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Laboratório de  
Engenharia de Software

# Software Evolution Visualization

A Systematic Mapping Study

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## Background

- We have worked in an infrastructure for software evolution visualization
- We have worked in a model for software evolution visualization

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## Mapping Study

- We ran a mapping study to characterize the area.

NOVAIS, R. L., TORRES, A., SOUTO, T, MENDONÇA NETO, M. G., ZAZWORKA, N. **Software Evolution Visualization: A Systematic Mapping Study**. In Information and Software Technology, p. 1860-1883, 2013.

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## Research questions

- What maintenance tasks are current SEV technologies evidently supporting and how do the approaches differ from each other?
  - Q1. What analysis tasks does the SEV claim to support?
  - Q2. What data source is used?
  - Q3. Which types of metrics are used?
  - Q4. What type of evaluation is done?
  - Q5. Which analysis strategy is used?

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## Research questions

- What maintenance tasks are current SEV technologies evidently supporting and how do the approaches differ from each other?
  - Q6. Which types of mechanisms of interaction are used?
  - Q7. Which types of visual attributes are used by the SEV?
  - Q8. What types of visual paradigms are used by the study?
  - Q9. What types of perspectives are used by the study?

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## Inclusion and Exclusion criteria

- Inclusion
  - Theoretical and practical Software evolution visualization works
- Exclusion
  - Studies that analyze software evolution data, and uses charts to discuss their findings were also excluded
  - frameworks, surveys and secondary experimental studies were excluded, since they report the approaches from others.

# Mapping Study

## Search String

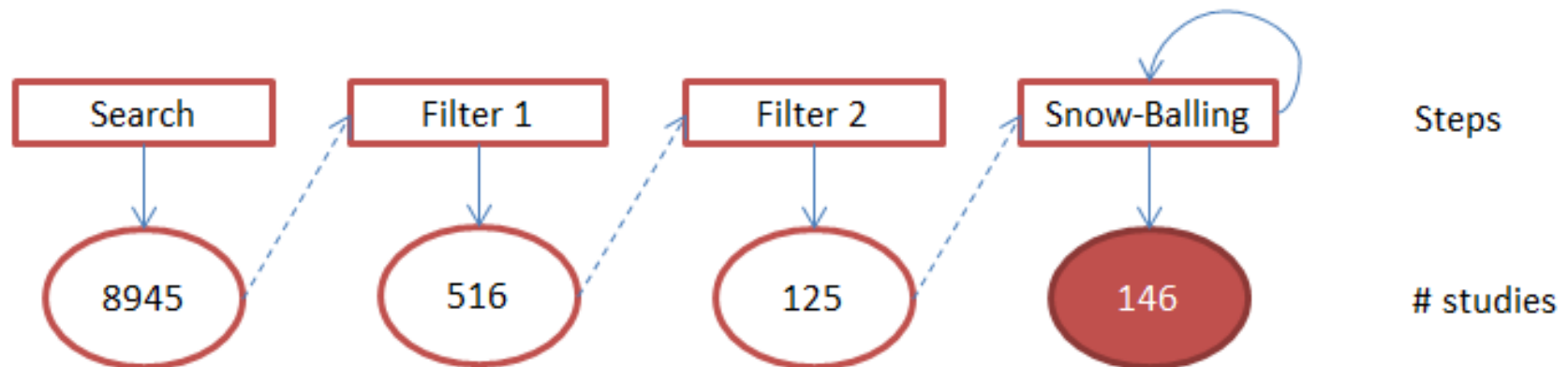
("software" OR "system")

AND

("visualization" OR "visual" OR "Visualisation")

AND

("evolution" OR "evolving")



## Digital databases

Digital databases	Search	Filter 1	Filter 2
IEEE	865	120	83
ACM	617	90	58
DBLP	56	28	26
Scopus	5274	156	70
Engineering Village	1564	89	64
Science Direct	569	35693	7
<b>Total</b>	8945	516	308
<b>Total without intersection</b>		270	125

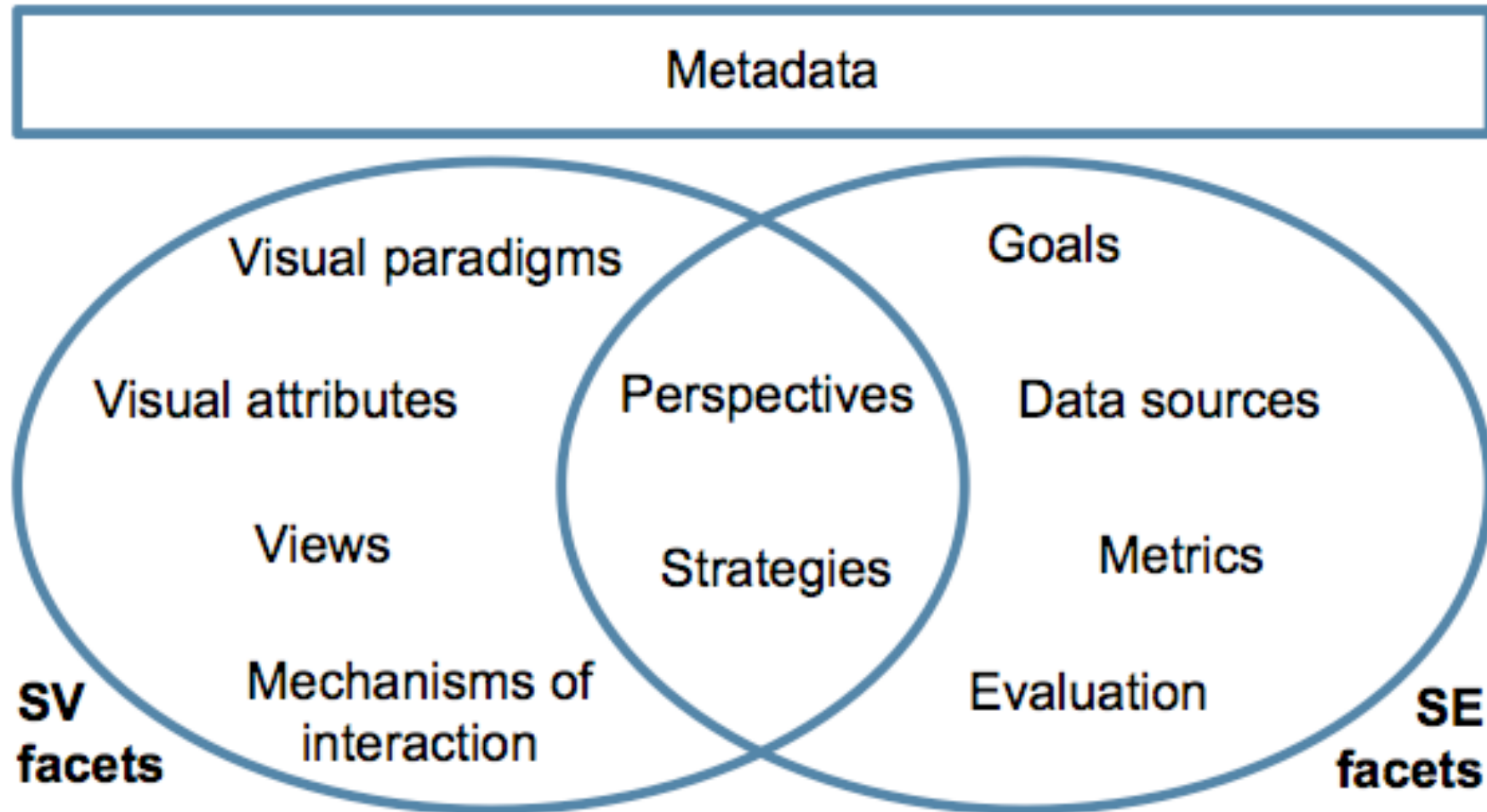


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## Papers Exclusively per digital database

