Information, Organization, and Management

Unit 5: Potential and Limitations of ICT

Prof. Dr. Martin Hepp
http://www.heppnetz.de
mhepp@computer.org

http://www.heppnetz.de/teaching/img/

Textbook: Wigand/Picot/Reichwald: *Information, Organization and Management,* John Wiley & Sons, 1997

Overview

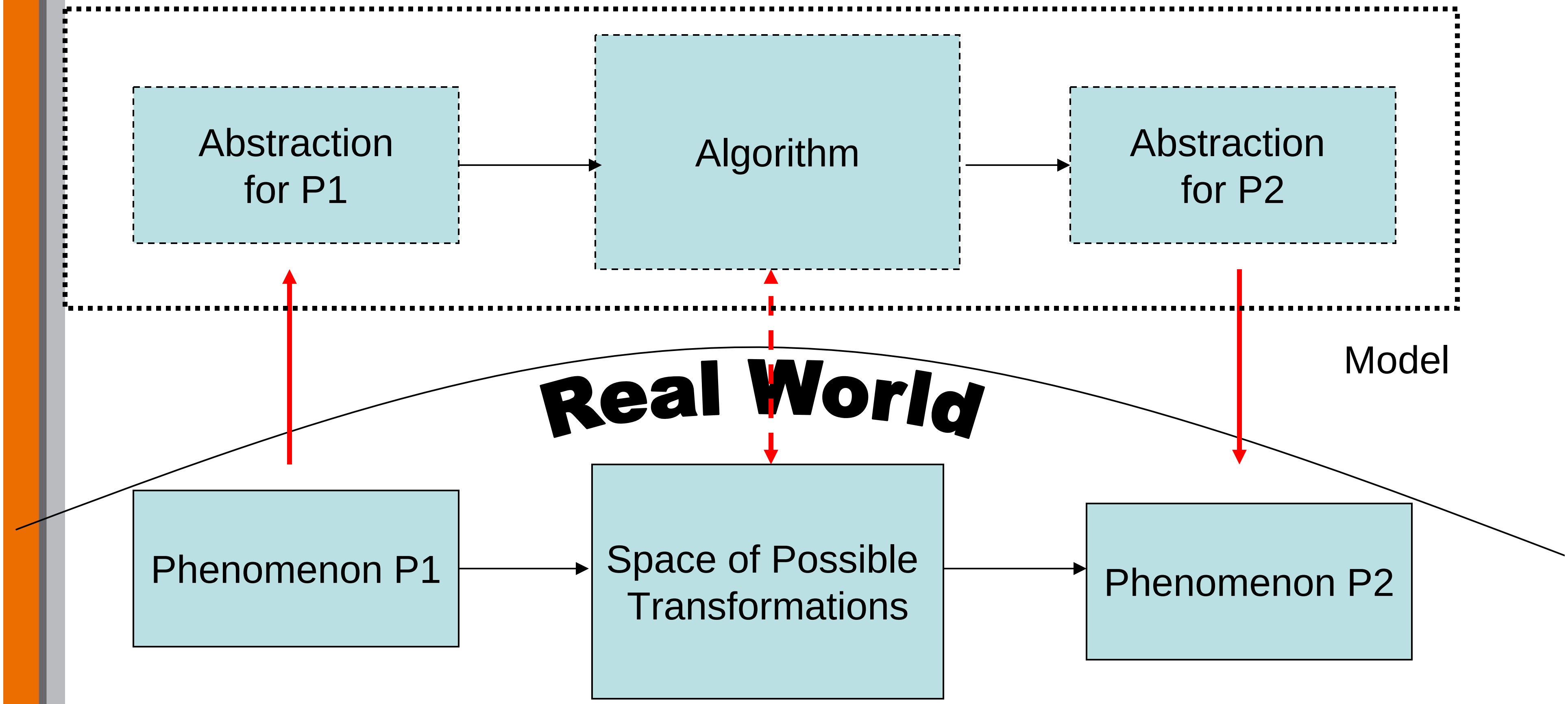
- Computer Systems, Models, and the Real World
- Formalization

Formalization: Importance and Limits

- Formalization as a precondition of ICT
- Algorithms: Sequence of processing steps that solves a given problem
- Alternative means for formalization/modeling/representation
  - Human language (problem: actor- and context-bound)
  - Data Models
  - Ontologies

