

## 33. Writing Special Types of Papers

Prof. Dr. Uwe Aßmann  
Softwaretechnologie  
Fakultät Informatik  
Technische Universität Dresden  
2016-0.3, 16-5-21  
[http://st.inf.tu-  
dresden.de/teaching/asics](http://st.inf.tu-dresden.de/teaching/asics)

- 1) Literature overview papers
- 2) Proof of correctness paper
- 3) Strategic analysis papers
- 4) Business case papers



# Obligatory Literature

- ▶ Mazeiar Salehie and Ladan Tahvildari. Self-adaptive software: Landscape and research challenges. *ACM Trans. Auton. Adapt. Syst.*, 4(2):14:1-14:42, May 2009.
- ▶ Wayne Wolf, Cyber-physical Systems. *IEEE Computer*, 2009
- ▶ [OpenImp] Kiczales Gregor, Lamping John, Christina Videira Lopies, Chris Maeda, Anurag Mendhekar, and Gail Murphy. Open implementation design guidelines. In *Proceedings of the 1997 International Conference on Software Engineering*, pages 481-490. ACM Press, 1997.
- ▶ [Maurya] Ash Maurya. *Running Lean*. O' Reilly.
- ▶ [BMC] Business Model Canvas. [www.businessmodelgeneration.com](http://www.businessmodelgeneration.com)

# to Do

## 3 Academic Skills in Computer Science (ASICS)

---

- ▶ exploit good papers from E. Visser
- ▶ C. Kirchner
- ▶ J. Cordy
- ▶ J. Bishop
- ▶ M. Shaw
- ▶ D. Garlan



# 33.1 More on Literature Analysis (LitA) Papers



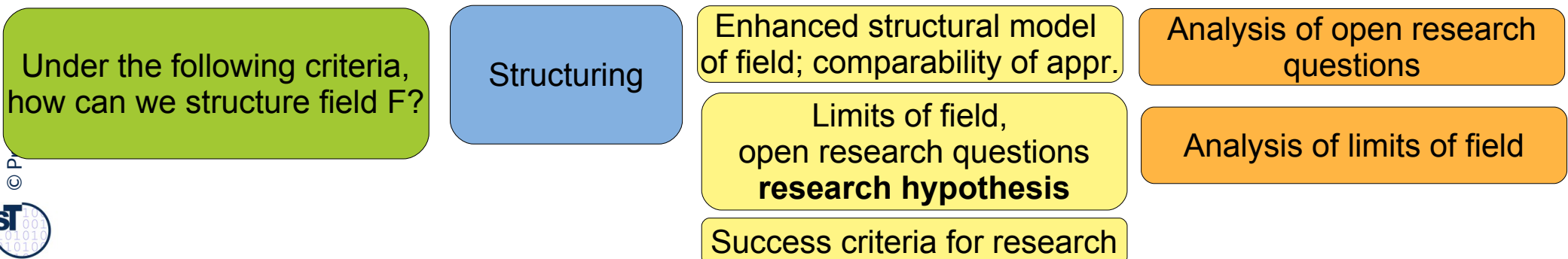
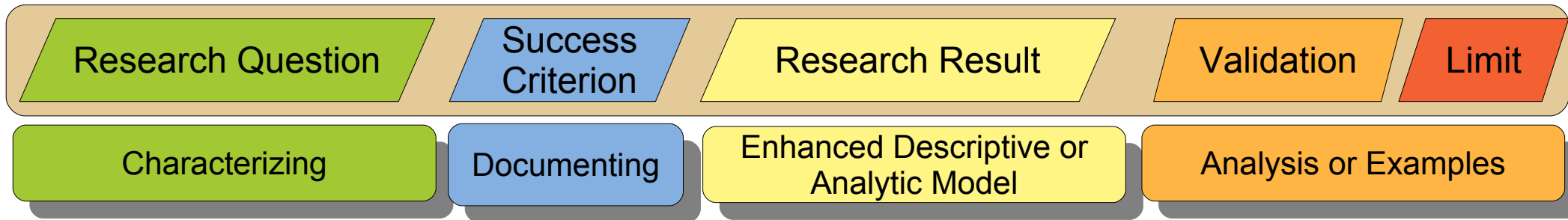
# Purposes of Literature Analysis

- ▶ Chapters of Masters and PhD Thesis
- ▶ Licentiate Thesis
  - A Swedish Licentiate is a Literature Overview PhD
  - In the German system, a single-authored paper about the thesis is a licentiate

# A Survey Paper (Literature Analysis) is an Enhanced Model Paper

Attention: every Bachelor/Master/PhD thesis needs at least one chapter of Literature Analysis (“related work”)

- ▶ A Survey Paper presents a survey of work in an area F.
  - Characterization criteria (comparison criteria) are used to structure the field
  - Every approach is characterized or classified according to the criteria
  - Features of every approach are *analyzed*
- ▶ The results are research questions, research limits, success criteria, i.e., if the literature analysis does not end in a good research hypothesis, it is too shallow
- ▶ Ex. First chapters of “Invasive Software Composition”



