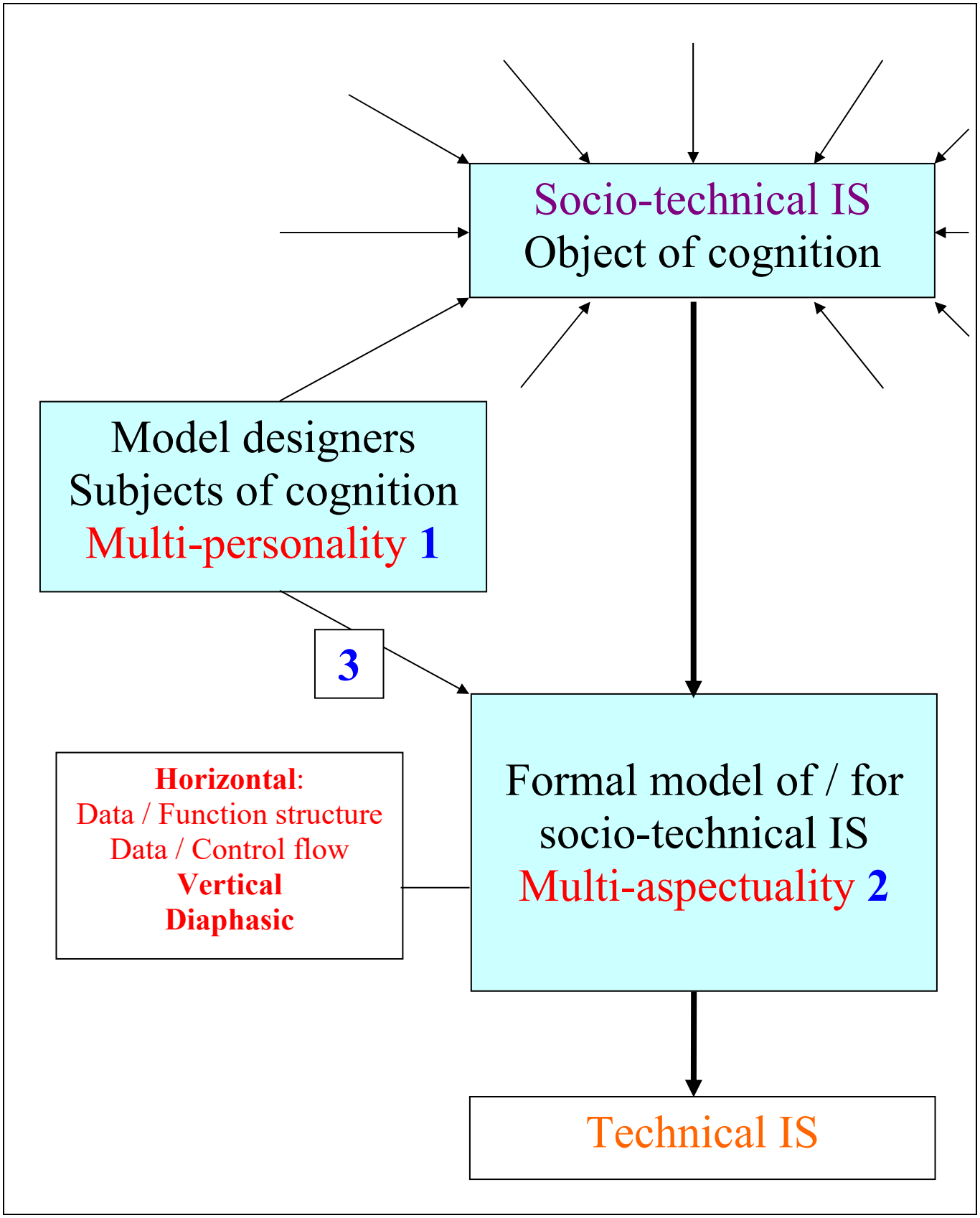
Alfred Holl

Multi-perspectivity in IS modeling

0 Multi-perspectivity in IS: Overview



Influences of multi-perspectivity on modeling and models

1 Multi-perspectivity in IS: Motivation 1

1.1 Starting point: Intermodel errors

→ Observations in IS modeling:

Intrapersonal inconsistencies

Frequent inconsistencies in organization / enterprise models even when designed by one author

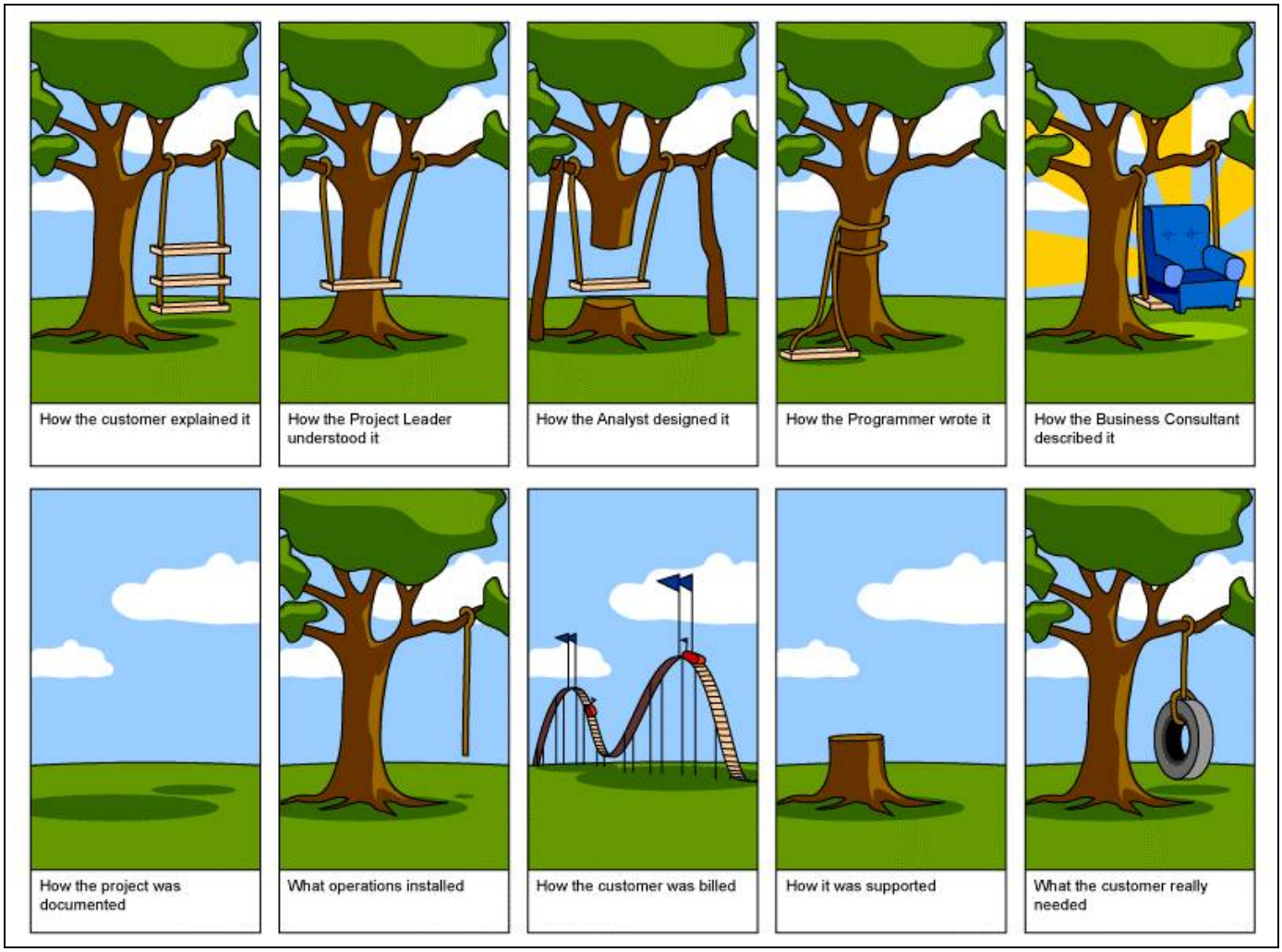
Interpersonal inconsistencies

**Discussions in project groups
based on unconscious different interpretations
of terminology**

→ Questions

scientific challenge: **better understanding**
pedagogic challenge: **better training**

1 Multi-perspectivity in IS: Motivation 2



(No clear reference; see www.businessballs.com/treeswing.htm, probably having its origin in a political caricature from 1972: www.leg.state.mn.us/lrl/oldnews.asp)

Ethnographic research:
mediation between the traditions of radically different cultures, e.g. producer vs. consumer, software practitioner vs. user

1 Multi-perspectivity in IS: Motivation 3

1.2 Introductory examples 1

Pantheism vs. personal god
God as creator vs. loving god (theodicee)
Human free will and determination
Freedom and necessity
Janus face
Wave-particle dualism

Group-psychological experiment

The members of a group get different written information about a problem.
They are asked to find a solution of the problem,
but they are not told that the texts are different.

The solution of the problem, however, can only be found
if all the group members realize
that they got different information and
put their knowledge together.