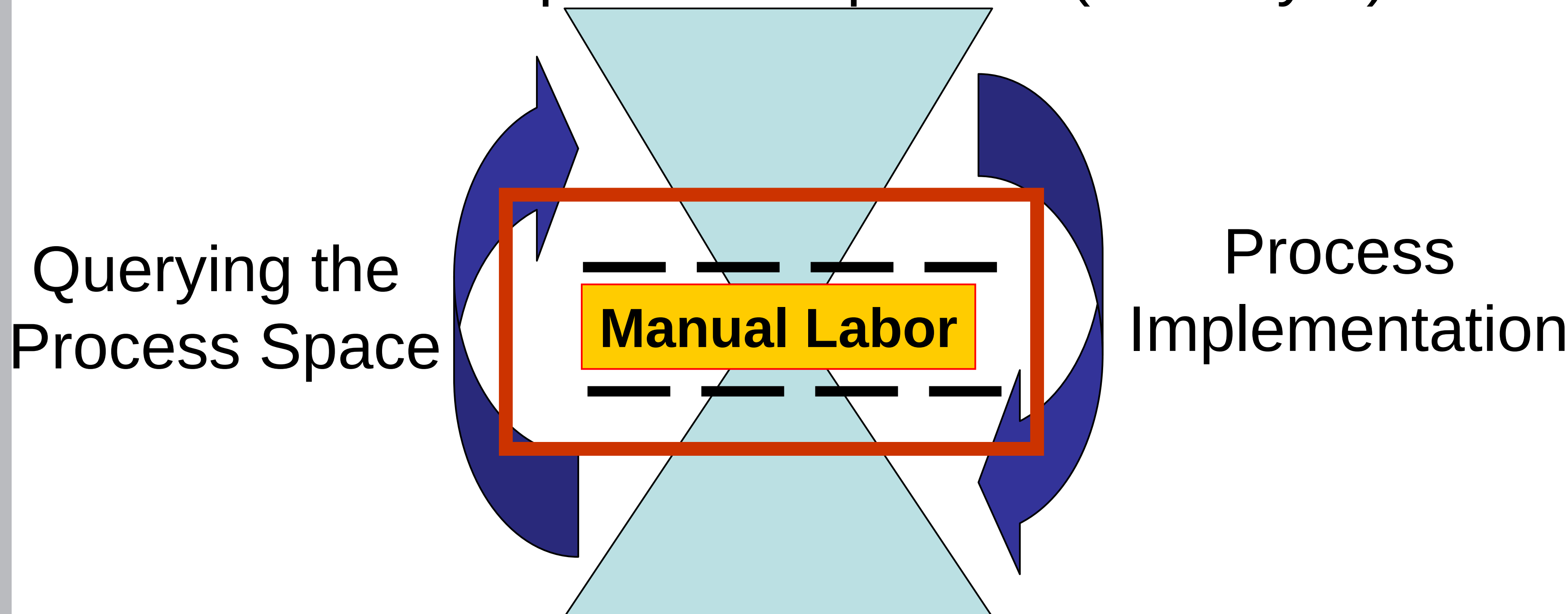
cf. Wigand/Picot/Reichwald (1997)

Computer Systems, Models, and the Real World



The Critical IT / Process Divide

Business Experts' Perspective ("Reality"?)



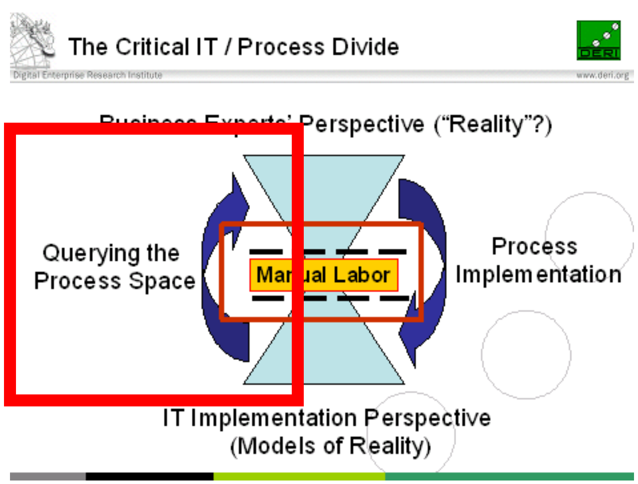
IT Implementation Perspective (Models of Reality)

Querying the Process Space

“Do we have a cost approval process for items below $ 200?”

“How many inventory management methods are currently in use?”

“In which of our food manufacturing machines are we processing meat *or* raw eggs?”



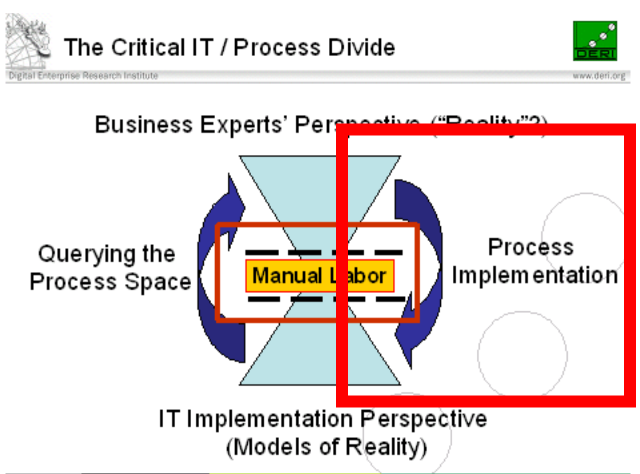
- **Process Models**
- **Process Instances**
- **Resources and Actors**
- **Data**

“We need to set up a billing process for our new Internet TV service”

Programming

(Web) Service Composition and Orchestration

Customizing of COTS Packages (e.g. SAP)



Levels of Semiotics

- Semiotics: Scientific research of objects and functions of communication processes
- Three levels:
  - Syntactic: Analysis of signals and relationship between signals
  - Semantic: Analysis of signals and their meanings
  - Pragmatic: Analysis of signals and their effects
- Example

cf. Wigand/Picot/Reichwald (1997)

Syntactic Level

- Signals and relation between signals
- Formal rules determining the structure (e.g. grammars)
- Example: XML Schema Definition, Backus-Naur Form (BNF)

cf. Wigand/Picot/Reichwald (1997)

Semantic Level

- Relation between signals and meanings (designata)
- Message: requires semantic agreement
- Example: Ontologies are such semantic agreements

cf. Wigand/Picot/Reichwald (1997)

