A Survey of Variability Modeling in Industrial Practice

Thorsten Berger, Ralf Rublack, Divya Nair, Jo Atlee, Martin Becker, Krzysztof Czarnecki, Andrzej Wasowski

VaMoS'13
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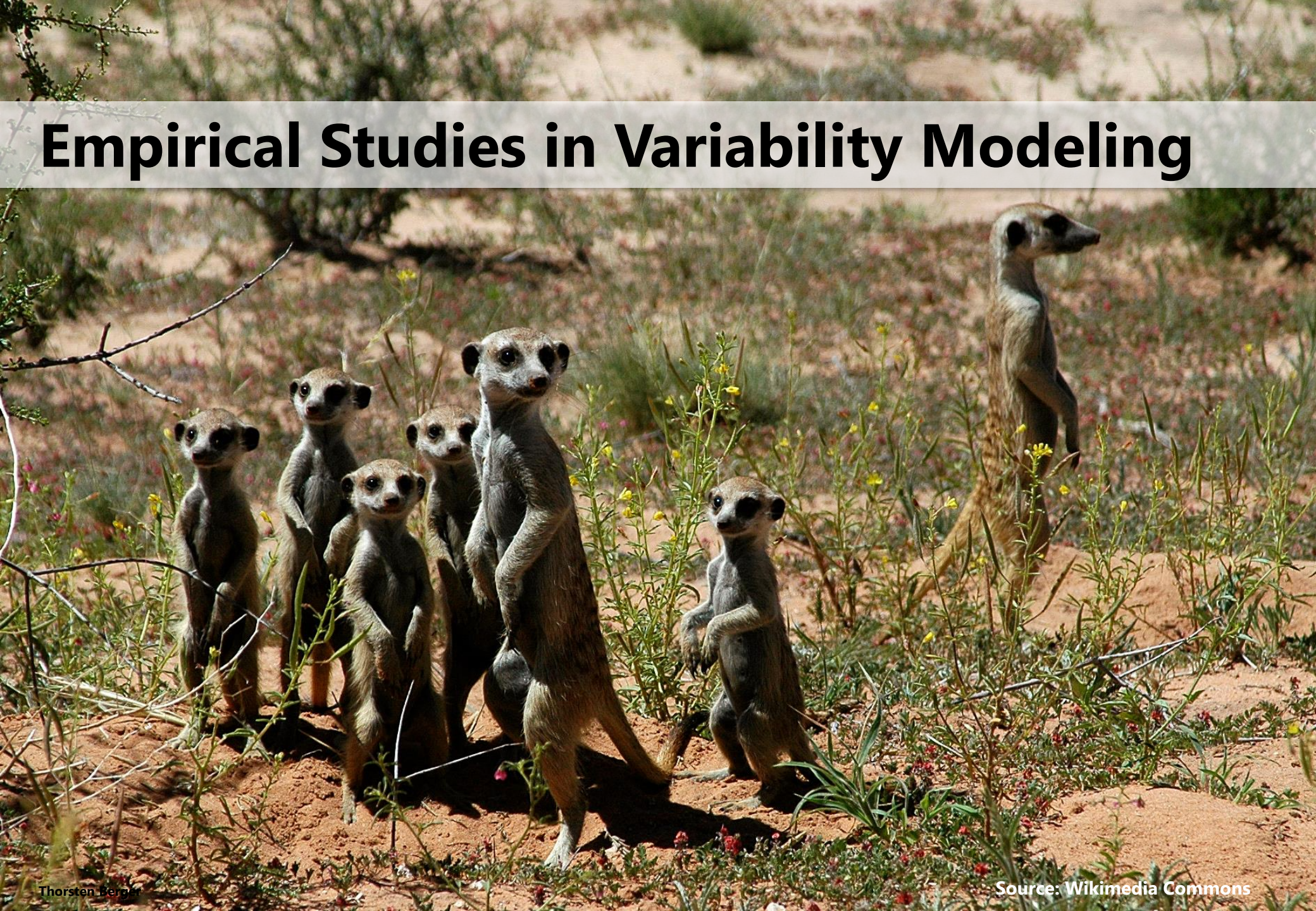
Empirical Studies in Variability Modeling

