Using System Dynamics Models to Understand and Improve Application Landscape Design

29.06.2016, Prof. Dr. Florian Matthes

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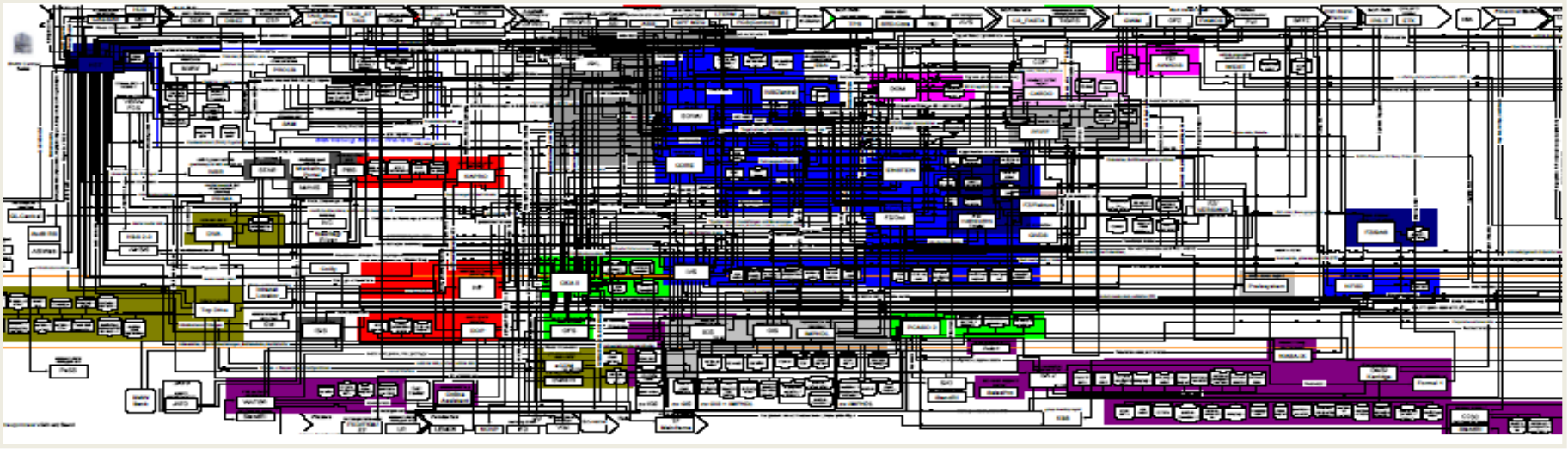
Outline

sebis

1. **Using System Dynamics Models to Understand and Improve Application Landscape Design**

Motivation



EA management approaches

- Describe as-is architecture
- Develop to-be architecture
- Define transition plan
- Define architectural principles