Pragmatic Level

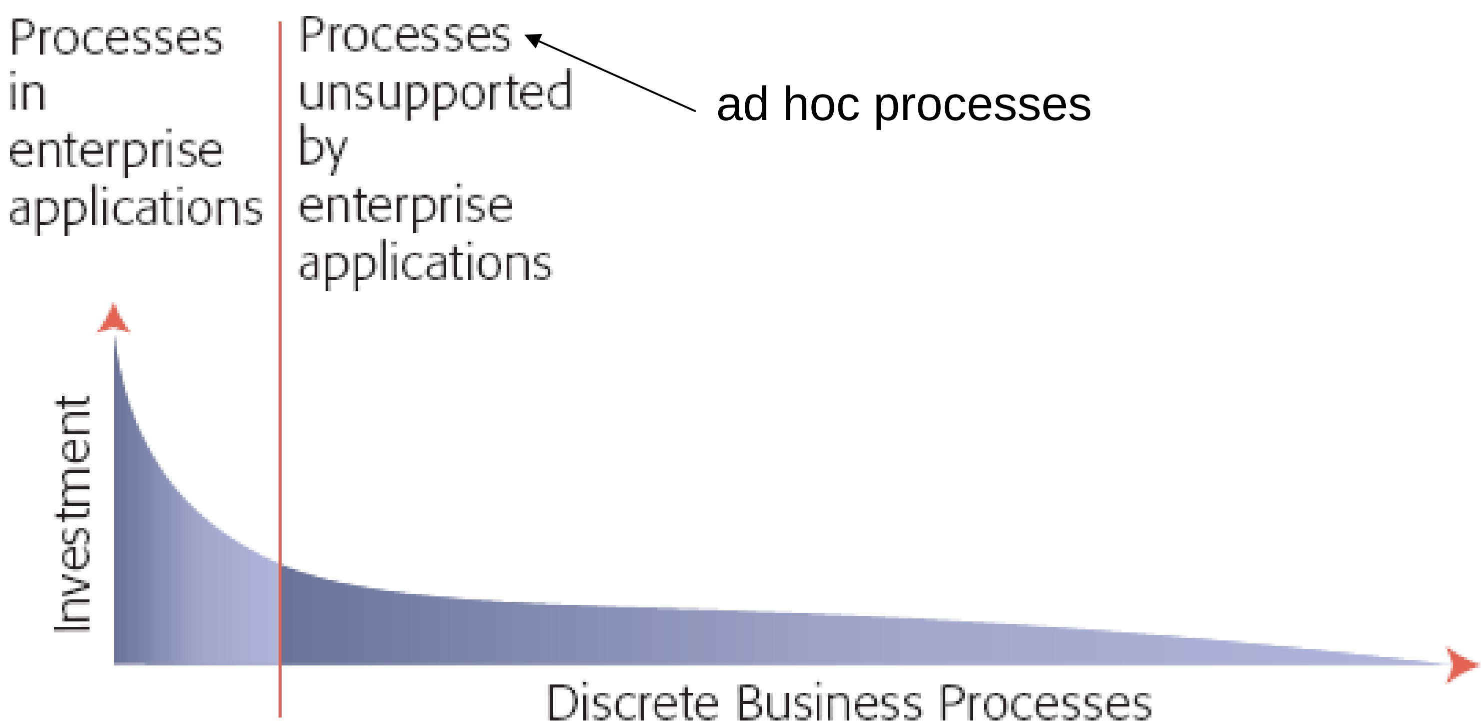
- Relation between signs and their effects
- Intended and actual effects
- Example: Ordering a book by sending a message „1 pcs of ‚Information, Organization, and Management'"

cf. Wigand/Picot/Reichwald (1997)

Problem 1: Modeling Costs

- Models can be used to delegate the execution of a formal process to a machine.
- This may save resources.
- However, creating a model consumes resources.
- The total savings do not automatically and always outweigh the modeling costs.

A real problem...



Supporting long tail of business processes

Problem 2: Blurry means for specifying the intended meaning

- Many modeling notations and languages are not very expressive
- Misunderstandings possible and frequent
  - e.g. semantics of cardinality constraints in ERM

Status Quo: Lack of Formal Semantics

Errors in Control Software for the Ariane Rocket

CH: Altitude relative to the **sea level of the Mediterranean Sea.**

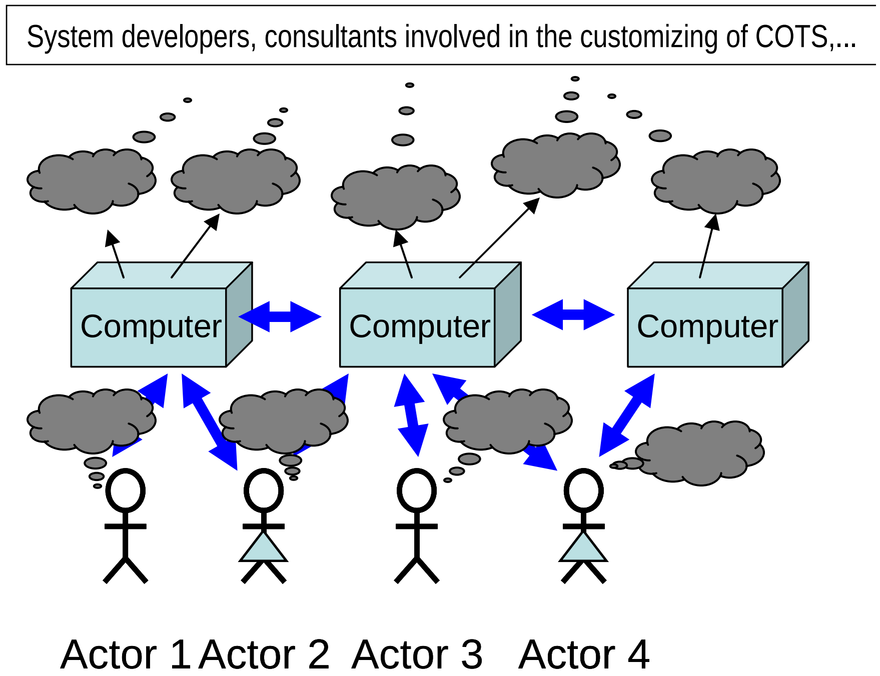
D: Altitude relative to the **sea level of the North Sea.**