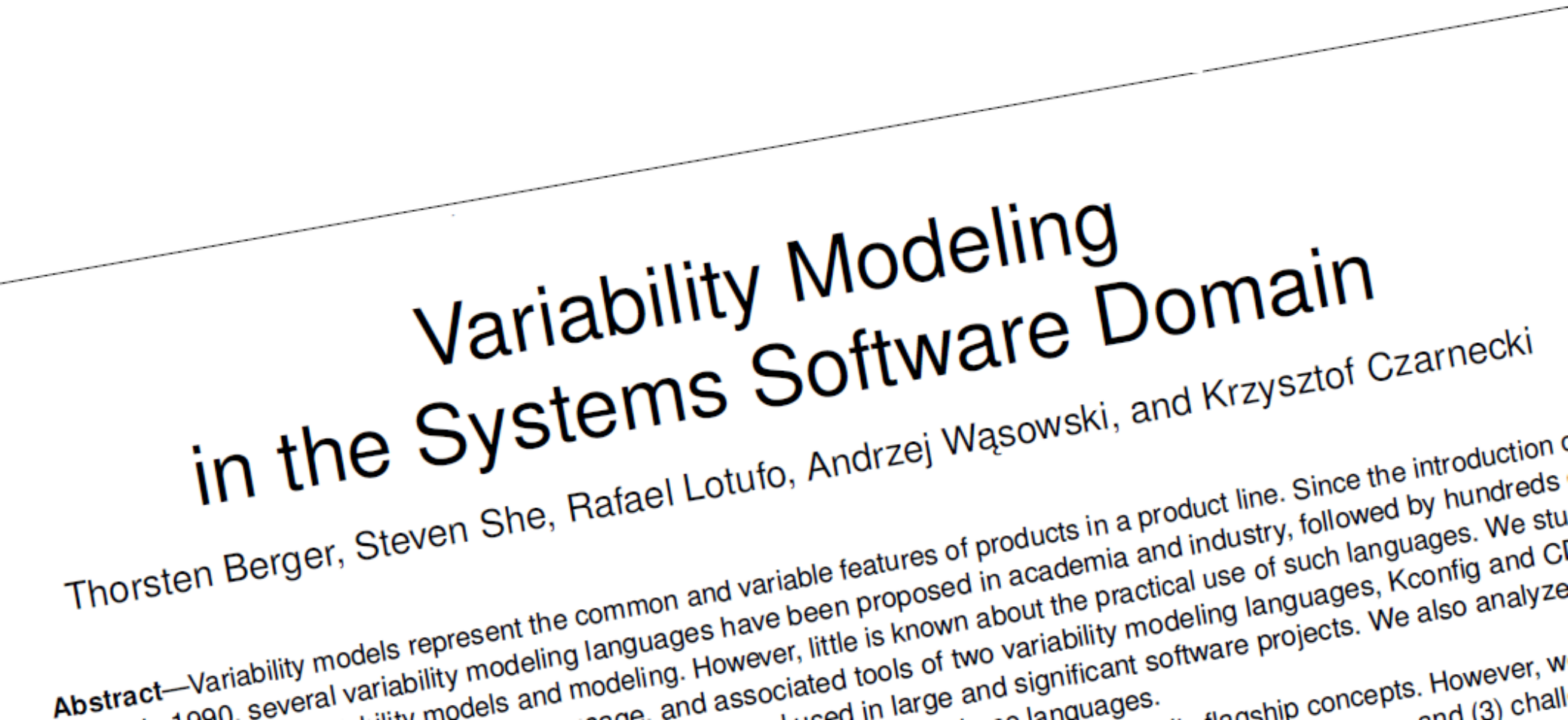


Thorsten Berger

Source: Wikimedia Commons

Open Source Variability Modeling

- **Open Source projects allow:**
  - In-depth language and artifact studies
  - Qualitative and quantitative analyses



