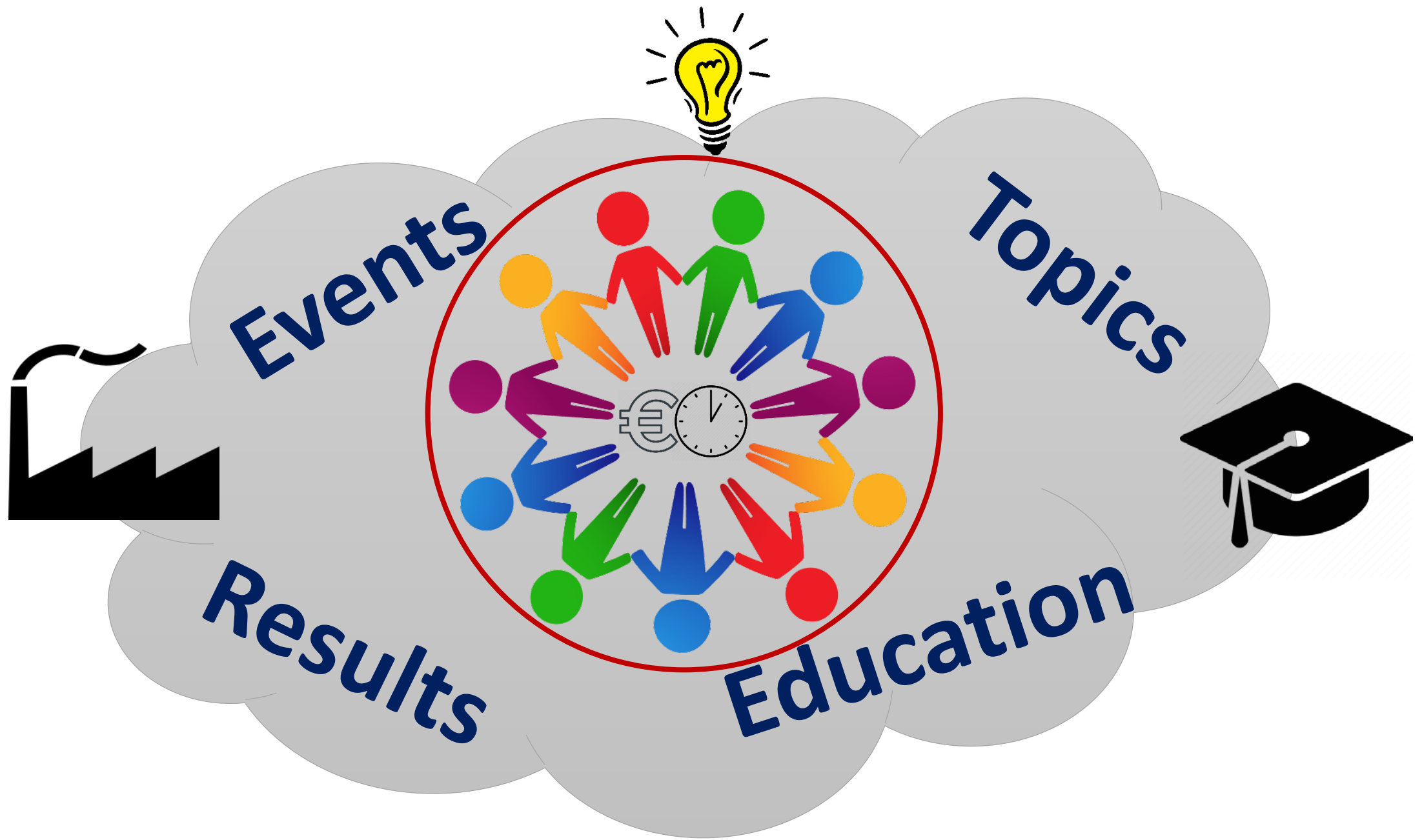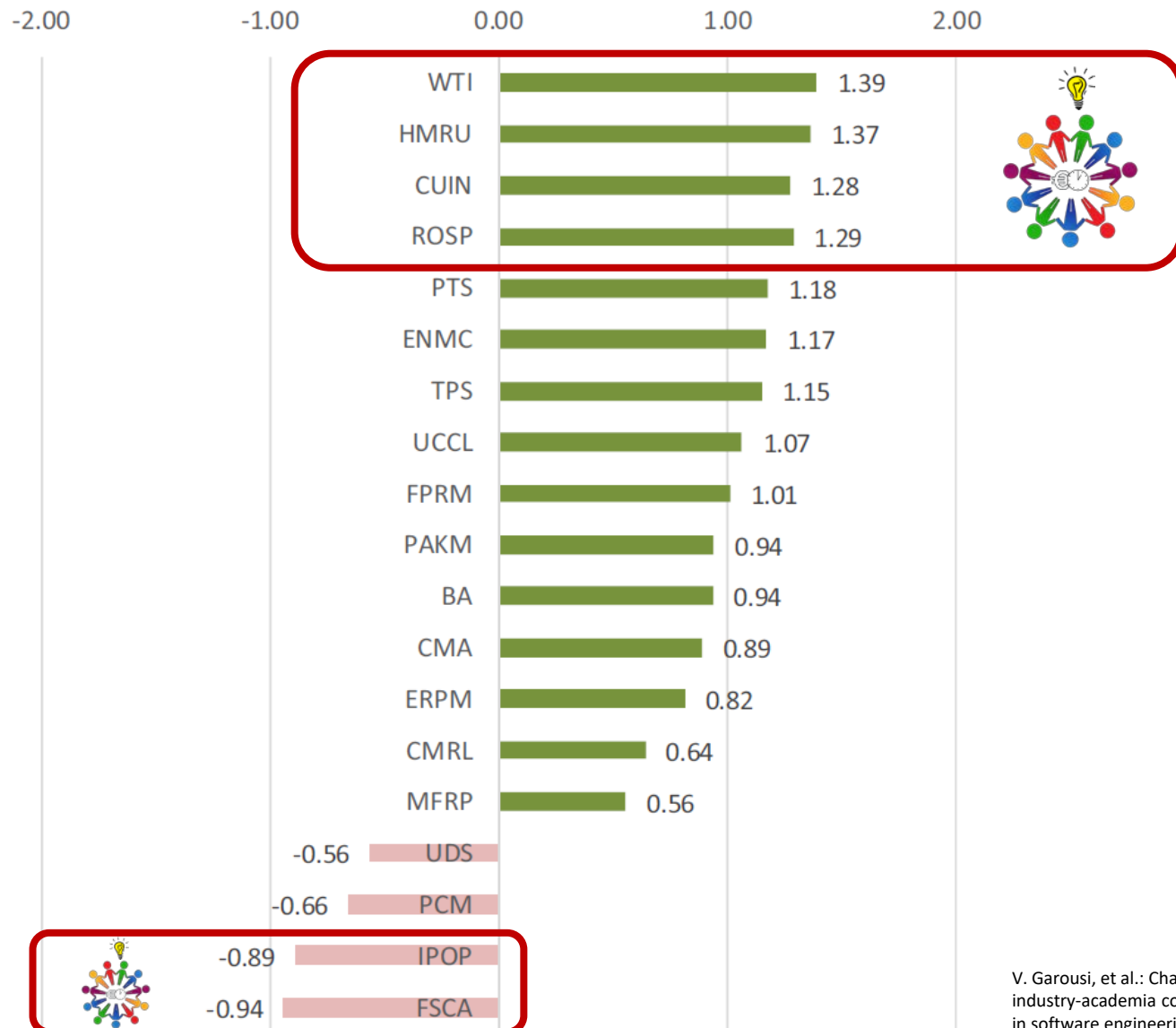- Proper and active knowledge management (PAKM)
- Ensuring engagement and managing commitment (ENMC)
- Considering and understanding industry's needs, and giving explicit industry benefits (CUIN)
- Having mutual respect, understanding and appreciation (HMRU)
- Being Agile (BA)
- Working in (as) a team and involving the "right" practitioners (WTI)
- Considering and manage risks and limitations (CMRL)
- Researcher's on-site presence and access (ROSP)
- Following a proper research/data collection method (FPRM)
- Managing funding/recruiting/partnerships and contracting privacy (MFRP)
- Understanding the context, constraints and language (UCCL)
- Efficient research project management (ERPM)
- Conducting measurement/ assessment (CMA)
- Testing pilot solutions before using them in industry (TPS)
- Providing tool support for solutions (PTS)