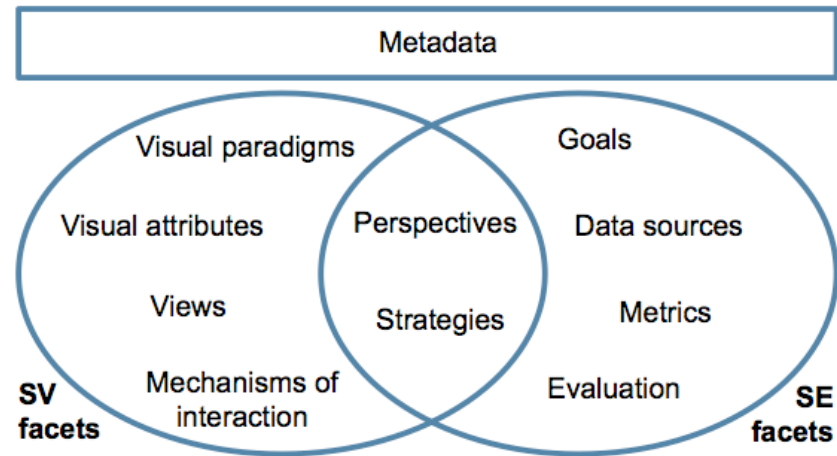
IEEE	ACM	DBLP	Scopus	EV	SD
22	0	2	5	4	1

# Classification Scheme



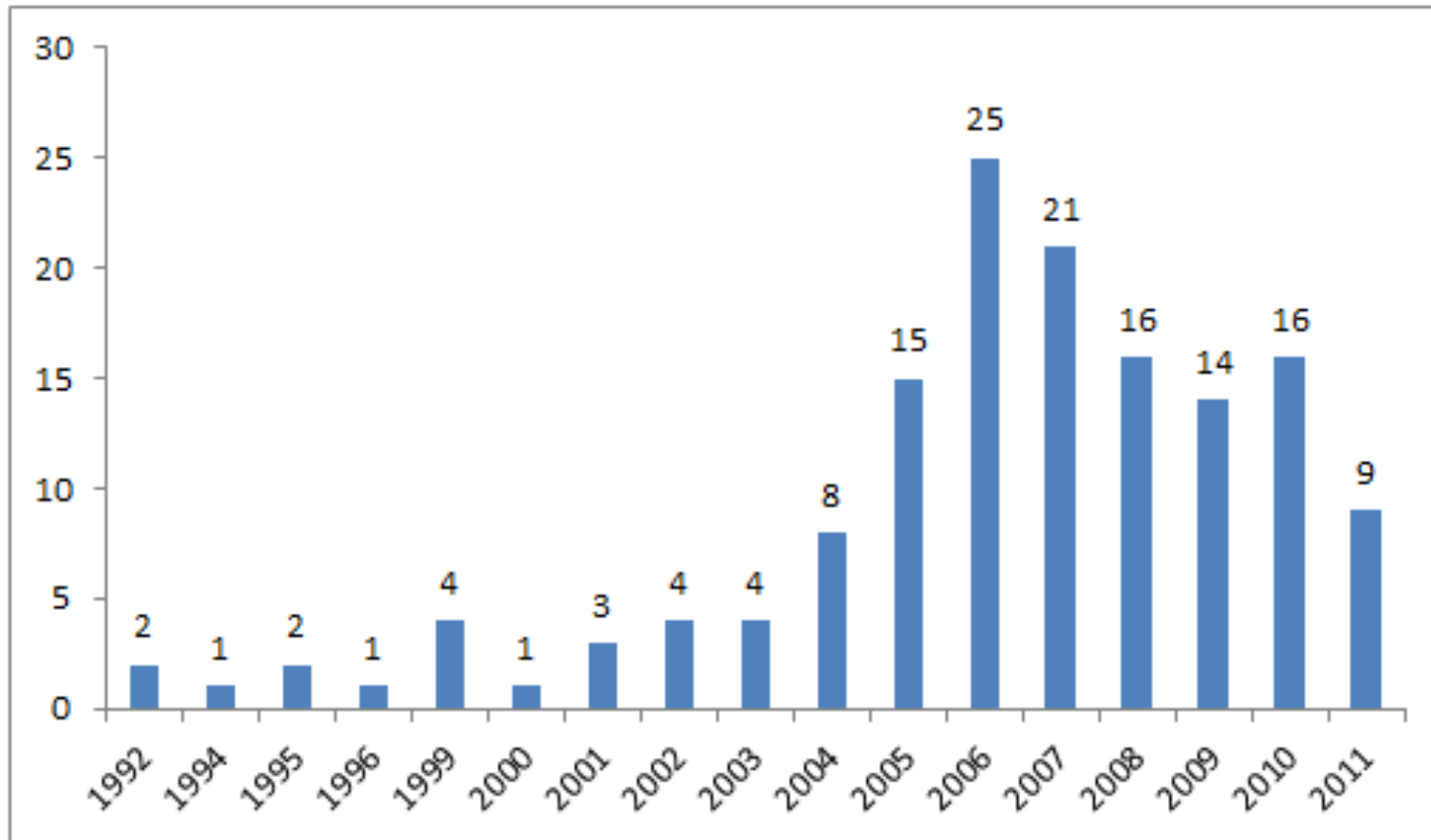


# Results



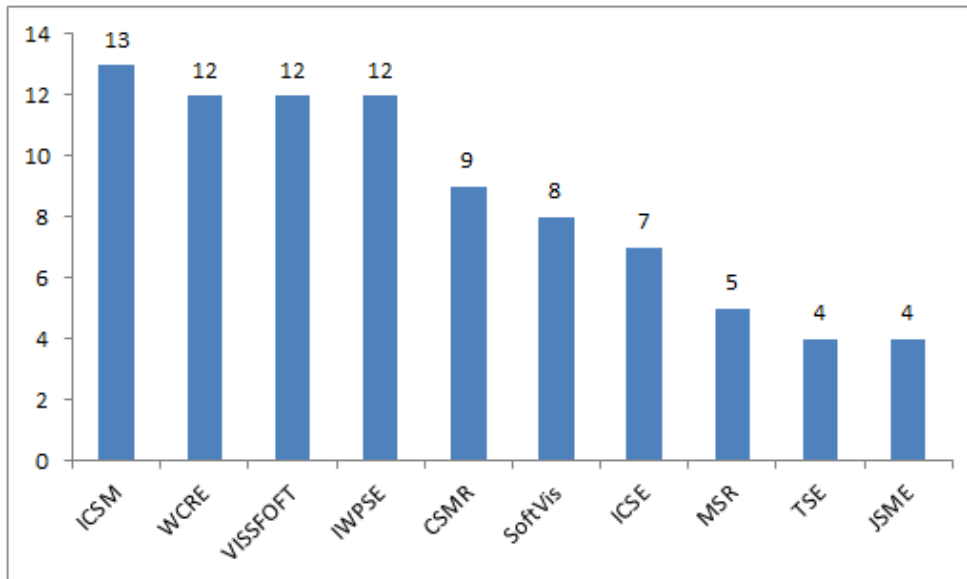
# Metadata

# Papers per year



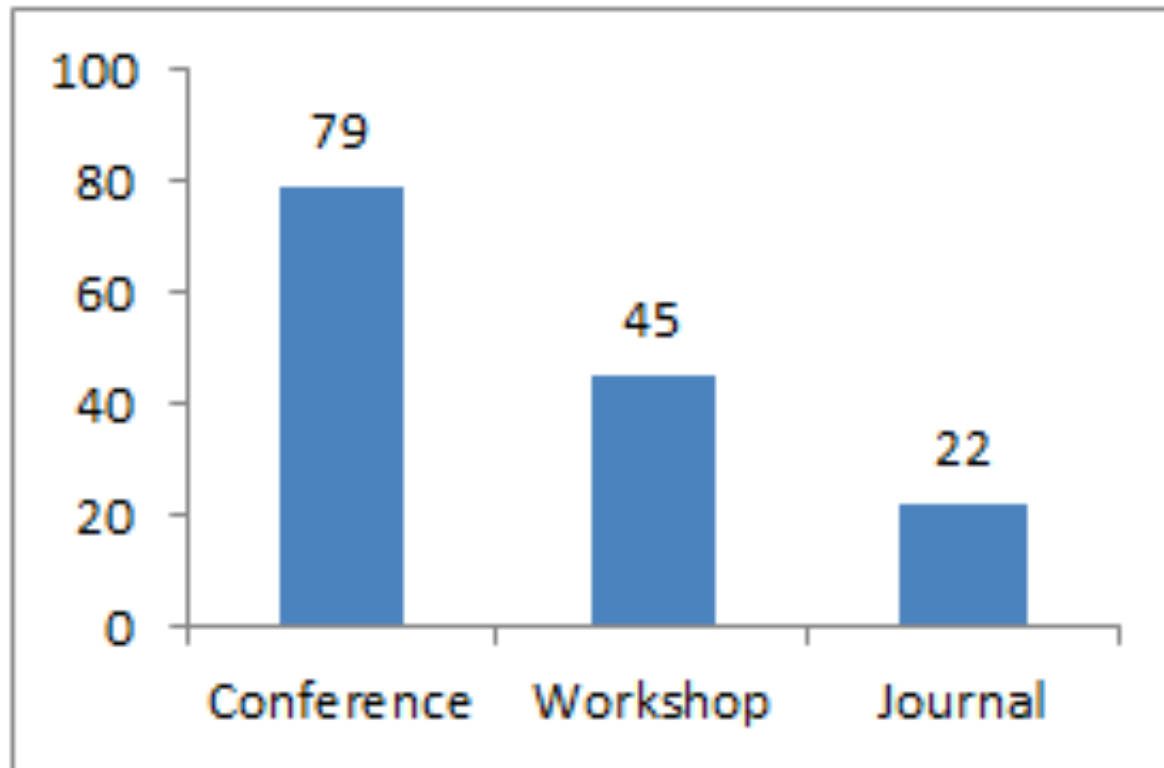
# Where they came from?

Papers come from SE  
instead of InfoVis venues

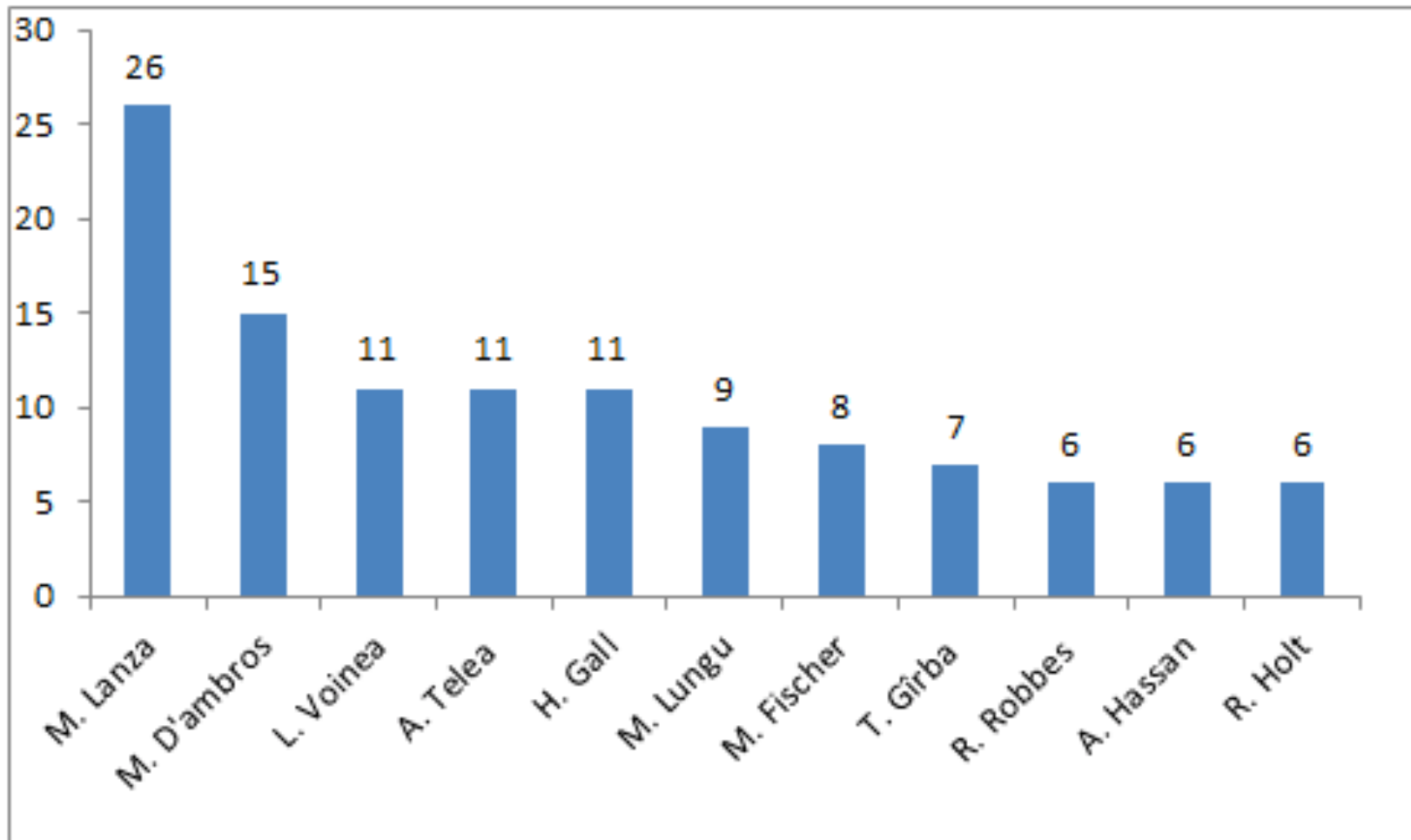


- International Conference on Software Maintenance
- Working Conference on Reverse Engineering
- International Workshop on Visualizing Software for Understanding and Analysis
- International Workshop on Principles of Software Evolution
- European Conference on Software Maintenance and Reengineering
- International Symposium on Software Visualization
- International Conference on Software Engineering
- International Workshop on Mining Software Repositories
- IEEE Transactions on Software Engineering
- Journal of Software Maintenance and Evolution

