



Summer School,
October 11, 2017 – Part 3

Enterprise Modeling

October 2017

Kurt Sandkuhl

The University of Rostock

Chair Business Information Systems

Agenda

■ Wednesday, 11. October 2017

9:00 Introduction to Research Methods

- Frequently used Research Methods in Computer Science and Business Information Systems

10:30 Coffee Break

11:00 Design Science Research (DSR)

- Origin and Popular DSR Models

12:30 Lunch Break

14:00 Enterprise Modeling

- Foundations, Purpose and Selected Methods

15:30 Coffee Break

16:00 Enterprise Architectures

- Approaches and Application Cases

17:00 End

Objectives

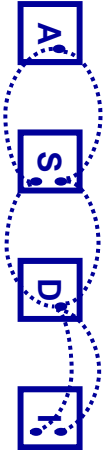
Objectives of this lecture

- To introduce the field of enterprise modelling (EM) with definitions and perspectives
- To give an overview to analysis techniques in EM
- To introduce different EM methods
- To show an example for EM projects

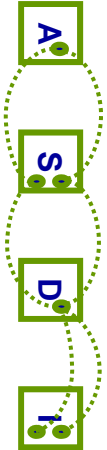
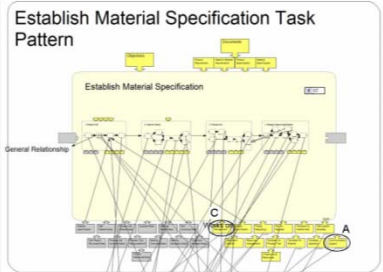
Introduction to Enterprise Modeling

Model and Reality

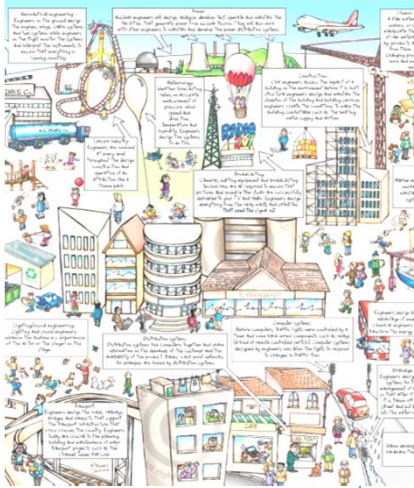
Reality



Model of the Organization



Reality



The Organization

Stakeholders

Method

The Model

Method

The required Activities

Enterprise Modeling

What is it?

- Enterprise Modeling aims at capturing the relevant structures, processes and knowledge of an enterprise in computerized models for solving the problem at hand

Example for possible purposes are

- Understand and visualize the current situation
- Identify and design improvements
- Prepare process innovations and improvements
- Begin information system development
- and many more

Enterprise Modeling – More formal definitions

Enterprise Modeling (Vernadat), 2002):

“Enterprise Modeling (EM), is the art of externalizing enterprise knowledge which adds value to the enterprise or needs to be shared. It consists in making models of the structure, behavior and organization of the enterprise.”

Enterprise Model (Gruninger & Fox, 1998):

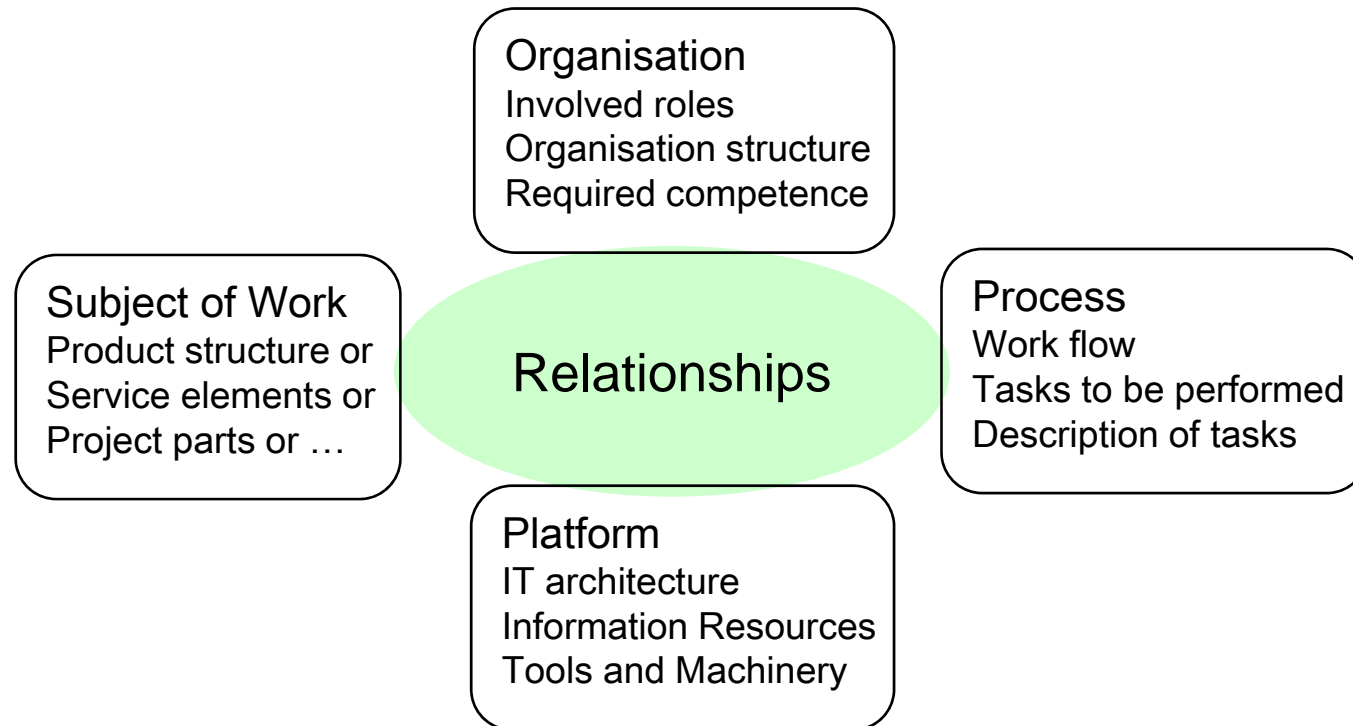
An enterprise model is a computational representation of the structure, activities, processes, information, resources, people, behavior, goals, and constraints of a business, government, or other enterprise. It can be both descriptive and definitional—spanning what is and what should be. The role of an enterprise model is to achieve model-driven enterprise design, analysis, and operation.