1 Multi-perspectivity in IS: Motivation 4

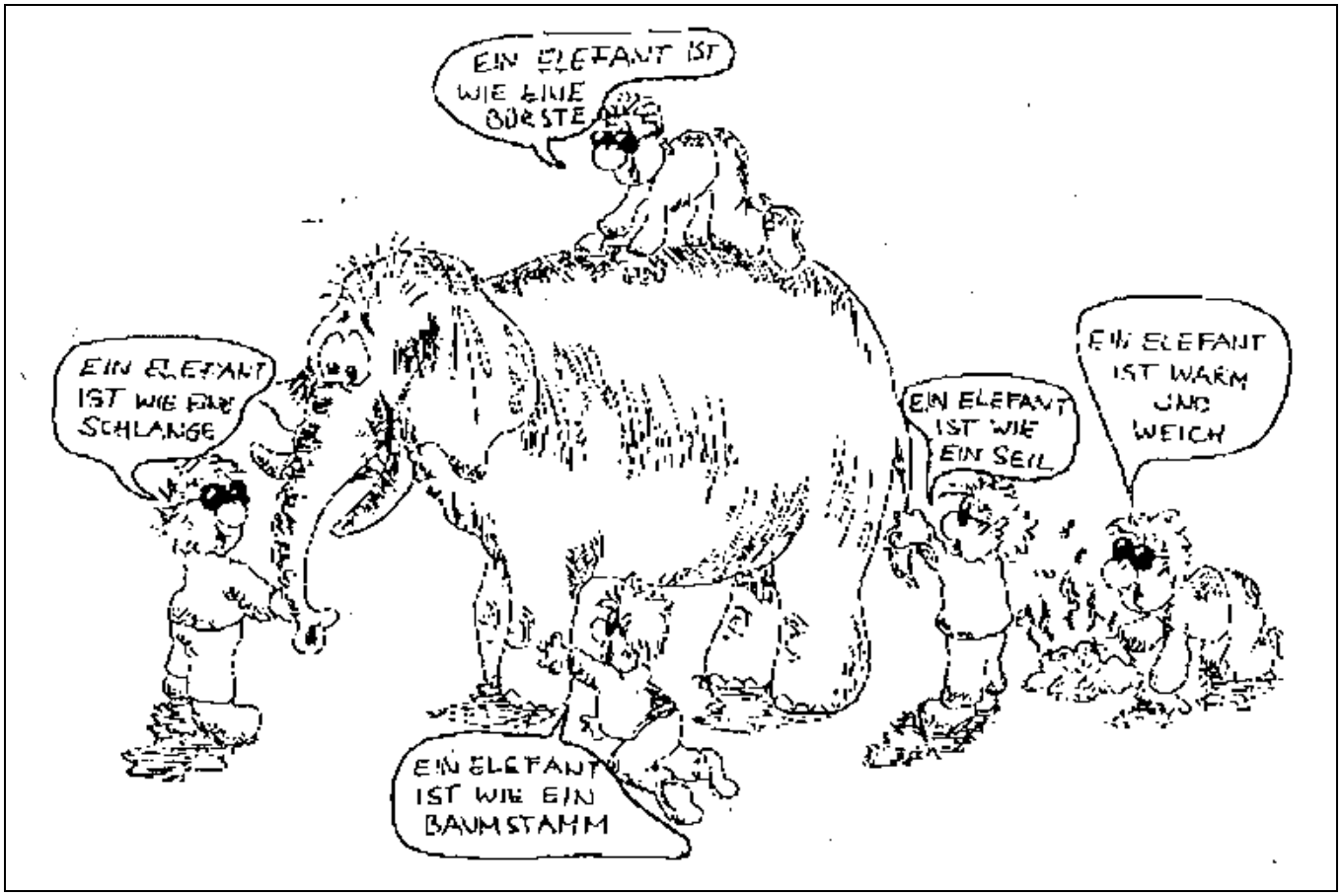
1.2 Introductory examples 2

Perception psychology

"Who sees the forest?"
(Hajos, Wahrnehmungspsychologie, 1991, 18)

1 Multi-perspectivity in IS: Motivation 5

1.3 Exemplary story:
The blind men and the elephant



(www.learn-line.nrw.de)

1 Multi-perspectivity in IS: Motivation 6

1.3 Exemplary story, first version: *The blind men and the elephant*

It was six men of Indostan
To learning much inclined,
Who went to see the Elephant
(Though all of them were blind),
That each by observation
Might satisfy his mind.

The *First* approached the Elephant,
And happening to fall
Against his broad and sturdy side,
At once began to bawl:
"God bless me! but the Elephant
Is very like a wall!"

The *Second*, feeling of the tusk,
Cried, "Ho, what have we here,
So very round and smooth and sharp?
To me 't is mighty clear
This wonder of an Elephant
Is very like a spear!"

The *Third* approached the animal,
And happening to take
The squirming trunk within his hands,
Thus boldly up and spake:
"I see," quoth he, "the Elephant
Is very like a snake!"

The *Fourth* reached out an eager hand,
And felt about the knee
"What most this wondrous beast is like
Is mighty plain," quoth he:
"'T is clear enough the Elephant
Is very like a tree!"

The *Fifth*, who chanced to touch the ear,
Said: "E'en the blindest man
Can tell what this resembles most;
Deny the fact who can,
This marvel of an Elephant
Is very like a fan!"

The *Sixth* no sooner had begun
About the beast to grope,
Than, seizing on the swinging tail
That fell within his scope,
"I see," quoth he, "the Elephant
Is very like a rope!"

And so these men of Indostan
Disputed loud and long,
Each in his own opinion
Exceeding stiff and strong,
Though each was partly in the right,
And all were in the wrong!

MORAL
So oft in theologic wars,
The disputants, I ween,
Rail on in utter ignorance
Of what each other mean,
And prate about an Elephant
Not one of them has seen!

(Saxe, John Godfrey: The blind men and the elephant – A Hindoo fable. 1882: 111 f.)

1 Multi-perspectivity in IS: Motivation 7

1.3 Exemplary story, second version: *Seven blind mice*

One day seven blind mice were surprised to find a strange Something by their pond.
"What is it?" they cried, and they all ran home.
On Monday, Red Mouse went first to find out. "It's a pillar," he said. No one believed him.
On Tuesday, Green Mouse set out. He was the second to go. "It's a snake," he said.
"No," said Yellow Mouse on Wednesday. "It's a spear." He was the third in turn.
The fourth was Purple Mouse. He went on Thursday. "It's a great cliff," he said.
Orange Mouse went on Friday, the fifth to go. "It's a fan!" he cried. "I felt it move."
The sixth to go was Blue Mouse. He went on Saturday and said, "It's nothing but a rope."
But the others didn't agree. They began to argue. "A snake!" "A rope!" "A fan!" "A cliff!"
Until on Sunday, White Mouse, the seventh mouse, went to the pond. When she came upon the Something, she ran up one side, and she ran down the other. She ran across the top and from end to end. "Ah," said White Mouse. "Now, I see.
The Something is
as sturdy as a pillar,
supple as a snake,
wide as a cliff,
sharp as a spear,
breezy as a fan,
stringy as a rope,
but altogether the Something is
an elephant!"
And when the other mice ran up one side and down the other, across the Something from end to end, they agreed. Now they saw, too.

(Young, Ed: Seven Blind Mice. 1992)

1 Multi-perspectivity in IS: Motivation 8

1.3 Exemplary story, German version: *The blind men and the elephant*

Es war einmal ein König, der vier weise Männer auf die Probe stellen wollte. Dazu ließ er in der Wüste ein großes Zelt aufstellen, in dem ein Elefant versteckt wurde.
Die vier Weisen wussten davon nichts und sollten nun in das vollkommen dunkle Zelt gehen und herausfinden, was darinnen sei.
Jeder der Männer gelangte durch einen anderen Eingang ins Zelt.
Der erste Weise bekam den Stoßzahn zu fassen und dachte, es sei vielleicht ein riesiger Speer.
Der zweite nahm das Schwänzchen des Elefanten in die Hand und meinte, es handle sich um einen Strick.
Der dritte fühlte eines der mächtigen Beine und vermutete, es sei ein Baumstamm.
Der vierte ergriff den Rüssel und glaubte, eine große Schlange in den Händen zu haben.
Auf diese Weise machte jeder der vier Weisen eine ganz eigene Erfahrung desselben, des Elefanten.

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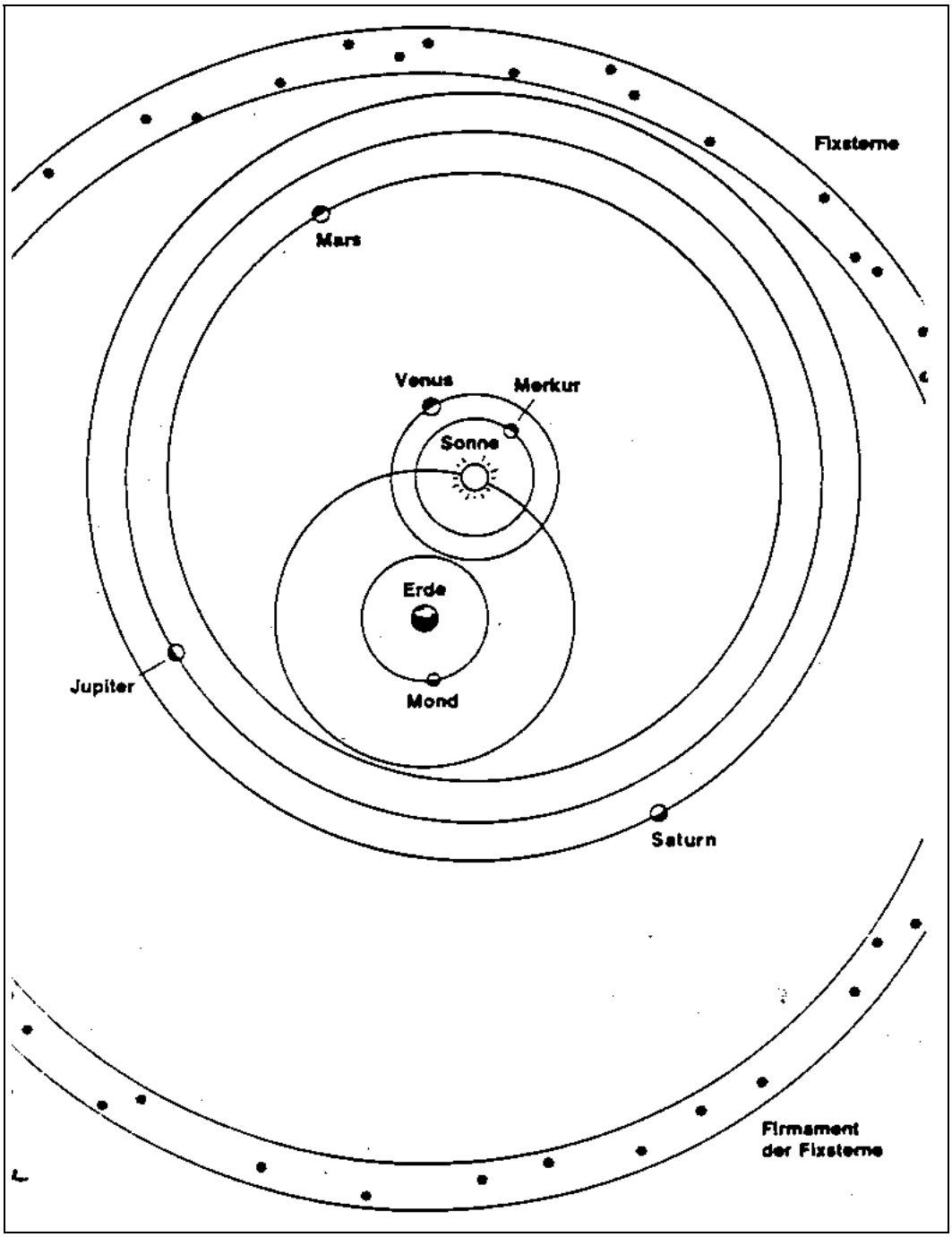
1.4 Examples of multi-perspectivity in models 1