Anti-patterns:
- (Anti-pattern): Following self-centric approach (FSCA)
- Unstructured decision structures (UDS)
- Poor change management (PCM)
- Ignoring project, organizational, or product characteristics (IPOP)

N = 101

V. Garousi, et al.: Characterizing industry-academia collaborations in software engineering: evidence from 101 projects. Empirical Software Engineering, 2019

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Together we are Stronger
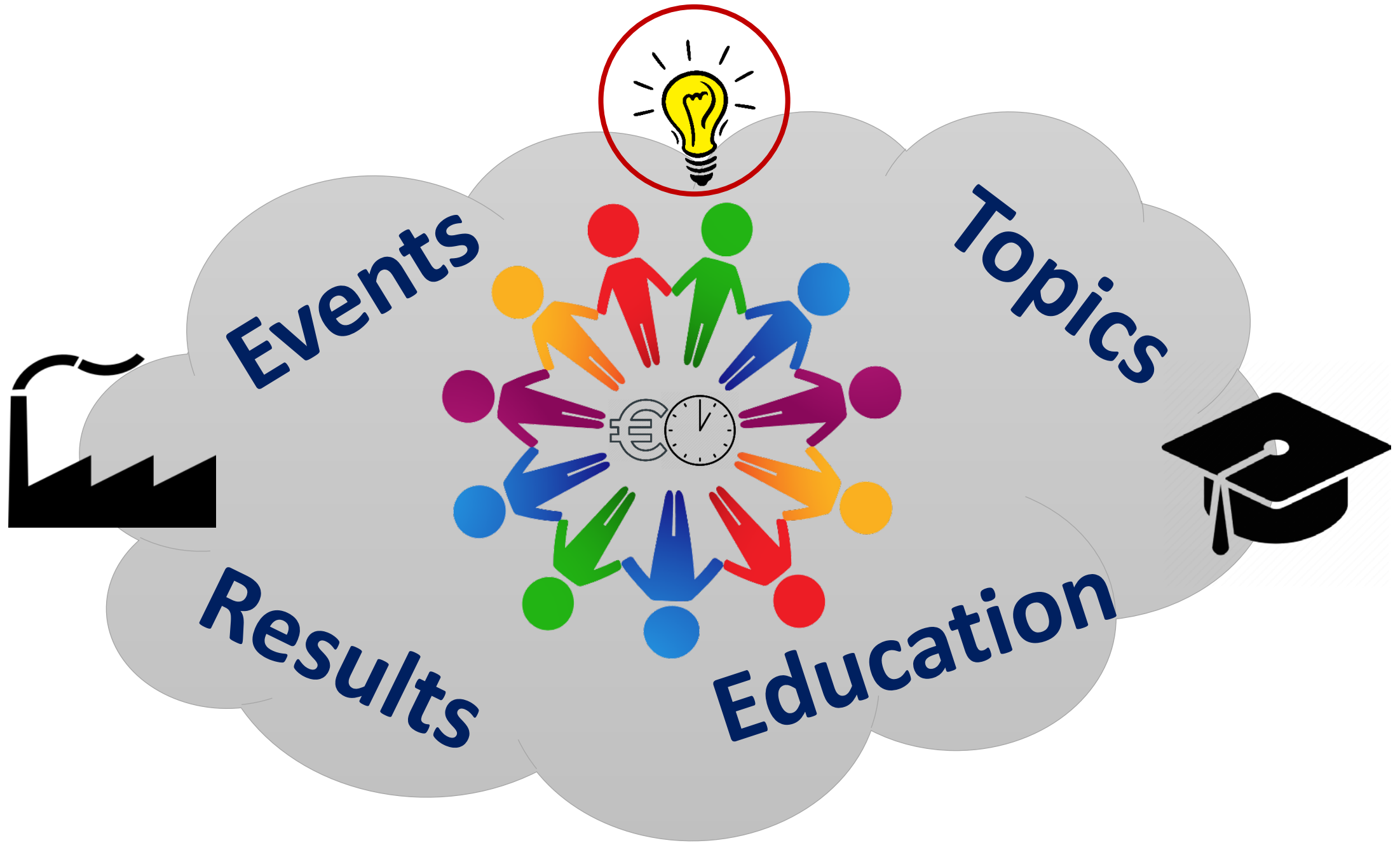
Topic: Risk-Based Testing with Defect Data