Business Process Management (van der Aalst, ter Hofstede & Weske 2003)

Supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents and other sources of information.

Enterprise Modeling – The difference to Process Modeling

The POPS* perspectives in enterprise modelling



Why to model product knowledge in relation with process, organization, etc.?

- A product component
 - Has a process lifecycle (design, manufacturing, maintenance, recycling phases)
 - Is handled by organizational roles and responsibilities (in different phases)
 - Which require knowledge and skills
 - And use systems, data, and software services
 - Has product decomposition structure, and variant hierarchy
 - Has timeline (expected lifespan etc.)
 - Has physical and spatial properties (size, weight etc.)
 - Has money parameters (cost, pricing etc.)
 - Has decisions that controls it (e.g. select among alternative designs)
 - etc.

Layers and Perspectives in Enterprise Modeling

Layers and perspectives are used for reducing complexity in enterprise modeling

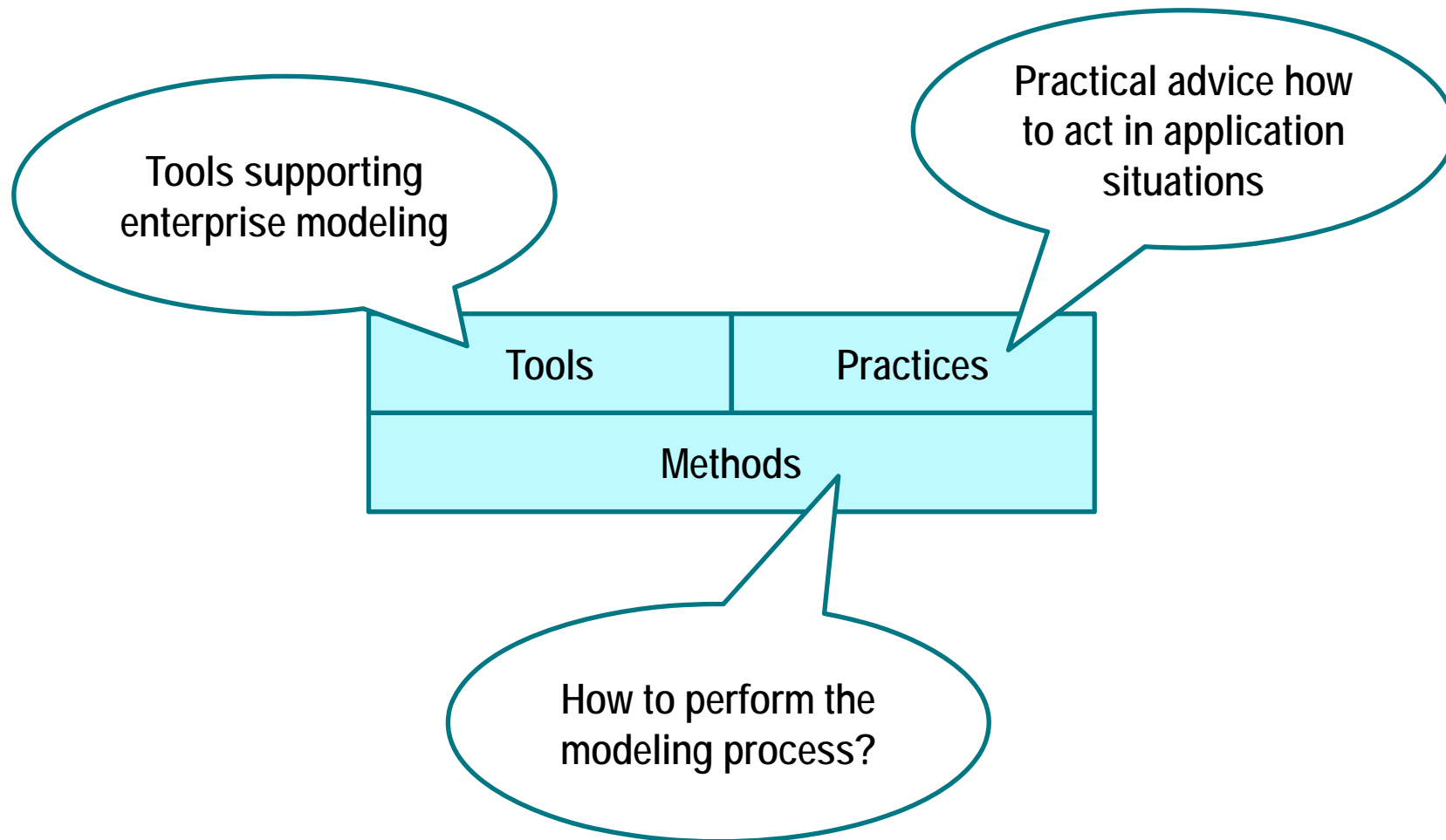
Modeling issue is divided into layers

- with respect to different participants and scopes
- showing different levels of abstraction
- Examples: conceptual model, technical specification, implementation