Variability Modeling
in the Systems Software Domain

Thorsten Berger, Steven She, Rafael Lotufo, Andrzej Wąsowski, and Krzysztof Czarnecki

Abstract—Variability models represent the common and variable features of products in a product line. Since the introduction o
1990, several variability modeling languages have been proposed in academia and industry, followed by hundreds
ility models and modeling. However, little is known about the practical use of such languages. We stu
age, and associated tools of two variability modeling languages, Kconfig and C
used in large and significant software projects. We also analyze
e languages.
flagship concepts. However, w
and (3) chall

Commercial Variability Modeling

Benefits and Challenges?

Variability Modeling in Industry

Notations and Tools?

Scales of Variability Models?

Methodology

- **Framework study on industrial practice**
  - Mixed-methods: Survey and Interviews
- **This talk: Survey**
  - Provide overview of industrial practices
  - Identify interesting targets
  - No hypothesis testing!
- **Main design criteria: simple and short**
- **Iterative development, including test drives with colleagues**
- **Target: practitioners**
  - Industrial partners, colleagues with industrial background, authors of experience reports

7-Minute-Questionnaire on Industrial Use of Variability Modeling

Dear participant,

thank you for taking some time to contribute to our study on industrial variability modeling. Answering [illegible] seven minutes. It comprises questions about your experience in variability modeling, specifically, we ask for:

- the purpose of variability modeling;
- the notations and tools used;
- the scale of your models;
- modeling problems:
- the context of variability modeling (some characteristics of the product line).

Of course we assure anonymity and will treat your information confidentially. We kindly ask for you contact information (name and email address) at the end of the questionnaire for verification and analysis (e.g. to identify duplicates); and to notify you about the study results.

Thanks,

Ralf Rublack - University of Leipzig
Thorsten Berger - University of Leipzig
Divya Nair - University of Waterloo
Martin Becker - Fraunhofer IESE
Andrzej Wasowski - ITU Copenhagen
Joanne Atlee - University of Waterloo
Krzysztof Czarnecki - University of Waterloo