## Papers per type of venues



# Authors

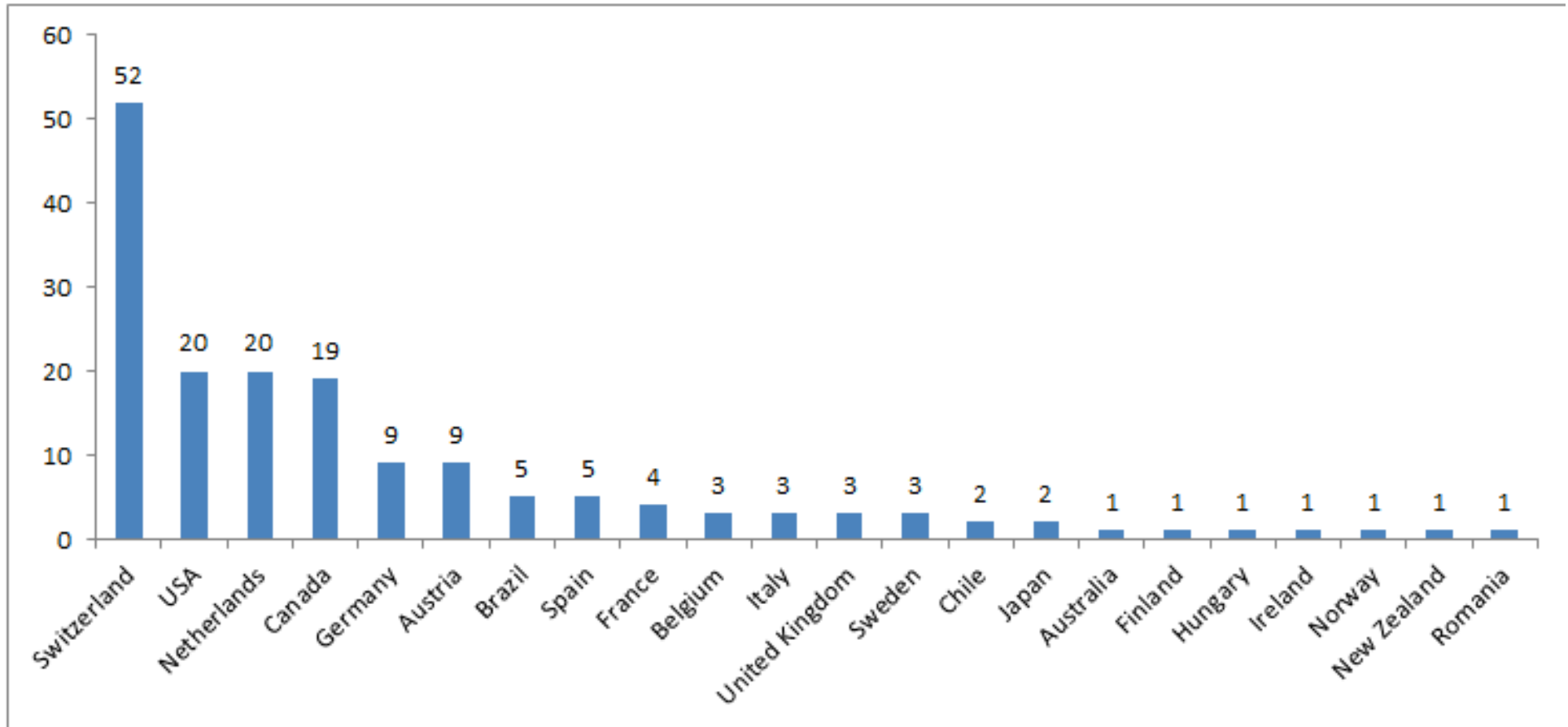




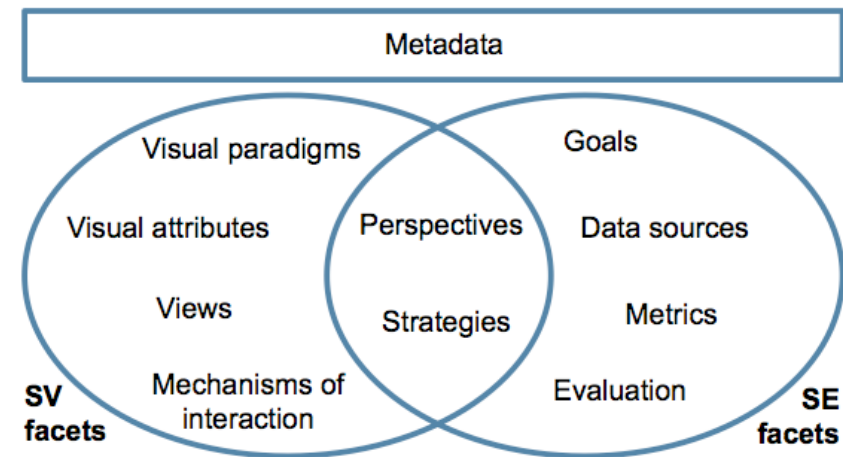
## Most Referred Papers Inside the Group

Paper	Number of references
The evolution matrix: recovering software evolution using software visualization techniques	35
A system for graph-based visualization of the evolution of software	29
Visualizing Software Release Histories: The Use of Color and Third Dimension	27
SeeSoft - A Tool for Visualizing Line Oriented Software Statistic	24
CVSscan: Visualization of code evolution	21
Visualizing multiple evolution metrics	20
Studying Software Evolution Information by Visualizing the Change History	20
Exploring Software Evolution Using Spectrographs	17
Characterizing the Evolution of Class Hierarchies	14
Software Bugs and Evolution: A Visual Approach to Uncover Their Relationship	12

# Affiliation



# Software Engineering tasks



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# Goal

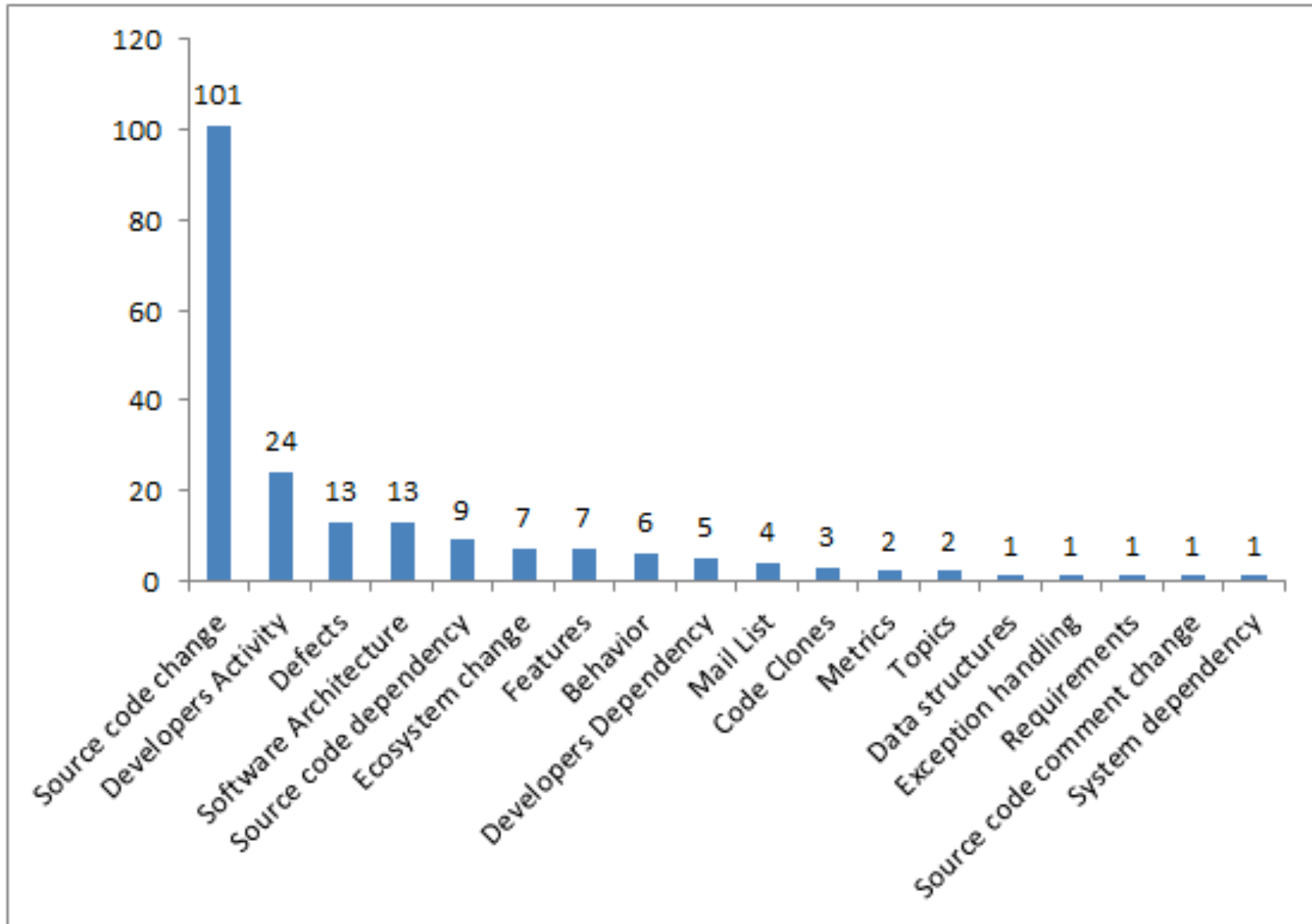
- SEV of what?
- SEV for what?