Model of the solar system



Model of the solar system by Tycho Brahe (1546-1601)
Egyptian model (Alexandria)
(Fuchs, Bevor die Erde sich bewegte, 1975, 140)

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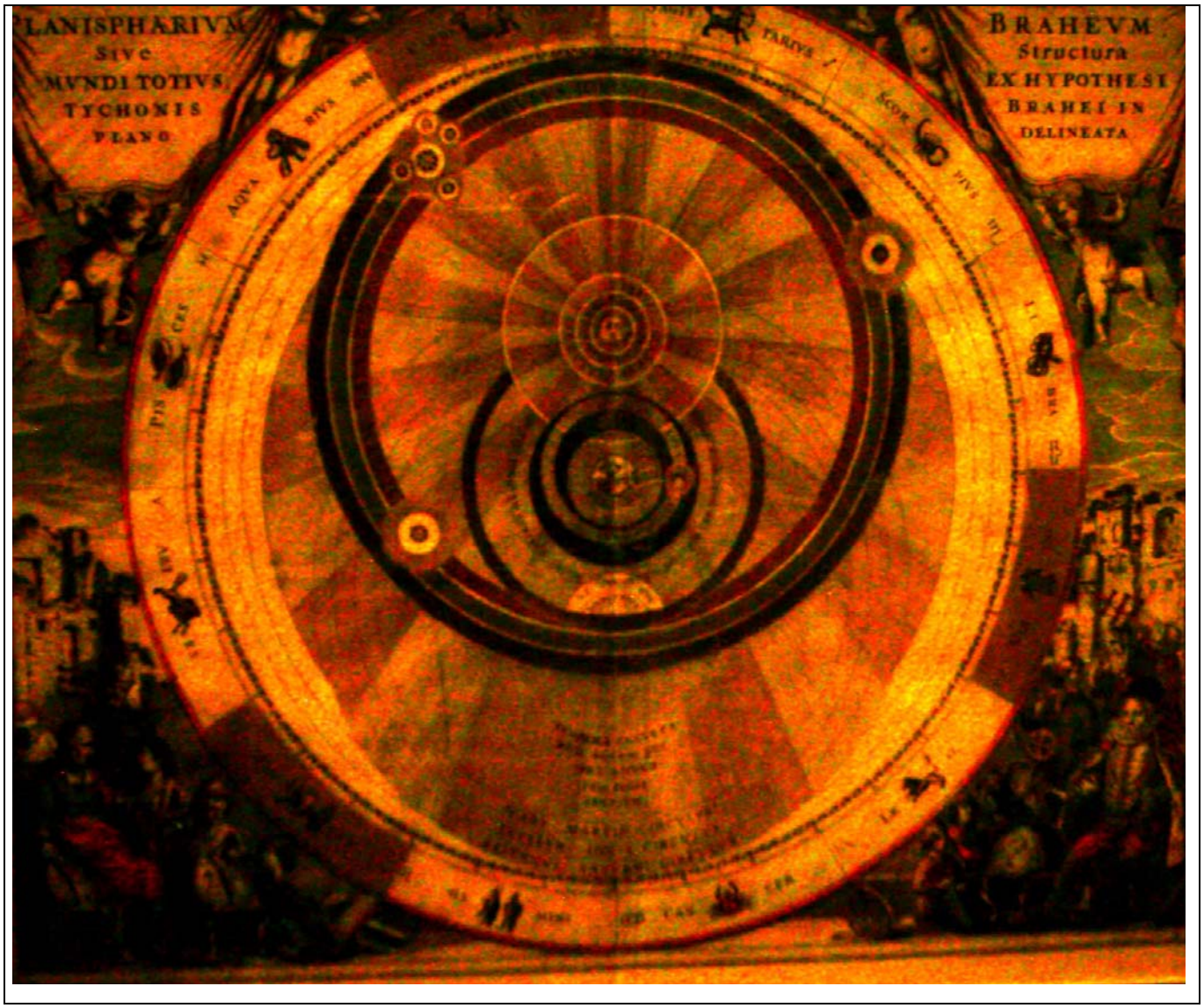
1.4 Examples of multi-perspectivity in models 2

Model of the solar system



Model of the solar system by Tycho Brahe (1546-1601)
(Museo Nacional del Virreinato, former Jesuit college
San Francisco Xavier, Tepotzotlán, México

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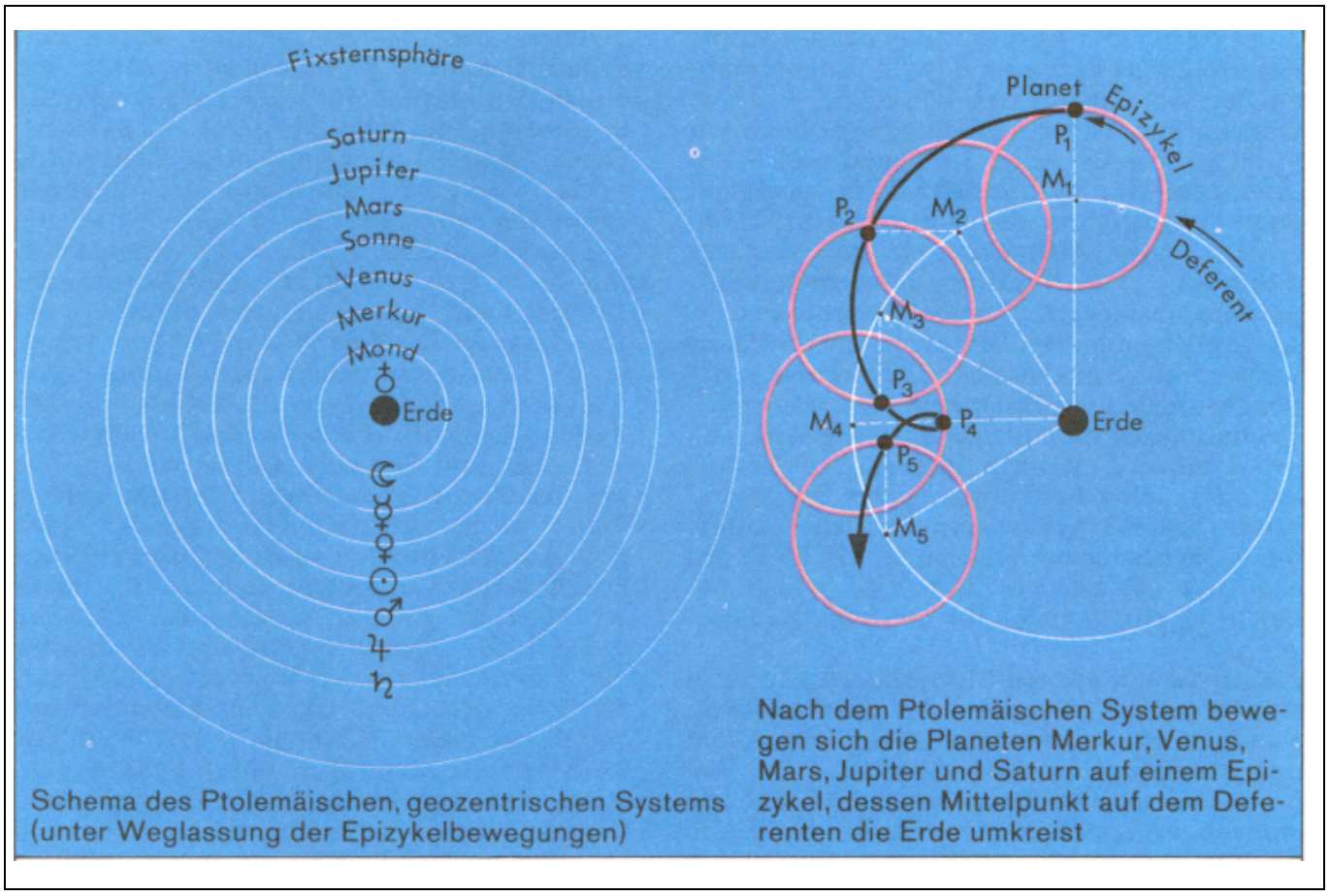
1.4 Examples of multi-perspectivity in models 3

Model of the solar system



Ptolemaic model of the solar system: epicycles
(dtv-Atlas Astronomie)

