TECHNISCHE UNIVERSITÄT DRESDEN

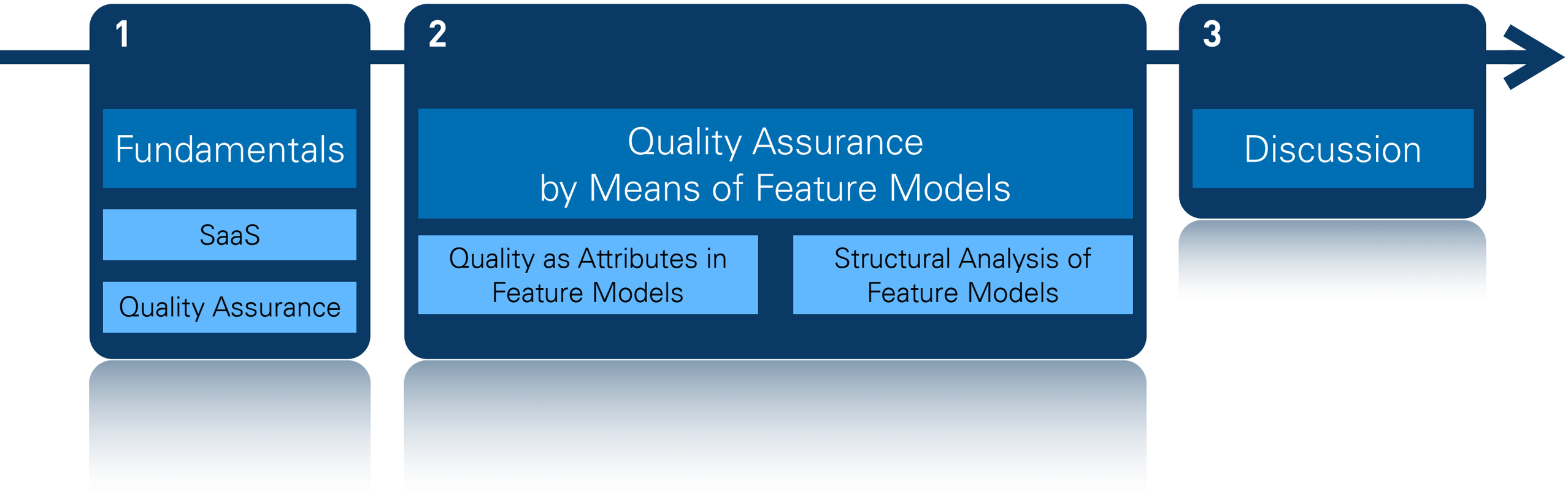
Faculty of Computer Science, Institute of Software- and Multimedia-Technology, Chair for Software Technology