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## SEV of what?

- Behavior
- Code Clones
- Data structures
- Defects
- Developer Activities
- Developer Dependency
- Exception handling
- Ecosystem change
- Features
- Mail List
- Metrics
- Requirements
- Software Architecture
- Source code changes
- Comment changes
- Source code dependency
- System dependency
- Topics

# SEV of what?

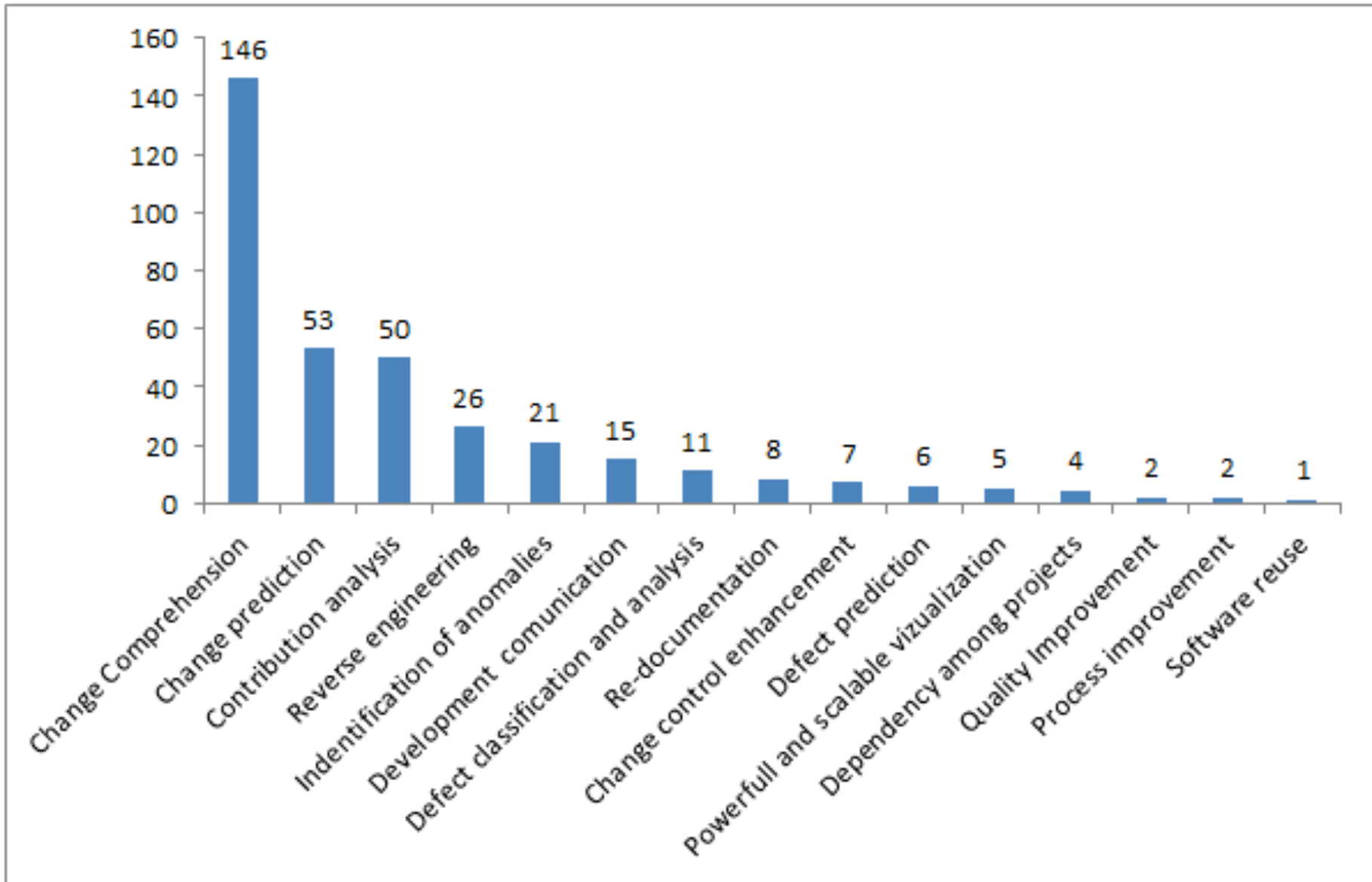


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## SEV for what?







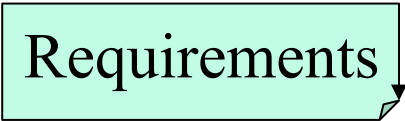

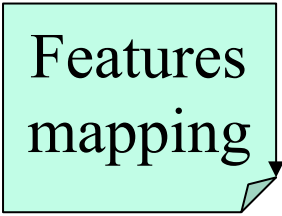
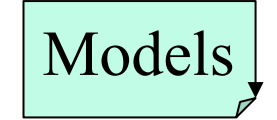
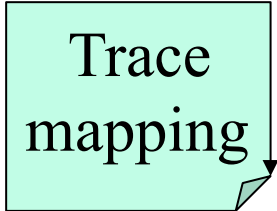
- **Change Comprehension**
- Change Control Enhancement
- Change Prediction
- **Contribution Analysis**
- Defect Classification and Analysis
- Development communication
- Quality improvement
- Process Improvement
- **Powerful and scalable visualization**
- Re-documentation
- Reverse engineering
- Software reuse
- **Identification of anomalies**
- Dependency among projects