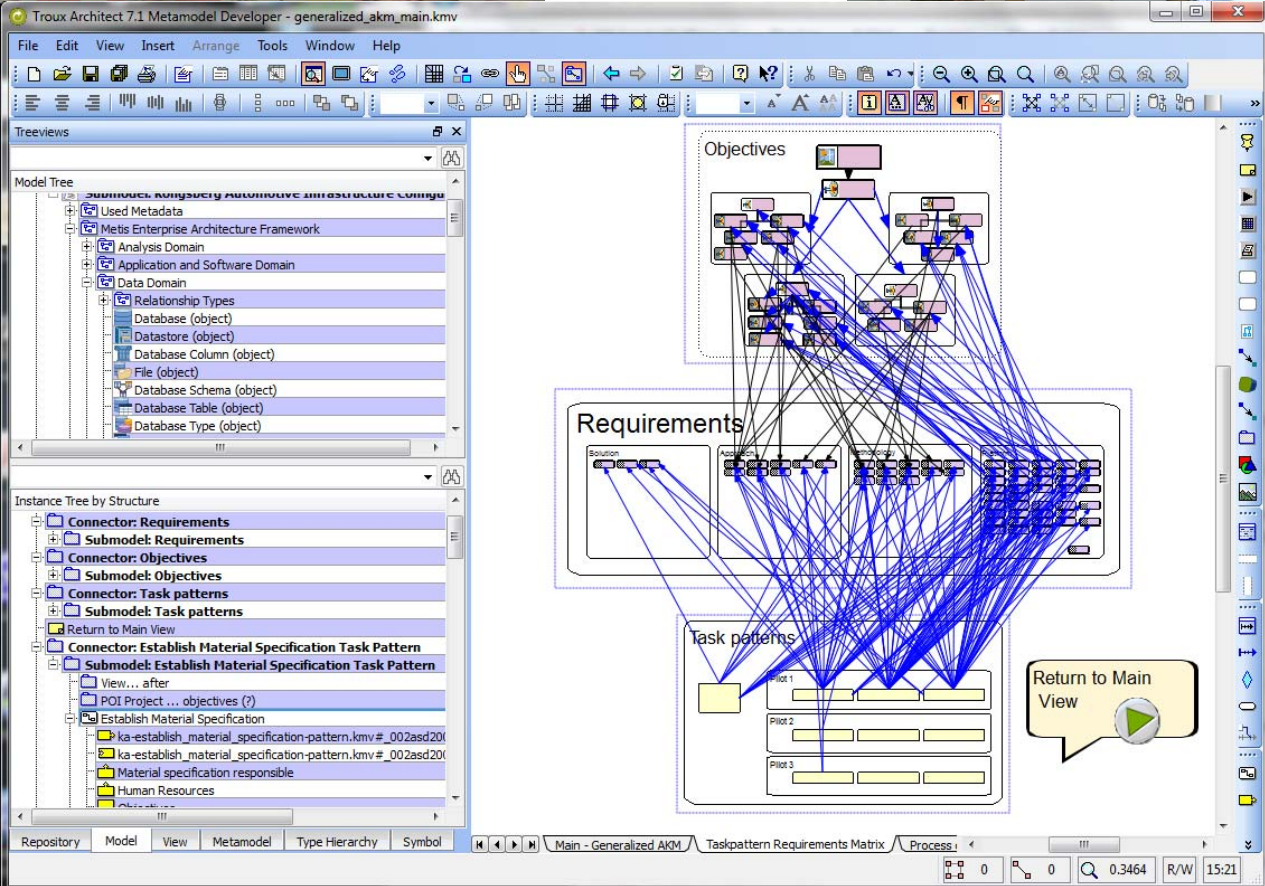
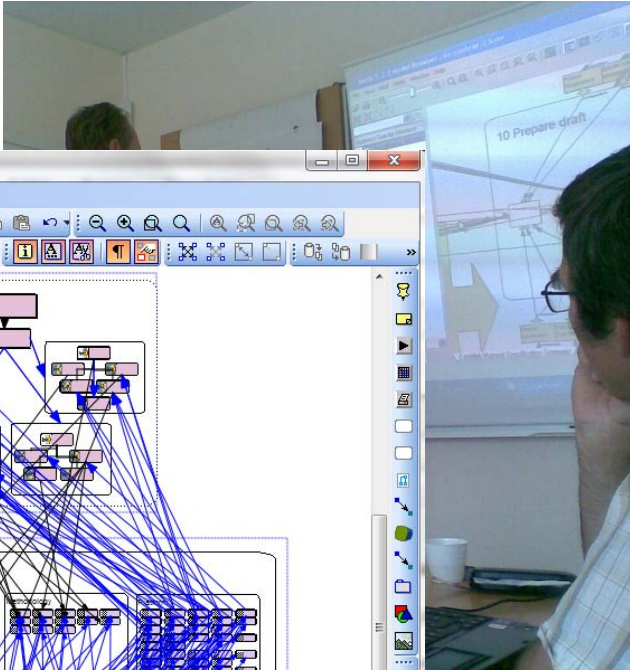
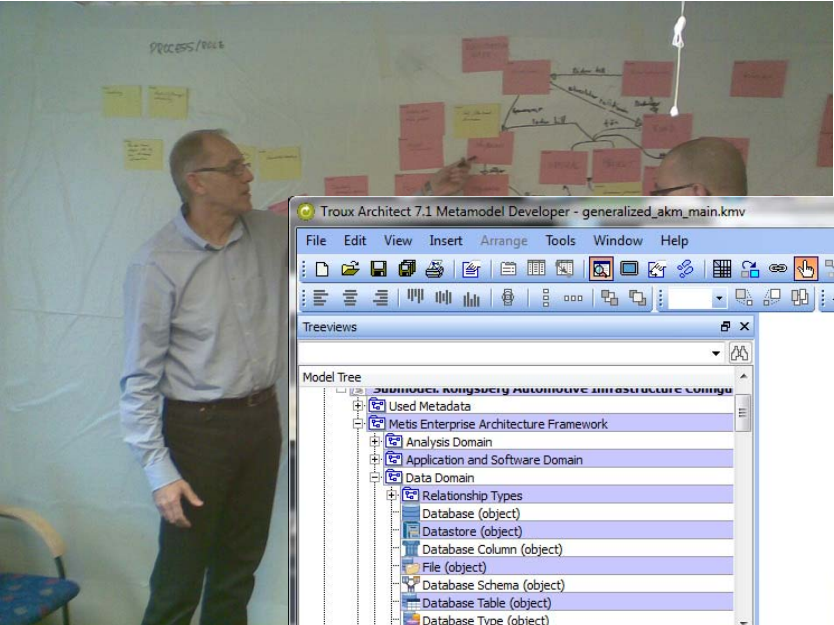
Perspectives of description