Gap: 27 cm

27 - (-27) = 54 ☺

Information Systems and Representation

- Hard- and Software, and mental models of actors (users) as **representations** of
  - objects (e.g. individuals, machines),
  - happenings (e.g. events), and
  - abstractions (e.g. social fictions).
- A large deal of challenges in Information Systems research can be reduced to **managing the creation and maintenance of representations**
  - between reality and the systems
  - between systems
  - between systems and their users



The Root of the Problem: *Weak Ties between Reality and Abstractions of Reality*

Weak, *informal* treaty

Reality

Treaty not accessible to computers

Model of Reality
- **Data**
- **Processes**

Symptoms:
- We can hardly validate whether a given ER model is correct
- We face difficulties making sure that the customization of SAP myERP matches the business needs of a given enterprise

IT represents reality and is part of reality

Reality

Model of Reality
- **Data**
- **Processes**

Reality := Reality + (relevant) Models of Reality

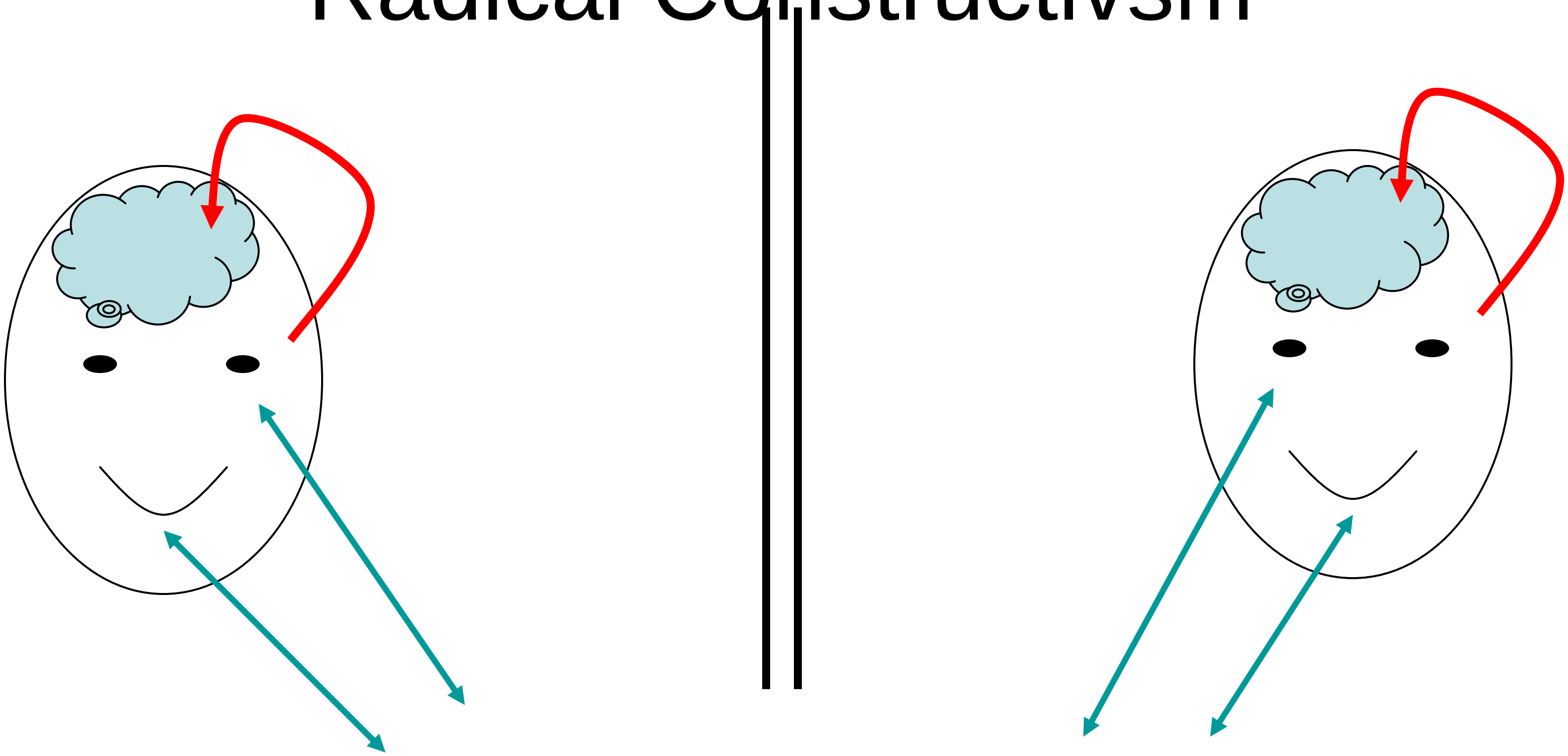
Consequences

- Unspotted semantic mismatches
- Broken processes and costly exceptions
- **A lot of human labor for maintaining the treaty between reality and IT and between IT and IT.**
  - Slow
  - Costly
  - Error-prone

Problem 3: Model Perspicuity

- If multiple business entities or individuals are involved, there need to be continuous agreement that model represents reality properly.