Quality Assurance by Means of Feature Models

David Gollasch

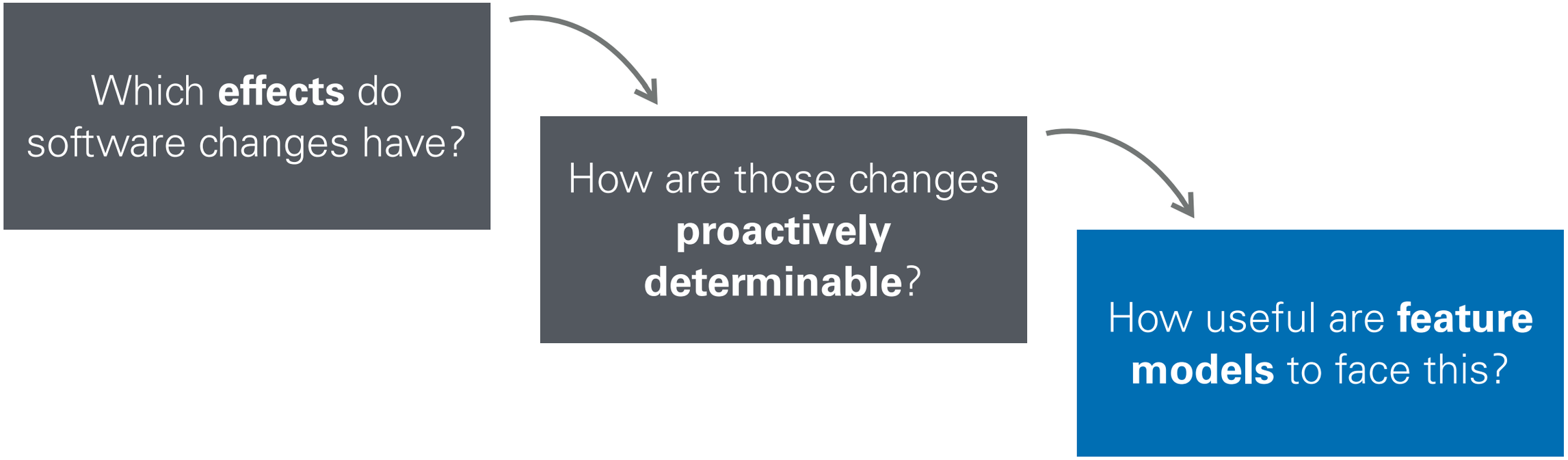
FOSD Meeting 2014, Dagstuhl, 07.05.2014

Contents


1
Fundamentals
SaaS
Quality Assurance
2
Quality Assurance
by Means of Feature Models
Quality as Attributes in
Feature Models
Structural Analysis of
Feature Models
3
Discussion

Motivation

Modern business applications are getting increasingly distributed over the Internet as multi-tenant **software as a service** (SaaS). This leads to new challenges in terms of **quality assurance** when developing or maintaining such applications, because **all customers are directly affected** very often.



1. Fundamentals

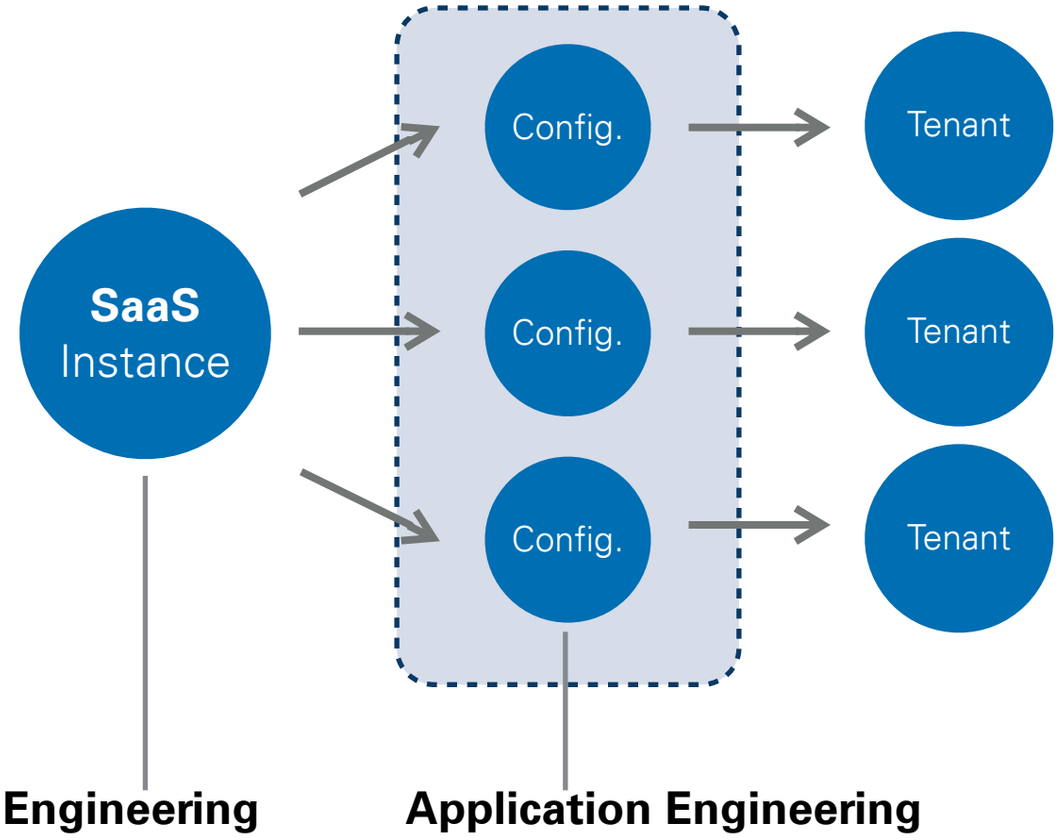
SaaS

Quality Assurance

[Schroeter et al. 2012]
[Mietzner et al. 2011]
[Linden 2007, p. 6 ff.]

Multi-Tenant Software as a Service Applications

…can be seen as a special kind of SPL



Configurations possible through product lines (SPL)

Why to focus on quality assurance?

Laws of software evolution (development of software in time)

1. Law of continous change
2. Law of increasing complexity
3. Law of decreasing quality
4. Law of diminishing productivity
5. Law of restricted growth

↓

key argument for quality assurance

How to assure quality in general?