- are related to different aspects of the issue to be modeled
- allow for separate inspection is possible and useful
- have to be closely related to each other
- Examples: data, functions, processes, organization

Methods, tools and practices



Enterprise Modelling Tools



Analysis Techniques

Analysis techniques

What is it?

- Analysis techniques are used to elicitate relevant information from real people working in real environments for a given purpose, like
 - Business analysis
 - Requirements analysis
 - Research work

Analysis techniques include

- Inquisitive techniques (brainstorming, focus groups, [interviews](#), questionnaires, [facilitated modeling](#), etc.)
- Observational techniques ([work diaries](#), think-aloud sessions, [shadowing and observation](#), fly on the wall)
- Independent techniques ([analysis of documentation](#), databases,, tool logs, etc.)

Important for all Analysis Techniques ...

- Define scope and purpose of analysis work before starting (define the “mission”)
- Get management support including
 - sufficient time and resources
 - Access to relevant documentation
 - Mandate to propose substantial organizational changes
- Involve participants in the analysis process as early as possible
 - Establish the importance of the project, which includes the analysis
 - Explain the purpose of the analysis work
 - Outline a process for the project and the analysis
 - Set a timeline
 - Explain specific goals and objectives
 - Explain who will be involved, why they are involved and what the results will be used for

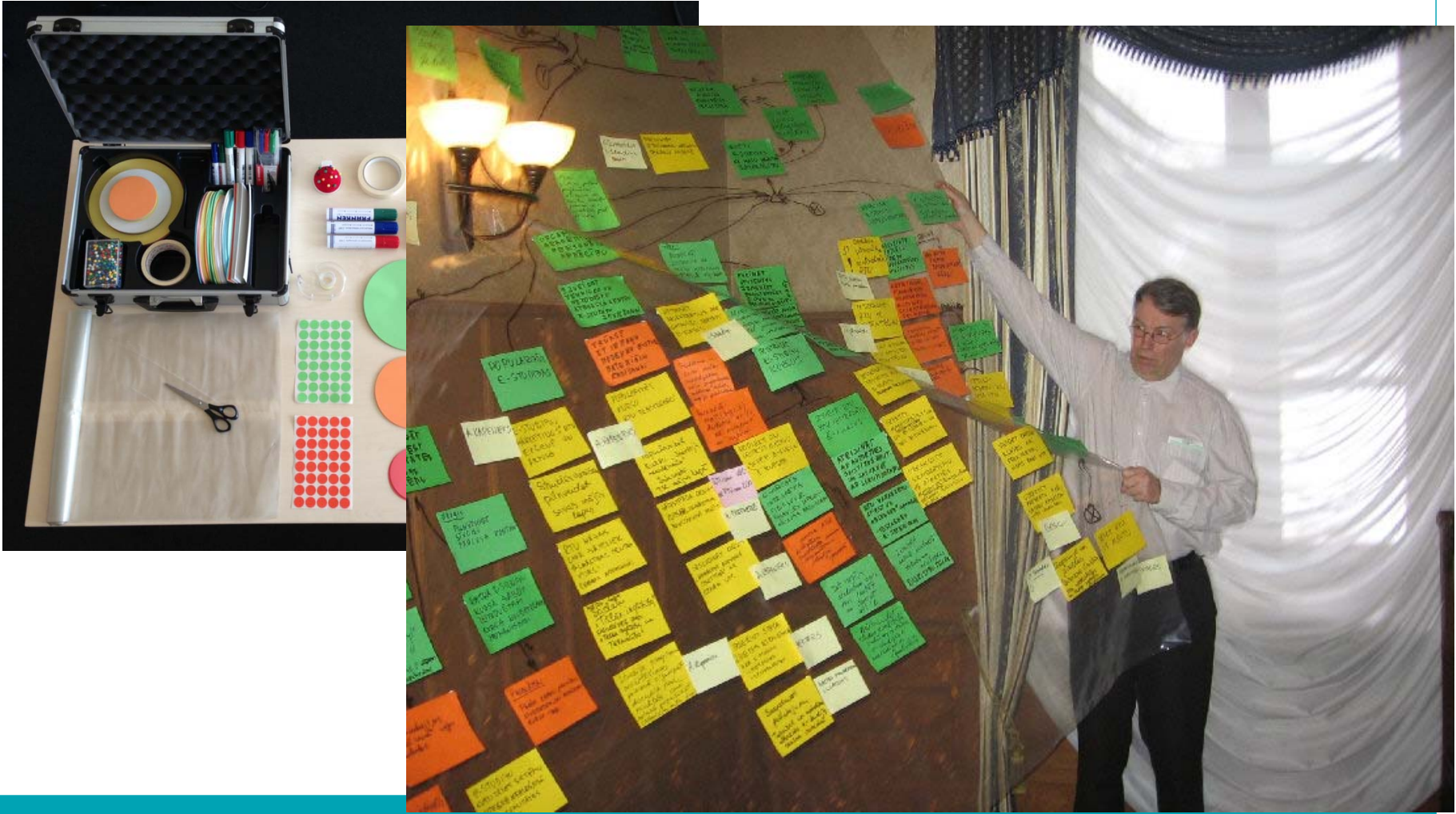
Facilitated Modeling Sessions

Facilitated Modeling Sessions are an essential part of participatory development of enterprise models

Participatory development involves relevant “stakeholders” **actively** in the **whole** process

- stakeholders become **designers** working towards a common set of goals
- stakeholders evaluate their own working results and develop an **ownership**
- Is a purposeful, goal-driven activity which explores different options
- Captures, exposes, and records reasons behind decisions taken
- This aims at achieving **consensus**

Tools for Participatory Modeling



Enterprise Modeling with 4EM

Enterprise Modeling Methods

- Hundreds of methods exist in the field of enterprise modeling
- Most of them focus on one specific aspect of modeling (process modeling, interaction modeling, goal modeling, etc.)
- Many methods with **academic** origin do not provide cookbook-like instructions, only research papers or rough descriptions
- Many methods with **industrial** origin do not provide handbooks for public use
- Method selected for this lecture:
 - 4EM

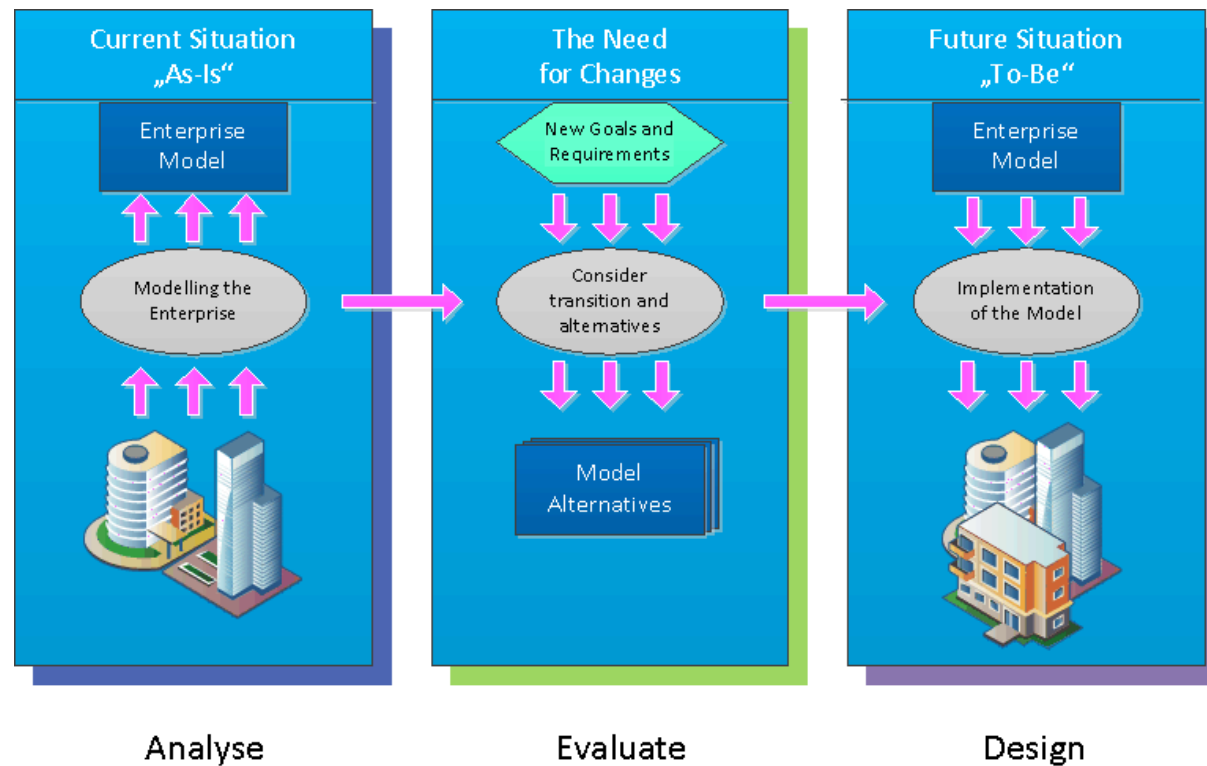
4EM (For Enterprise Modelling)

- 4EM in general
 - is a framework for enterprise modeling, which was designed for ill-structured (“wicked”) problem situations, typically occurring in organisational planning and/or design.
- 4 EM is the successor of the “Enterprise Knowledge Development” method EKD
- 4EM is used for teaching purposes at several universities.