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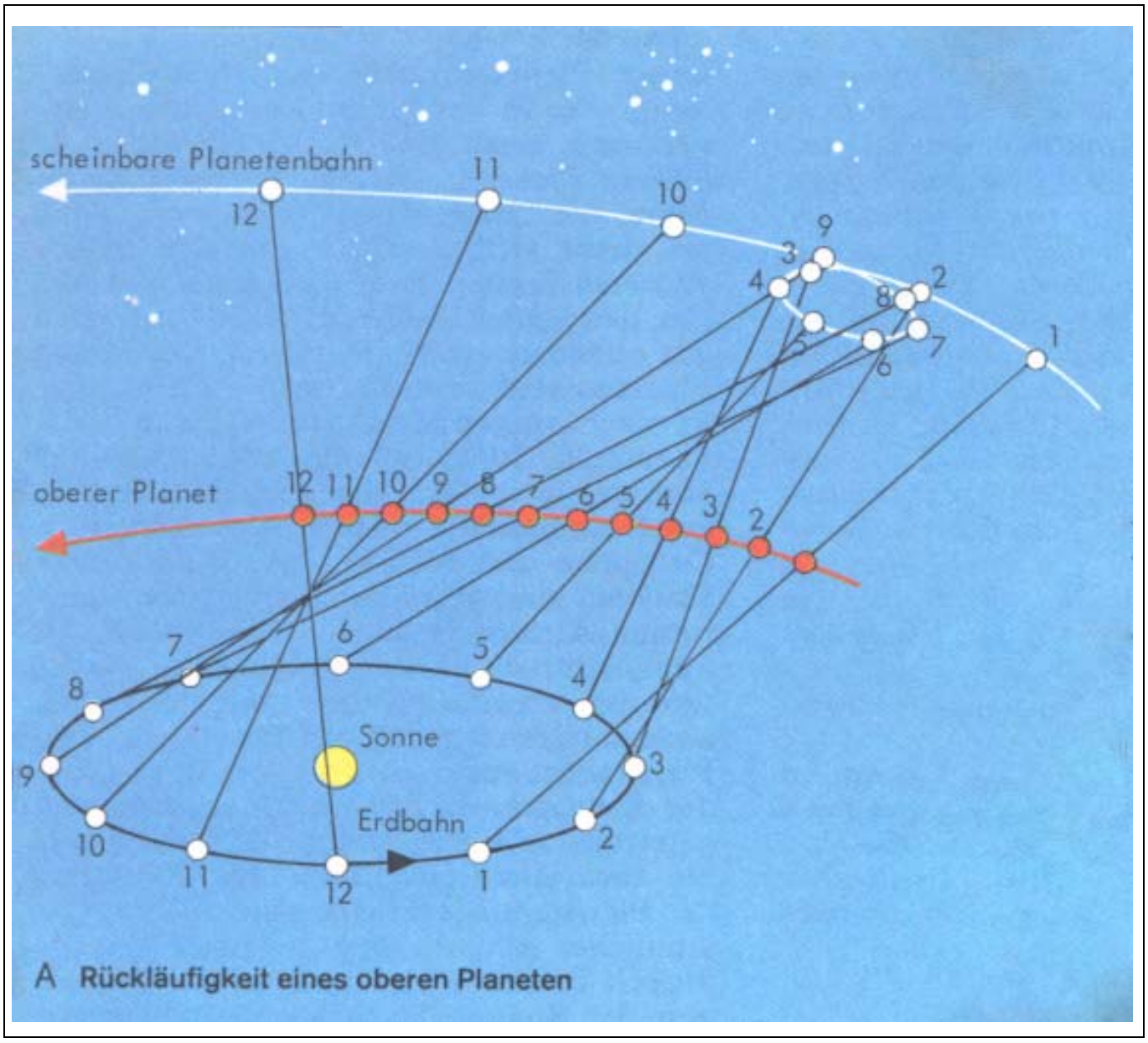
1.4 Examples of multi-perspectivity in models 4

Model of the solar system

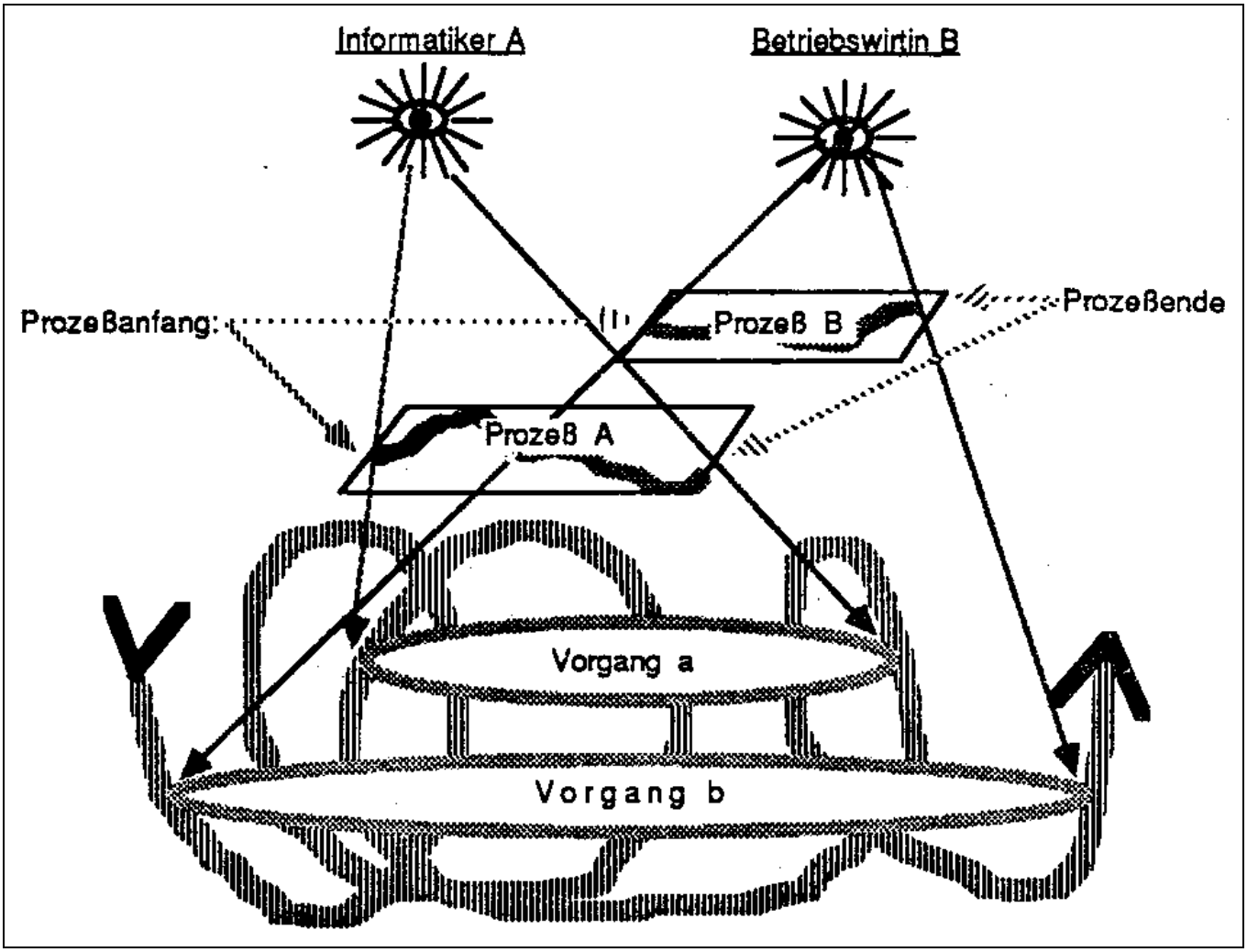


Ptolemaic model of the solar system: recession of a planet
(dtv-Atlas Astronomie)

1 Multi-perspectivity in IS: Motivation 13

1.4 Examples of multi-perspectivity in models 5

Courses of events in an organization and business processes



The process is defined by the observer

(Steinmüller, Informationstechnologie u. Gesellschaft, 1993, ***, = Report 5: 19)

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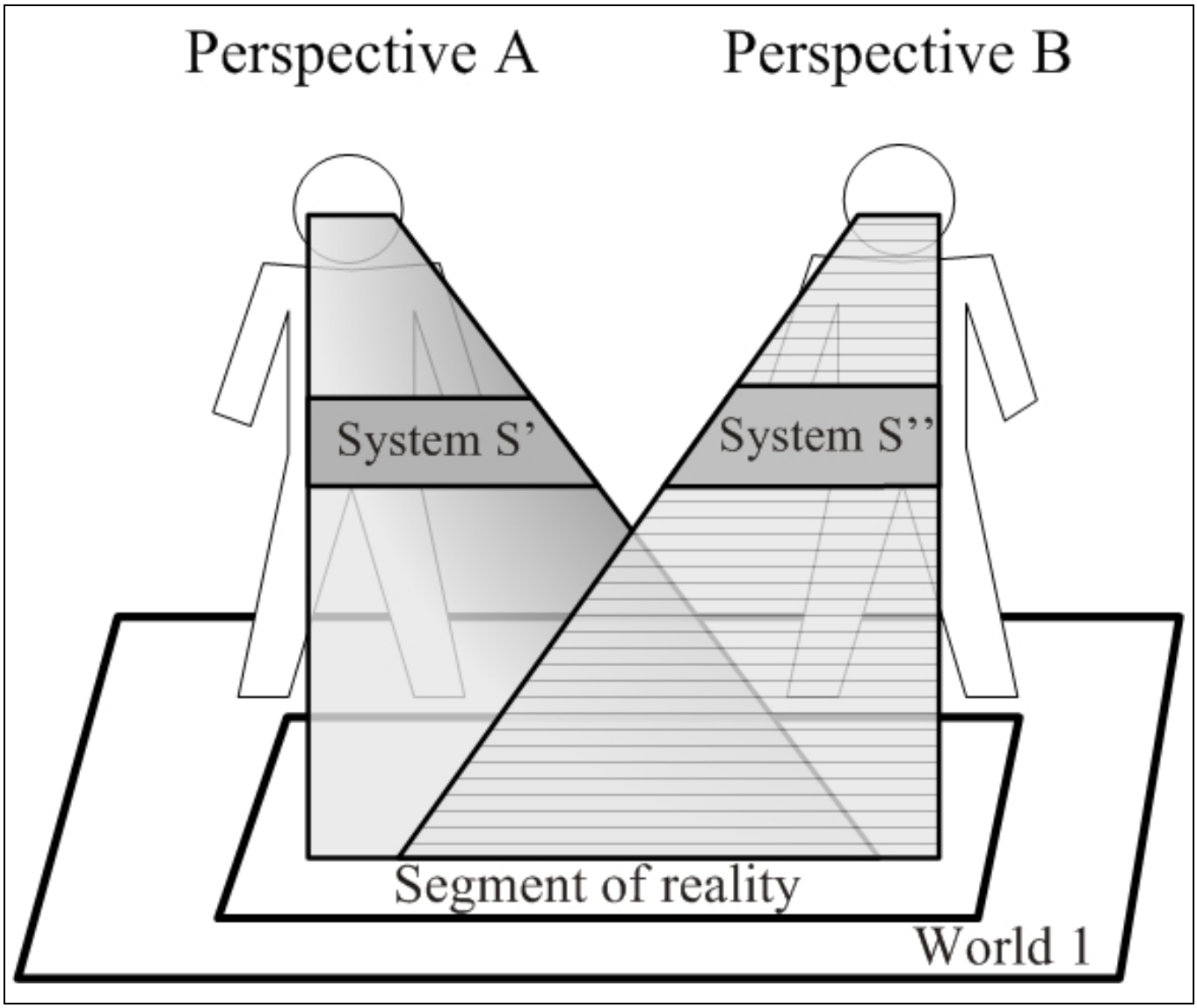
1.4 Examples of multi-perspectivity in models 6

Different views of the same real object



Systems are relative to perspectives
***or:* The system is defined by its observer**
***or:* Everyone sees something else**
(adapted from Steinmüller,
Informationstechnologie und Gesellschaft, 1993, p. 168)

2 Aspects of IS models 1

Multi-perspectivity in general means
that an object is / can be / has to be considered
from different perspectives.