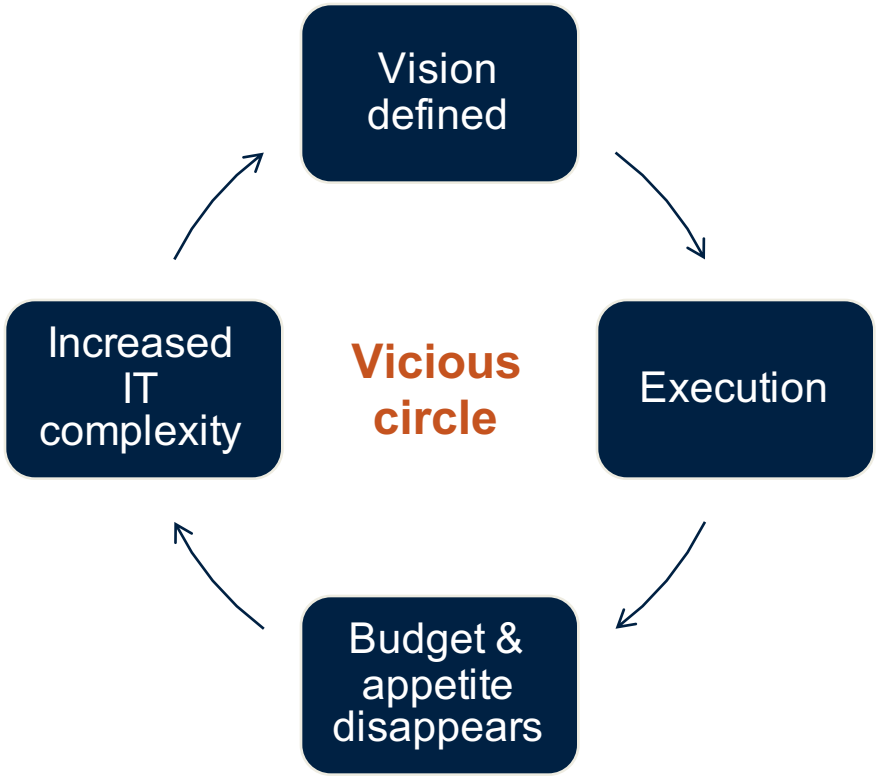
Organizations as complex systems

- Emergent and non-linear behavior, path-dependence
- Autonomous agents without central control
- Understanding causal dependencies (behavior) becomes essential

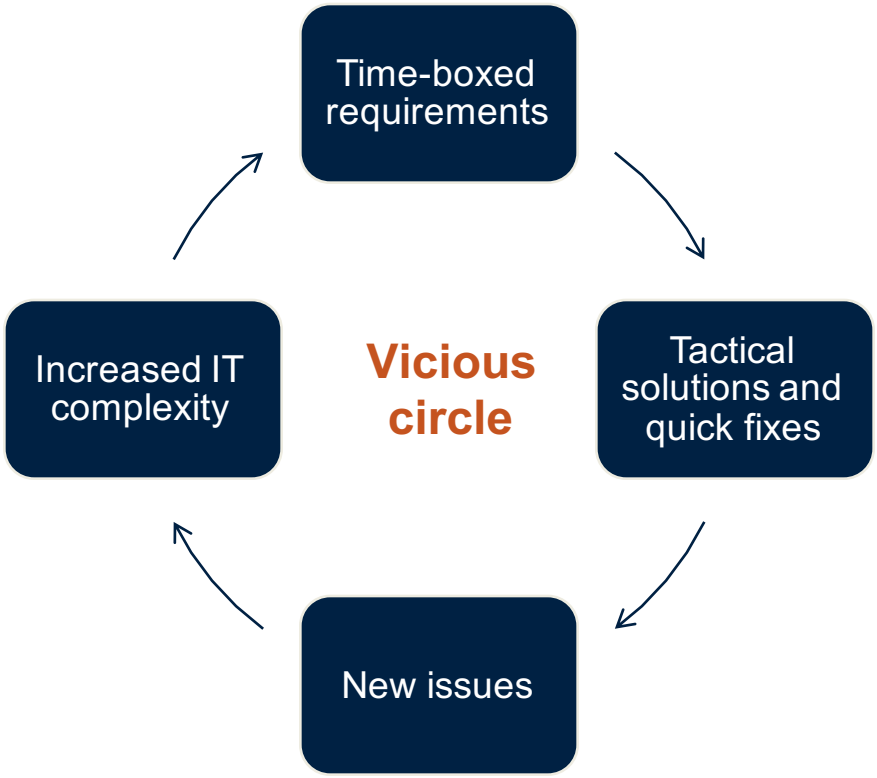
→ *How can we enable enterprise architects to develop SD models?*