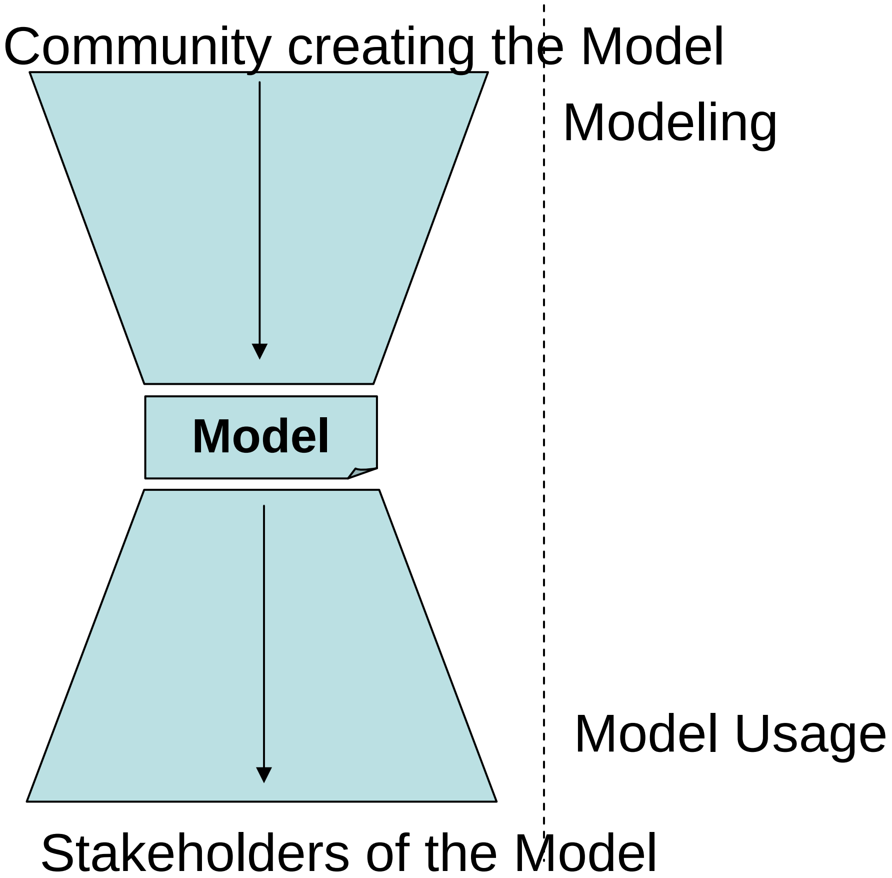
Radical Constructivsm



World: Phenomenona etc.

cf. Wigand/Picot/Reichwald (1997)

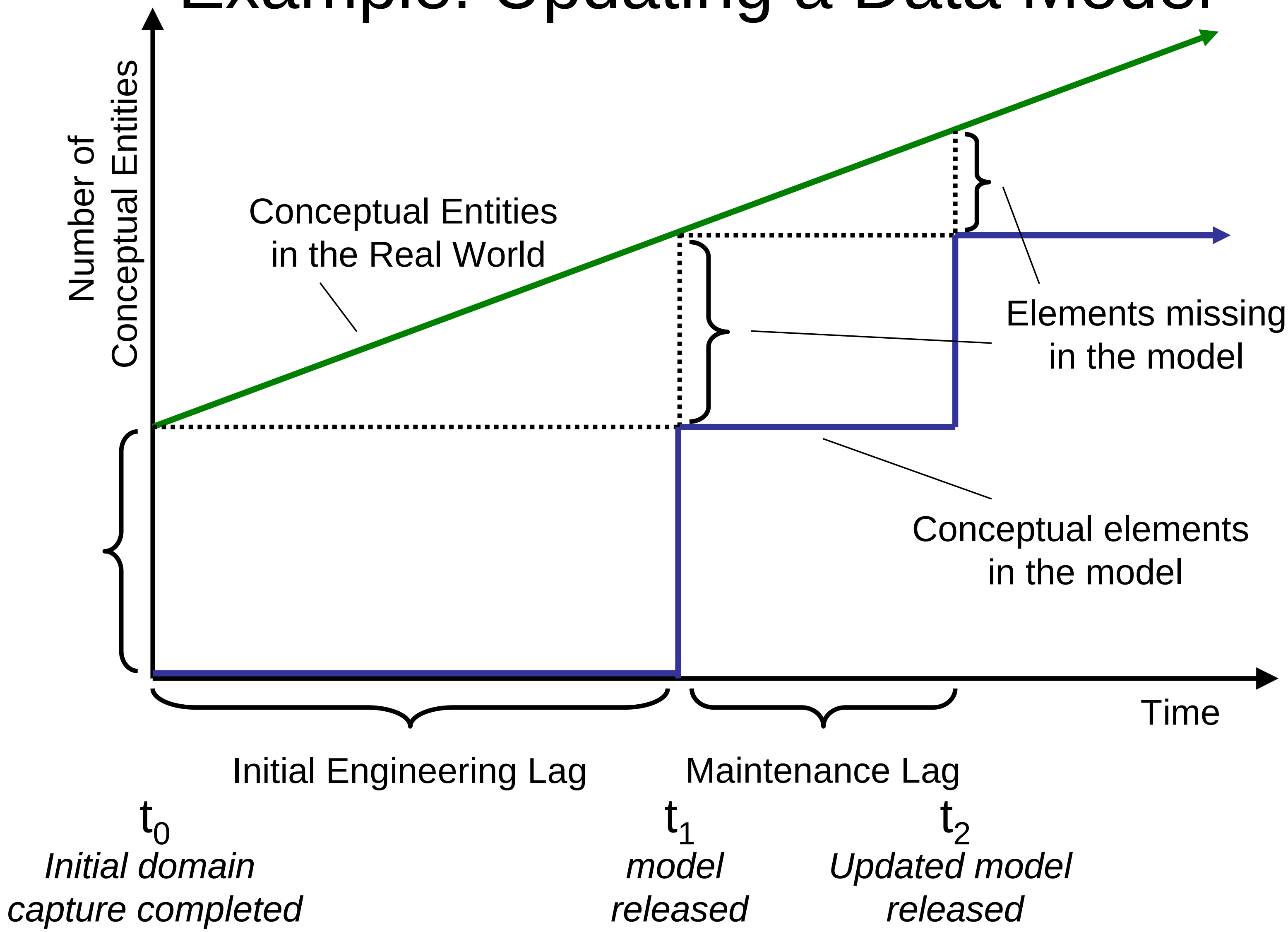
The Model Perspicuity and Agreement Bottleneck