Examples

- Sweden: Jönköping University (Ulf Seigerroth), Stockholm University (Janis Stirna), Skövde University (Anne Persson)
- Latvia: Riga Technical University (Marite Kirikova)
- Norway: NTNU Trondheim (John Krogstie)
- The Netherlands: Open University (Remko Harms)
- Rostock University (Kurt Sandkuhl, Matthias Wißbotzki)

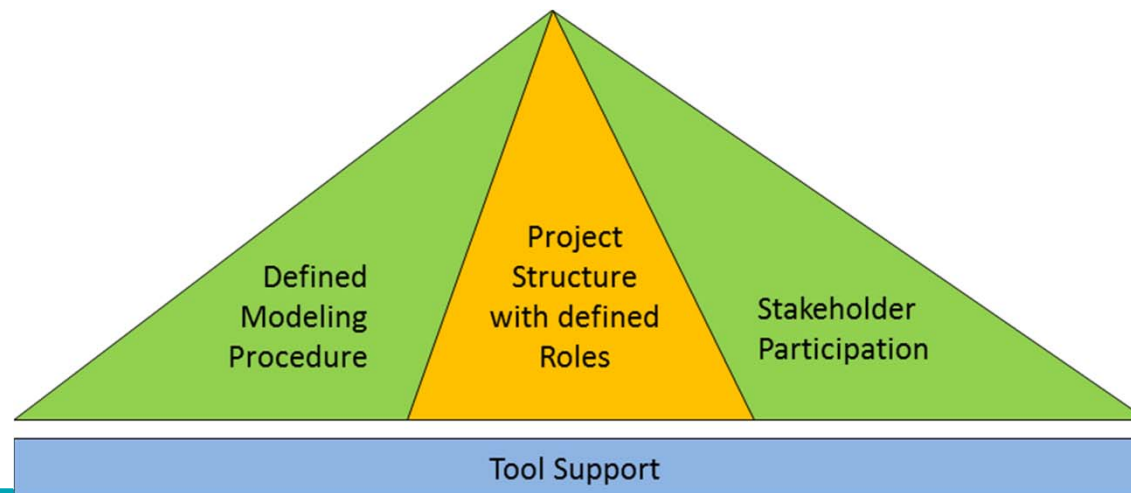
4EM applicability



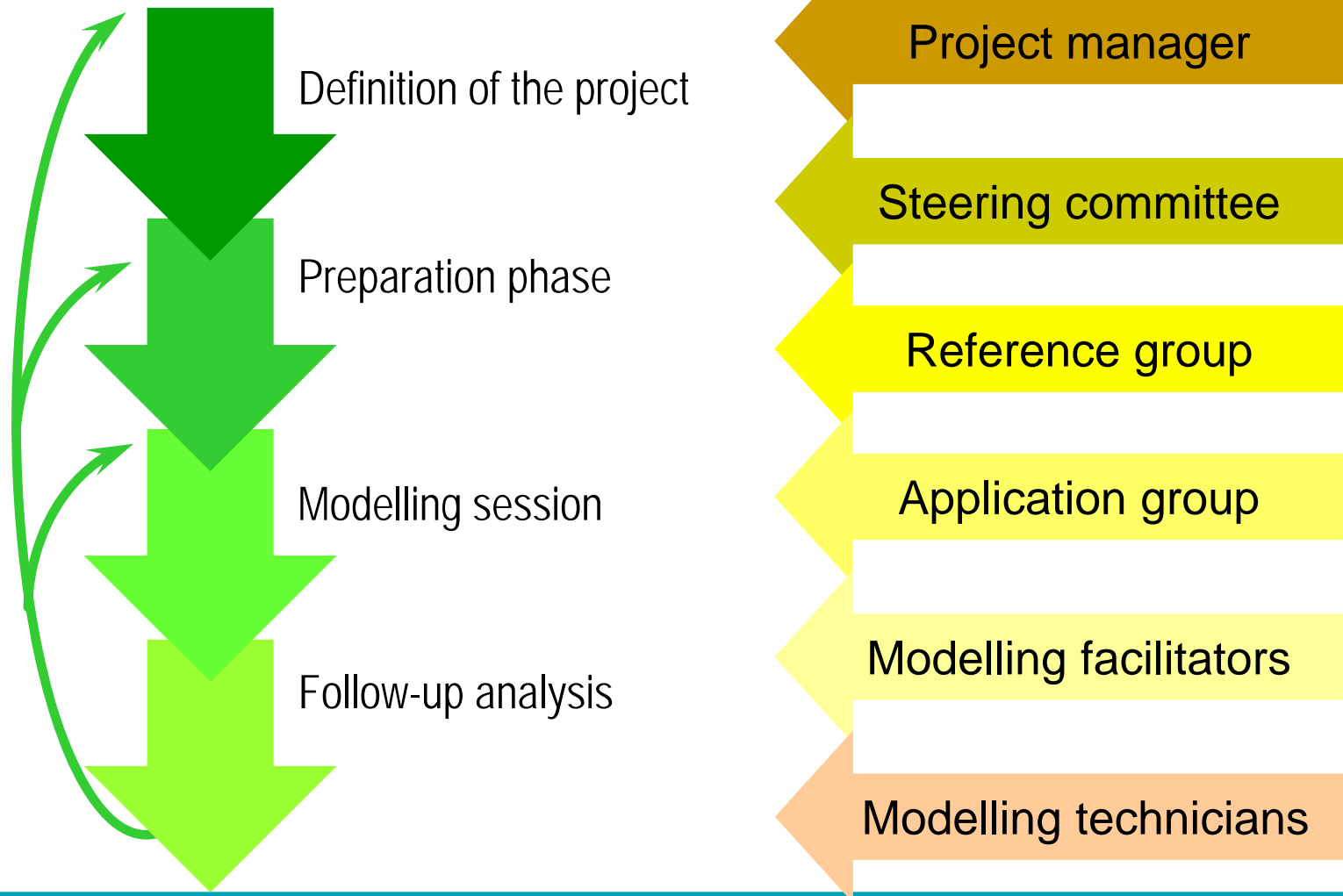
4EM modelling

4EM consists of three core elements:

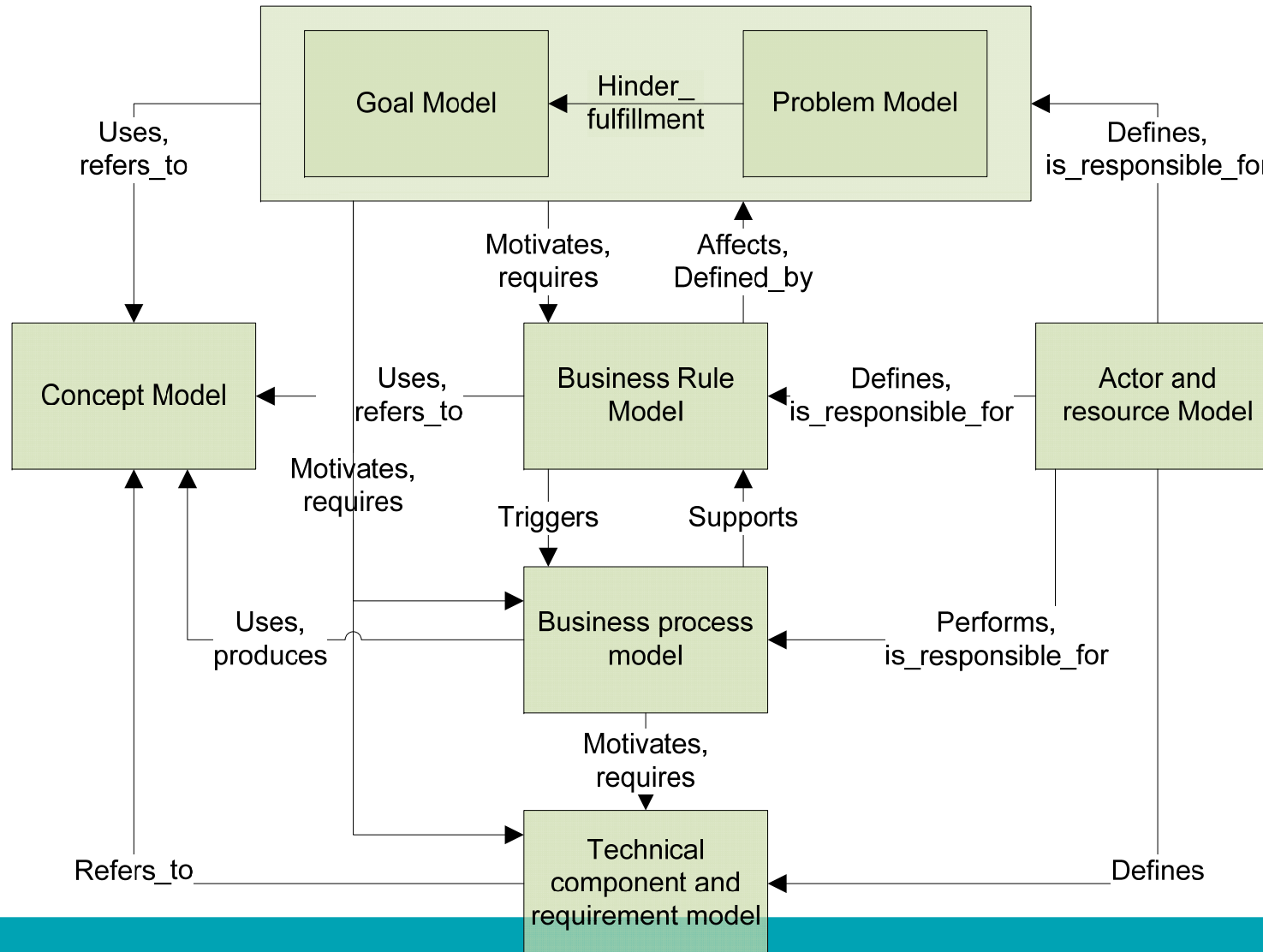
- A defined procedure to modeling using a fixed notation (defined procedure and notation)
- Performance of enterprise modeling in the form of a project with predetermined roles (project organization and roles)
- A participatory process to involve enterprise stakeholders and domain experts (stakeholder participation)