Illustrative example from practice

Big visions



Time-boxed requirements

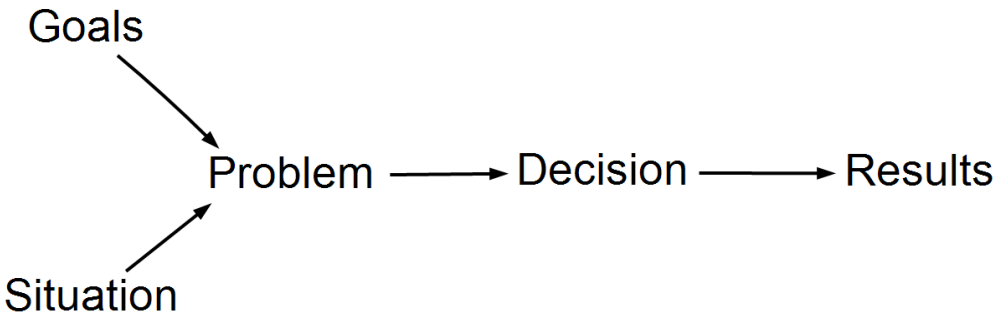


Impact of shared understanding on application landscape design

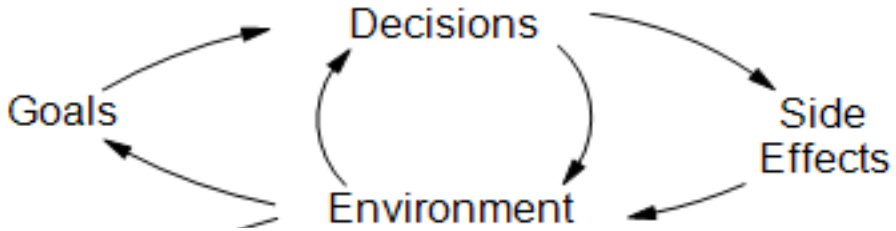
Assumption: AL design is a wicked problem to be solved collaboratively

→ Shared understanding and consensus building become essential

Event-oriented world-view



The feedback view accounts for dynamics



Sterman, John (2000): Business dynamics. Systems thinking and modeling for a complex world. Boston: Irwin/McGraw-Hill.

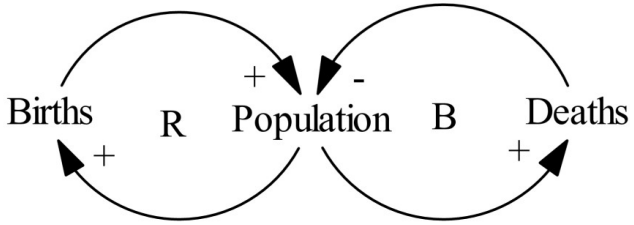
System dynamics foundations

SD is an approach to understanding the behavior of complex systems over time.

Typical SD models

- Causal Loop Diagrams (CLDs)
- Stock-and-Flow Diagrams (SFDs)

(a)