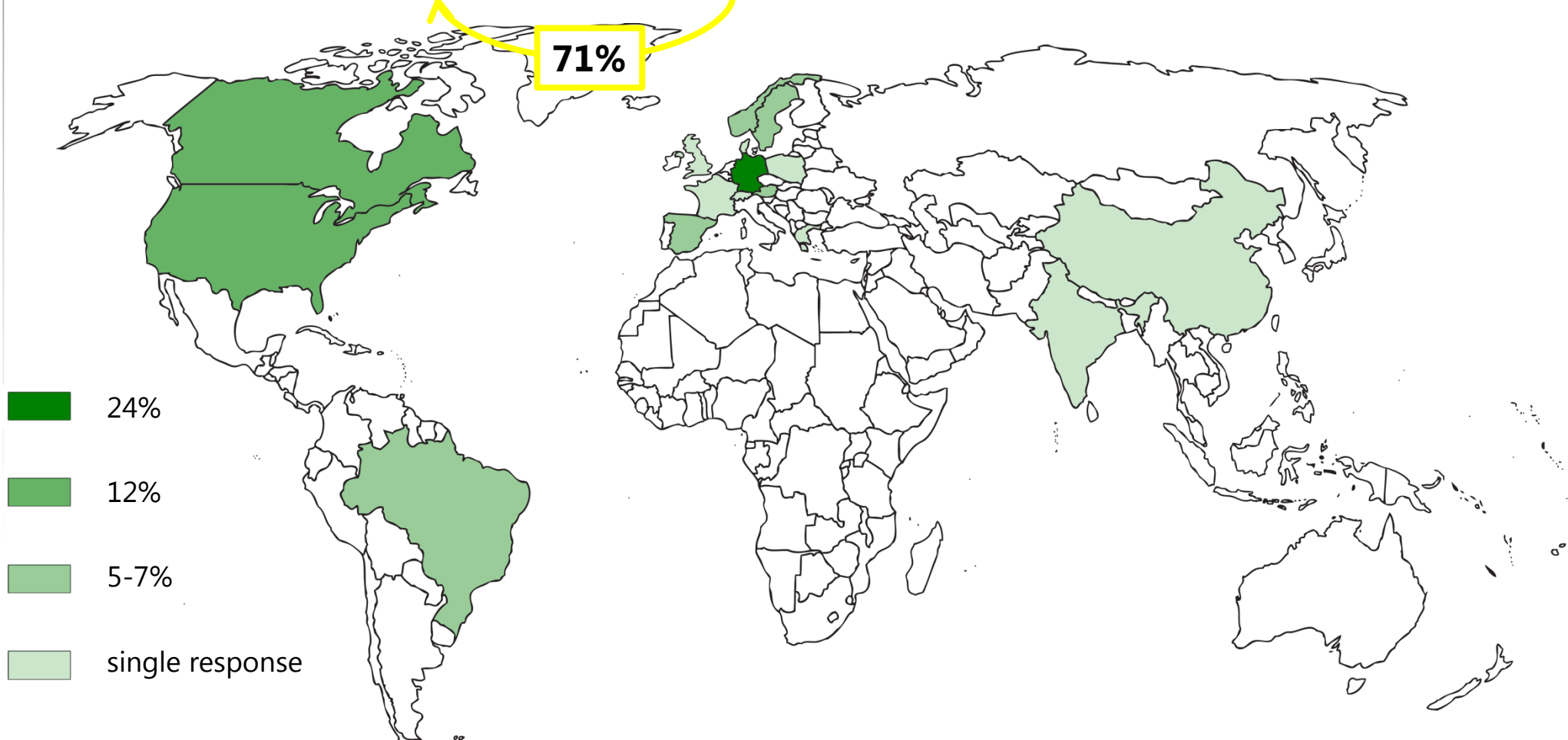
Next

0%

Responses

Responses

- **42 responses:** 35 remaining after filtering (pure researchers)
- **Experience:** 57% have >5 years of experience with product lines
- **Roles:** 71% are modelers, 68% researchers, 51% developers, 40% team leaders,…



Some Results

more details in the paper

Context

of variability modeling

Application Domain

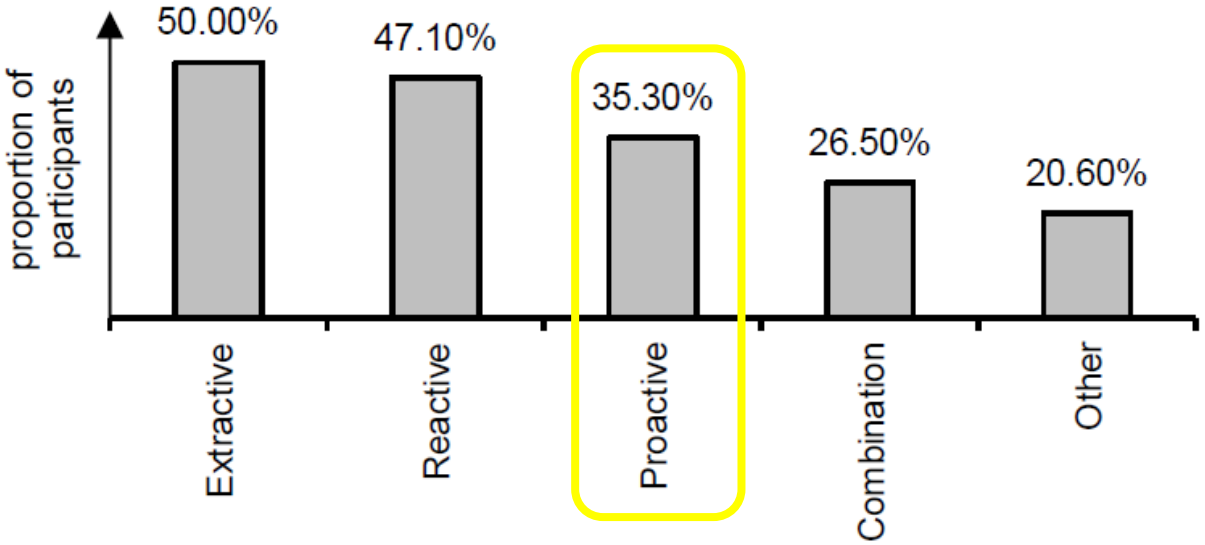
application domain	
automotive	11
industrial applications and energy	8
enterprise and eCommerce	7
aerospace and defense	5
medical	4
consumer electronics	2
government	2
telecommunication	2
other	10