Motivation: Implementation of ISO/IEC/IEEE 29119 Software Testing Standard

https://softwaretestingstandard.org/
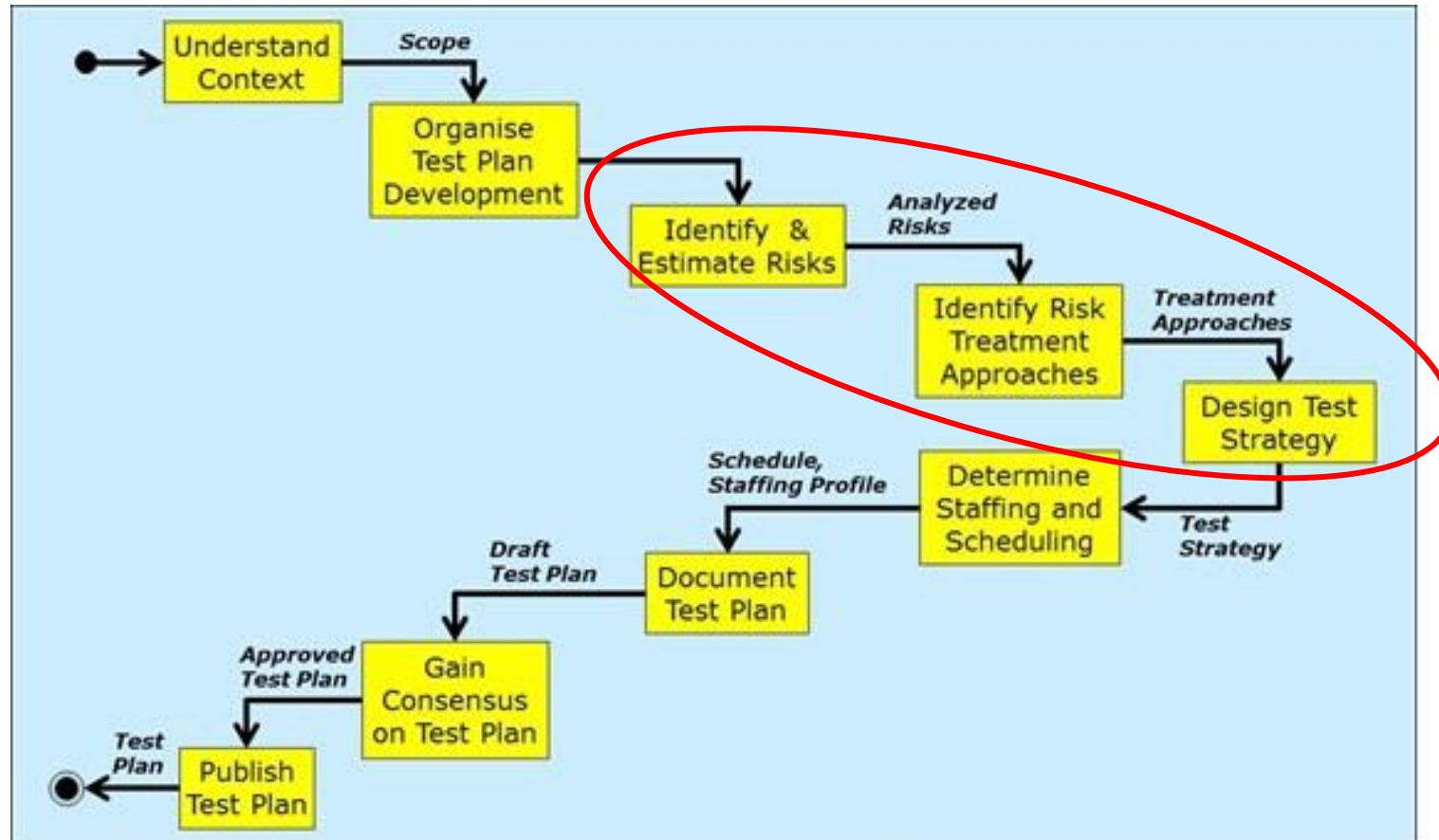
Risk-Based Software Testing

Test Design
Test Automation
Test Execution
Test Evaluation

Risk Level

Risk Item

Risk-Based Test Strategy

Risk Value

Probability (P)

Impact (I)

Probability Criteria

Impact Criteria

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Testing With Defect Taxonomies: Approach & Results

Requirements

ID	Requirement
...	...
REQ_0024	Creation and editing of a detailed invoice
REQ_0111	Charges for medical services

Defect Taxonomy

Top-Level Categories	DC	Description Examples	Severity
Functionality (Process, GUI, Navigation etc.)	...	...	...
	F2	GUI-navigation, erroneous display of data	major
	...	...	...
Logic (Evaluation of business rules,	...	...	...
	L3	Error in checking of invoices amount	critical