# SEV for what?

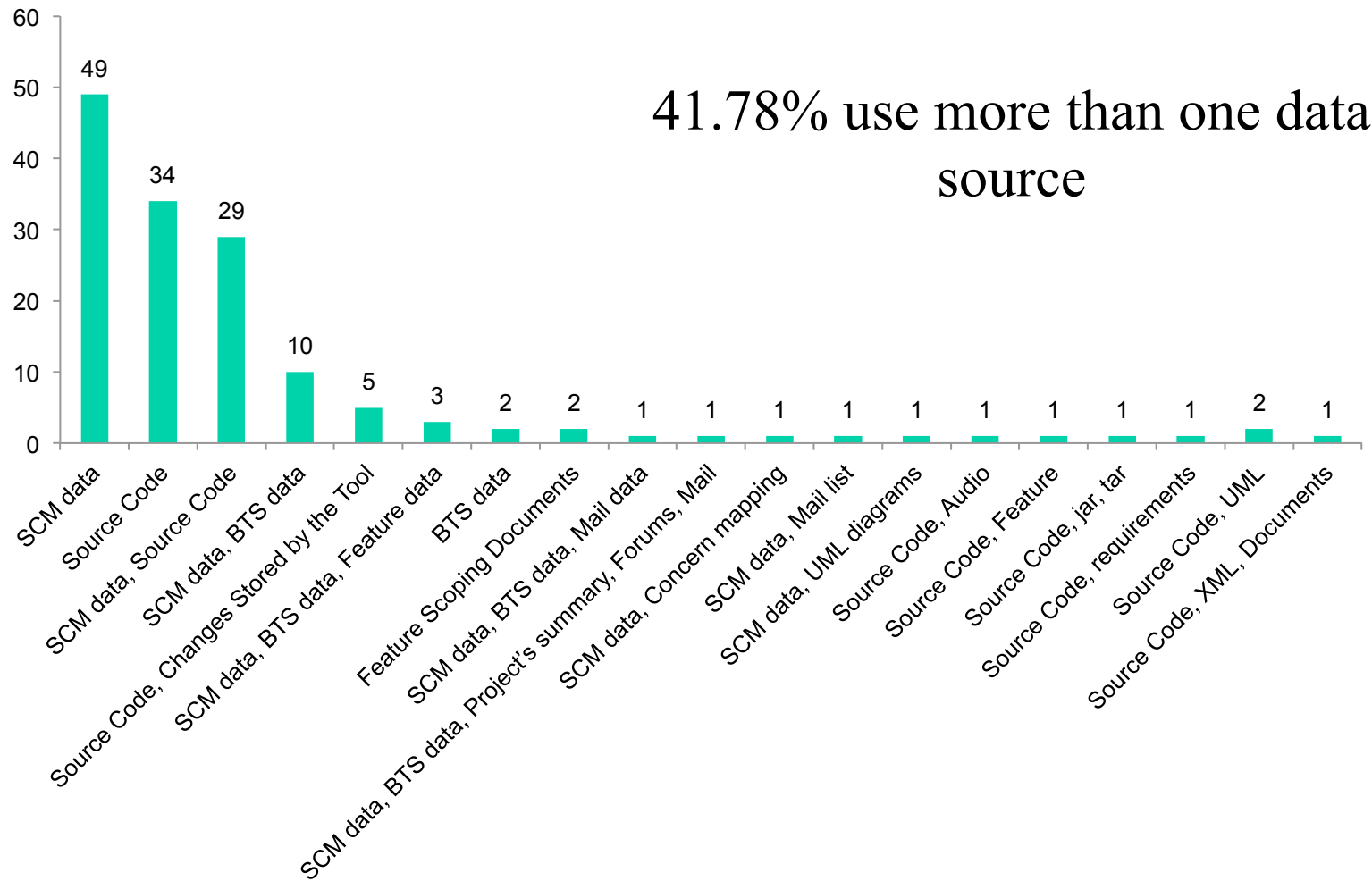




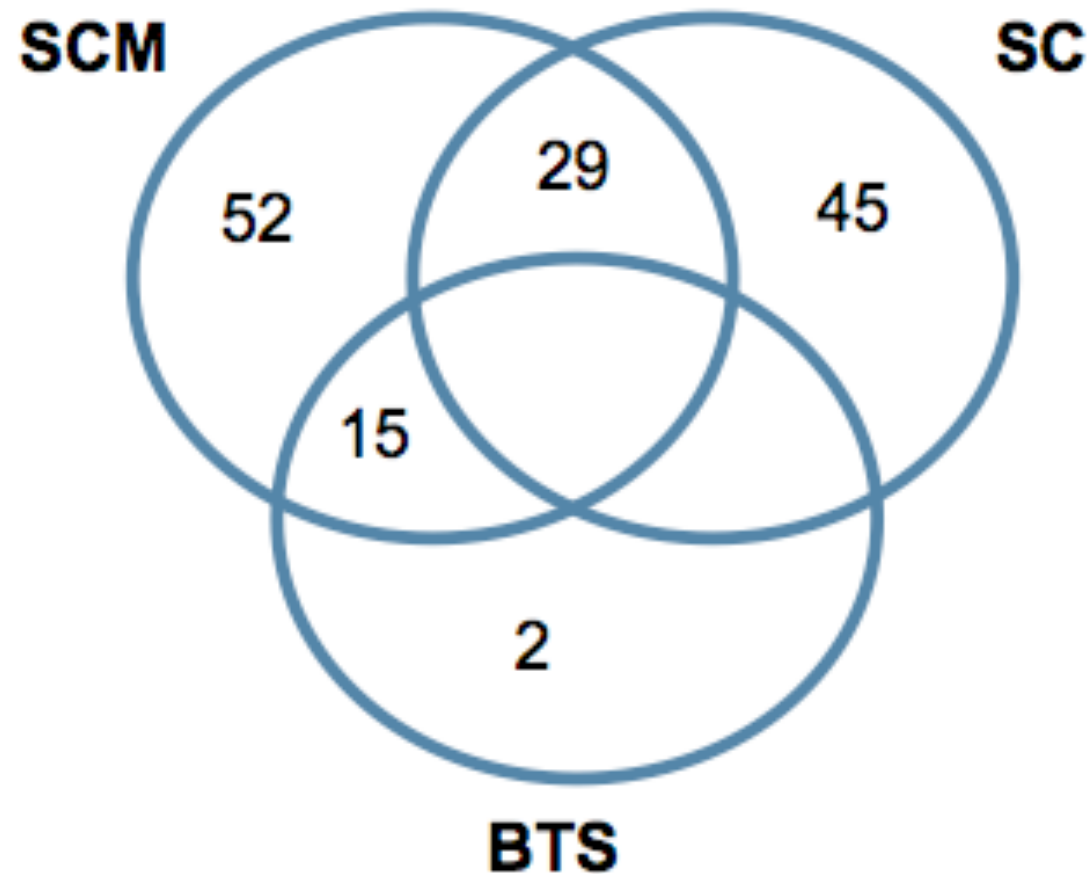
# Data Sources

Entity	Data sources		
Source Code Management	 CVS	 SubVersion	 GIT
Bug Tracking System	 Mantis	 BugZilla	 Trac
Other Types	 Requirements  Forums	 Features mapping	 Models  Trace mapping