Embedded systems still most important, but applied in other interesting domains.

underwater accoustics, geo information systems, travel, logistics

Context of Variability Modeling

- **Product line adoption strategies**



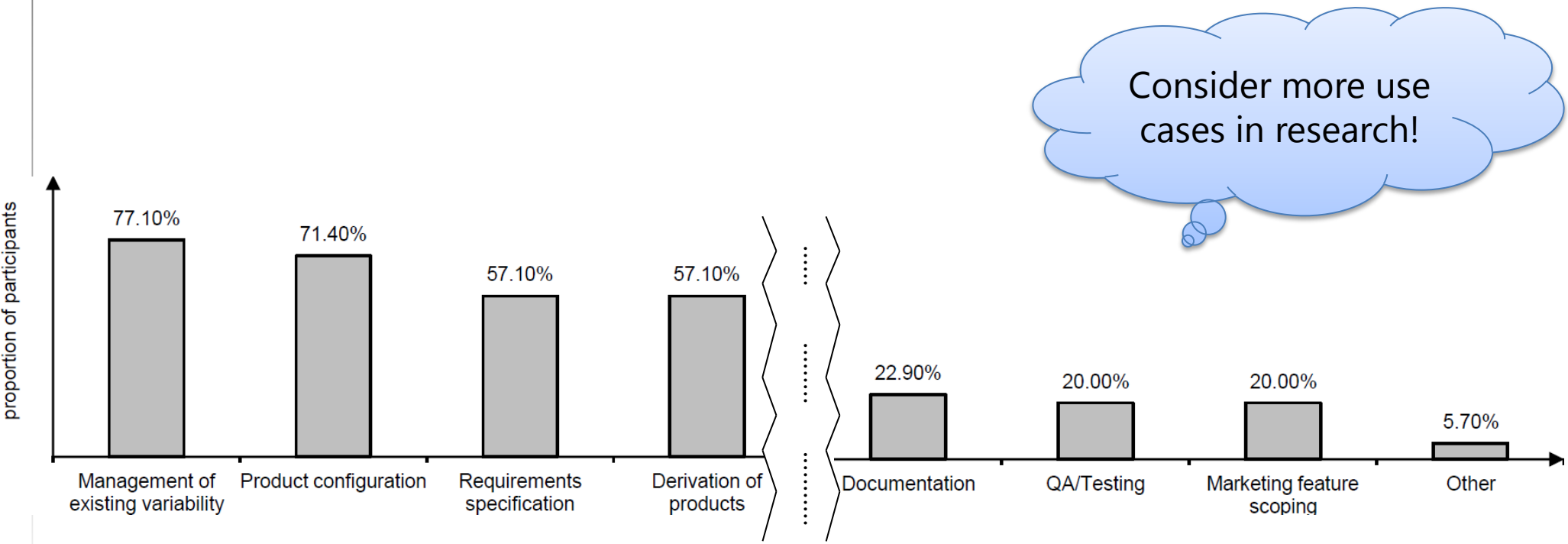
- **Artifacts**
  - 64% source code (static variability) vs. 36% running product (dynamic variability)
  - 72% components/modules, 53% requirements, 53% architecture, followed by platform, tests, libraries, and documentation