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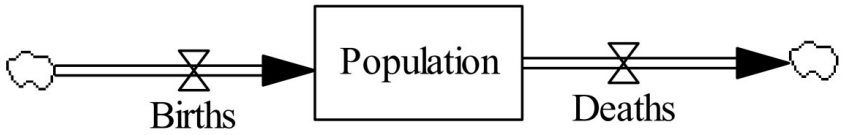
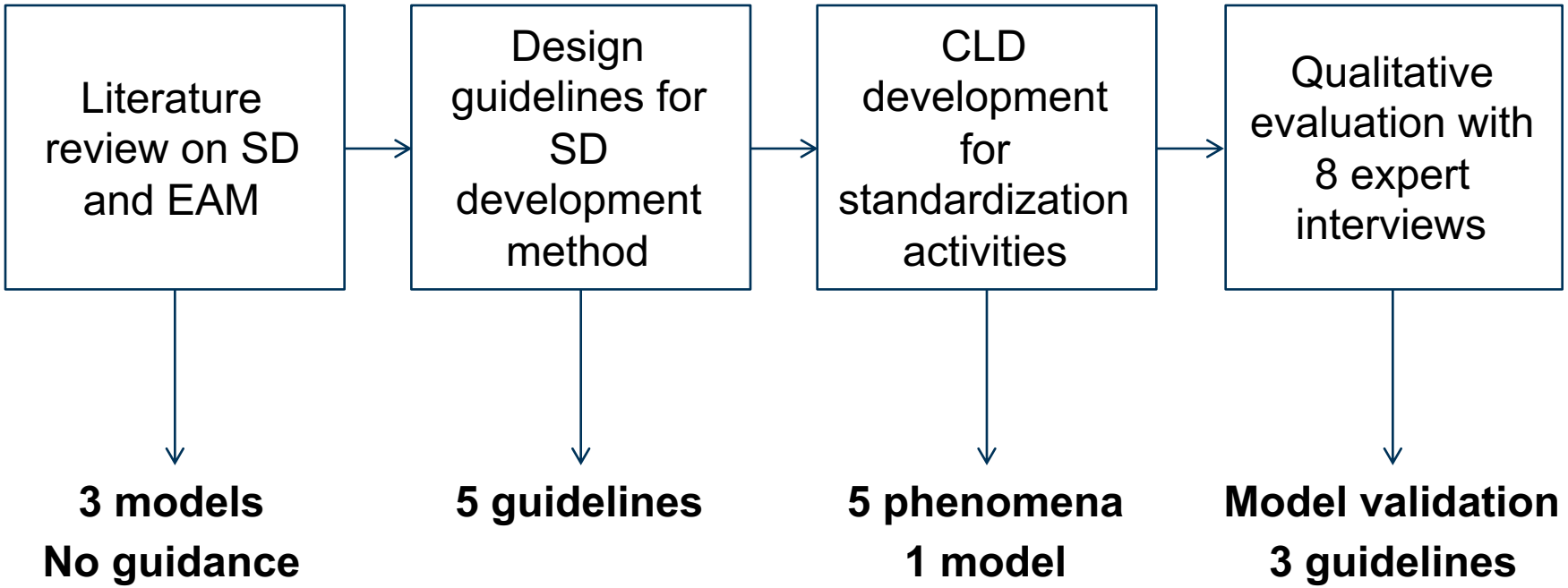


Forrester, Jay W. (1961): Industrial dynamics: MIT Press Cambridge, MA.
Sterman, John (2000): Business dynamics. Systems thinking and modeling for a complex world. Boston: Irwin/McGraw-Hill.

Research approach



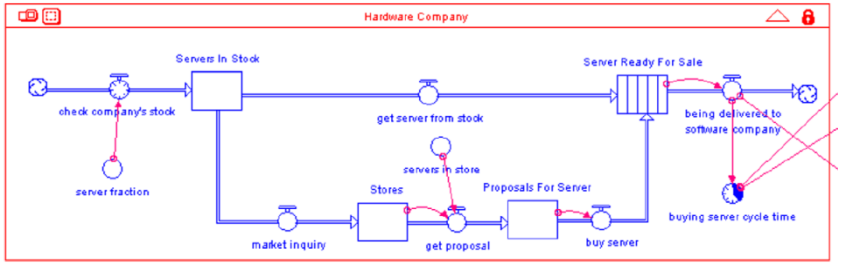
Literature review

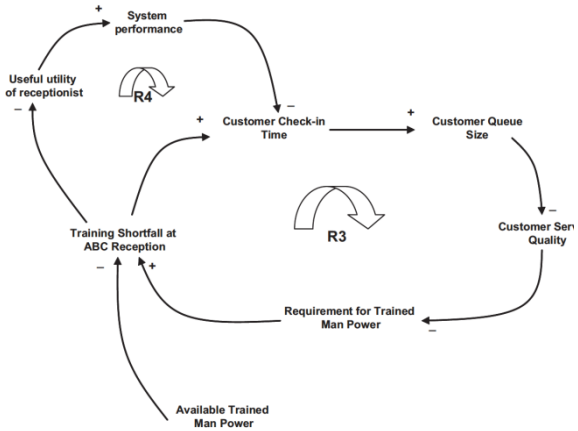
Search term: “Enterprise Architecture” or “Enterprise Architecting” and “System Dynamics”, “Causal Loop” or “Causal Model”