# Papers per data source

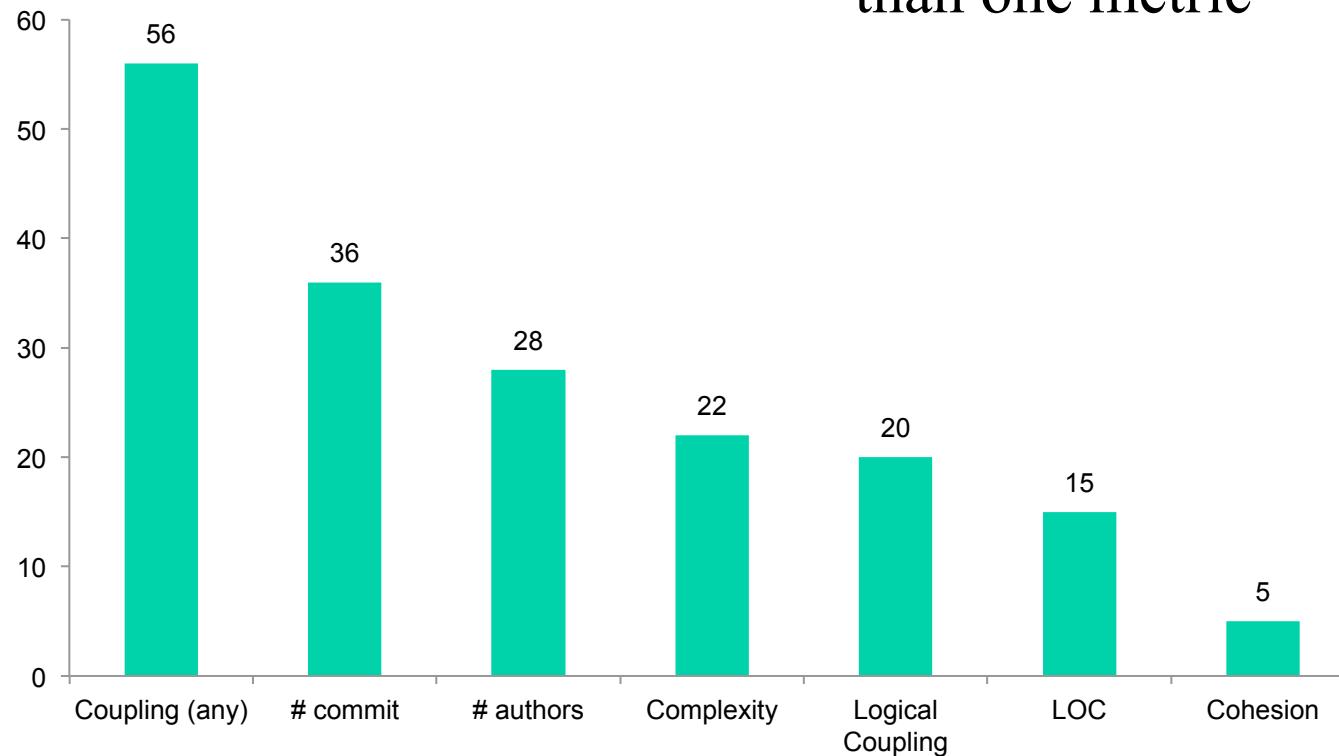


## Looking at the three main data sources

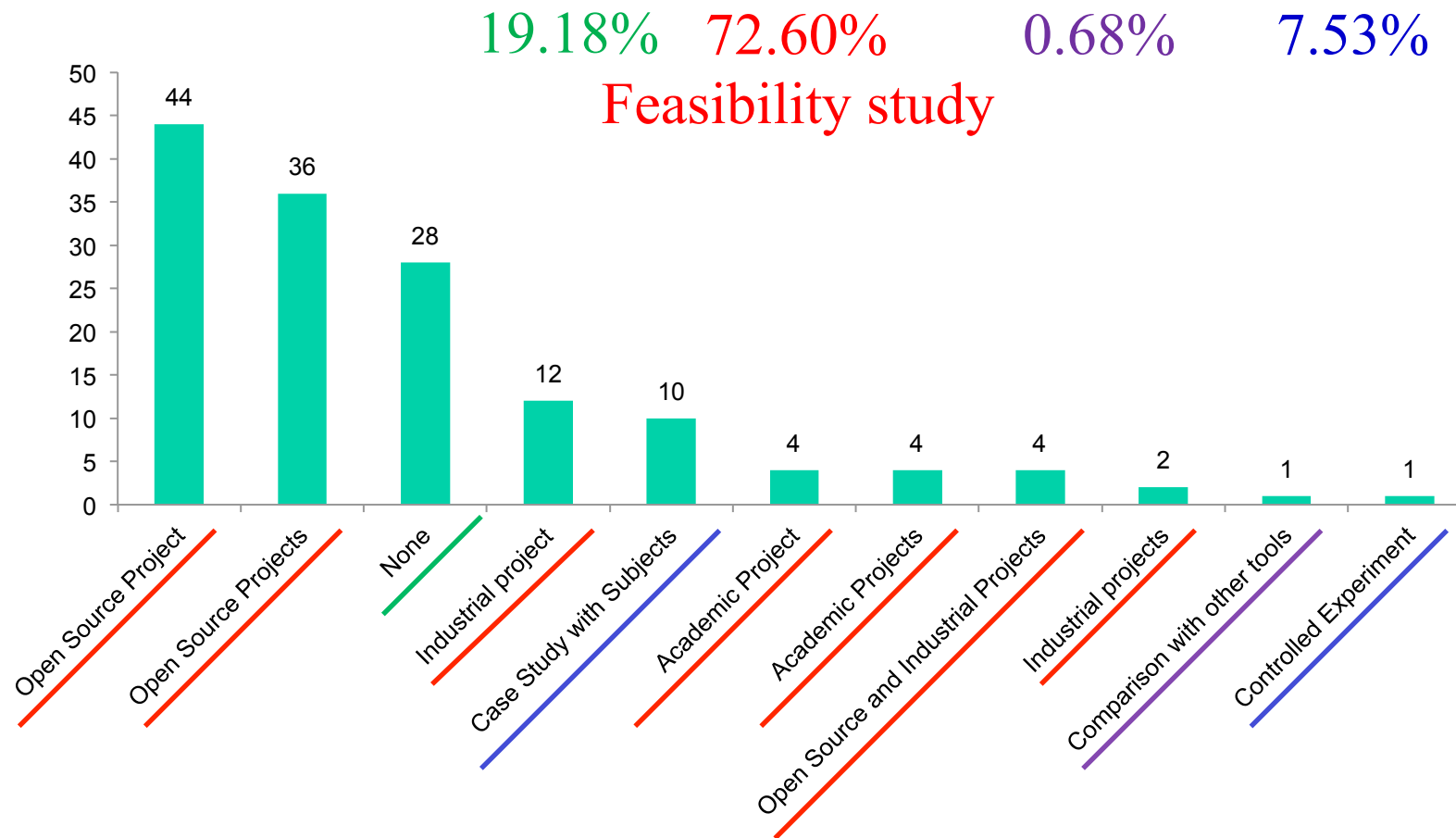


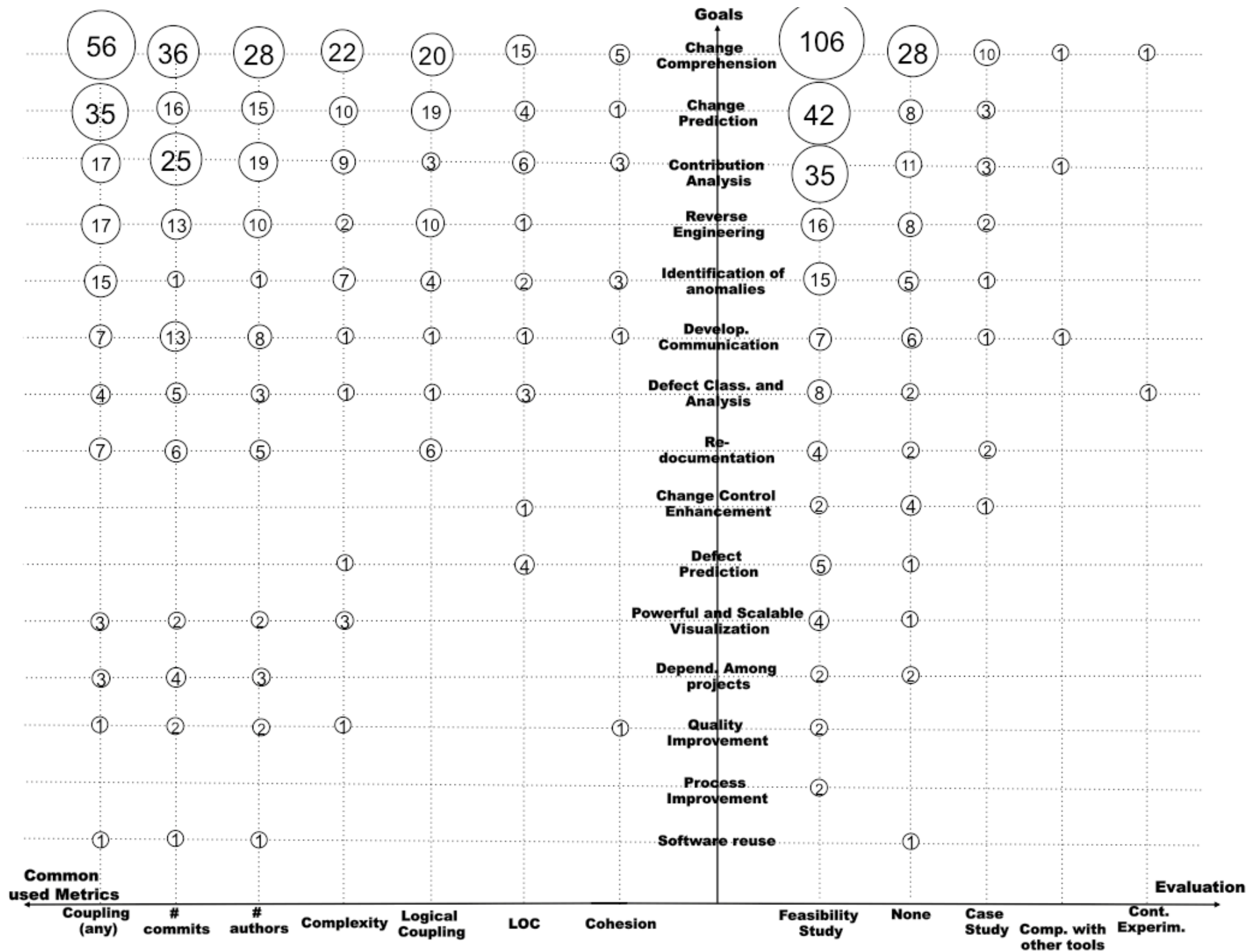
# Papers per (main) metrics

78.08% of the authors use more than one metric



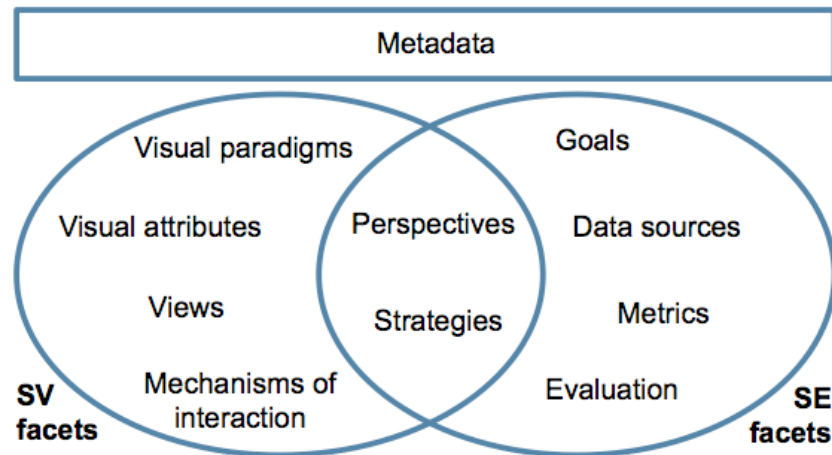
# Papers per type of validation



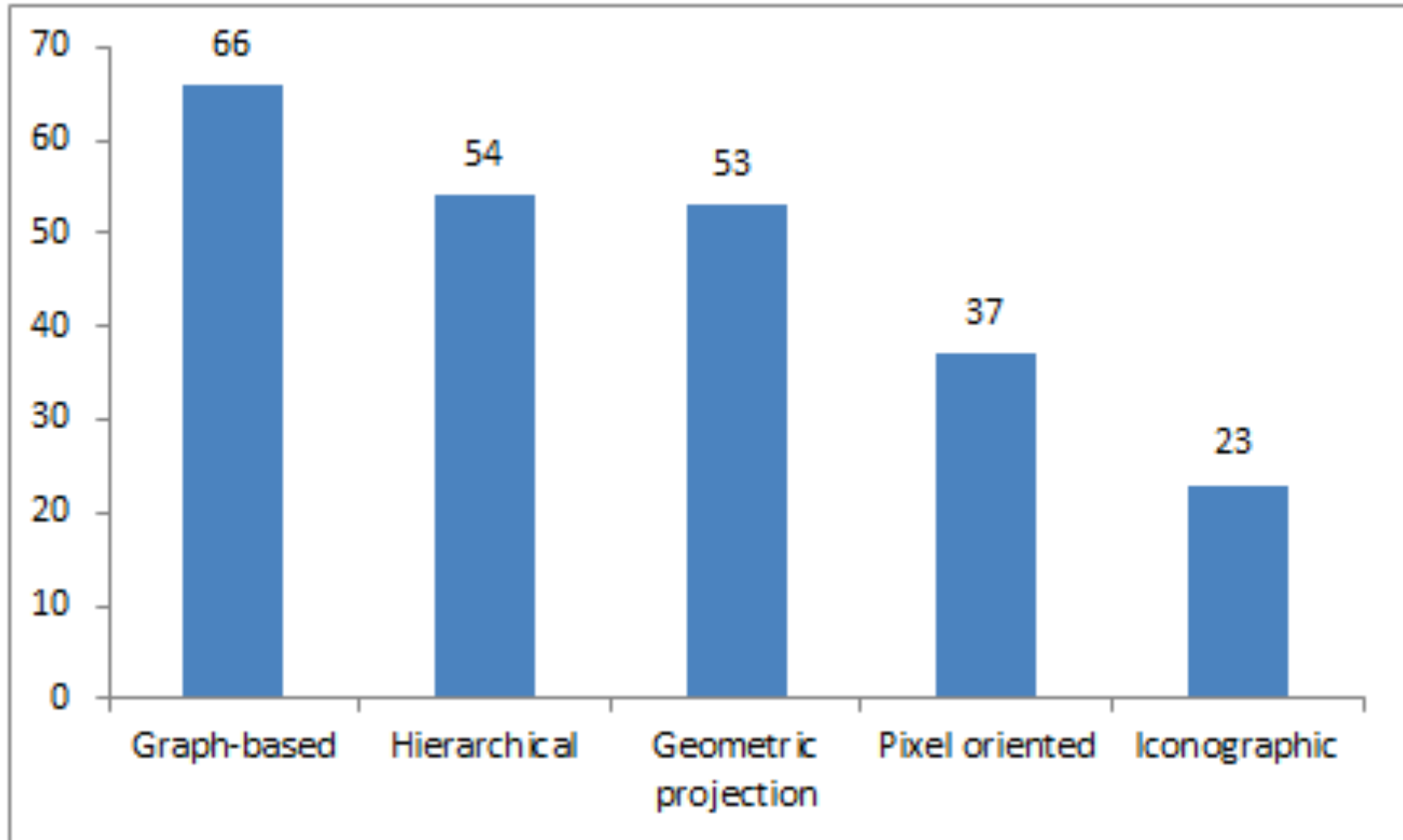


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# Software Visualization

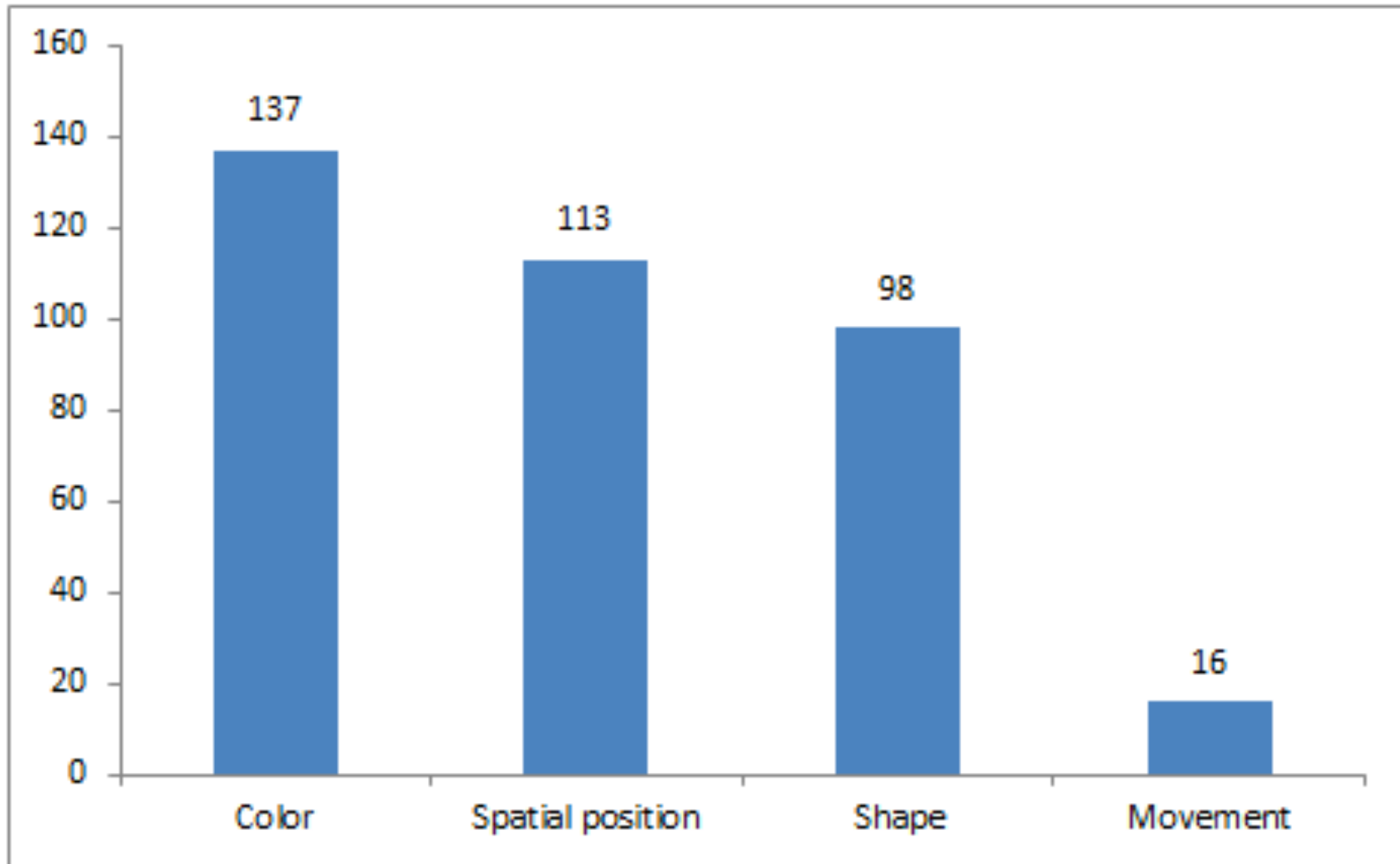


# Visual Paradigm

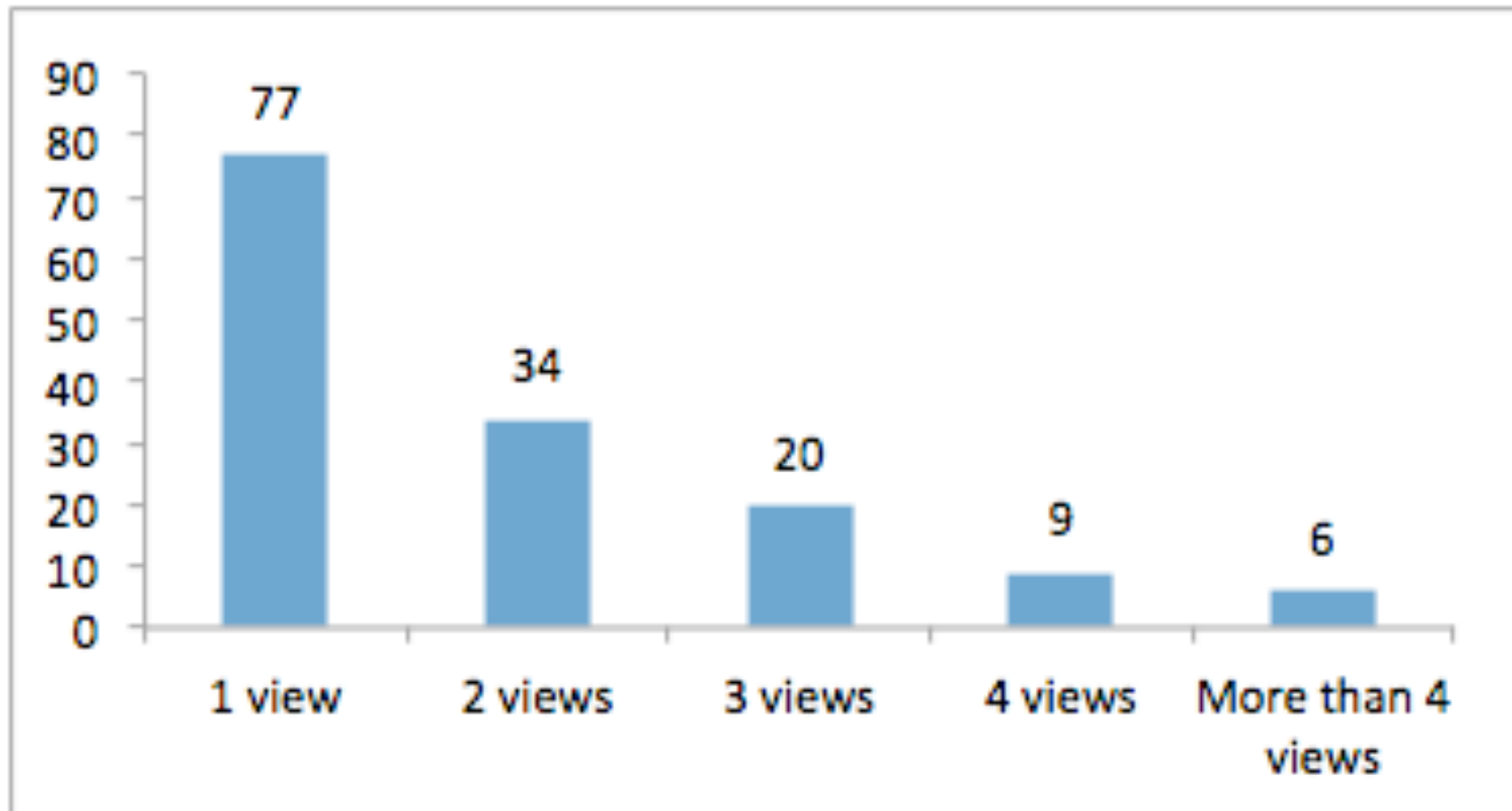