Test Strategy

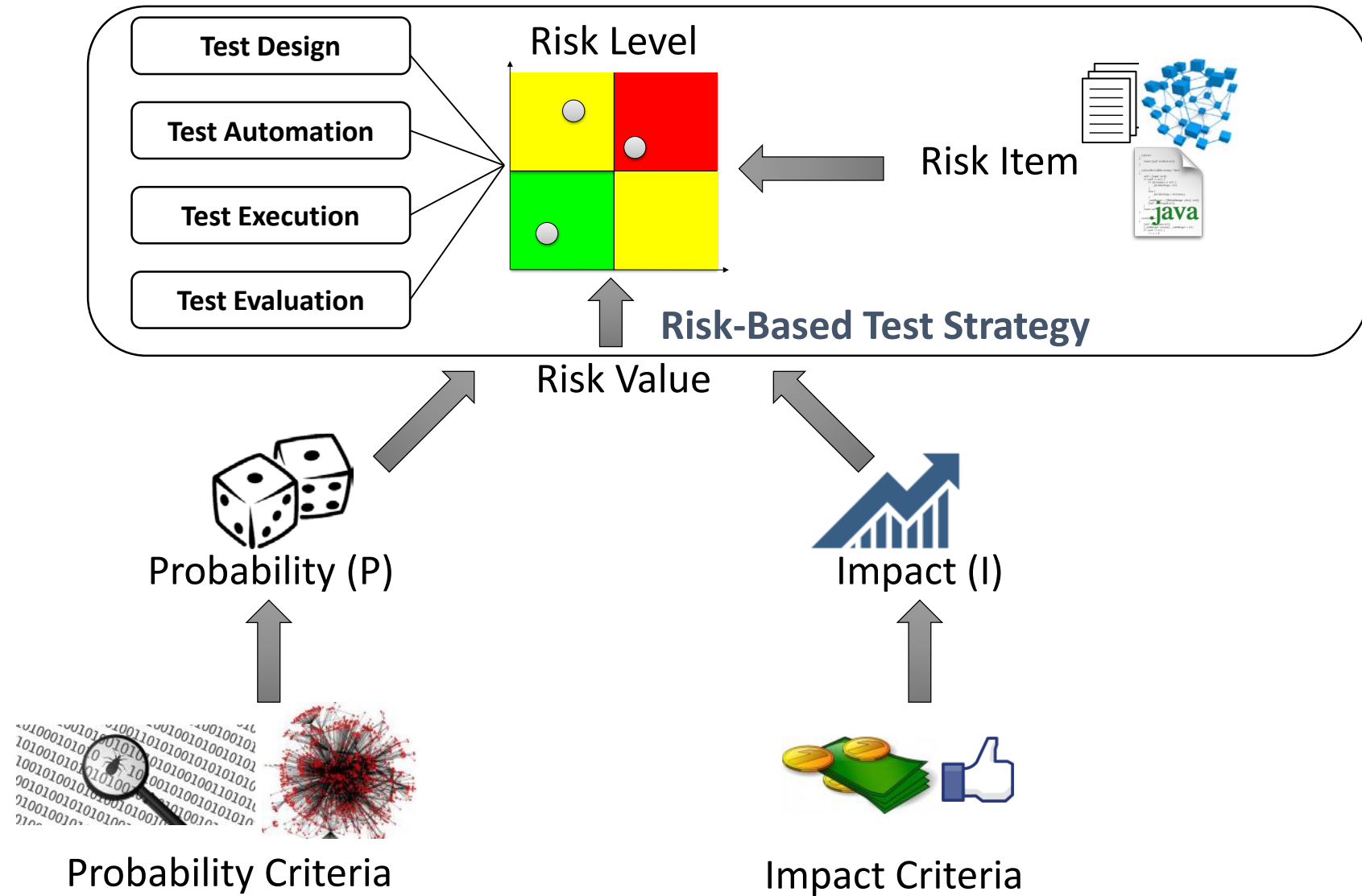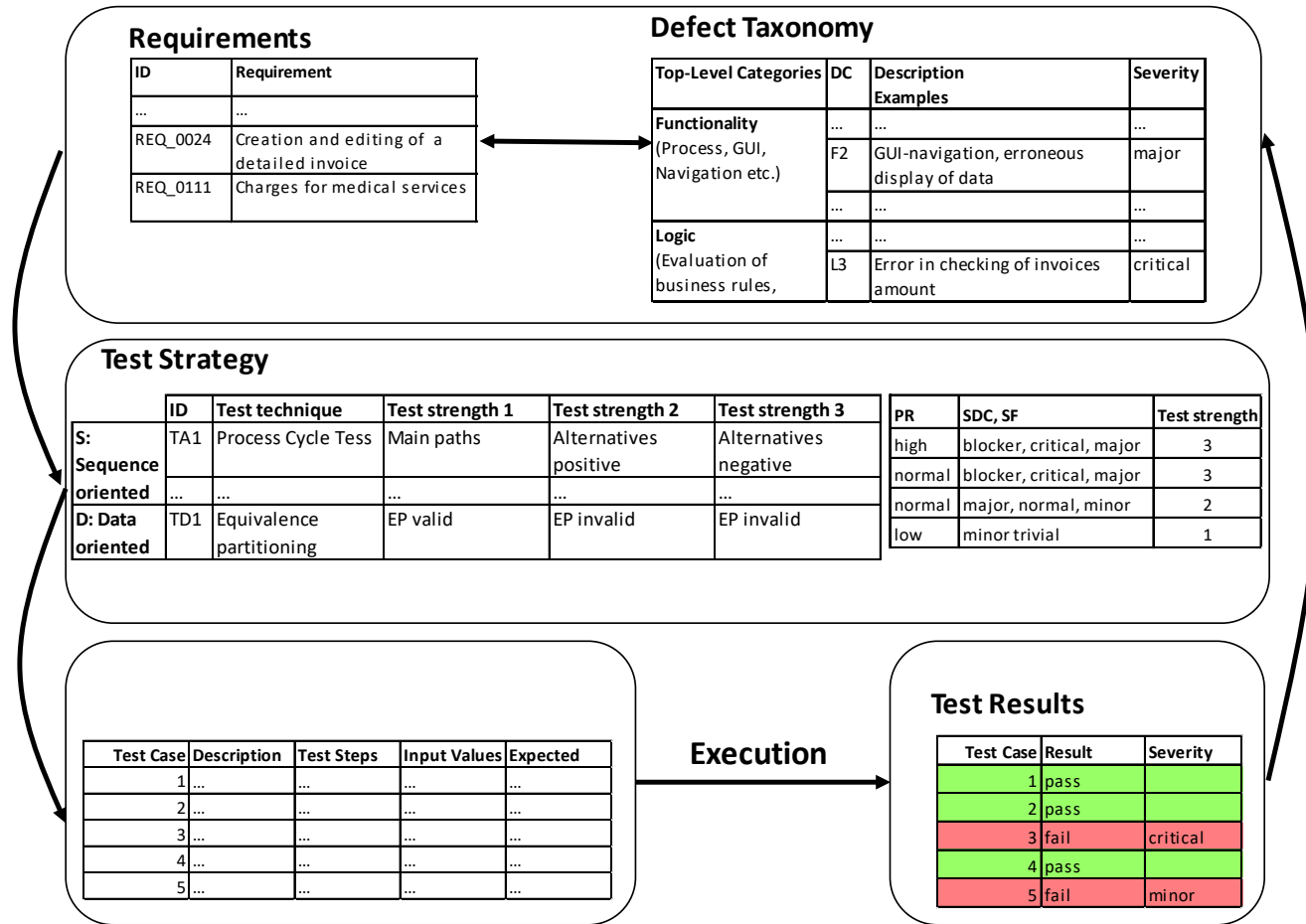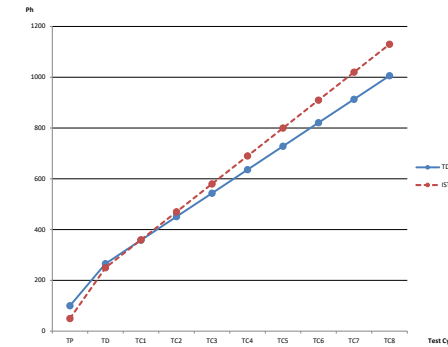|	ID	Test technique	Test strength 1	Test strength 2	Test strength 3
S: Sequence oriented	TA1	Process Cycle Tess	Main paths	Alternatives positive	Alternatives negative
	...	...	...	...	...
D: Data oriented	TD1	Equivalence partitioning	EP valid	EP invalid	EP invalid

PR	SDC, SF	Test strength
high	blocker, critical, major	3
normal	blocker, critical, major	3
normal	major, normal, minor	2
low	minor trivial	1

Execution

Test Cases

Test Case	Description	Test Steps	Input Values	Expected
1	...	...	...	...
2	...	...	...	...
3	...	...	...	...
4	...	...	...	...
5	...	...	...	...