Take a **quality goal and try to reach it** due to further development

X exclusive

G gradual

Q quantized

Prioritize development process: Remove unnecessary features to **avoid wasting time and money**.

analyse product structure

2. Quality Assurance by Means of Feature Models

Quality as Attributes in Feature Models

Structural Analysis of Feature Models

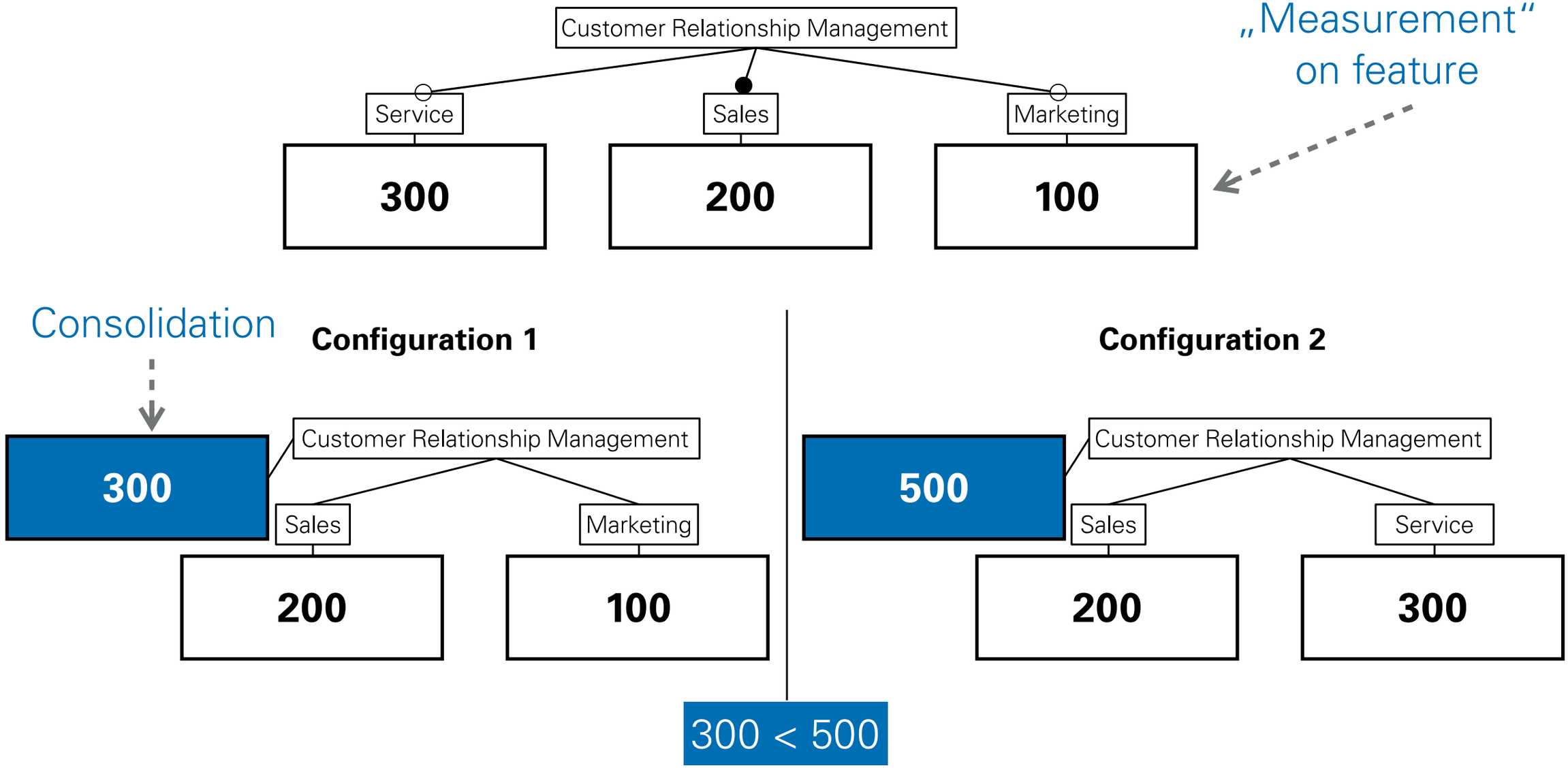
Qualities as Attributes in Feature Models

- Steps to analyze quality goals:

1. Classification as X, G or Q goal
2. Find metric or heuristics
3. Consolidation for configuration

Type	Quality Goal	Question/Interpretation
X goal	Capabilities	Are the requirements fulfilled?
G goal	Efficiency	How efficient is the feature or configuration?
Q goal	Resource usage	How much memory needs the calculation?

Example: Comparing Configurations (Summation as Consolidation)



Consolidation Methods

- simple approach for X goals: **binary (achieved/not achieved)**
  ex: If there is one sub feature which does not achieve the X goal, the whole configuration does not achieve the goal.