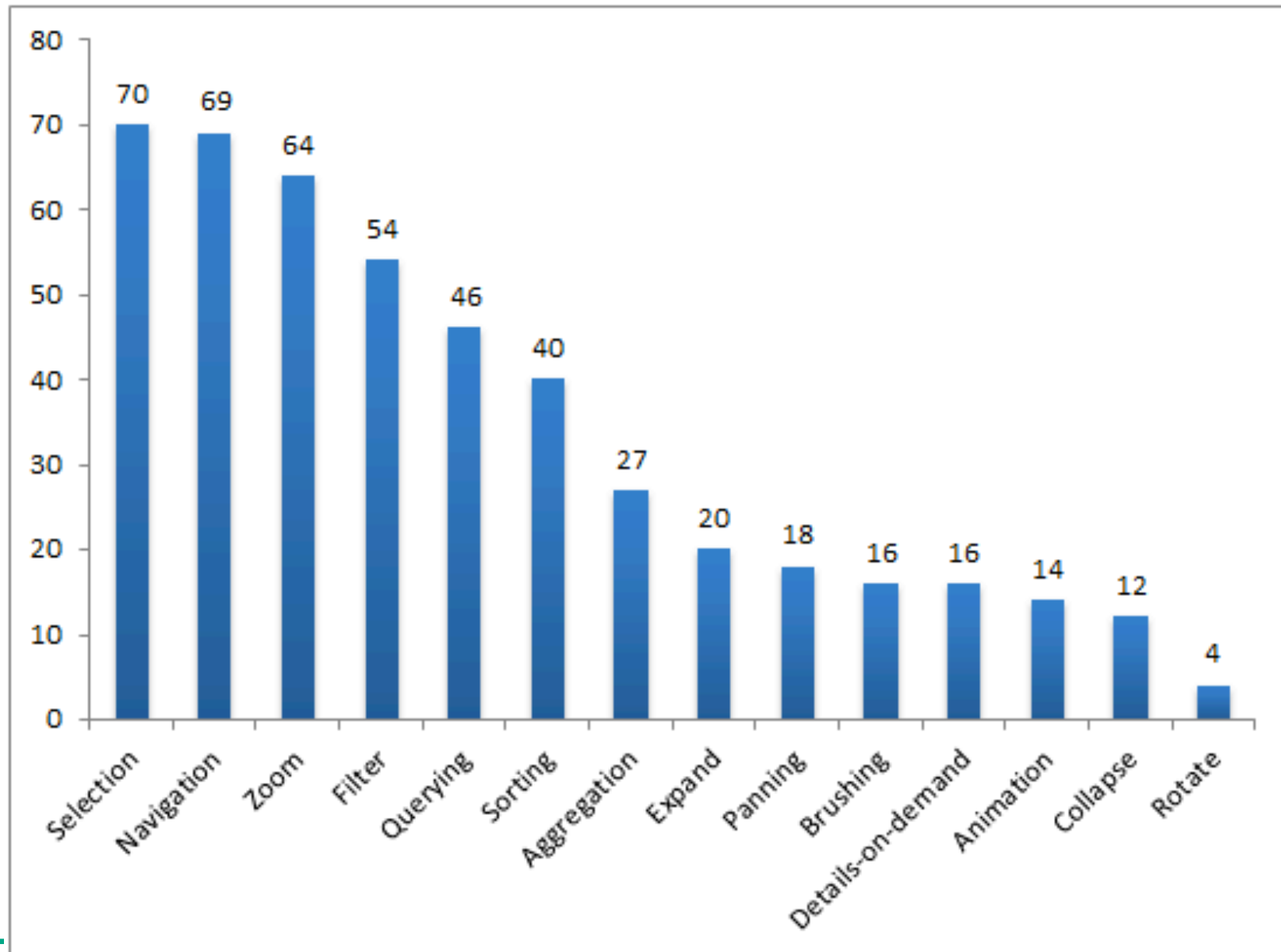
# Visual Attributes



# Views

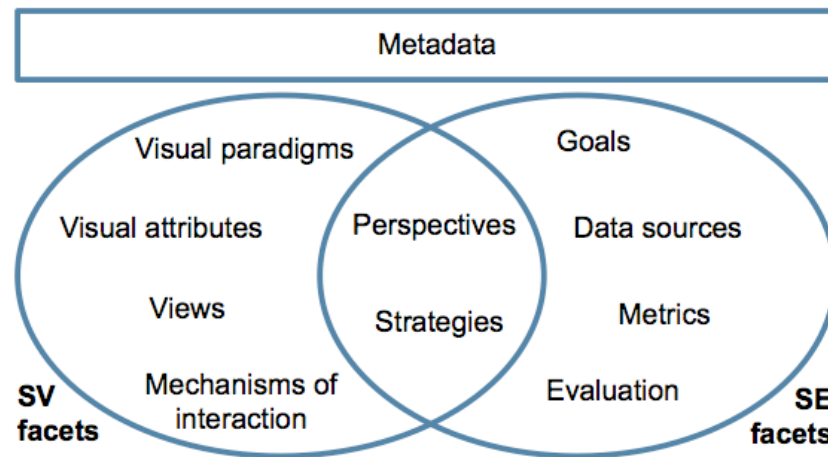


# Mechanisms of interaction

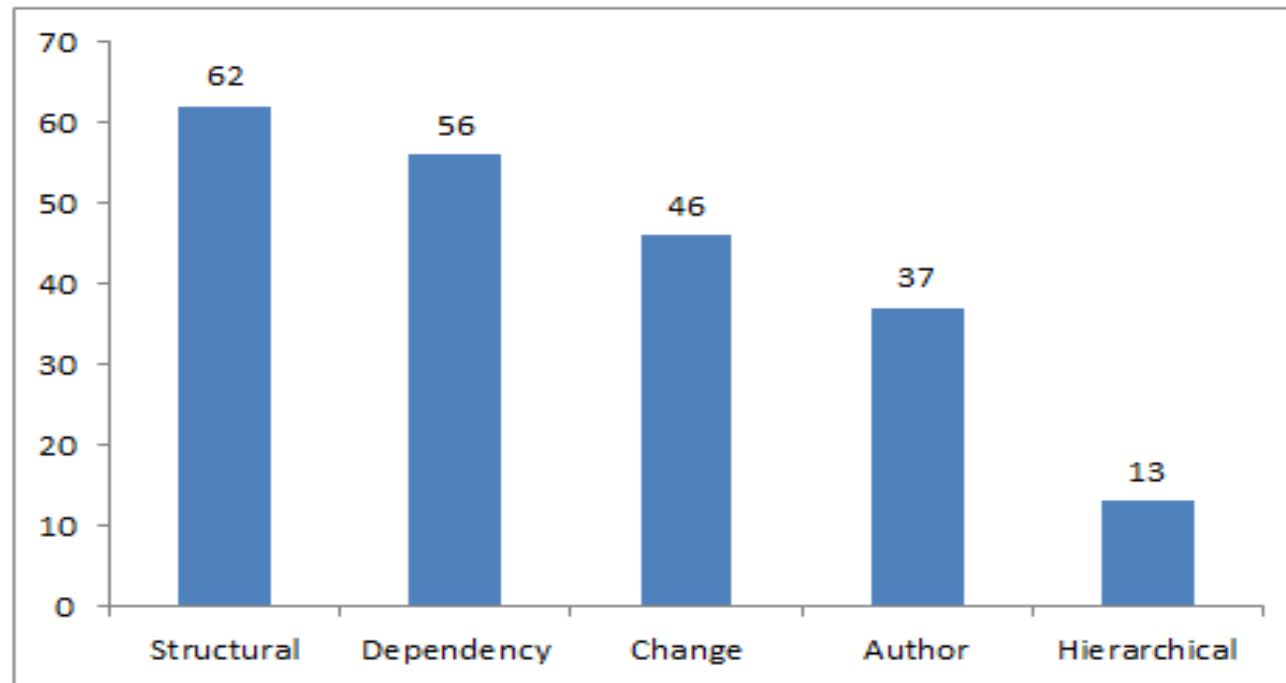


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# The way SEV tools are used to execute software engineering tasks



## Papers per (main) perspectives



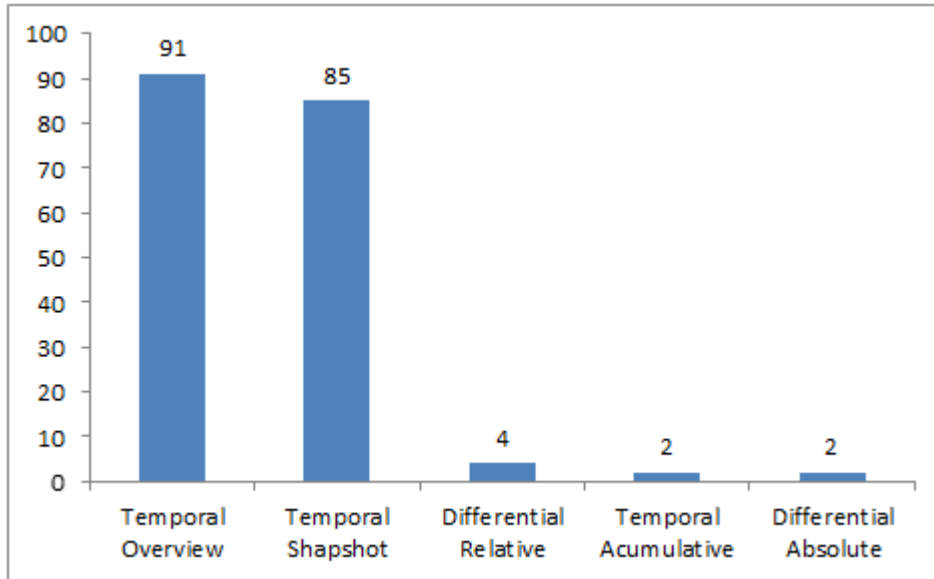
54,79% of the studies use more than one perspective

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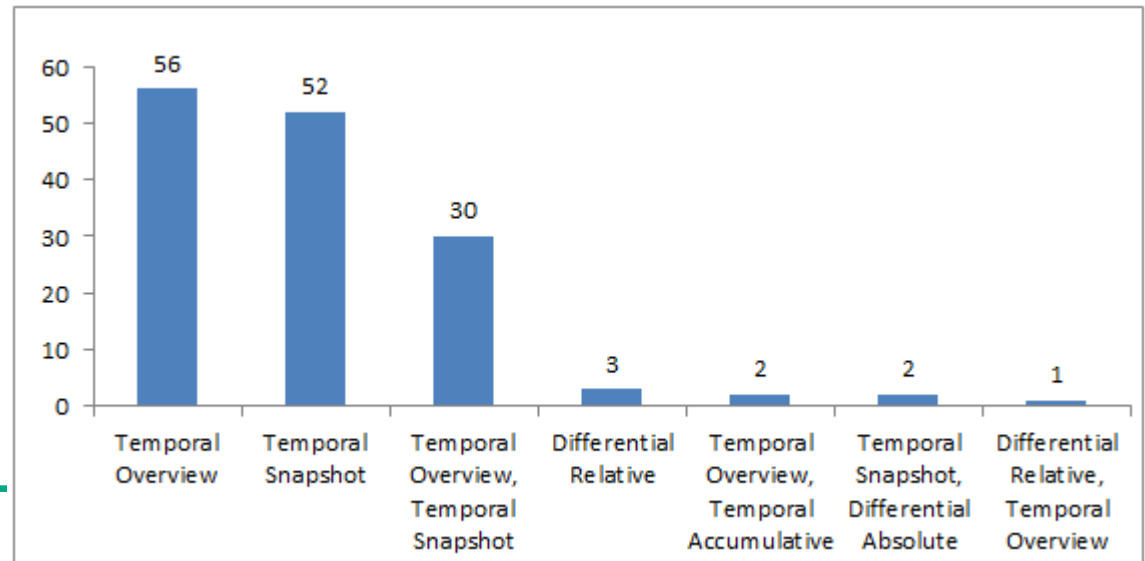