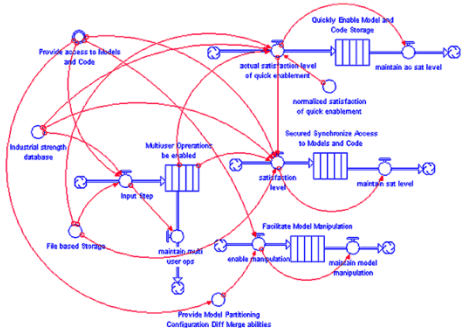
Search engines: EBSCO, ScienceDirect, IEEE Xplore, ACM DL, GoogleScholar, SpringerLink, AISeL

Results

- 3 concrete SD models
- No methodological support
- Simulation is often the goal, integrated with other notations
- Problem identification and model creation are underexposed







Webster, J.; Watson, R. (2002): Analyzing the Past to Prepare for the Future: Writing a Literature Review. In: *MIS Quarterly* 26 (2), S. 13–23.

Guidelines from literature

Guideline 1: Distinguish a Divergent and a Convergent Creation Phase

→ Known from Complex Problem Solving

Guideline 2: Gather Input from Heterogeneous People

→ Use the wisdom of the crowd

Guideline 3: Model for the Purpose of Learning

→ Shared mental models are of priority

Guideline 4: Ensure Transparency

→ Data provenance has been identified to be crucial for EA

Guideline 5: Validate with Data

→ Simulations increase trust

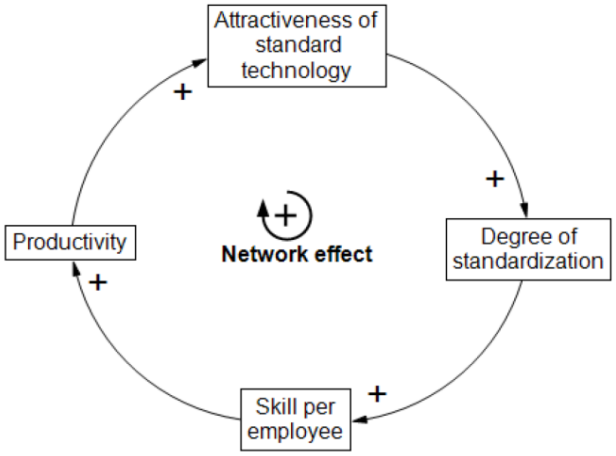
Exemplary CLD modeling (1)

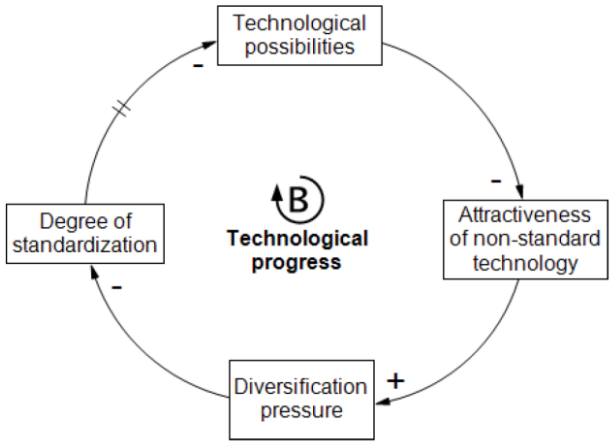
Modeling approach

1. Derivation of dynamic hypotheses from literature and personal experience
2. Creation of visual representations
3. Integrated model construction