# Content of an “Overview” - Paper

7

Academic Skills in Computer Science (ASICS)

- ▶ In a research field, you have read a lot of papers. You produce sections on:
- ▶ **Principles and basic terminology**
- ▶ **Taxonomy or Facet classification** of the field
- ▶ **Problem model:** Use a POA to describe the problems of the field
- ▶ **Research landscape** with portfolio diagrams or kiviati diagrams
  - **Research project list** of European, DFG, BMBF projects
  - **Technology list**
  - **Technology hierarchy**
- ▶ **Qualitative comparison model** with qualitative comparison criteria
  - one- or multidimensional (Kiviati graphs)
- ▶ **Quantitative comparison model** with **scales and metrics:** Use a GQM to evaluate quantitatively
- ▶ **Variability model:** describe the variations points of the technology, as well as the main variants. Develop a feature model.
- ▶ **Research map:** collect the main research questions
- ▶ **Research roadmap:** collect a prospective path for the future. What will be in 3, 5, 10 years?
- ▶ **Strategy analysis and strategy map:** do a strategic analysis, e.g., SWOT, Value Proposition Analysis, Balanced Score Card (BSC)
- ▶ **Value chain:** which products exist with which components? who has to collaborate? which technologies are important? which suppliers exist? who is the OEM?

# Principles, Terminology, Classification

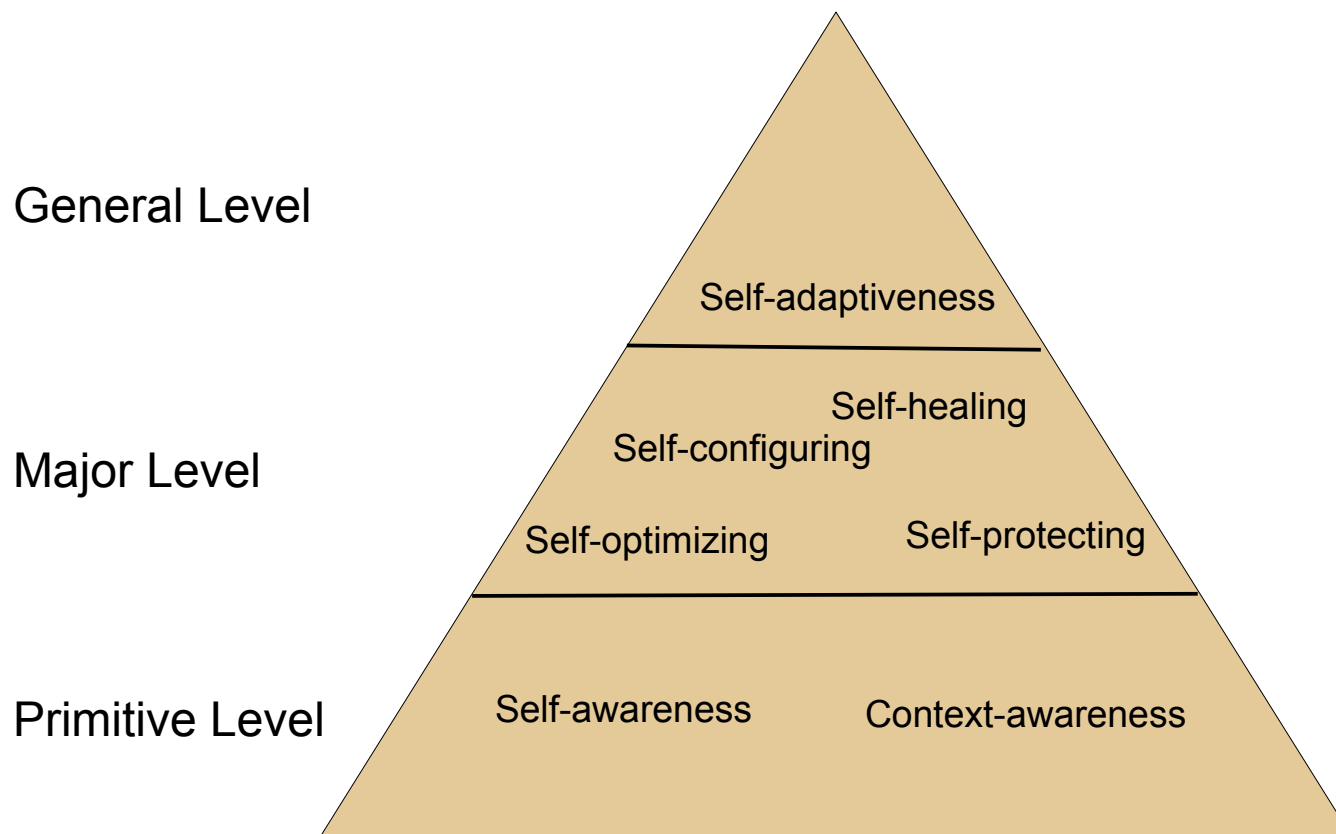
- ▶ Basic concepts (terms) of a field are defined and explained by examples.
- ▶ Definitions are made in
  - defintory sentences
  - defintory paragraphs
- ▶ From differentiae of terms, a **Taxonomy (hierarchical classification)** of the field can be constructed
- ▶ A Multihierarchy (multitaxonomy) uses multiple inheritance and leads to an **acyclic classification**
- ▶ If the attributes of a concept do not form differentiae, a Facet classification can be made
  - Facets are independent orthogonal partitions of the concept's attributes