Test Results

Test Case	Result	Severity
1	pass	
2	pass	
3	fail	critical
4	pass	
5	fail	minor

Metrics	Project A	Project B
NOR	41	28
NUC	14	20
SIZE (NUC+NOR)	55	48
NOT	148	170
NOF	169	114
NOT/SIZE	2.69	3.54
NOF/NOT	1.14	0.67

Effectiveness

Efficiency

Tool Support

Presentations
Publications

M. Felderer, A. Beer: Using Defect Taxonomies for Testing Requirements. IEEE Software, 2015
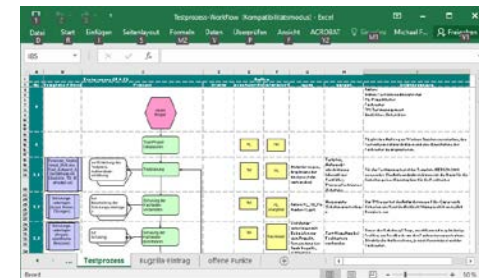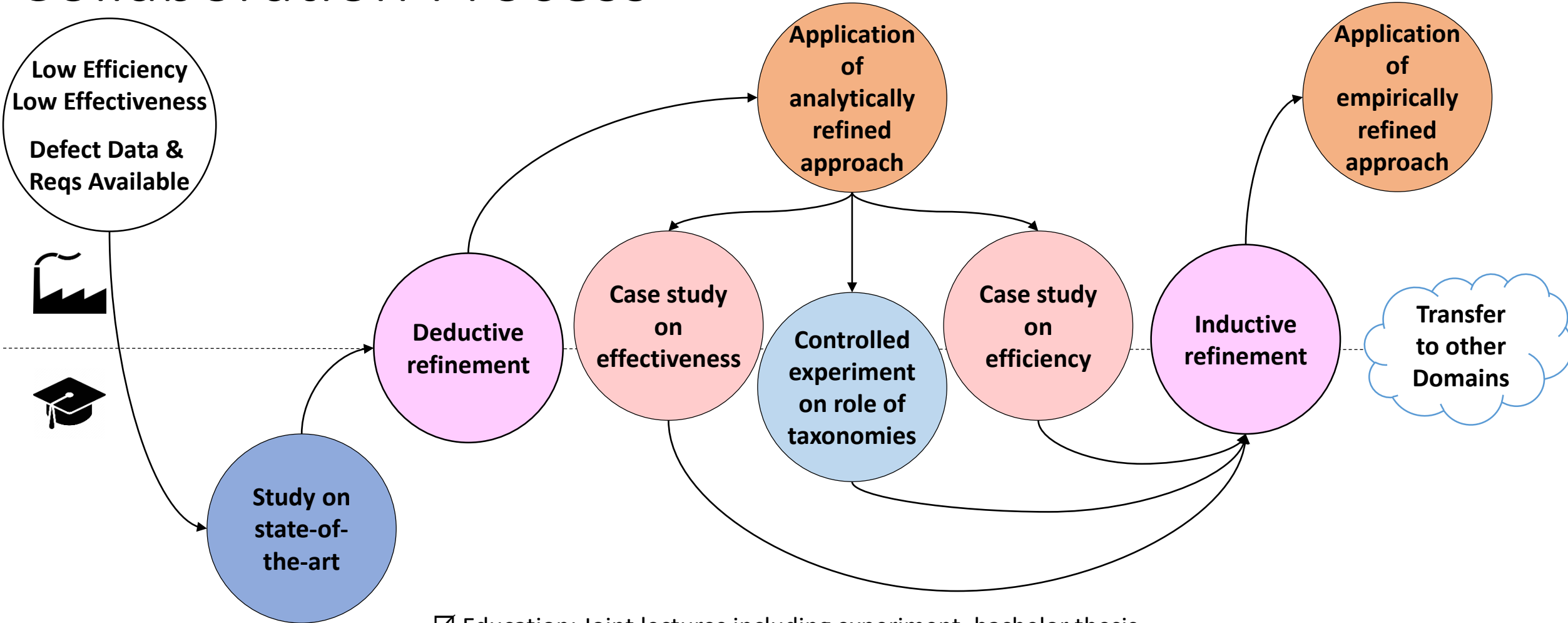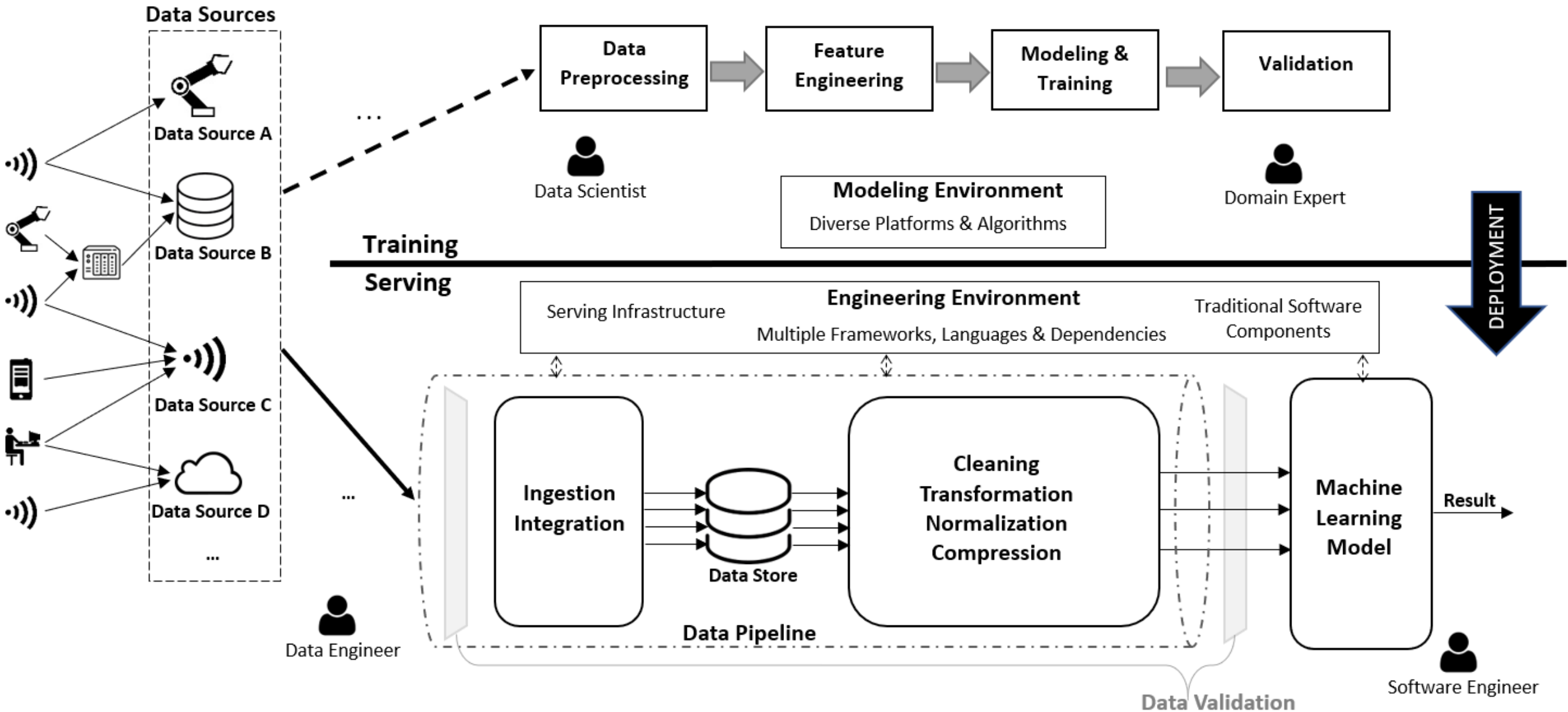
Collaboration Process