Dynamic hypotheses

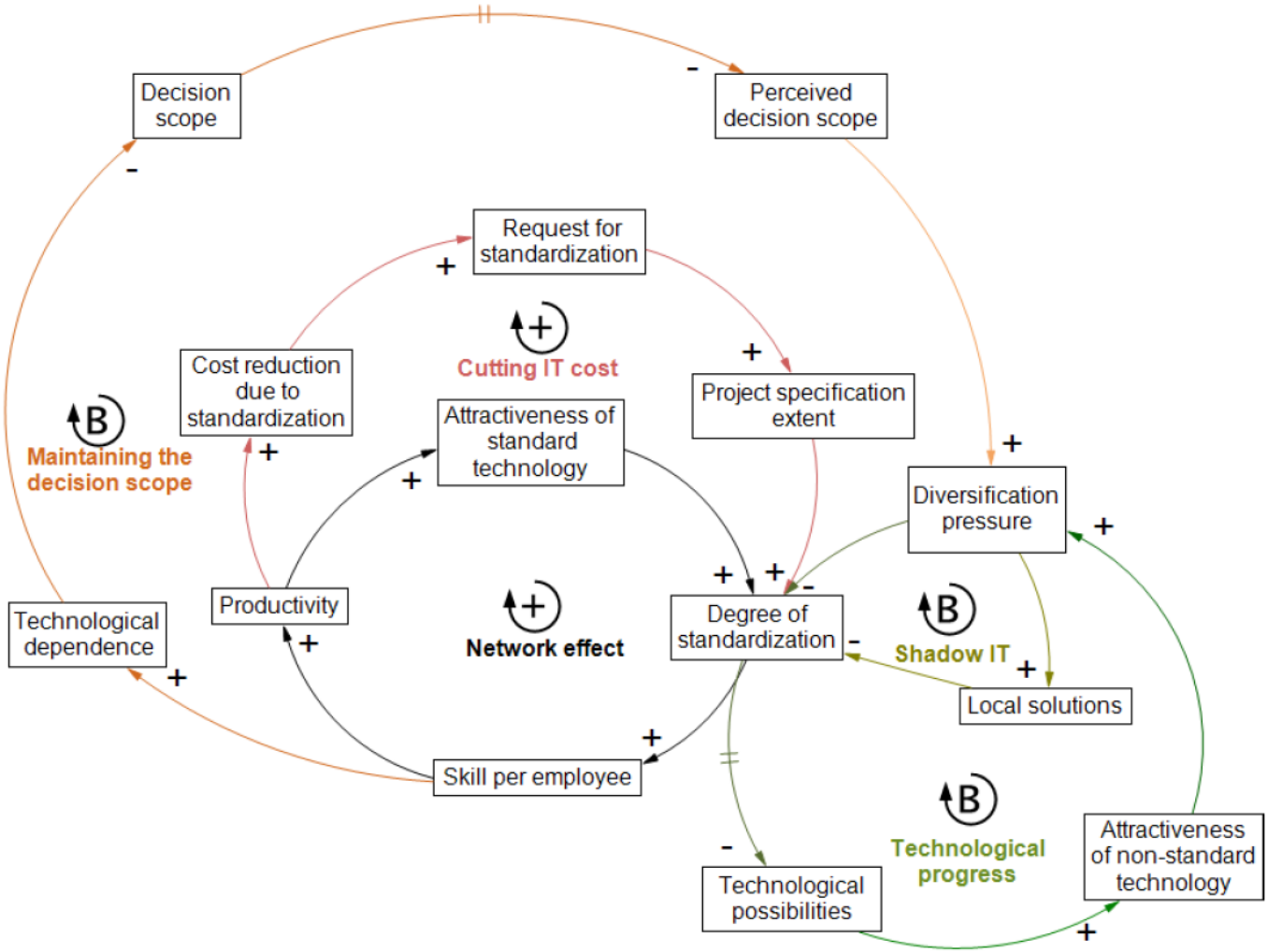
- Network effect
- Technological progress
- Shadow IT
- IT cost cutting
- Maintaining the decision-scope





Exemplary CLD modeling (2)

Integrated CLD model



Model evaluation (1)

Evaluation approach

- 8 expert interviews face-to-face or via video conference tools, diverse background
- None of the interviewees was familiar with System Dynamics models
- All interviewees were familiar with standardization efforts in their organization
- Stepwise presentation and evaluation of dynamic hypotheses
- Evaluation of the modeling notation

Id	Role	Industry	Experience
1	Enterprise architecture consultant	Insurance	3 years
2	Project manager (business)	Automotive	>10 years
3	Project manager (IT)	Gas industry	6 years
4	Project manager (business)	Automotive	3 years
5	Head of Sales & Marketing Analytics	Pharma	>10 years
6	Enterprise architect	Automotive	2 years
7	IT revision	Service industry	1 years
8	Solution architect	Automotive	>10 years