# Strategies

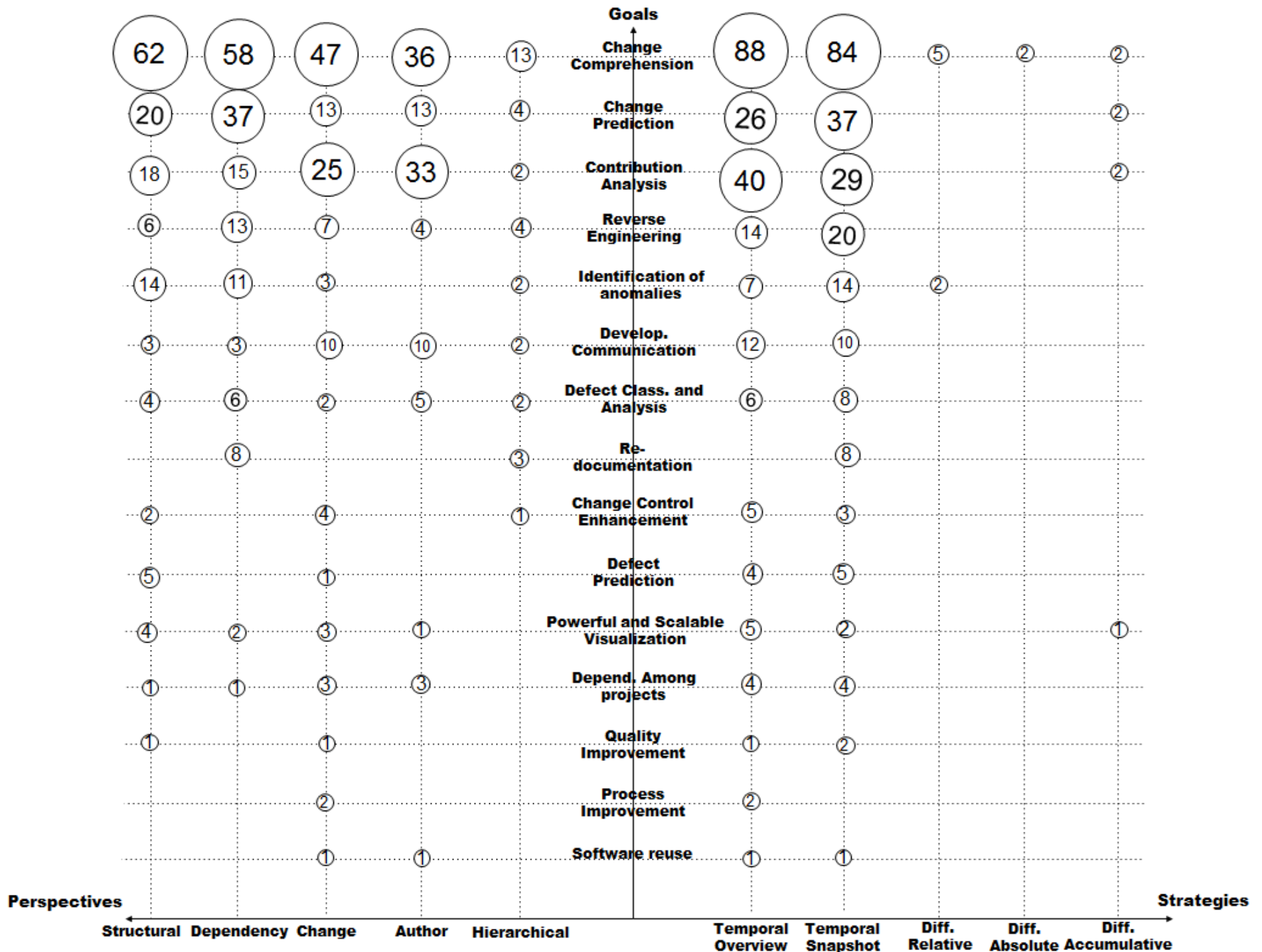
- Differential Relative
- Differential Absolute
  - Temporal Overview
  - Temporal Snapshot
  - Temporal Cumulative

# Papers per Strategies



Only 23.97% use combination of strategies







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## Summarizing the mapping results

- The actual adoption of SEV in industrial environments is very low
- There is very little evaluation of the proposed approaches
- Very few with multi-strategies



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