- ☑ Education: Joint lectures including experiment, bachelor thesis
- ☑ Results: Publications/Presentations on I and A venues, Evaluated Tool-Supported Approach
- ☑ Events: Co-organization of workshop on RE and Testing with I and A participants
- ☑ People: Personal commitment and close cooperation between researcher and practitioner
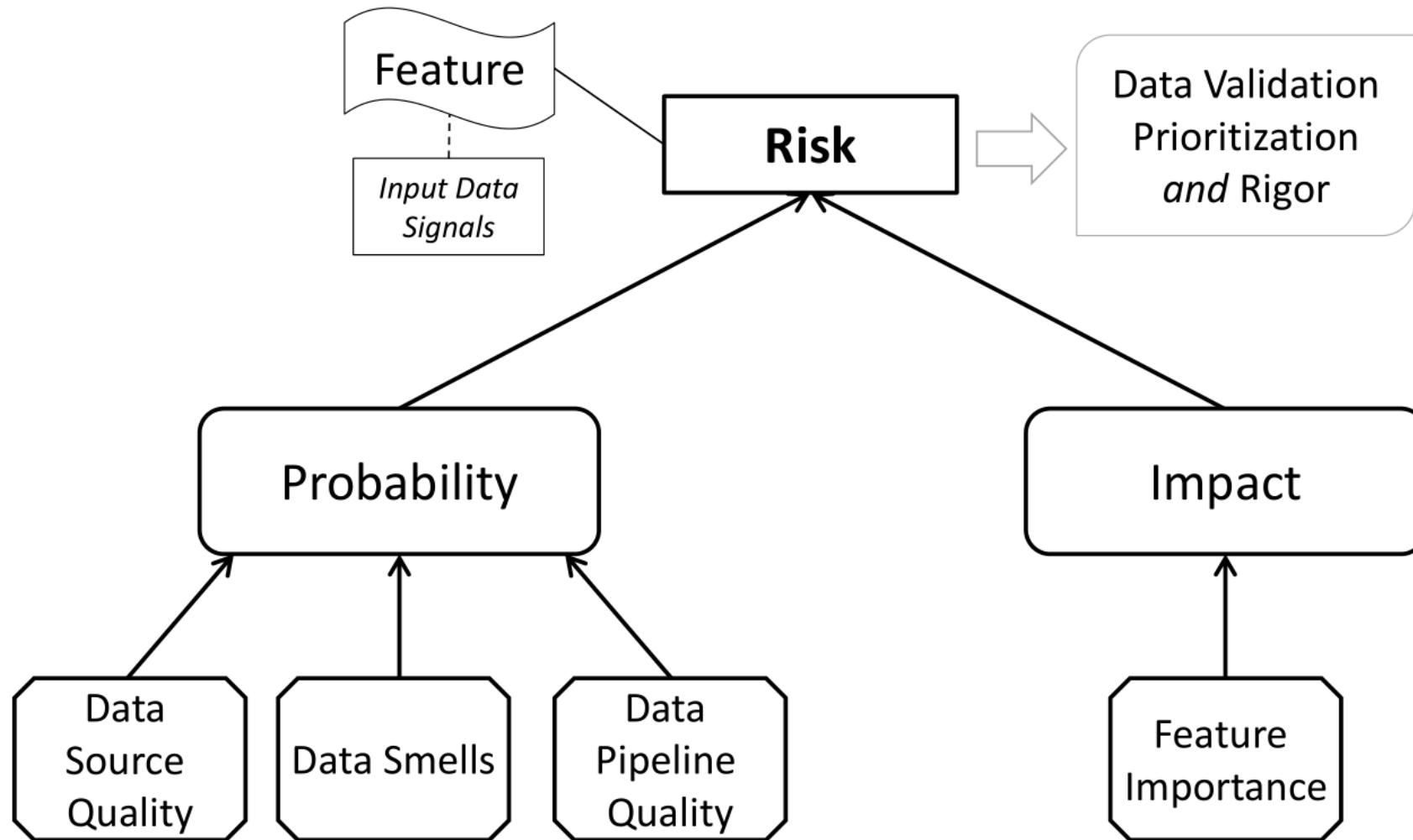
Deployment of Machine Learning Based Systems