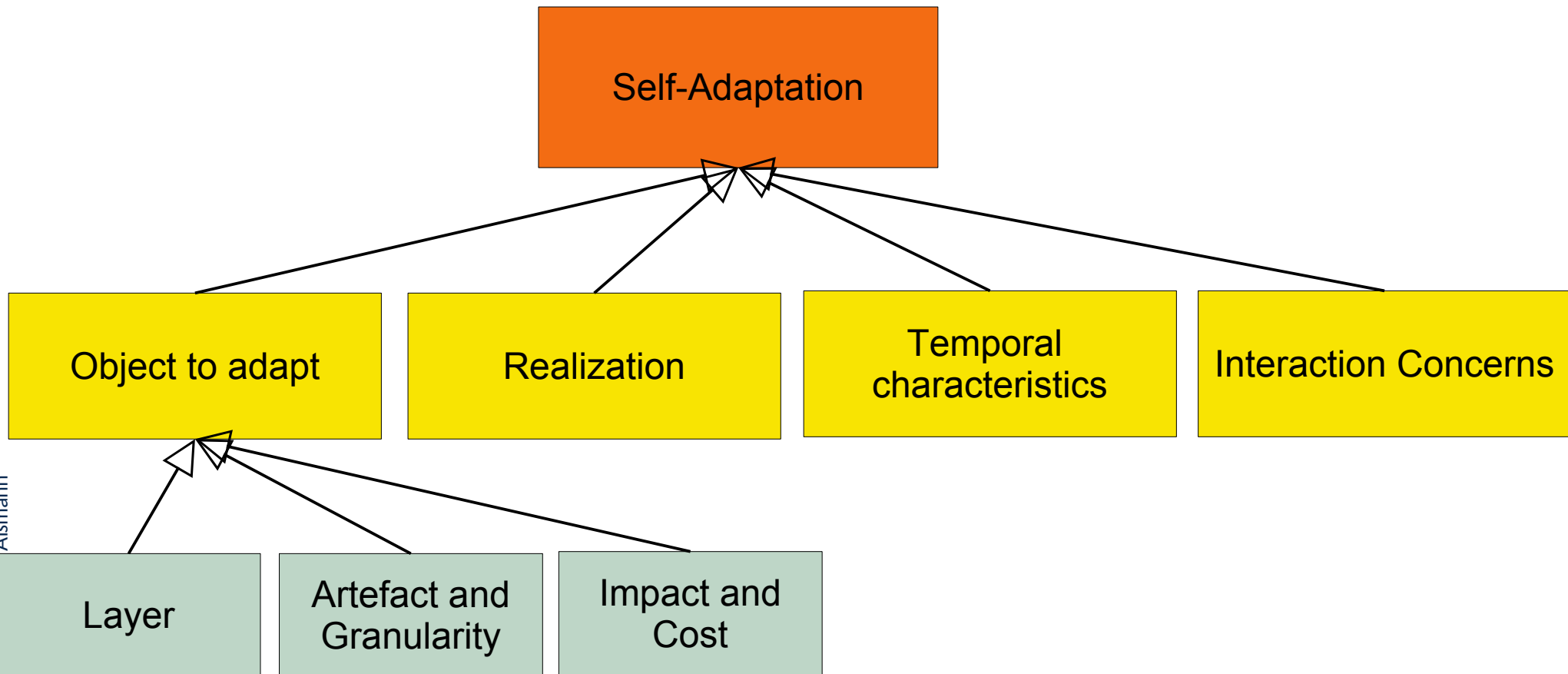
# Concept Map

- ▶ For an overview on the research field and its classification, use a simple concept map [Hierarchy of self-adaptive systems, Salehie Fig 1]