- simple arithmetic operations for Q/G goals: **e.g. summation**

- complex consolidation **method with dependencies**, because not every feature set allows a simple summation of the quality values,
  e.g. in terms of memory consumption.
  If F_A and F_B → multiply sum with 0.5.

[Siegmund et al. 2012]
[Lettner et al. 2011]

Further Measurement Approaches

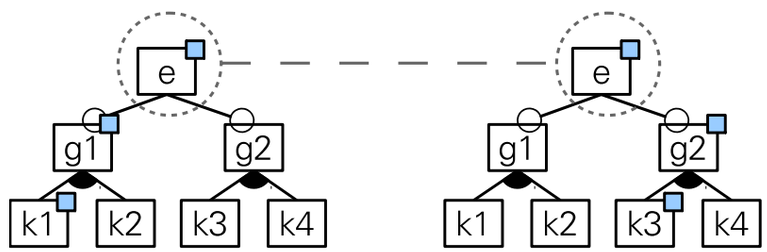
- **Not every quality goal can be measured easily, e.g. safety properties!**
- Quality measurement at a **concrete software instance** respectively configuration
  - usage of Benchmarks
  - usage of model and code
- Quality determination by means of a **business approach**
  - Assigning „costs“ to each feature
  - Negotiation of „total costs“ for a configuration according to economical principles (discounts, price increase, ...)

Structural Similarity of Configurations

- **When does comparing configurations make sense?**
- Comparison of similar configurations as a lead for further investigations

Configurations **are similar, if there are commonalities** that can be identified. This does not necessarily refer to the selection of equal features. Similarity also involves **structural commonalities**. *(derived definition)*

same parent feature



same parent feature

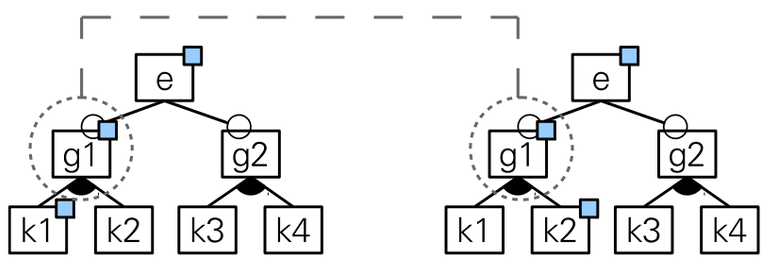
Structural Similarity of Configurations

- **When does comparing configurations make sense?**
- Comparison of similar configurations as a lead for further investigations

Configurations **are similar, if there are commonalities** that can be identified. This does not necessarily refer to the selection of equal features. Similarity also involves **structural commonalities**. *(derived definition)*

same parent feature

same group



same group

Structural Similarity of Configurations

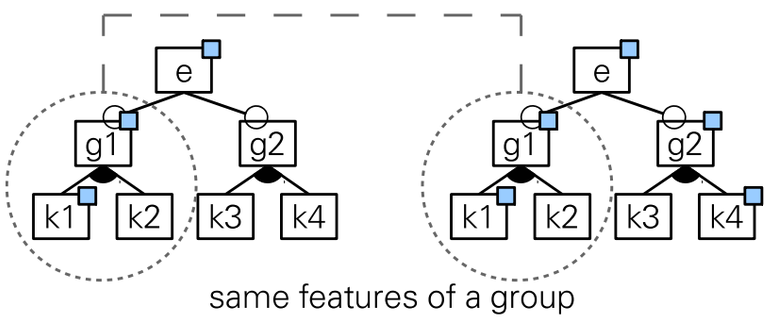
- **When does comparing configurations make sense?**
- Comparison of similar configurations as a lead for further investigations

Configurations **are similar, if there are commonalities** that can be identified. This does not necessarily refer to the selection of equal features. Similarity also involves **structural commonalities**. *(derived definition)*

same parent feature

same group

same features of a group



Structural Similarity of Configurations

- **When does comparing configurations make sense?**
- Comparison of similar configurations as a lead for further investigations