Benefit

of variability modeling

Benefit

- **Wide range of perceived values beyond configuration!**



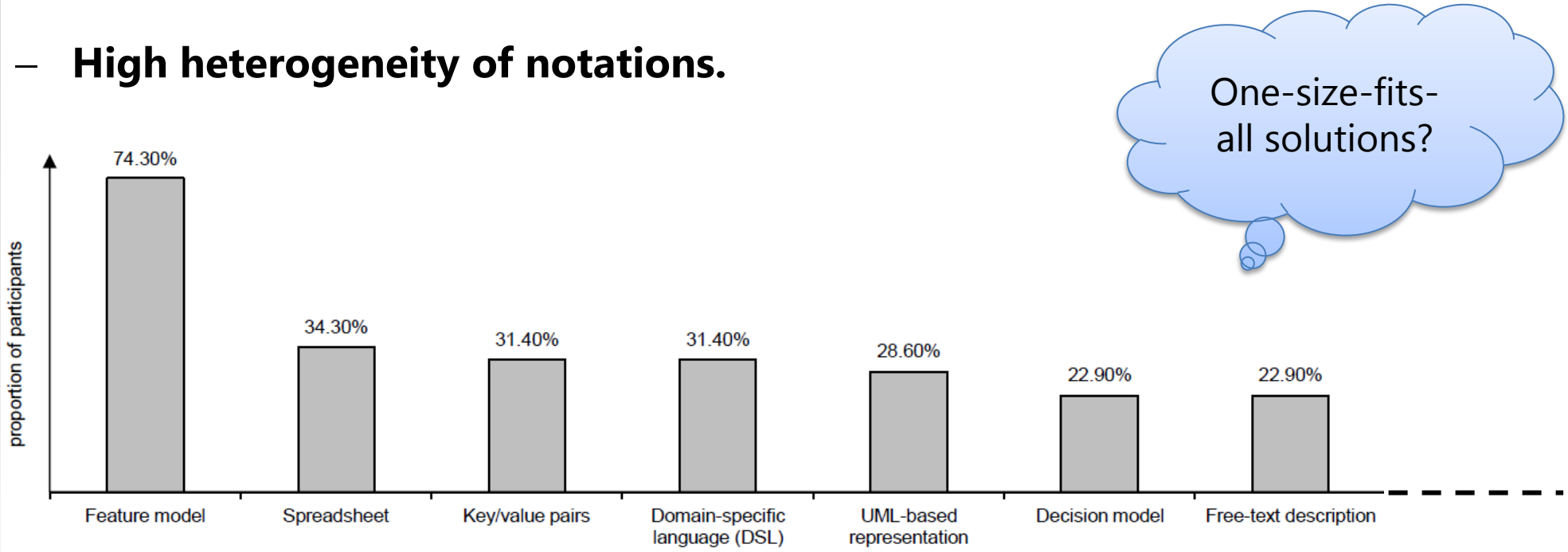
- **Other:**
  - maintenance and cost estimations,
  - planning of development and evolution