In order to reduce their complexity,
models in IS have to be decomposed (split)
into small and transparent partial models.

Every partial model represents a special perspective.

The different perspectives / partial models
carry the danger of inconsistencies (logical contradictions)
They have to be harmonized / balanced (model balancing → 5).

In IS, one can distinguish between three types of decomposition
which correspond to three types of multi-perspectivity.

All of the three dimensions of multi-perspectivity are the motivation for dealing in detail with multi-perspectivity and the exemplary story of the blind men and the elephant.

2 Aspects of IS models 2

2.1 Horizontal multi-perspectivity / decomposition: static and dynamic data and function models 1

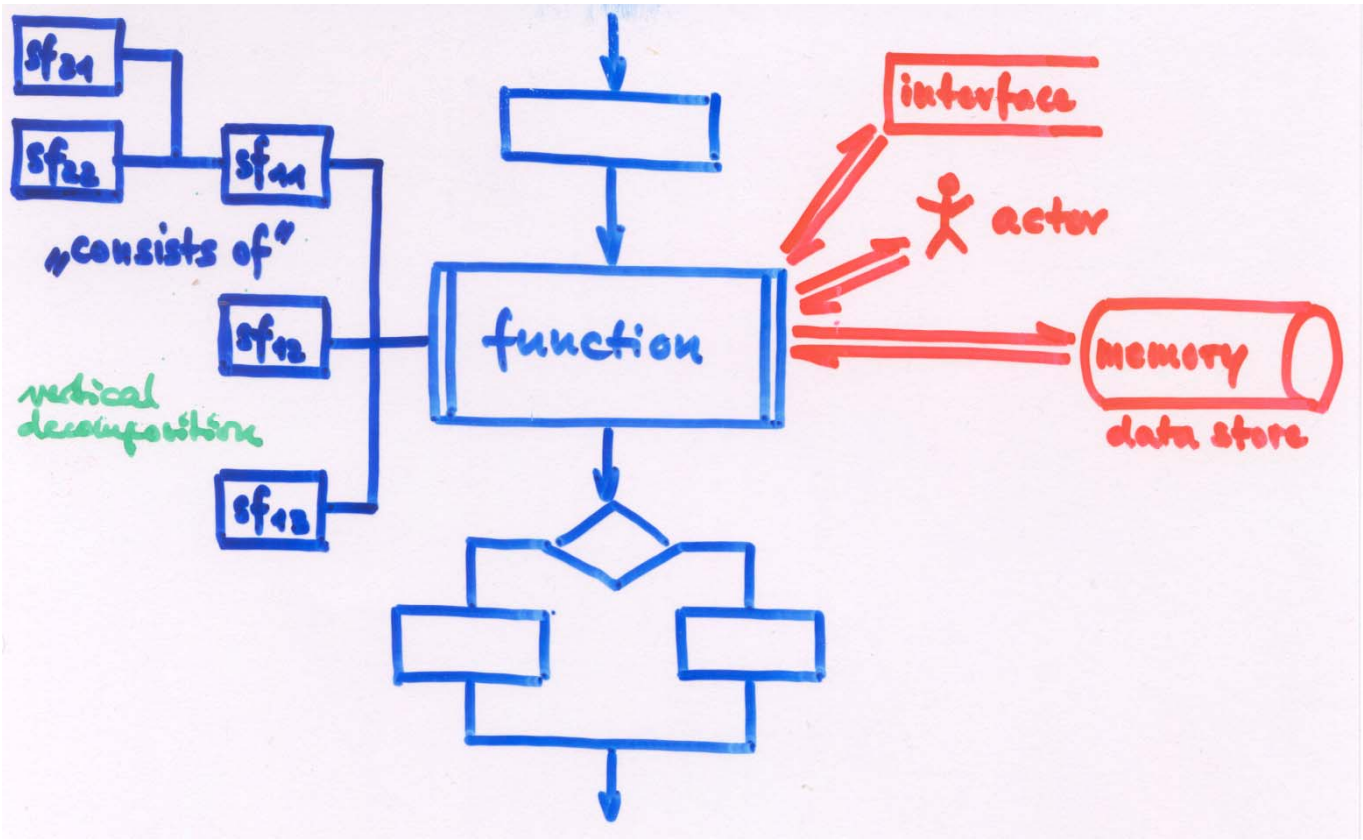
Aspects and their notations

	static/structure models	dynamic/behavior models
data models	data (structure) models: data structure diagrams; entity-relationship models (ERM) UML class diagrams	information flow models: information / data flow charts / diagrams; Structured Analysis (SA); UML use case diagrams
function models	function structure models: compositional function trees; Jackson trees	control flow models: algorithms (functions); Nassi-Shneiderman diagrams, block diagrams (flow charts); business process models; UML activity diagrams; (UML sequence diagrams)

Each of the four aspects represents a certain perspective.

2 Aspects of IS models 3

2.1 Horizontal multi-perspectivity / decomposition: static and dynamic data and function models 2



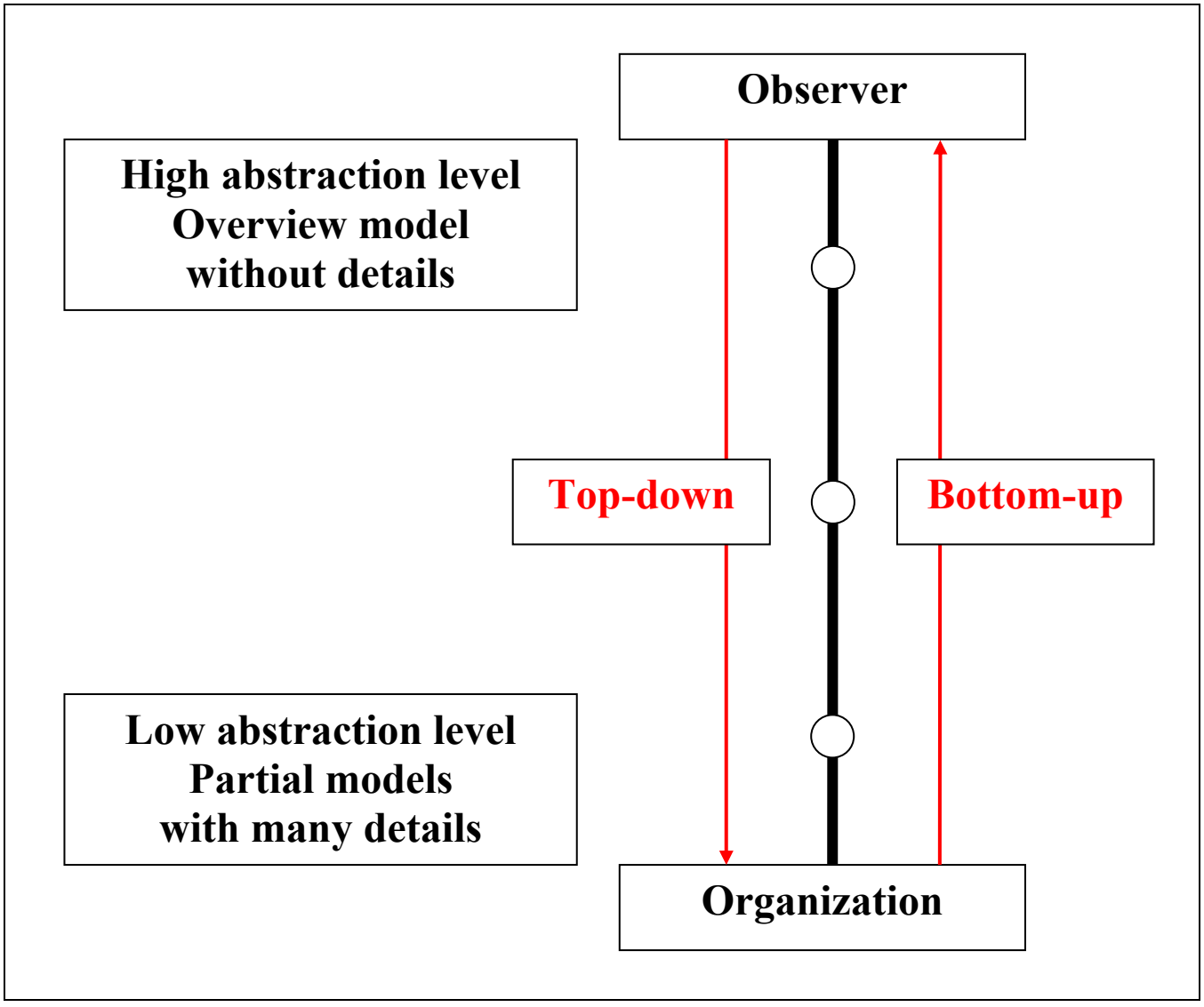
Static function model: function structure model irrespective of tests, iterations, sequences	Dynamic function model: control flow model	Dynamic data model: information flow model	Static data model: data structure model