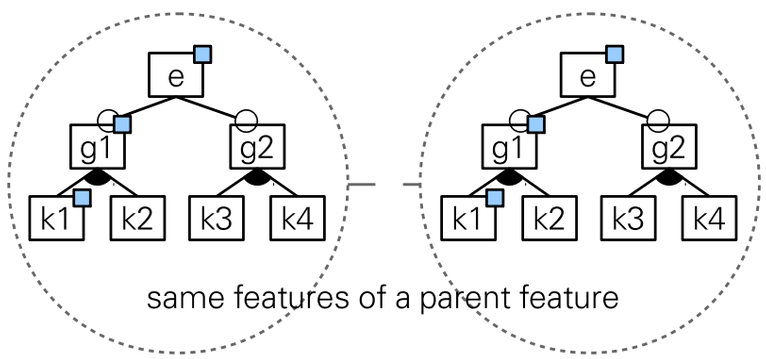
Configurations **are similar, if there are commonalities** that can be identified. This does not necessarily refer to the selection of equal features. Similarity also involves **structural commonalities**. *(derived definition)*

same parent feature

same group

same features of a group

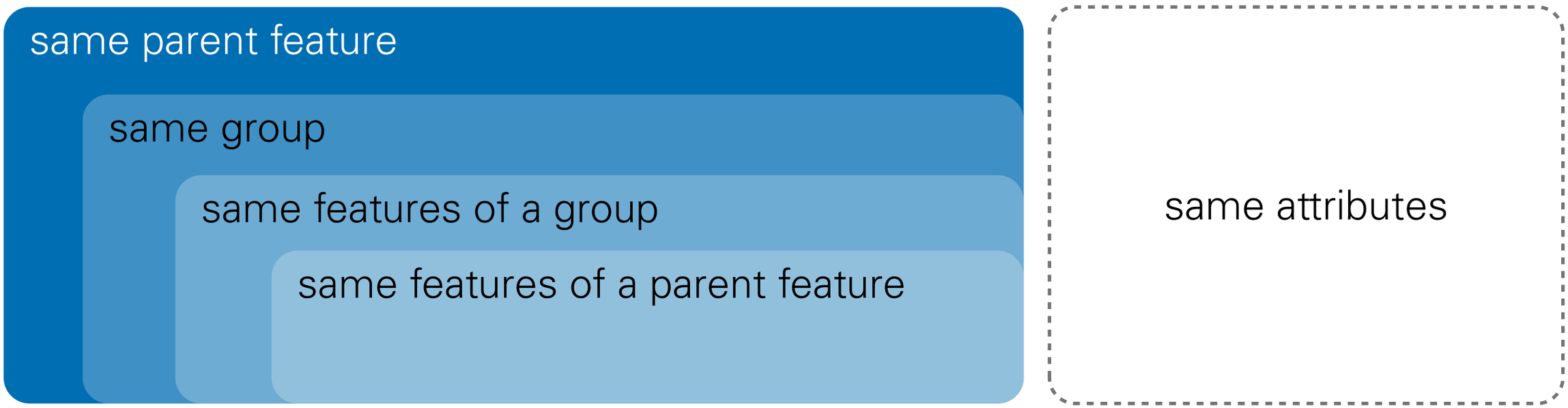
same features of a parent feature



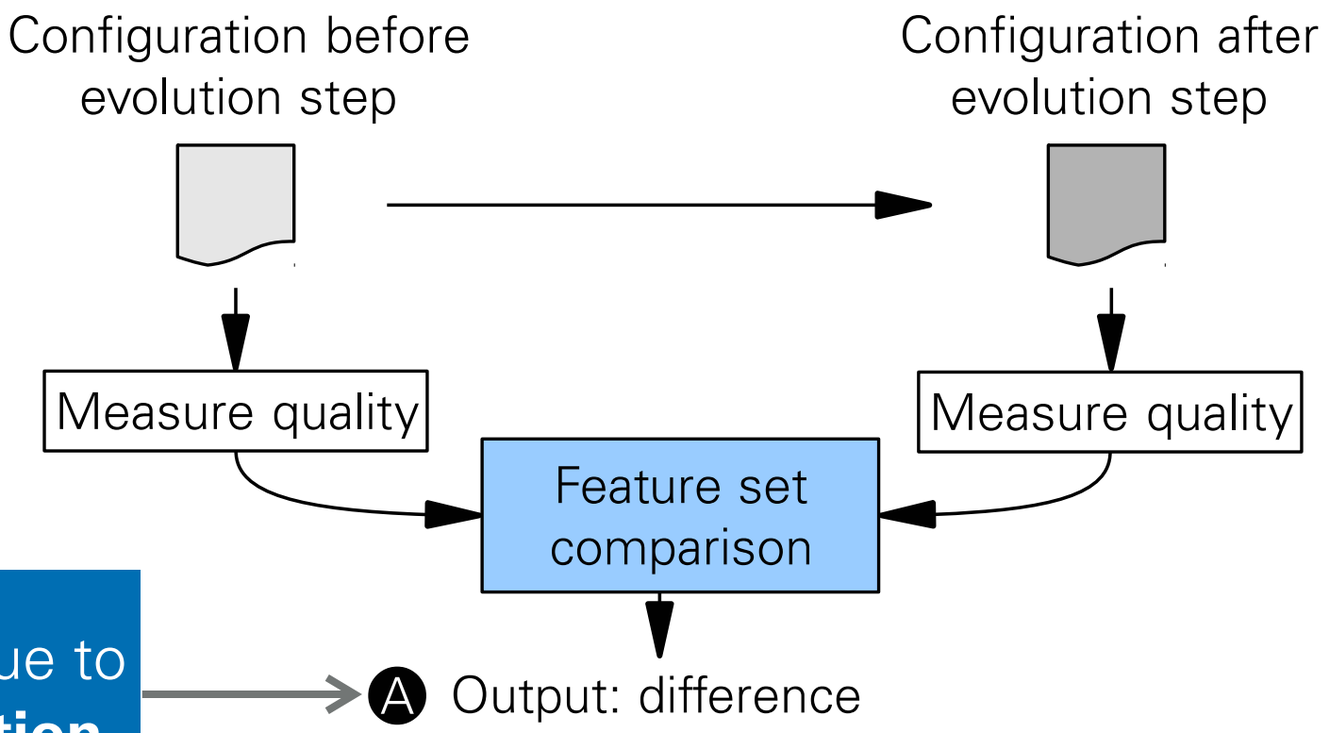
Structural Similarity of Configurations

- **When does comparing configurations make sense?**
- Comparison of similar configurations as a lead for further investigations

Configurations **are similar, if there are commonalities** that can be identified. This does not necessarily refer to the selection of equal features. Similarity also involves **structural commonalities**. *(derived definition)*