Model evaluation (2)

Results

- Notation was easily understandable (except delay symbols)
- Interviewees speculated about the role mostly concerned about the presented phenomena
- Each hypothesis was confirmed by all experts, although the relative importance they assigned fluctuated
- In two cases, a change of the interviewee's mental model could be observed
- Integrated model was considered to be overwhelming at first glance
- Supporting communication was considered to be the major benefit of CLDs

Additional guidelines

- Explicitly include roles
- Use consistent terminology
- Limit the number of modeling elements for presentation

Summary & future research

Summary

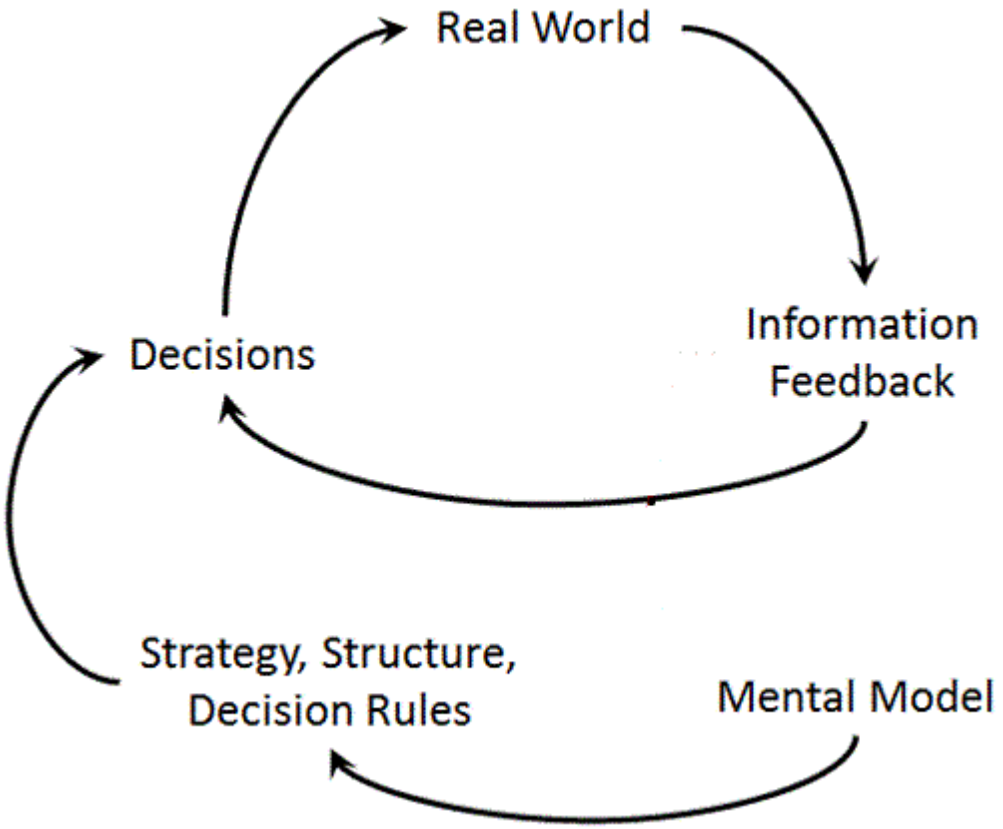
- 8 Guidelines for CLD development identified
- Concrete CLD for Technology Standardization developed
- CLD content and it's ability to create shared mental models evaluated

Future work

- Analyze to which extend CLDs can support decision making
- Develop a CLD creation method based on the identified guidelines
- Evaluate such method in a real world environment