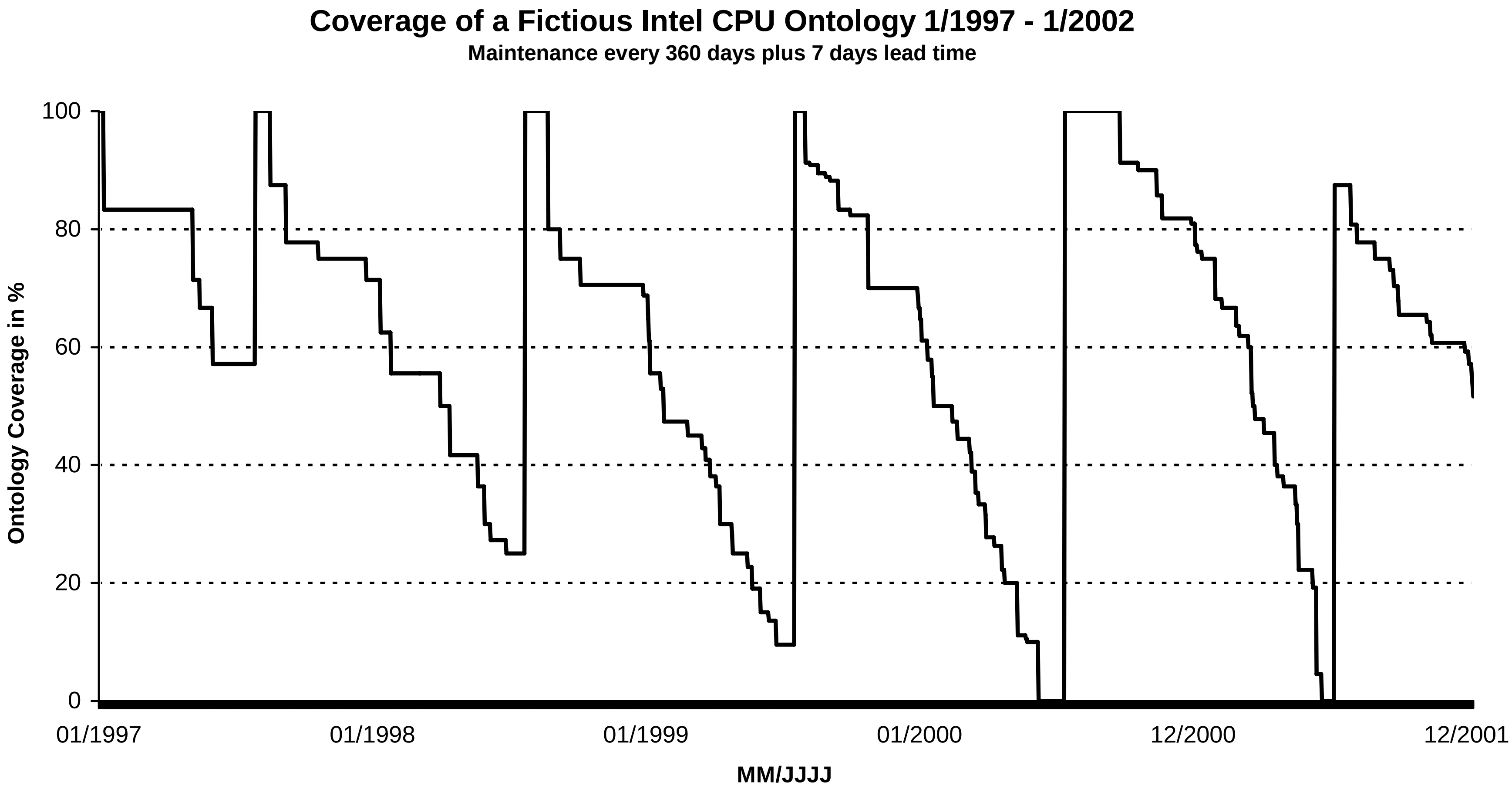
Problem 4: Dynamics and Evolution

- The world is subject to conceptual dynamics
  - new types of goods
  - new requirements
  - new laws and regulations
- We may not be able to yield a model fast enough to keep pace with change.
- It is hard to spot whether a given model (abstraction) is compatible with the current state of the world.