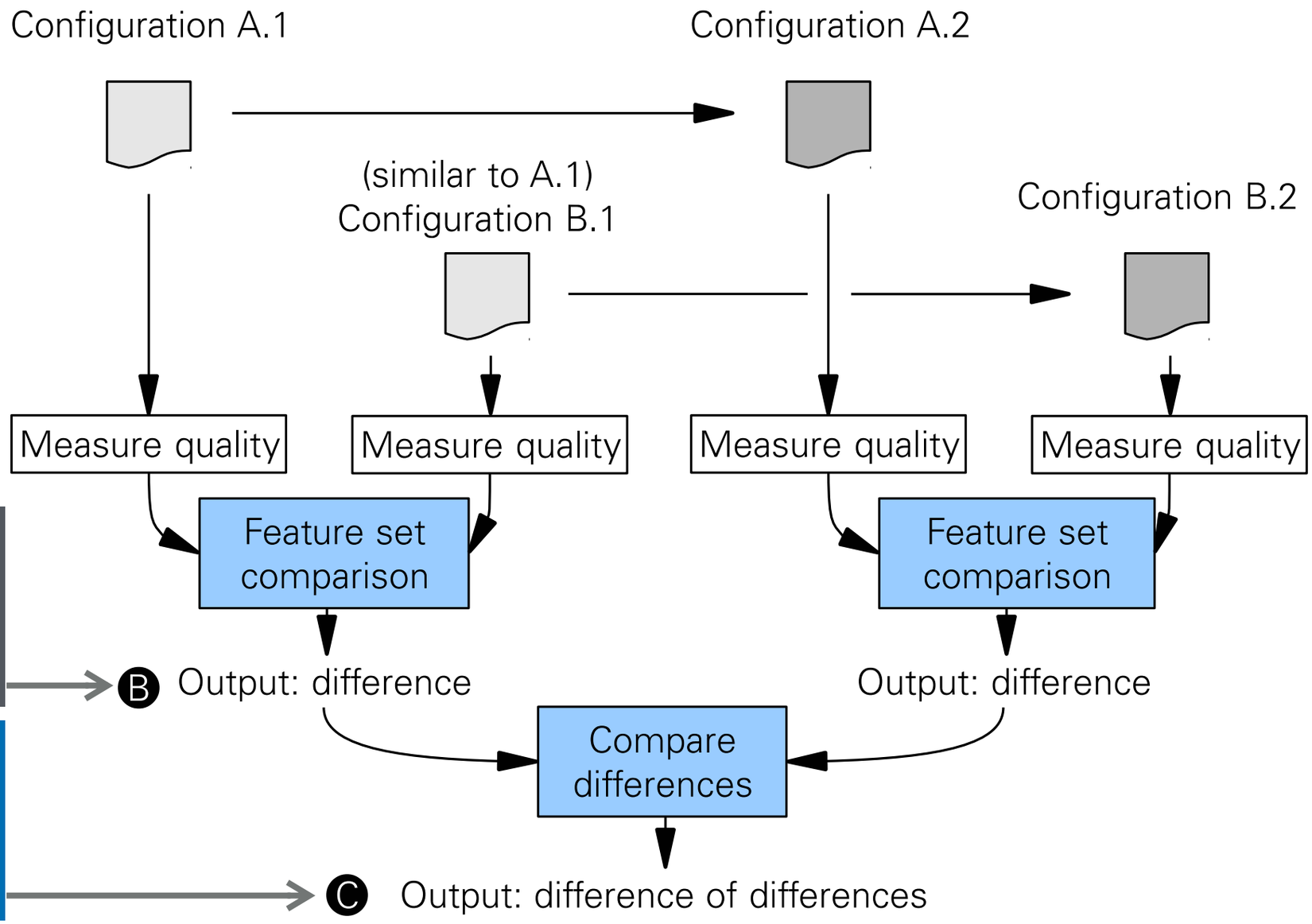


Draw Conclusions (1)



Quality change due to **software evolution**

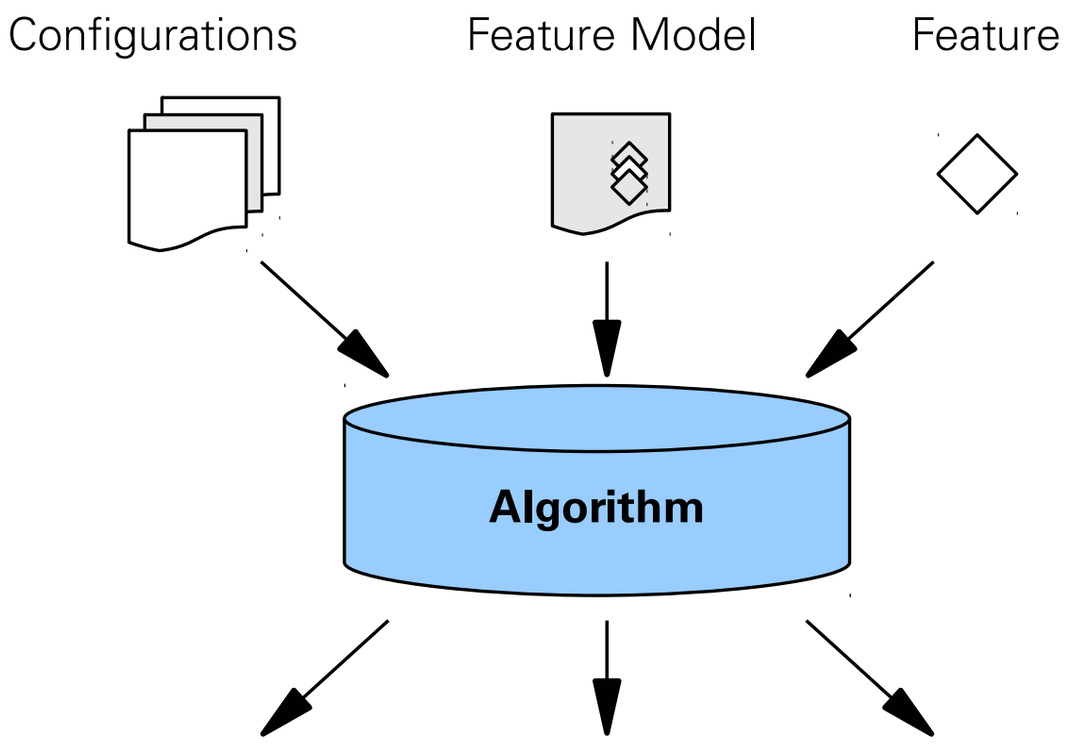
Draw Conclusions (2)



Quality difference of similar configurations

…and its change due to **software evolution**

Structural Analysis of Feature Models



- Comparisons only based on a feature model and existing derived configurations.
- Complete automation possible
- Conceptual implementation in **Java** as **Eclipse plugin** within the extFM-Tooling project (https://github.com/extFM/extFM-Tooling/)

3. Discussion

- Possible starting points for further research

Analysis of the shown methods without the SaaS context	Further research in attributed feature models	Extension of analysis tools
Integration of the prototypical implementation in a practically usable tool	Combination of attributed and structural analysis	Empirical investigation in practicability in real projects

TECHNISCHE UNIVERSITÄT DRESDEN

(References on next slides)

Faculty of Computer Science, Institute of Software- and Multimedia-Technology, Chair for Software Technology

Thank you for your attention!