2 Aspects of IS models 4

2.2 Vertical multi-perspectivity / decomposition: levels of abstraction 1

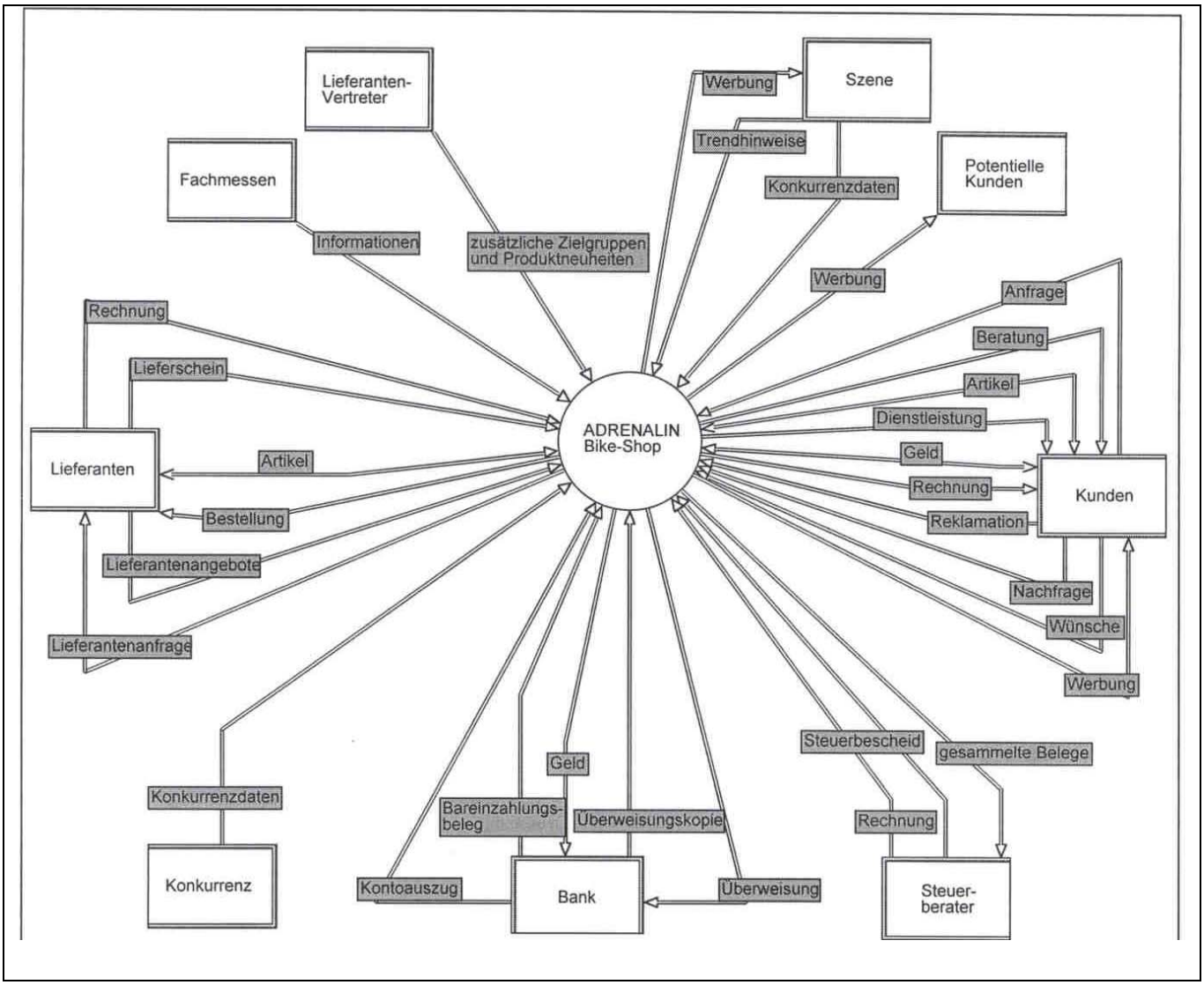
Using design methods (top-down, bottom-up, inside-out), models have to be decomposed into small and transparent partial models on different levels of abstraction (hierarchical levels with different degrees of abstraction).

Every level of abstraction represents a certain perspective.



2 Aspects of IS models 5

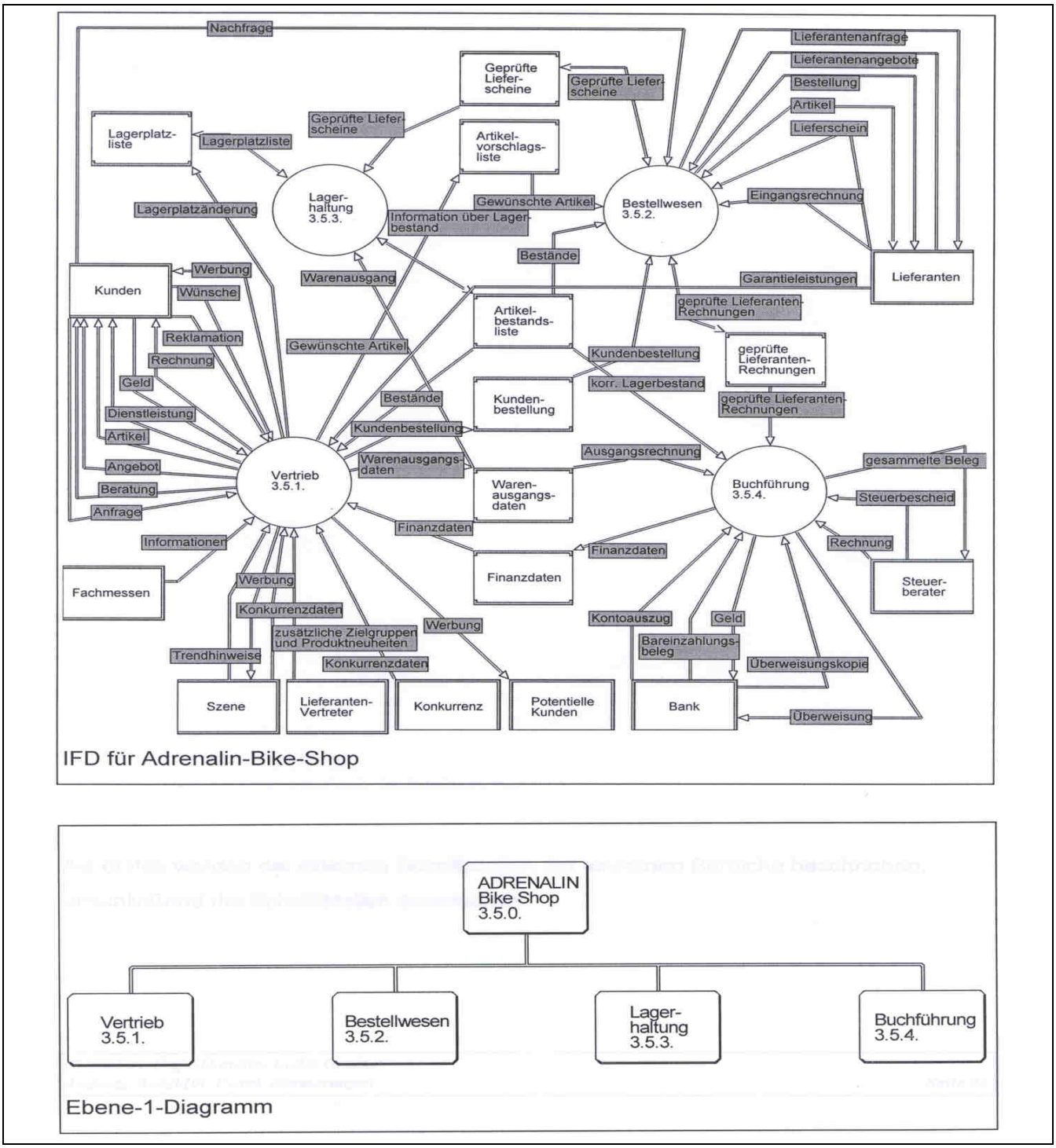
2.2 Vertical multi-perspectivity / decomposition: levels of abstraction 2



Structured analysis (SA) level 0 diagram (context diagram)

2 Aspects of IS models 6

2.2 Vertical multi-perspectivity / decomposition: levels of abstraction 3



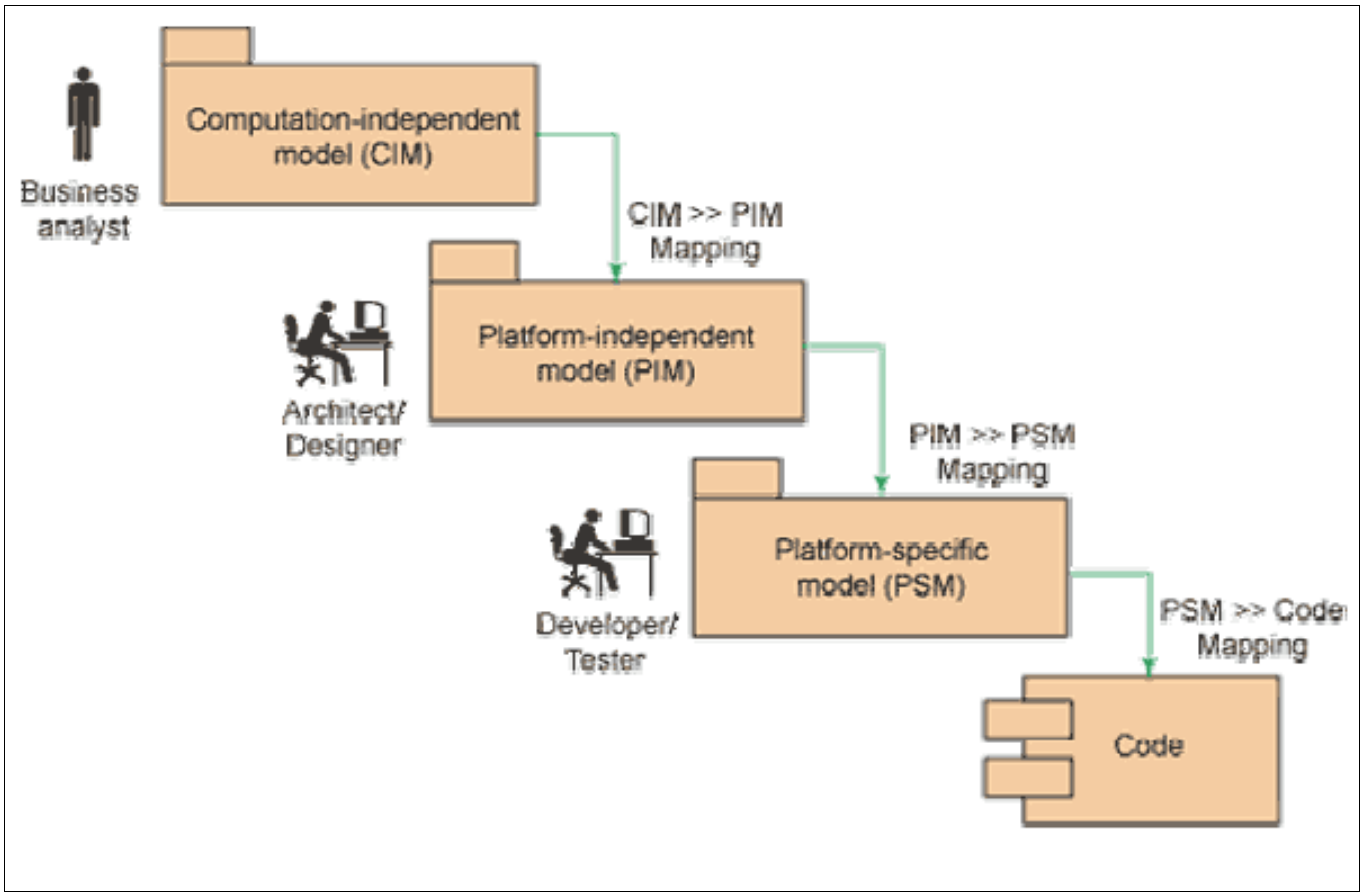
Structured analysis (SA) level 1 diagram

2 Aspects of IS models 7

2.3 Diaphasic multi-perspectivity: phase concepts / software process models 1

**On its way through a systematic phase concept –
through a software (development) process model,
a model of a technical IS has to be transferred in several steps
via different models,
each of which in turn is split vertically and horizontally,
from an organization / enterprise model on the information level
to a technical model on the implementation level.**
Every software process phase represents a certain perspective.