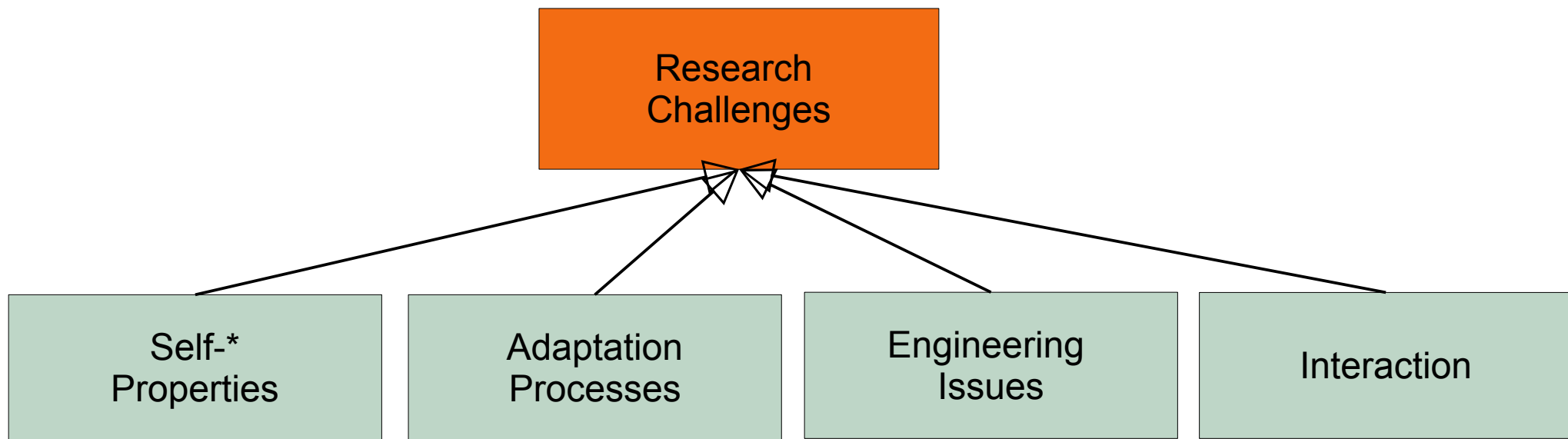


# Facet Classification of Field

- ▶ The following taxonomy is really a facet classification [excerpt from Salehie, Fig. 3]
- ▶



- ▶ A Simple Taxonomy of Research Challenges
- ▶ From [Salehie, Fig. 5]



# Classification Paper

12 Academic Skills in Computer Science (ASICS)

- ▶ Facet classification of Requirements
- ▶ Martin Glinz: Rethinking the Notion of Non-Functional Requirements

## Outline

- ▶ 1. Introduction
  - ▶ 2. A new faceted classification of requirements
    - see Fig. 1
    - 2.1 What and why
    - 2.2 The kind facet
    - 2.3 The representation facet
    - 2.4 The satisfaction facet
    - 2.5 The role facet
    - 2.6 Examples
  - ▶ 3. Facet combinations and dependencies
    - 3.1 Typical combinations
    - 3.2 Goals vs. requirements
  - ▶ 4. Conclusions
    - summary
    - benefits
- ▶ Classification of a domain (domain model presentation)
    - Mens, Czarnecki, Van Gorp. A Taxonomy of Model Transformations.

- ▶ A **Research Landscape** collects several lists:
  - **Related discipline list** enumerates all research disciplines treating the research problem from different angles
  - **Research project list** of European, DFG, BMBF projects [Salehie Table III]
  - **Technology list** (Register allocation by linear scan, Chaitin graph coloring, attribute evaluation) with examples and citations [Salehie Table i]
  - **Technology hierarchy** [Salehie Fig. 1]
- ▶ **Relational Matrix analyses** compare lists or hierarchies with other lists or hierarchies, e.g.,
  - (research project list x facet classification) [Salehie Table VI]
  - (research project list x taxonomy)
  - (technology list x taxonomy)
  - (technology list x research project list) [Salehie Table V]
- ▶ **Formal concept analysis** is a specific relational matrix analysis. It compares lists of objects with lists of attributes
  - (research project list x technology list) [Salehie Table IV]

# Qualitative Comparison Model with Qualitative Criteria

- ▶ **The criteria list (criteria table, attribute list)** collects a simple table to compare technologies, approaches, objects
- ▶ Qualitative comparison is usually done then in a boolean matrix, from which an FCA can be started. [Salehie Table IV]

# Quantitative Comparison Model using Weighted Scales

- ▶ Multi-criteria Attribute Analyses
  - e.g., 2-dimensional attribute analysis of objects (2 criteria), with portfolio diagrams
  - n-dimensional attribute analysis with kiviatic diagrams
- ▶ Metrics:
  - **School grading:** simple school grades are given to a list of objects or approaches, to evaluate approaches in different dimensions
  - This can be displayed by a Kiviatic graph
- Other scales can be used

# Problem Model of the Field

- ▶ Use a problem-objective analysis (ZOPP, B-POPP, BATE-POPP, or GQM) to describe the problems of the field
- ▶ ZOPP uses hierarchical problem models
- ▶ GQM acyclic problem models



# Variability Model of a Technology

- ▶ describe the variations points of the technology, as well as the main variants. Develop a **feature model**.
- ▶ (see course Software technology II)

# Research Challenge Map

- ▶ Collect the main research questions
- ▶ Example [Wolf-CPS] (only 2 pages)
  - 2 short introduction paragraphs
  - Theoretical underpinnings
  - Efficiency Boost
  - Control theory issues
  - Cyber-physical roadmap
  - Conclusion paragraph

# Research Roadmap

- ▶ Based on a Research Challenge Map, collect a prospective path for the future. What will be in 3, 5, 10 years?
  - Use the national roadmap's circular scheme
- ▶ Research Roadmap with Strategy Analysis
  - Do a strategic analysis for the research field, e.g., SWOT, or a BSC
  - Do a Value Proposition Analysis with the field, e.g., PAIN-GAIN POPP
- ▶ How should the research field develop? What should be done? Which risks exist?