1

Fundamentals

SaaS

Quality Assurance

2

Quality Assurance by Means of Feature Models

Quality as Attributes in Feature Models

Structural Analysis of Feature Models

3

Discussion

DRESDEN concept
Exzellenz aus Wissenschaft und Kultur

References (1)

- Illustrationen von www.freedigitalphotos.net
- **[Buxmann et al. 2008]** Peter Buxmann, Thomas Hess und Sonja Lehmann. "Software as a Service". In: Wirtschaftsinformatik 50.6 (2008), S. 500–503.
- **[Blaisdell 2012]** Rick Blaisdell. Mandantenfähigkeit in der Cloud: Die Vorteile verstehen. Blog. Juli 2012. url: http://www.enterprisecioforum.com/de/blogs/rickblaisdell/mandantenf%C3%A4higkeit-der-cloud-die-vorteil (besucht am 06.07.2013).
- **[Böckle et al. 2004]** Günter Böckle, Peter Knauber und Klaus Pohl. Software-Produktlinien: Methoden, Einführung und Praxis. Hrsg. von Klaus Schmid. Heidelberg: Dpunkt.verlag, 2004.
- **[Kang et al. 1990]** K. C. Kang, S. G. Cohen, J. A. Hess, W. E. Novak und A. S. Peterson. Feature-Oriented Domain Analysis (FODA) Feasibility Study. Techn. Ber. Carnegie-Mellon University Software Engineering Institute, Nov. 1990.
- **[Linden 2007]** Frank van der Linden. Software Product Lines in Action: The Best Industrial Practice in Product Line Engineering. Berlin, New York: Springer, 2007.
- **[Benavides et al. 2009]** David Benavides, Sergio Segura und Antonio Ruiz-Cortés. Automated Analysis of Feature Models: A Detailed Literature Review. Techn. Ber. ISA-09-TR-04. Seville, Spain: Applied Software Engineering Research Group, University of Seville, 2009.

References (2)

- **[Benavides et al. 2005]** David Benavides, Pablo Trinidad und Antonio Ruiz-Cortés. "Automated Reasoning on Feature Models". In: LNCS, Advanced Information Systems Engineering: 17th International Conference, CAISE 2005. Springer, 2005.
- **[Sneed 2012]** Harry Sneed. Software Product Management. Blockvorlesung. Technische Universität Dresden, Fakultät Informatik, Okt. 2012.
- **[VÖRBY 2013]** VÖRBY. Datei:ISO 9126 Grafik.png. Page Version ID: 113618779. Juli 2013. url: http://de.wikipedia.org/w/index.php?title=Datei:ISO 9126Grafik.png&oldid=113618779 (besucht am 02. 08. 2013).
- **[Balzert 1998]** Helmut Balzert. Lehrbuch der Software-Technik-2 : Software-Management, Software-Qualitätssicherung, Unternehmensmodellierung. Heidelberg, Berlin: Spektrum Akad. Verl., 1998.
- **[Mohmood, Hill 2011]** Zaigham Mahmood und Richard Hill. Cloud Computing for Enterprise Architectures. Computer Communications and Networks. London, Dordrecht, Heidelberg, New York: Springer, 2011.
- **[Gumzej, Halang 2010]** Roman Gumzej und Wolfgang A. Halang. Real-time Systems' Quality of Service. London, Dordrecht, Heidelberg, New York: Springer, 2010.
- **[Siegmund et al. 2012]** Norbert Siegmund, Marko Rosenmüller, Martin Kuhlemann, Christian Kästner, Sven Apel und Gunter Saake. "SPL Conqueror: Toward optimization of non-functional properties in software product lines". In: Software Quality Journal 20.3-4 (2012), S. 487–517.

References (3)

- **[Mietzner et al. 2011]** Ralph Mietzner , Frank Leymann & Tobias Unger (2011) Horizontal and vertical combination of multi-tenancy patterns in service-oriented applications, Enterprise Information Systems, 5:1, 59-77
- **[Schroeter et al. 2012]** Julia Schroeter, Peter Mucha, Marcel Muth, Kay Jugel, and Malte Lochau. Dynamic Configuration Management of Cloud-based Applications. In: Proceedings of the 16th International Software Product Line Conference (SPLC'12), Volume 2, SCArVeS Workshop, ACM, September 2012
- **[Lettner et al. 2011]** Daniela Lettner, Daniel Thaller, Michael Vierhauser, Rick Rabiser, Paul Grünbacher, Wolfgang Heider: Supporting business calculations in a product line engineering tool suite. SPLC Workshops 2011: 26
- **[Roos-Frantz et al. 2011]** Fabricia Roos-Frantz, David Benavides, Antonio Ruiz-Cortés, André Heuer, Kim Lauenroth. Quality-aware analysis in product line engineering with the orthogonal variability model. Springer Science+Business Media, LLC 2011