**Example: Model-Driven Architecture (MDA)
by Object Management Group (OMG)**



(Journal of Object Technology 2006, http://www.jot.fm/issues/issue_2006_03/column4/images/figure3.gif)

2 Aspects of IS models 8

2.3 Diaphasic multi-perspectivity: phase concepts / software process models 2

main phase	subphase	model level	model purpose
analytical phase: problem analysis	elicitation of the current state of the soc-tech IS	information-relevant models	descriptive models (systems analysis)
	analysis of the current state of the soc-tech IS		
	design of the planned state of the social IS (LOCK)		prescriptive models (require-ments engineering)
	design of the planned state (business concept) of the technical IS (KEY)		
synthetical phase: IT system development	design of the IT concept of the technical IS	implementa-tion-relevant models	
	programming		
	test		
	use	information-relevant models	
maintenance			

3 Analysis of multi-perspectivity in IS modeling 1

3.1 Different aspects: multi-aspectuality

A description of an organization contains so many details
(due to the complexity of reality)
that it is impossible
to cover them all in only one diagram (type):
– vertical/hierarchical decomposition
– horizontal decomposition

3.2 Different model designers: multi-personality

Different model designers can model
– one aspect of an organization:
alternative models (cf. solar system)
– different aspects of an organization

3.3 Multi-aspectuality and multi-personality

aspects (formal) / persons	one aspect	several aspects
one designer intrapersonal	–	multi-aspectual
several designers interpersonal	multi-personal; alternative models	multi-personal and multi-aspectual

3 Analysis of multi-perspectivity in IS modeling 2

3.4 Ambiguous mapping of reality segments to models

Mapping of reality segments to models is ambiguous,
that is, one reality segment can be described by several models, even by several correct models.
There is not only one single model for every segment of reality (cf. Tycho Brahe).

Distinctive features of good models:
– (mathematical) simplicity
– brevity, economy
– elegance, esthetics
– understandability
– optimization
– high explanatory and cognitive value
– improvement towards a
– – formal model
– – mathematical-logical model
– – axiomatic model

Examples:
– equations of motion (transformation of coordinates)
– relational data models (normalization):
3NF is the mathematically simplest form
– different model representations in IS

Famous axiom systems:
Giuseppe Peano (1858 – 1939): 1889 natural numbers
David Hilbert (1862 – 1943): 1899 Euclidean geometry of the plane

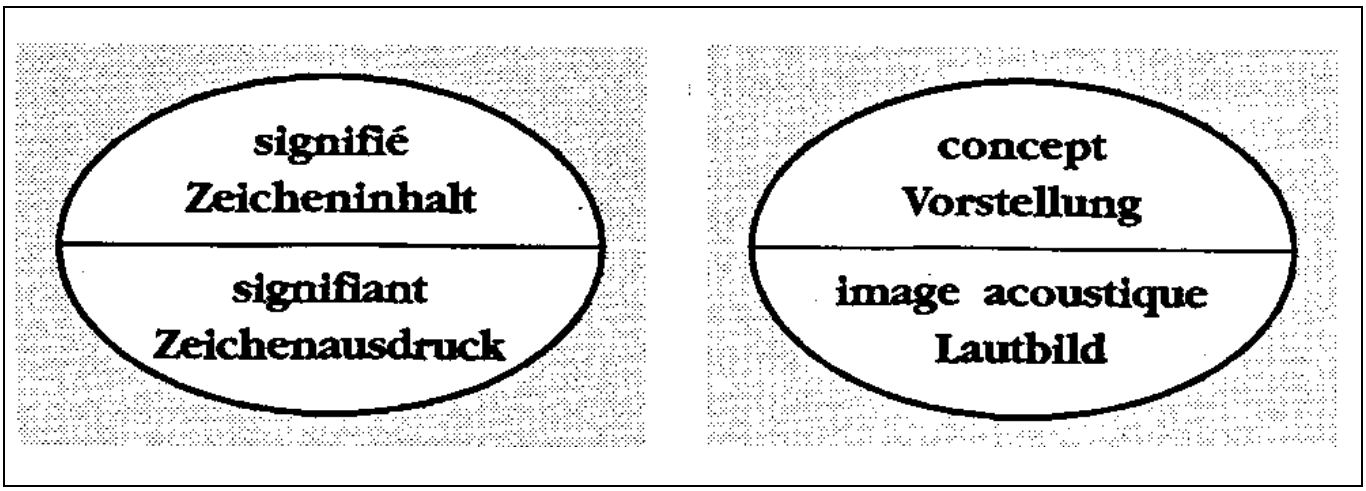
3 Analysis of multi-perspectivity in IS modeling 3

3.5 Natural and formal languages: (non-)ambiguous communication 1

Structuralist linguistics
School of Geneva: Ferdinand de Saussure (1857-1913)

Bilateral semiotic sign:
– form (vox, significant, sequence of letters / phones, graphemes / phonemes)
– meaning (conceptus, signifié, concept)

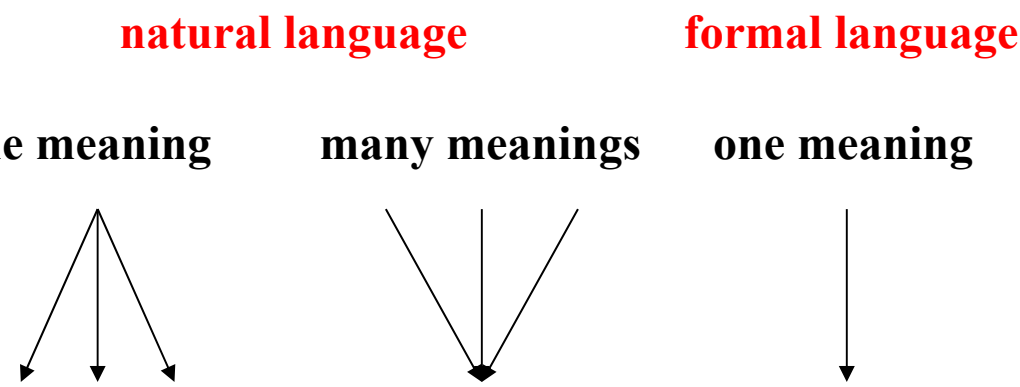
The assignment between form and meaning is arbitrary (code is learnt by psychological conditioning)



Bilateral semiotic sign
(Linke, Studienbuch Linguistik, 2004 [1991], 31)

3 Analysis of multi-perspectivity in IS modeling 4

3.5 Natural and formal languages: (non-)ambiguous communication 2



	synonymy	**homonymy polysemy**	**non-ambiguity**
e.g.	***glasses spectacles***	***floor, earth, tree, root***	

Quasi-synonymy, quasi-homonymy: overlapping meanings

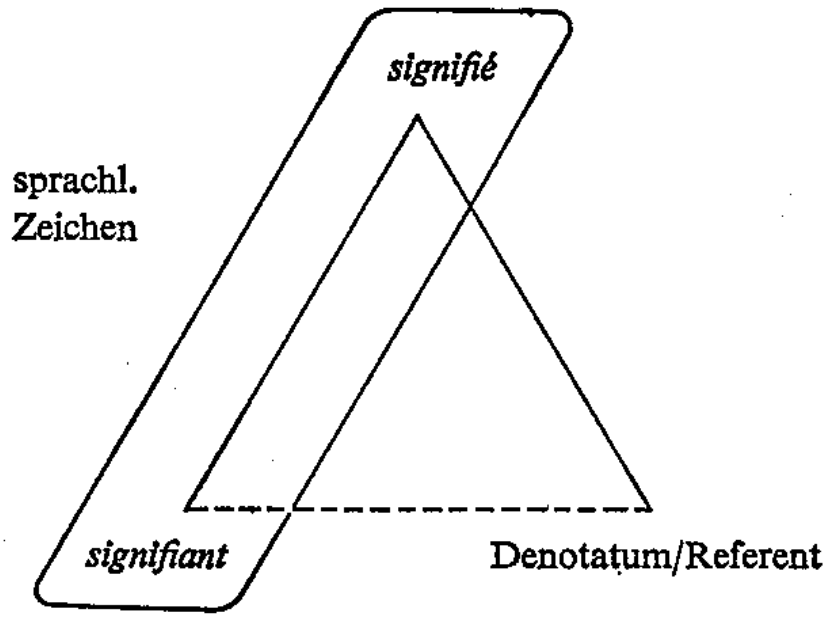
Features of formal languages:
- **standardization of word semantics (meanings)**
- **diachronic stability of word semantics**
- **standardization of phrase semantics:**
  e.g. SPO only for propositions, not for questions
  sequence of parts of a sentence determines semantics