# Example: Simple Comparative Survey

- ▶ Comparison paper of different technologies:
  - J. S. Bradbury, J. R. Cordy, J. Dingel, M. Wermelinger. Survey of Self-Management in Dynamic Software Architecture Specifications. WOSS 2004. ACM.
  - Straightforward, simple paper comparing many different technologies.
- ▶ Comparison on architectural structure, behavior, reconfiguraiton
- ▶ Comparison on change initiation
- ▶ Comparison on reconfiguration operations
- ▶ Comparison on selection operations
- ▶ Scalability of the approaches

## 33.2 “Proof of Correctness” Papers

- ▶ Evaluation: mathematical proof



# Correctness and Completeness of a Translation/Compilation Process

- ▶ Radke/Arend/Taentzer Paper on Essential OCL constraints
- ▶ Definition 1: Mathematical model (algebraic signature specification) of Class/Metaclass Diagrams
- ▶ Definition 2: Signaturer specification of system state (object snapshot)

## 33.3 Strategic Analysis Paper



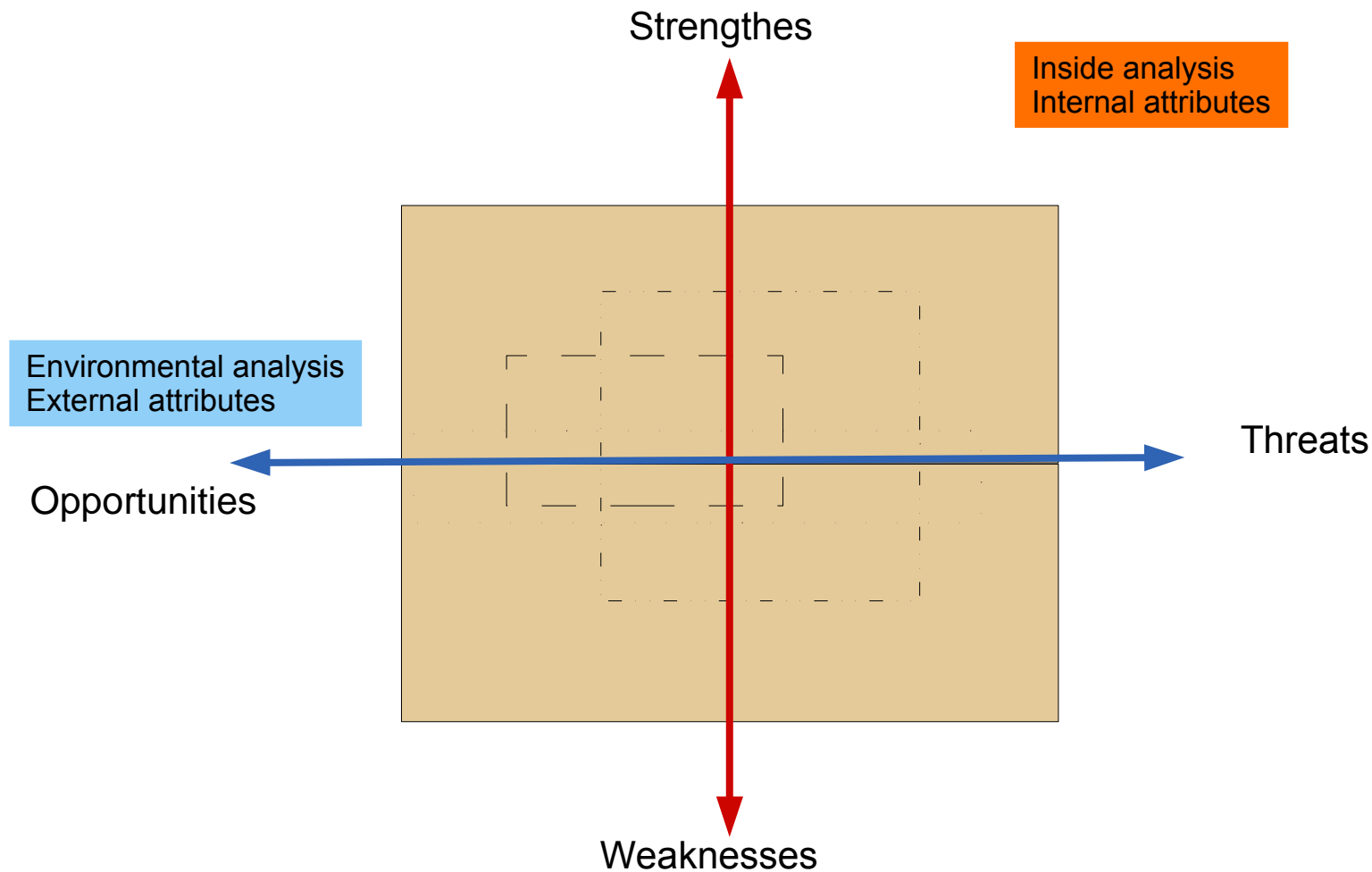
# The Question of a Strategic Analysis

- ▶ Where should we go from here?
- ▶ What are valuable directions?
- ▶ Which goals pay off?
  