Machine Learning Based Software System

Machine Learning-based Software System

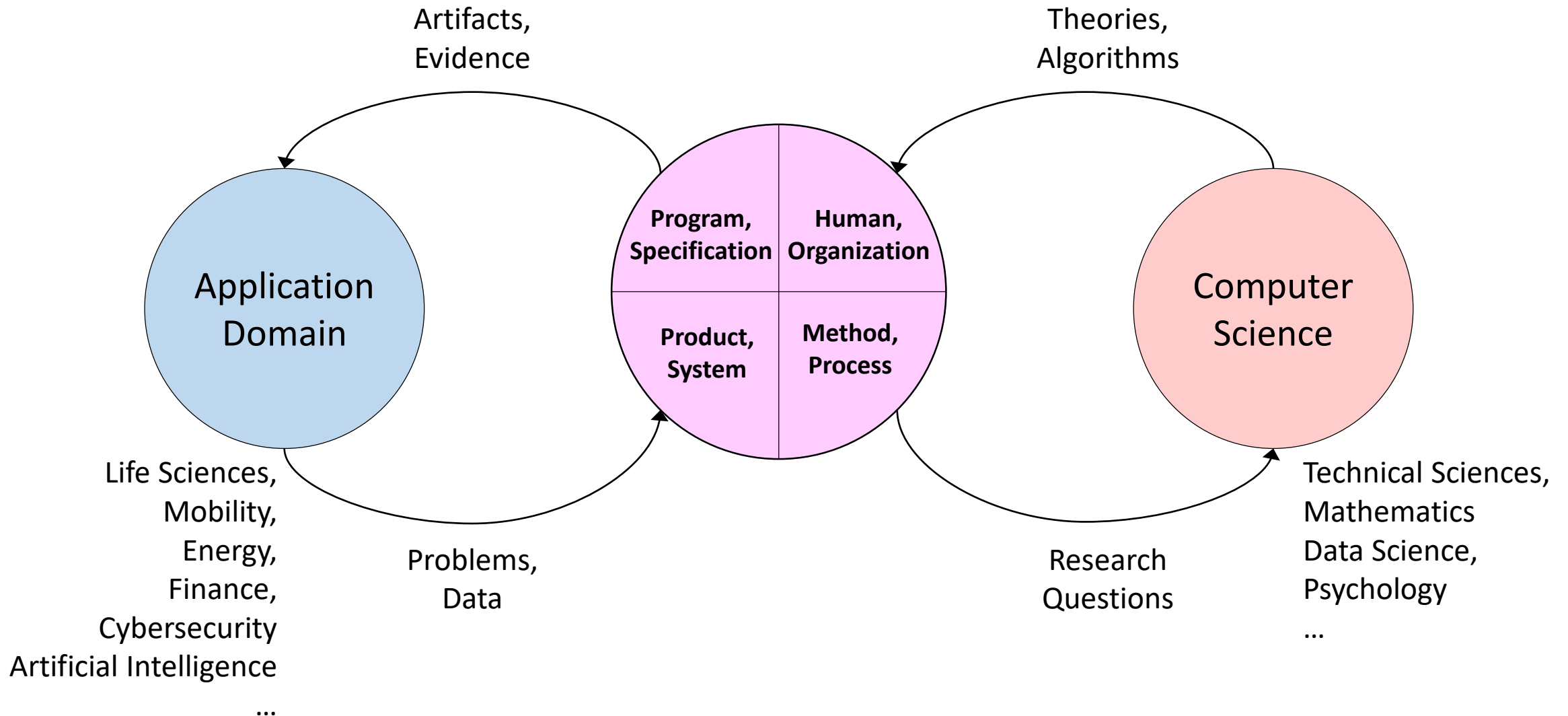D_{xi} ... Input Data Signal i from Data Source x