Notations and Tools

used by practitioners

Notations

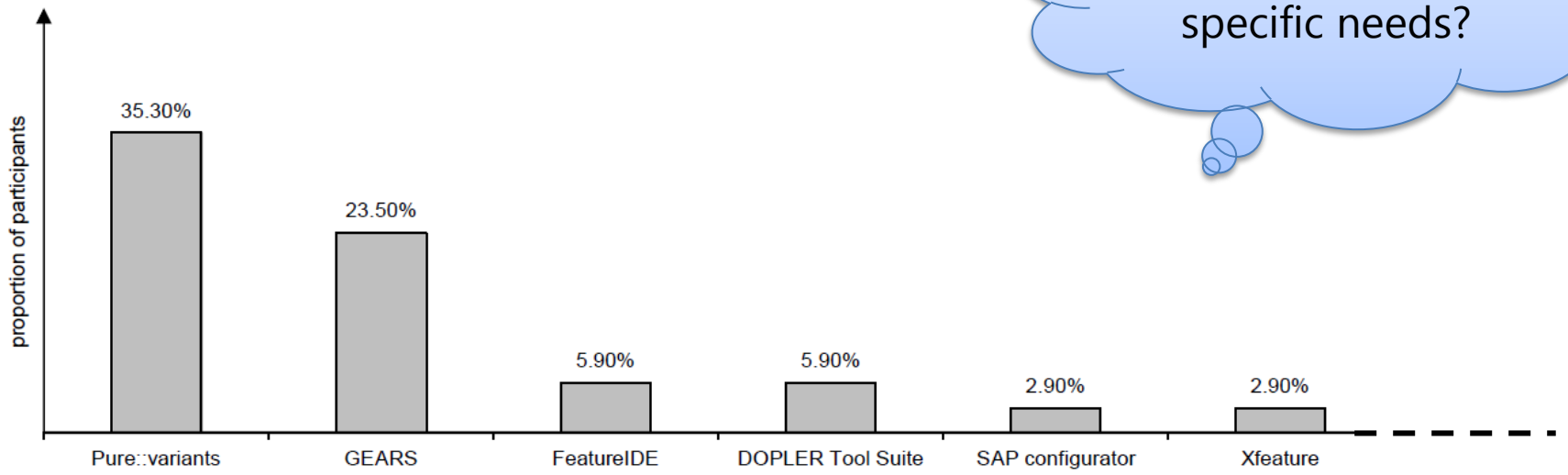
- **High heterogeneity of notations.**



- **23% of respondents reported own notations, such as: Design Structure Matrix and CVL**
- **Most respondents use more than one notation (avg. 3)**

Tools

- **High heterogeneity of tools.**



Hypothesis:
Attributed to domain-specific needs?

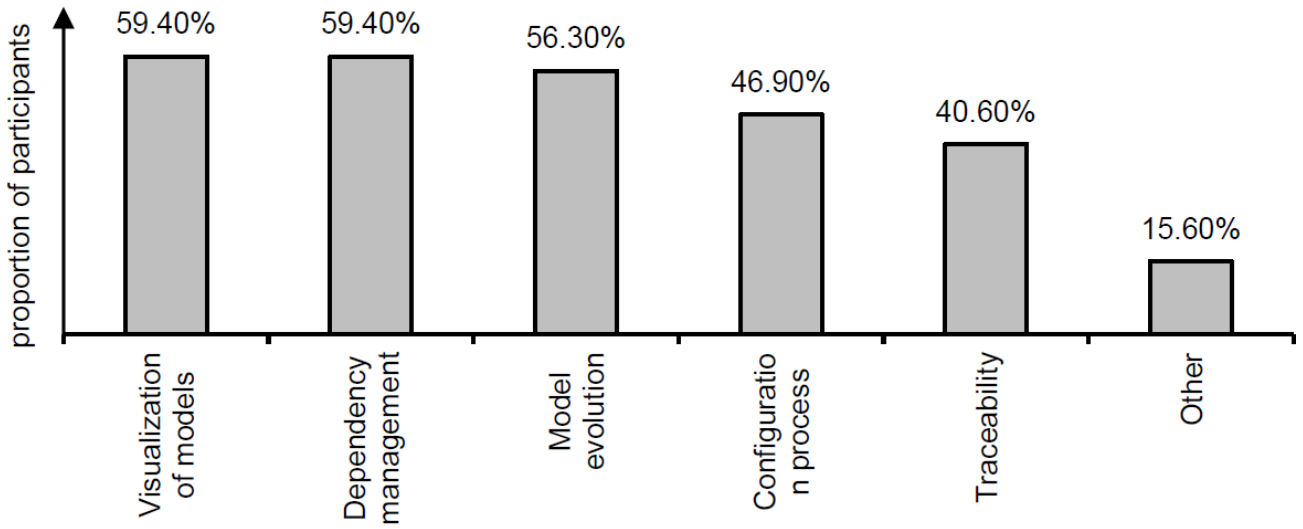
- **Many other, often unknown tools identified.**
  - 38% use home-grown tools
  - 30% use another open source tool
  - 27% use another commercial tool