- ▶ Important for:
  - research proposals
  - research exposés
  - individual grant proposals
  - research grant proposals



# SWOT Analysis for Research Relevance

- ▶ SWOT is a 4-dimensional attribute analysis for the development of a strategy for of a project [Albert Humphrey]
- ▶ For strategic decisions of your thesis and your research



# Value Proposition Analysis

- ▶ VPA is similar to Problem/Goal Analysis, however, it thinks about the **pains** and the **gains** of the customer or target group.
  - Pains are problems that hurt the customer
- ▶ Usually, the goal is to reduce pain and improve gain.
- ▶ A VPA is important in the beginning of a Master's or PhD process, because it helps to clarify the scope of the work.
- ▶ Use Pain-Gain-B-POPP to do VPA or Value Proposition Canvas (Osterwalder)
  - [http://www.businessmodelgeneration.com/downloads/value\\_proposition\\_canvas.pdf](http://www.businessmodelgeneration.com/downloads/value_proposition_canvas.pdf)

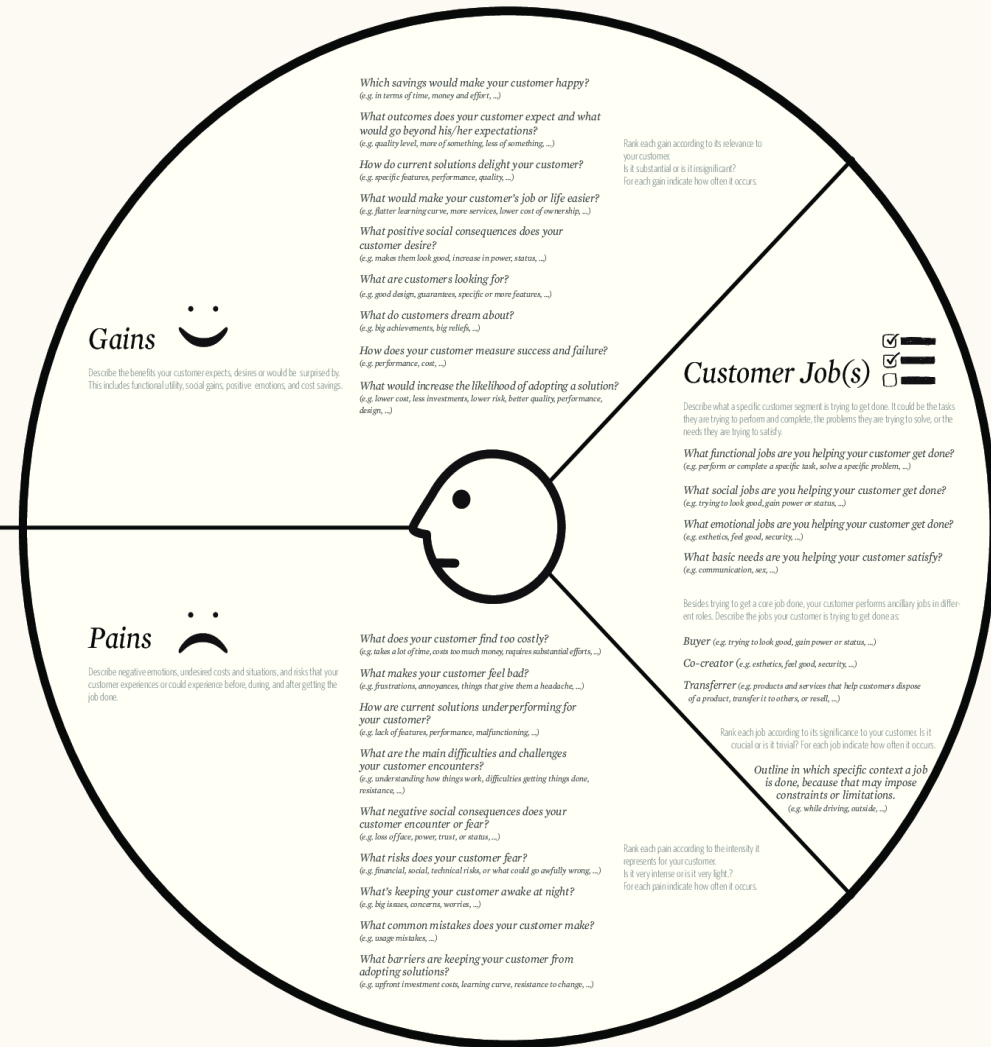
# The Value Proposition Canvas

Designed for:

Designed by:

On: Day Month Year

Iteration: No.