3 Analysis of multi-perspectivity in IS modeling 5

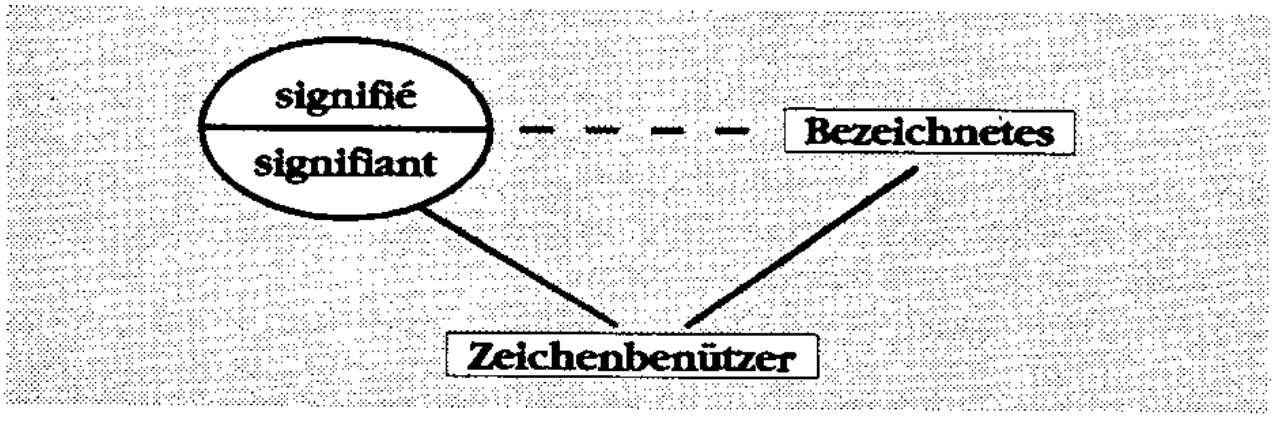
3.5 Natural and formal languages: (non-)ambiguous communication 3

2.1. Das semiotische Dreieck

Signifiant und *signifié* konstituieren das sprachliche Zeichen. Das *signifiant*, z. B. die Lautfolge [vwaty:R], verweist über das *signifié*, die Bedeutung „Auto", auf eine Klasse von konkreten Gegenständen, die Automobile. Eine direkte Beziehung zwischen *signifiant* und Denotatum besteht nicht – deshalb die gestrichelte Linie.



The semiotic triangle
(Felixberger / Berschin, Sprachwissenschaft, 1974, 15)



Semiotic triangle plus user
(Linke, Studienbuch Linguistik, 2004 [1991], 31)

3 Analysis of multi-perspectivity in IS modeling 6

3.5 Natural and formal languages: (non-)ambiguous communication 4

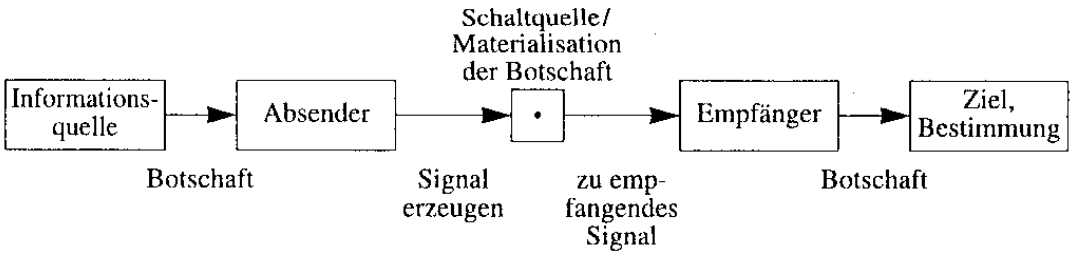


Abb. 3: Shannons Kommunikationsmodell – für die Molekulartheorie der Evolution unzureichend

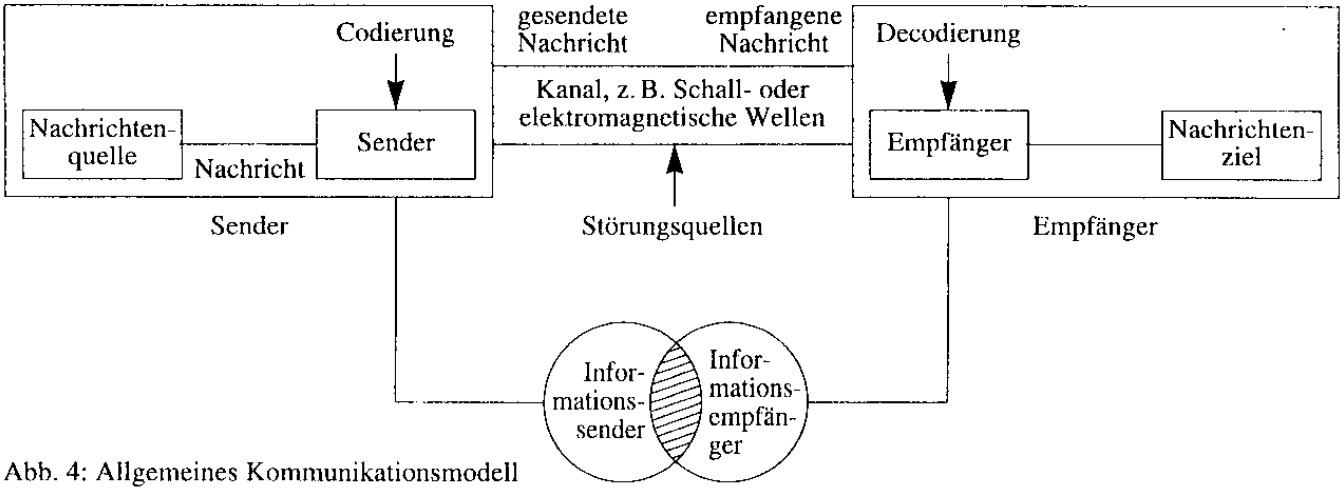


Abb. 4: Allgemeines Kommunikationsmodell

General model of communication
(Irrgang, Evolutionäre Erkenntnistheorie, 1993, 159)

4 Conclusion using the exemplary story 1

Exemplary stories provide a fascinating mechanism.

4.1 Starting point

4.1.1 (Core of the) exemplary story and its internal moral

**Some blind men touch different parts of an elephant's body.
Each of them gets an individual impression,
which he considers as absolute.
Once the blind men have been confronted
with the others' opinions and
have learned that they are different,
each one insists on his own opinion,
rejects the other ones as wrong and
all of the blind men start quarreling.**

4.1.2 Internal moral

**The cognitive behavior of the blind men
is judged as epistemologically stupid.**

4 Conclusion using the exemplary story 2

4.2 Generalization towards an epistemological level (*tertium comparationis*)

4.2.1 Generalized story

**Independently of each other,
some persons acquire
individual partial knowledge about an object of cognition and
consider it as complete and absolute knowledge.
Even when they are confronted with different opinions,
each one insists on his own opinion,
rejects the other ones as wrong and
all of the persons start quarreling.**

4.2.2 Generalized moral

**To consider incompatible opinions (partial knowledge),
which are based
on (unnoticed) mono-perspective, incomplete cognition,
as complete and absolute knowledge
is detrimental.
This kind of knowledge is not reliable.**

4.2.3 Epistemological addition

**Human thinking is mostly oligo-perspective.
Everyday life does not require to
automatically logically coordinate and harmonize knowledge.
Therefore, the human inconsistency checking apparatus does not
automatically work with formal-logical precision.**

4 Conclusion using the exemplary story 3

4.3 Analogical transfer to an application area: IS modeling

4.3.1 Story adapted to an application area

Research groups of an ant state examine an elephant.
(Steinmüller, Wilhelm: Informationstechnologie und Gesellschaft, Einführung in die angewandte Informatik, Darmstadt 1993: 51 Cognition of objective truth?)

4.3.2 External moral

Consequence: The government decided to stop the project due to inconsistent results and unsolvable differences in the scientists' opinions.
"Das Projekt wurde auf Beschluss der Regierung wegen unüberbrückbarer Meinungsverschiedenheiten unter den Wissenschaftlern abgebrochen."

4.3.3 Conclusion for IS modeling

Different model designers have different pre-knowledge and different psychic-mental-intellectual-social dispositions, they can use the same words with different meanings and even one model designer often has difficulties to keep his multi-aspectual models consistent.

Therefore
– different points of view are normal and cannot be avoided
– contradictions and incompatibilities in models from different points of view are normal.

5 Treatment of multi-perspectivity in IS modeling 1

5.1 Treatment of contradictions and incompatibilities: model balancing 1

Elimination / harmonization
of contradictions, inconsistencies, incompatibilities
between partial models
which have their origin in horizontal and vertical decomposition.

Incompatibilities have to be eliminated in order to deploy IT!
Formal-mathematical models do not allow contradictions.
→ Principle of key (IT) and lock (organization)

Is the reality of an organization of that kind,
that consistent formal models are possible?

Personal experience: Yes!
I've only seen contradictions due to mistakes in models,
due to different implicit pre-conditions.

Consequence:
Organizations are not so complex as sub-atomic particles.
Hypothesis of coherency

Even alternative models need some parts in common,
a basis of comparison,
otherwise they are not comparable.

5 Treatment of multi-perspectivity in IS modeling 2

5.1 Treatment of contradictions and incompatibilities: model balancing 2

Abb. 9: Interferenzvorgang. Zeichnung: Charles Addams. 1940

Interference, wave particle dualism
(Kanitscheider, Mechanistische Welt, 1993, 111)

5 Treatment of multi-perspectivity in IS modeling 3

5.2 Compatibility-checking tools

e. g. in the context of UML

→ 3.5 Bilateral semiotic sign, unequivocal communication

Therefore, there are two common situations (3.5):
– homonymy/polysemy: one form, several meanings
– synonymy: several forms, one meaning

Tools can only check the syntactic level (form),
but not the semantic level (meaning)!

5.3 Glossaries, terminology management

The terminology used is defined as exactly as possible:
rich definition

5.4 Conclusion: The model designer's awareness

necessary because the problem is not solvable

6 References

pdf-files of my own publications: see my homepage.

Holl, Alfred; Feistner, Edith:
Mono-perspective views of multi-perspectivity: IS modeling and 'The blind men and the elephant'.
Växjö: Växjö University Press 2006 [= Acta Wexionensia 87/2006 (Information Systems)];
short version = contribution to:
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