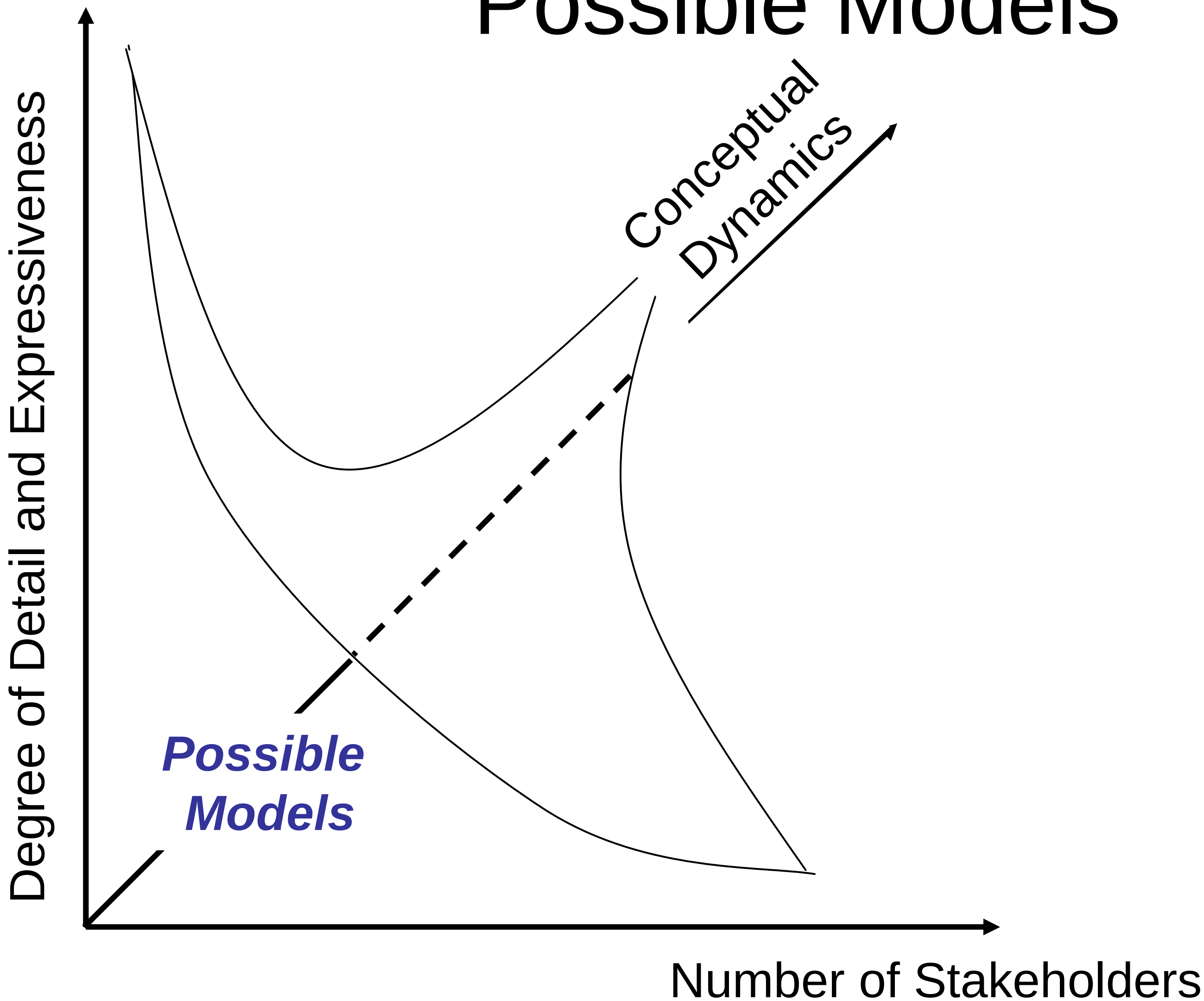
Example: Updating a Data Model



Domain Dynamics vs. Modeling Lag



Possible Models

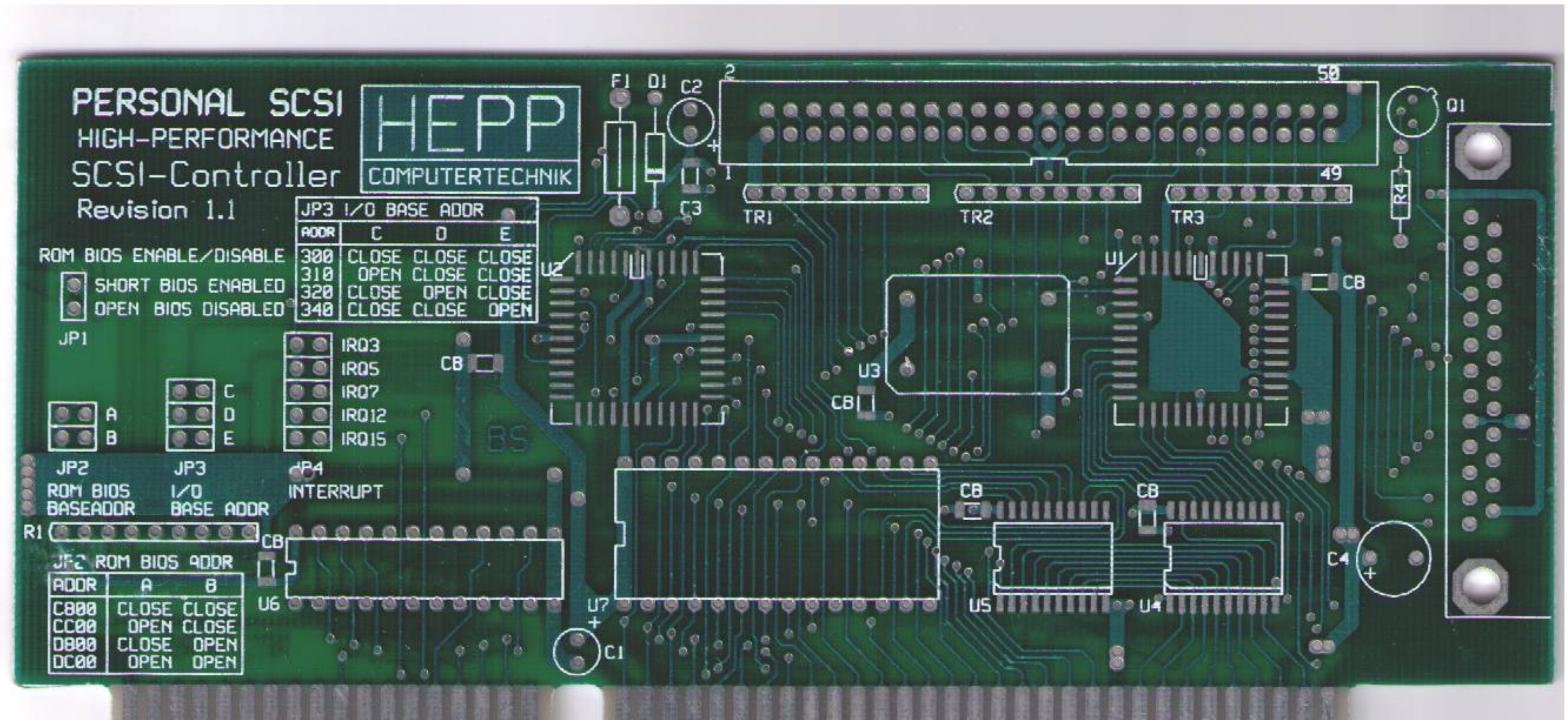


Problem 5: Computability

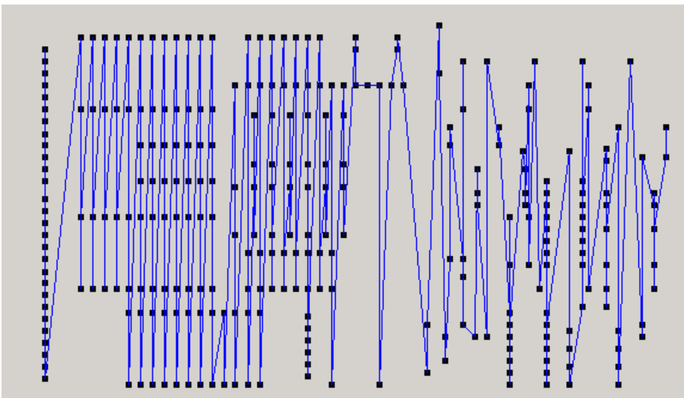
- Many typical business problems can be formalized, but cannot be executed at reasonable computational costs.
- This holds even for rather simple challenges.
- Example: Traveling Salesman Problem
- Also, in business contexts, the time for computing a result may not be available.

cf. Wigand/Picot/Reichwald (1997)

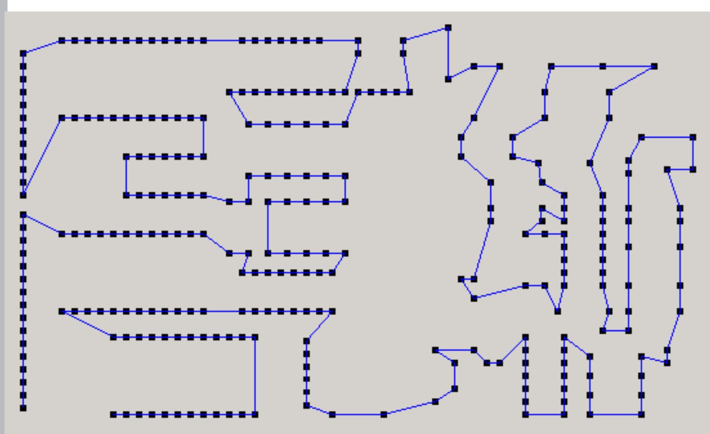
Example: Tool Path Optimization (1)