Challenges and Mitigation Strategies

faced and employed by practitioners

Challenges

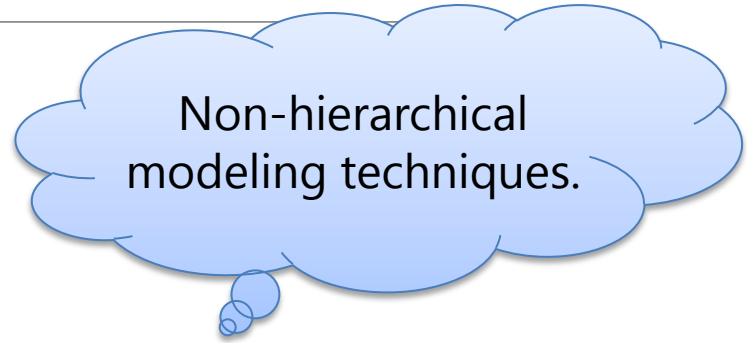
- **Respondents reported 2-3 challenges in average.**

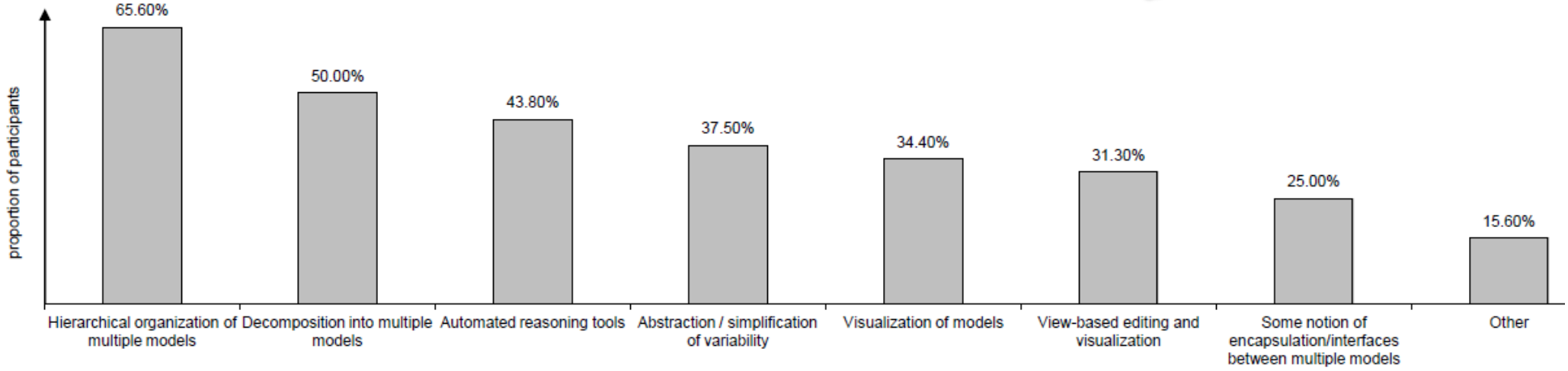


- **Other challenges:**
  - modularization, testing, model reduction,
  - *"getting developers to understand why we do this [...]"*

Mitigation Strategies

– **Hierarchical organization is key!**





– **Variability models are fragile!**

  – Other:“assign configuration / variability-dependent tasks to a small selection of people“.

Summary and Conclusions

Summary and Conclusions

- **Our survey questionnaire shows:**
  - Wide range of applications and perceived benefits
  - Heterogeneity of notations and tools
  - Large models (>10000 units) with cross-tree constraints
- **Community might need to:**
  - Widen the focus of variability modeling
  - Research tools and methods that support diversity of notations
  - Refocus research to re-engineering and reverse-engineering approaches
- **Limitations:**
  - Only successful projects considered
  - Many results require qualitative follow-up investigations.

Thanks for Listening!

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