## Value Proposition

Create one for each Customer Segment in your Business Model

## Customer Segment

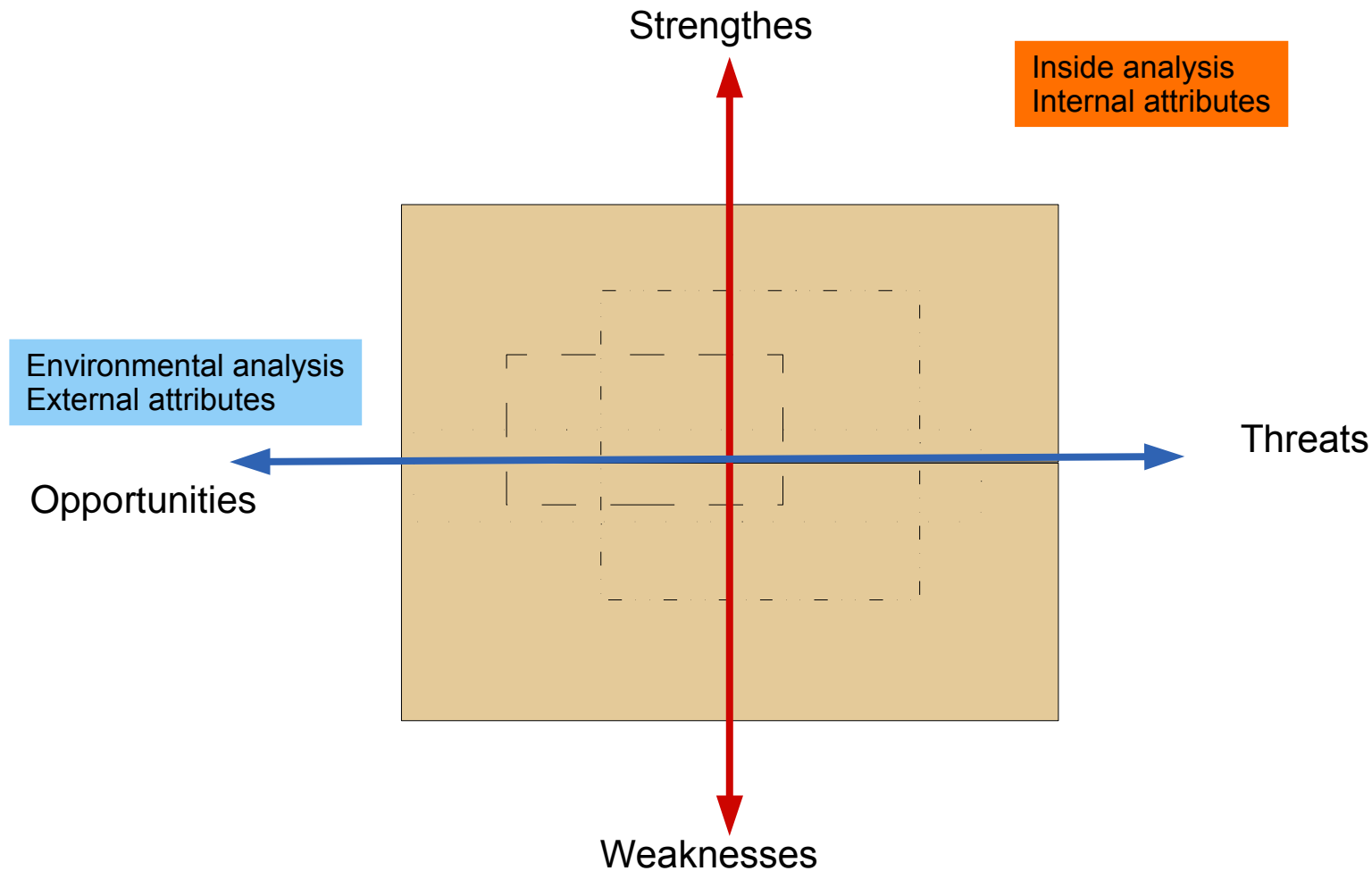
www.businessmodelgeneration.com



Use in Conjunction with the Business Model Canvas

# SWOT Analysis for Strategic Analysis

- ▶ For a research proposal, a memo to the boss, a white paper to the customers, write a **strategic analysis paper**
- ▶ Define 4 sections S W O T



## 33.4 Business Case Paper

- ▶ with Lean Canvas and BMC
- ▶ Useful for grants for venture capital and BMBF Exist
- ▶ <http://www.exist.de/DE/Home/inhalt.html>



# Lean Canvas [Maurya]

- ▶ The Lean Canvas offers a nice structure for business cases
  - for brainstorming and collaborative work
  - for an outline of a business case paper
- ▶ Starts with a POA, but bridges it to the customers' and the value proposition

Problem	Solution	Unique Value Proposition	Unfair Advantage	Customer Segments
	Key Metrics		Channels	
Cost Structure			Revenue Streams	

Lean Canvas is adapted from The Business Model Canvas (<http://www.businessmodelgeneration.com>) and is licensed under the Creative Commons Attribution-Share Alike 3.0 Un-ported License.