Example: Tool Path Optimization (2)



Simple ordering of
hole coordinates by X- and Y-axis.

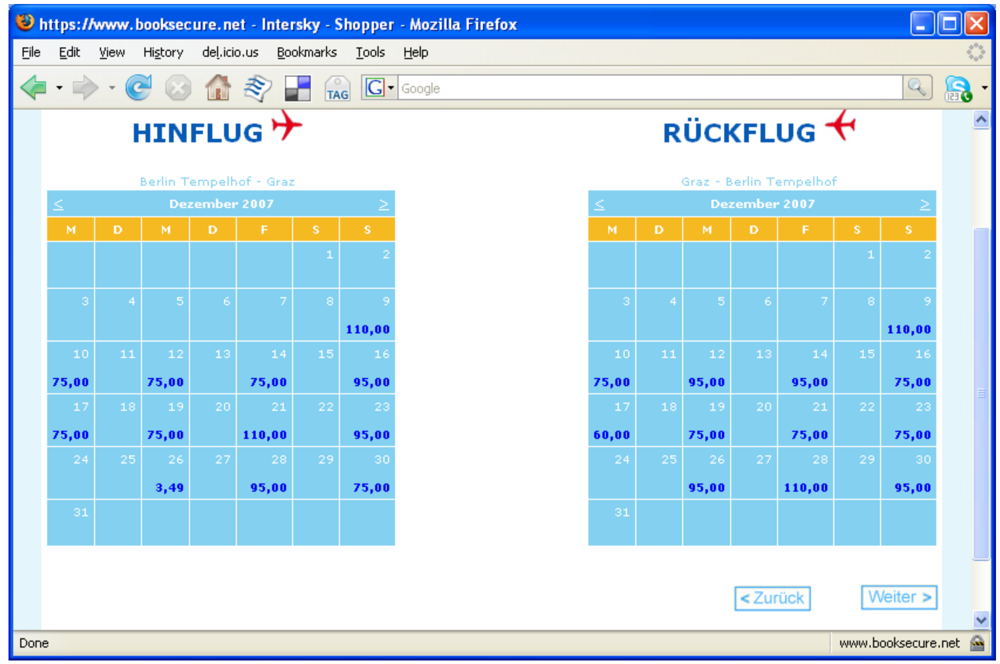


Same layout – optimized for
shortest tool route:
80% shorter -> ~ 80% production
time saved

Examples (C) 2004 by Paul McGuire, taken from
http://www.geocities.com/ptmcg/drill/index.html

Example: Yield Management for Airlines

- At what price should you offer an available seat?
- Influenced by
  - General demand
  - Special events at target destination
  - Alternative travel connections
  - Etc.



Thank you!

The slides of today‘s class will be available at http://www.heppnetz.de/teaching/img/ shortly.