F_i ... Feature i
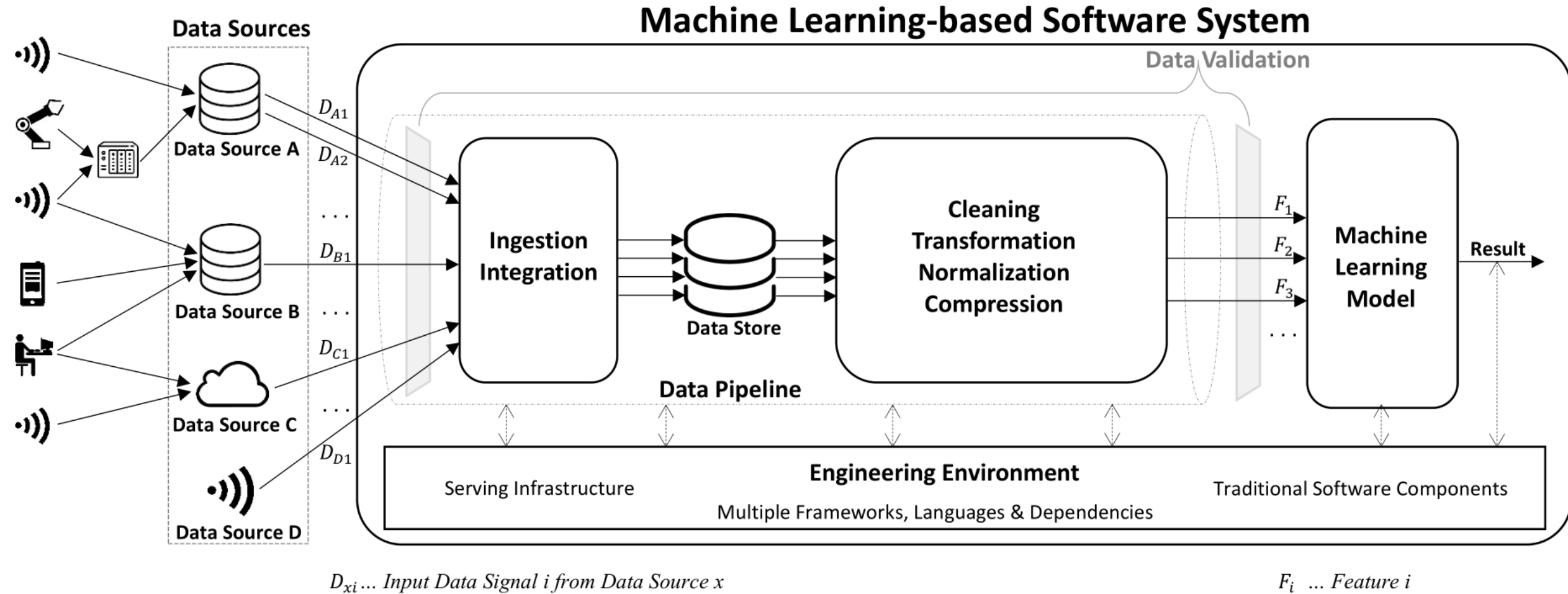
Risk-Based Data Validation Approach
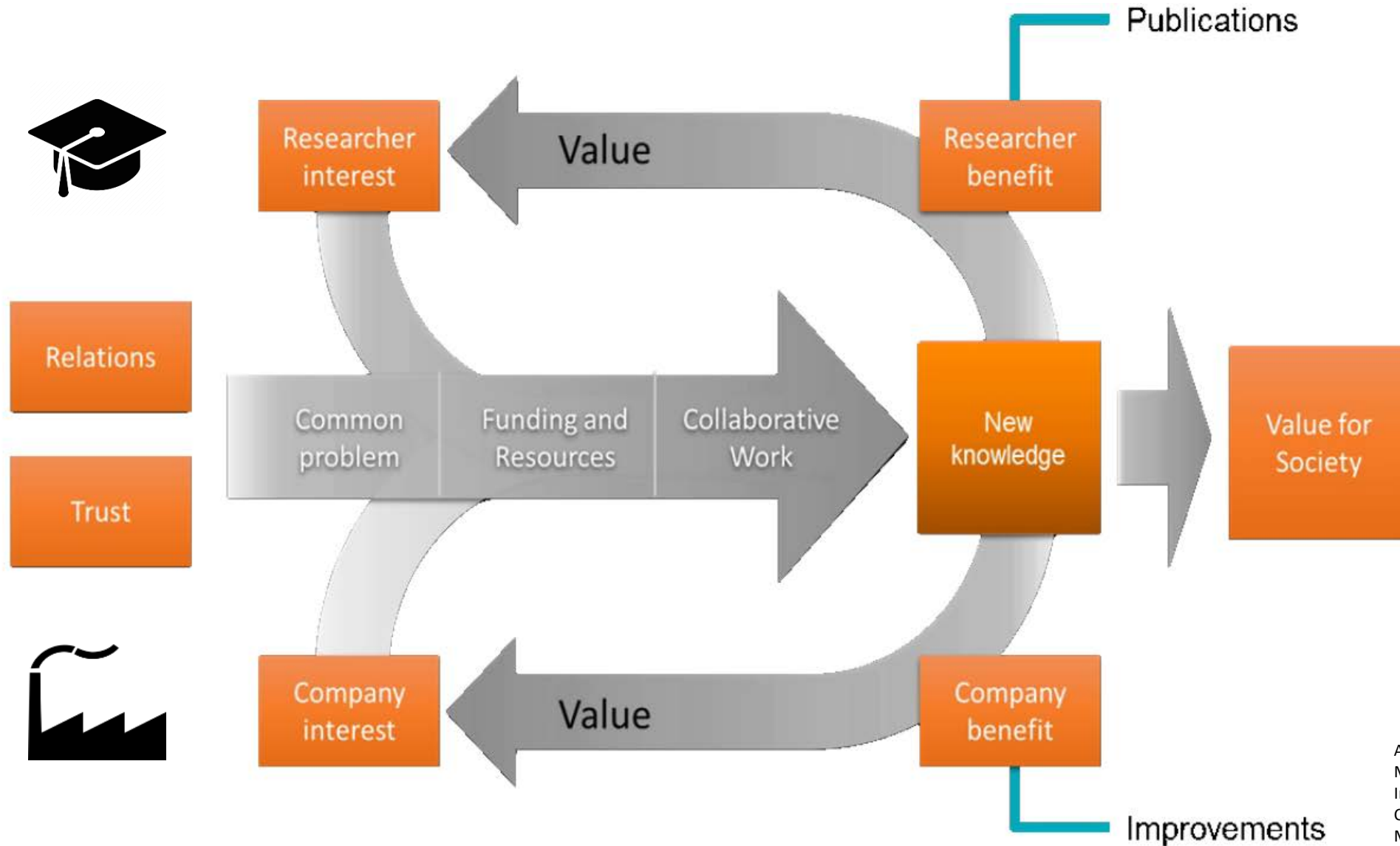

H. Foidl, M. Felderer: Risk-based data validation in machine learning-based software systems. MaLTeSQuE@ESEC/SIGSOFT FSE 2019, 2019

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Software Engineering Research Fosters IAC

Artifacts, Evidence

Theories, Algorithms

Application Domain

Program, Specification | Human, Organization

Product, System | Method, Process

Computer Science

Life Sciences, Mobility, Energy, Finance, Cybersecurity Artificial Intelligence …

Problems, Data

Research Questions

Technical Sciences, Mathematics Data Science, Psychology …

Industry Academia Co-Production

A. Sannö, A. Ericson Öberg, E. Flores-Garcia, M. Jackson: Increasing the Impact of Industry-Academia Collaboration through Co-Production. Technology Innovation Management Review, 2019

se | 20
SOFTWARE ENGINEERING

Konferenzprogramm

- ❑ **Wissenschaftliches Hauptprogramm**
- ❑ **Track zum Technologietransfer im Software Engineering**
- ❑ **SEUH – Software Engineering im Unterricht der Hochschulen**
- ❑ **Forschungsmethoden im Software Engineering**
- ❑ **Workshops**

http://se20.ocg.at

24. bis 28. Februar 2020, Innsbruck, Österreich

References

1. C. Wohlin: Software Engineering Research under the Lamppost. IJCST 2013, 2013

2. Á. Beszédes, L. Vidács: Academic and Industrial Software Testing Conferences: Survey and Synergies. TAICPART 2016, 2016

3. V. Garousi, M. Felderer, M. Kuhrmann, K. Herkiloglu: What Industry wants from Academia in Software Testing. Hearing pracitioners' opinions. EASE 2017, 2017

4. V. Garousi, M. Felderer: Worlds Apart. Industrial and Academic Focus Areas in Software Testing. IEEE Software, 2017

5. V. Garousi, G. Giray, E. Tüzün, C. Catal, M. Felderer: Aligning software engineering education with industrial needs: A meta-analysis. Journal of Systems and Software, 2019

6. Garousi, V., Felderer, M., Mäntylä, M.: Guidelines for including grey literature and conducting multivocal literature reviews in software engineering. Information and Software Technology, 2019

7. V. Garousi, M. Felderer, T. Hacaloğlu: Software test maturity assessment and test process improvement: A multivocal literature review. Information and Software Technology, 2017

8. V. Garousi, et al.: Characterizing industry-academia collaborations in software engineering: evidence from 101 projects. Empirical Software Engineering, 2019

9. M. Felderer, A. Beer: Using Defect Taxonomies for Testing Requirements. IEEE Software, 2015

10. H. Foidl, M. Felderer: Risk-based data validation in machine learning-based software systems. MaLTeSQuE@ESEC/SIGSOFT FSE 2019, 2019

11. A. Sannö, A. Ericson Öberg, E. Flores-Garcia, M. Jackson: Increasing the Impact of Industry-Academia Collaboration through Co-Production. Technology Innovation Management Review, 2019

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