Learning in Complex Systems

Single-loop learning

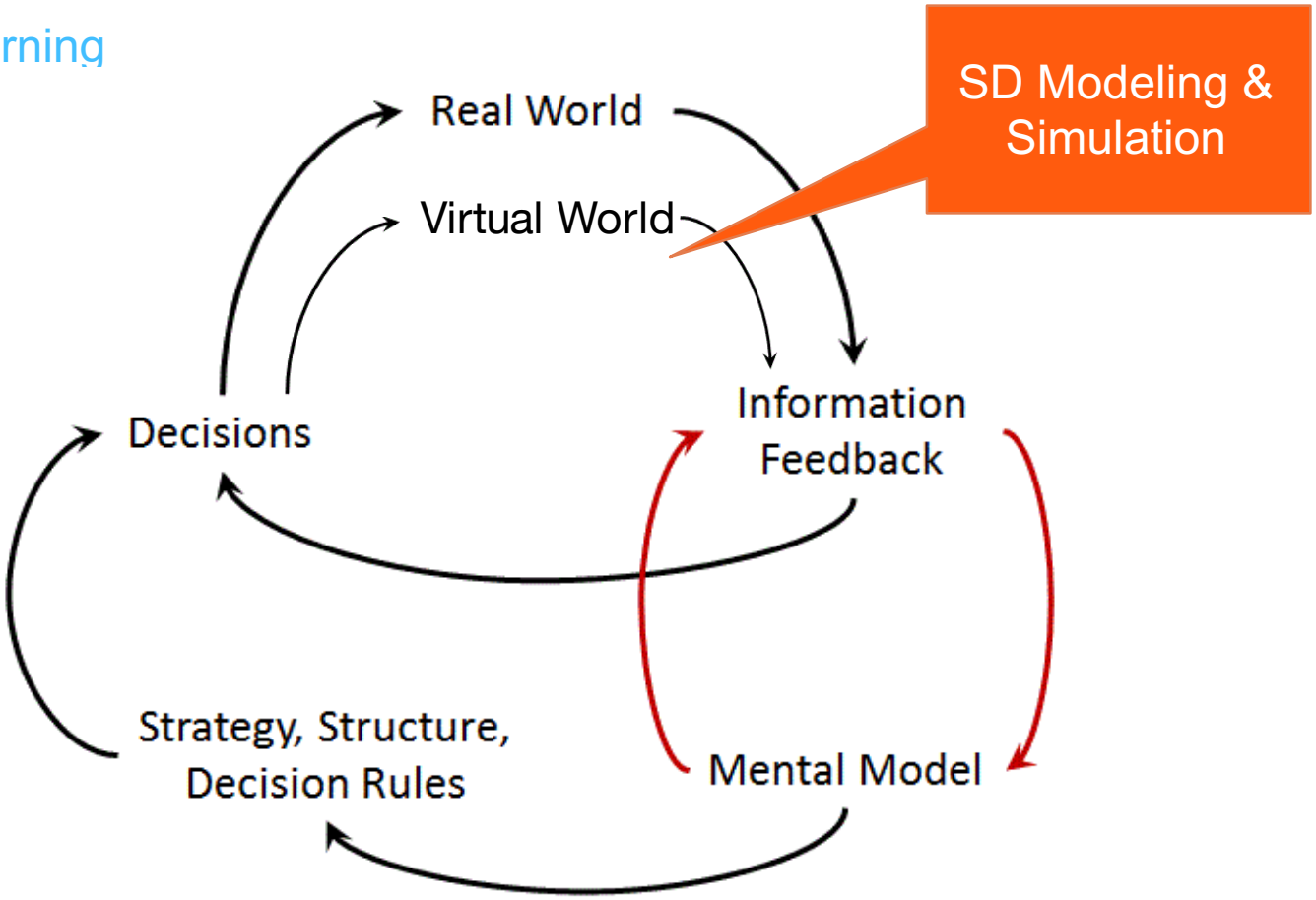


Information feedback is interpreted by existing mental models.

Sterman, John (2000): Business dynamics. Systems thinking and modeling for a complex world. Boston: Irwin/McGraw-Hill.

Learning in Complex Systems

Double-loop learning



Feedback from the real world can also stimulate changes in mental models.

Sterman, John (2000): Business dynamics. Systems thinking and modeling for a complex world. Boston: Irwin/McGraw-Hill.

Thank you for your attention. Questions?

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