# Lean Canvas with Filling Order

<i>Problem</i>  <b>1</b>	<i>Solution</i>  <b>4</b>	<i>Unique Value Proposition</i>  <b>3</b>	<i>Unfair Advantage</i>  <b>9</b>	<i>Customer Segments</i>  <b>2</b>
	<i>Key Metrics</i>  <b>8</b>		<i>Channels</i>  <b>5</b>	
<i>Cost Structure</i>  <b>7</b>		<i>Revenue Streams</i>  <b>6</b>		

# Value chain

- ▶ which products exist with which components? who has to collaborate? which technologies are important?
- ▶ which suppliers exist?
- ▶ which customers exist?
- ▶ which customer segments exist?
- ▶ who is the OEM?











# BMC for Business Model Development and Writeup

## The Business Model Canvas

Designed for:

Designed by:

On: Day Month Year  
 Iteration: No.

<h3>Key Partners</h3>  <p>Who are our Key Partners?          Who are our key suppliers?          Which Key Resources are we acquiring from partners?          Which Key Activities do partners perform?</p> <p><b>KEY RESOURCES FOR KEY PARTNERS:</b>          Operational and economic          Reduction of risk and uncertainty          Acquisition of particular resources and activities</p>	<h3>Key Activities</h3>  <p>What Key Activities do our Value Propositions require?          Our Distribution Channels?          Customer Relationships?          Revenue streams?</p> <p><b>KEY RESOURCES:</b>          Production          Problem Solving          Platform/Network</p>	<h3>Value Propositions</h3>  <p>What value do we deliver to the customer?          Which one of our customer's problems are we helping to solve?          What bundles of products and services are we offering to each Customer Segment?          Which customer needs are we satisfying?</p> <p><b>VALUE PROPOSITIONS:</b>          Revenue          Performance          Customization          "Staple for Job Done"          Pricing          Brand Status          Risk          Cost Reduction          Field Reduction          Availability          Convenience/Usability</p>	<h3>Customer Relationships</h3>  <p>What type of relationship does each of our Customer Segments expect us to establish and maintain with them?          Which ones have we established?          How are they integrated with the rest of our business model?          How costly are they?</p> <p><b>EXAMPLES:</b>          Personal assistance          Dedicated Personal Assistance          Self Service          Automated Services          Communities          Co-creation</p>	<h3>Customer Segments</h3>  <p>For whom are we creating value?          Who are our most important customers?</p> <p><b>Mass Market</b>  <b>Niche Market</b>  <b>Segmented</b>  <b>Diversified</b>  <b>Multi-sided Platform</b></p>
<h3>Key Resources</h3>  <p>What Key Resources do our Value Propositions require?          Our Distribution Channels? Customer Relationships?          Revenue Streams?</p> <p><b>KEYS TO SUCCESS:</b>          Physical          Intellectual (brand, patents, copyrights, data)          Human          Financial</p>		<h3>Channels</h3>  <p>Through which Channels do our Customer Segments want to be reached?          How are we reaching them now?          How are our Channels integrated?          Which ones work best?          Which ones are most cost-efficient?          How are we integrating them with customer routines?</p> <p><b>CHANNEL PRIORITIES:</b>          1. Awareness          How do we raise awareness about our company's products and services?          2. Evaluation          How do we help customers evaluate our organization's Value Proposition?          3. Purchase          How do we allow customers to purchase specific products and services?          4. Delivery          How do we deliver a Value Proposition to customers?          5. After sales          How do we provide post-purchase customer support?</p>		
<h3>Cost Structure</h3> <p>What are the most important costs inherent in our business model?          Which Key Resources are most expensive?          Which Key Activities are most expensive?</p> <p><b>BY HOW MUCH DOES COST DRIVERS CHANGE OUR COST STRUCTURE, LOW PRICE VALUE PROPOSITION, MAXIMUM CUSTOMER, EXTENSIVE CUSTOMER SUPPORT?</b></p> <p><b>KEYS TO SUCCESS:</b>          Economies of scale          Economies of scope</p>		<h3>Revenue Streams</h3>  <p>For what value are our customers really willing to pay?          For what do they currently pay?          How are they currently paying?          How would they prefer to pay?          How much does each Revenue Stream contribute to overall revenues?</p> <p><b>KEYS:</b>          Asset sale          Usage fee          Subscription Fee          Licensing/Leasing/Leasing          Licensing          Advertising fee          Advertising</p> <p><b>KEYS TO SUCCESS:</b>          Product/Service dependent          Customer segment dependent          Volume dependent</p> <p><b>KEYS TO SUCCESS:</b>          Algorithmic (marketing)          Network effects          Real-time Market</p>		