The 4EM Process



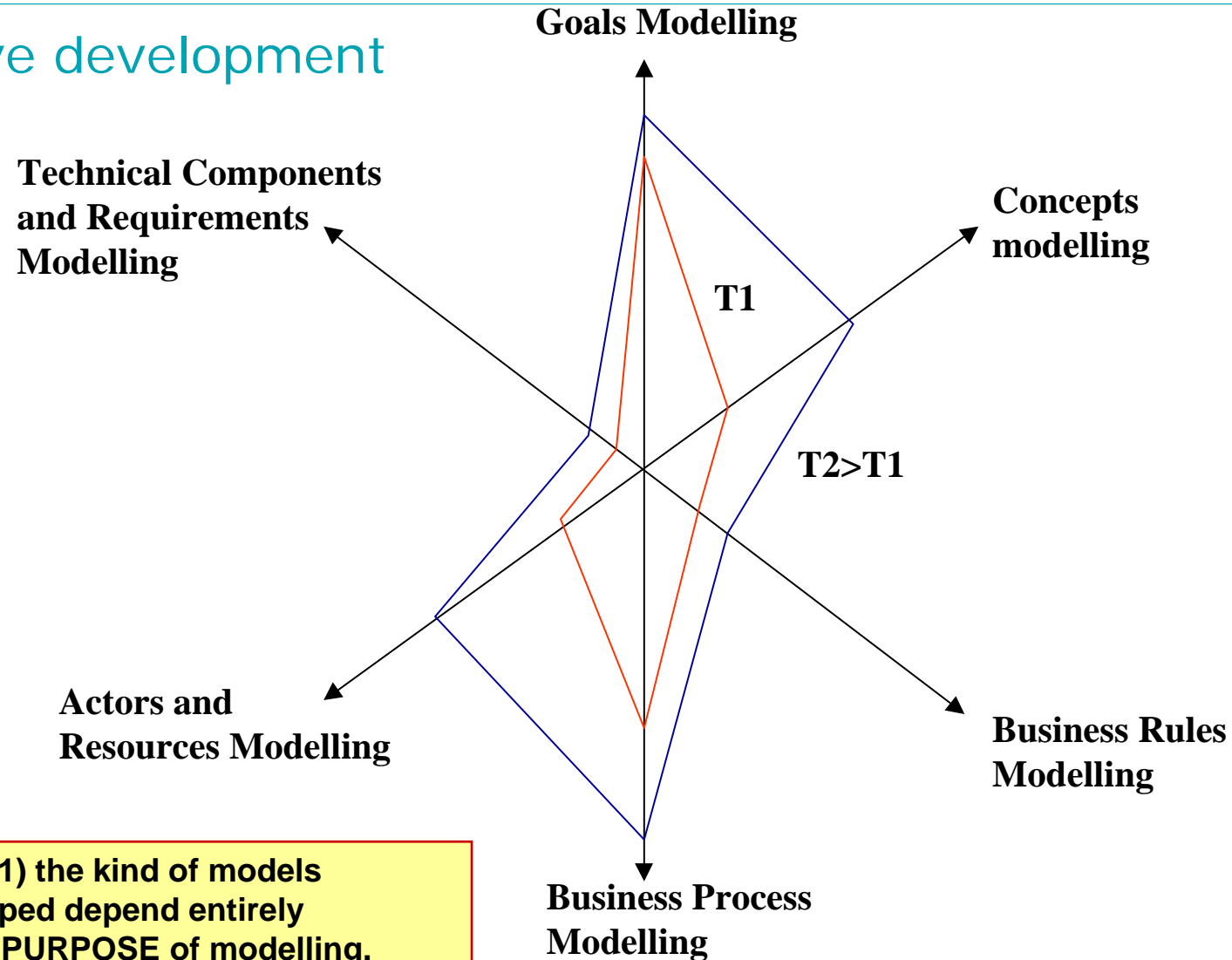
Model types of the 4EM framework (product models)



Short description of the different models

- Goal model (problem detection)
 - Describes what people want to achieve in their business activities
- Process model
 - Describes the flow of activities
- Actors and resource model
 - Who is involved, both actors (having roles) and the organisation
- Concepts model
 - To define the "things" and "phenomena" one is talking about in the other models
- Business Rules Model
 - Describes rules triggering processes or defining constraints
- Technical Components Model
 - Defines information systems and their use in the enterprise

Iterative development



**Note: (1) the kind of models developed depend entirely on the PURPOSE of modelling.
(2) You do not necessary have to start with goals modelling**

The modelling process...

- Modelling is far from trivial:
 - The right persons need to be involved. Choosing the modelling team is important
 - The right things need to be modelled. Choosing the scope for the modelling need to be correctly done
 - The modelled elements need to be modelled correctly. They need to be sufficiently defined in order to be understood

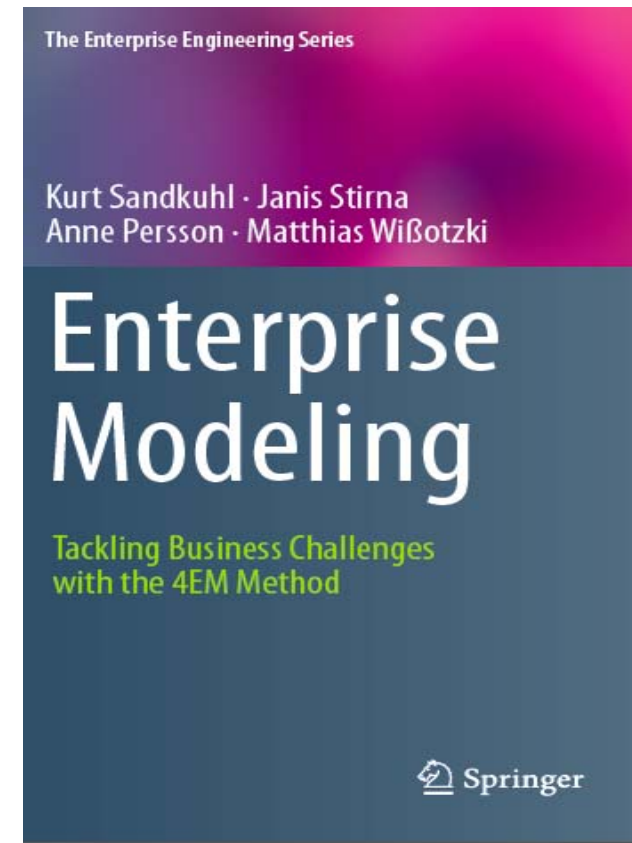
... the modelling process

- Is both a top down and a bottom up approach
 - It can be difficult to model all the elements (e.g. processes) at a certain granularity level correctly from start
 - Even if you are an expert in the field, you may not have structured or organised the elements previously
 - It is part of the purpose of the modelling to find out the structure, to clarify how things are organised.
 - The model(s) need to be reworked several times
 - To find the elements and the structure or way of organising the elements
 - To find the connections between the different models

4EM method

4EM book:

- Sandkuhl, K.; Stirna, J.; Persson, A. and M. Wißotzki (2014)
- Enterprise Modeling: Tackling Business Challenges with the 4EM Method
- The Enterprise Engineering Series
- Springer Verlag, Berlin Heidelberg. ISBN 978-3662437247.



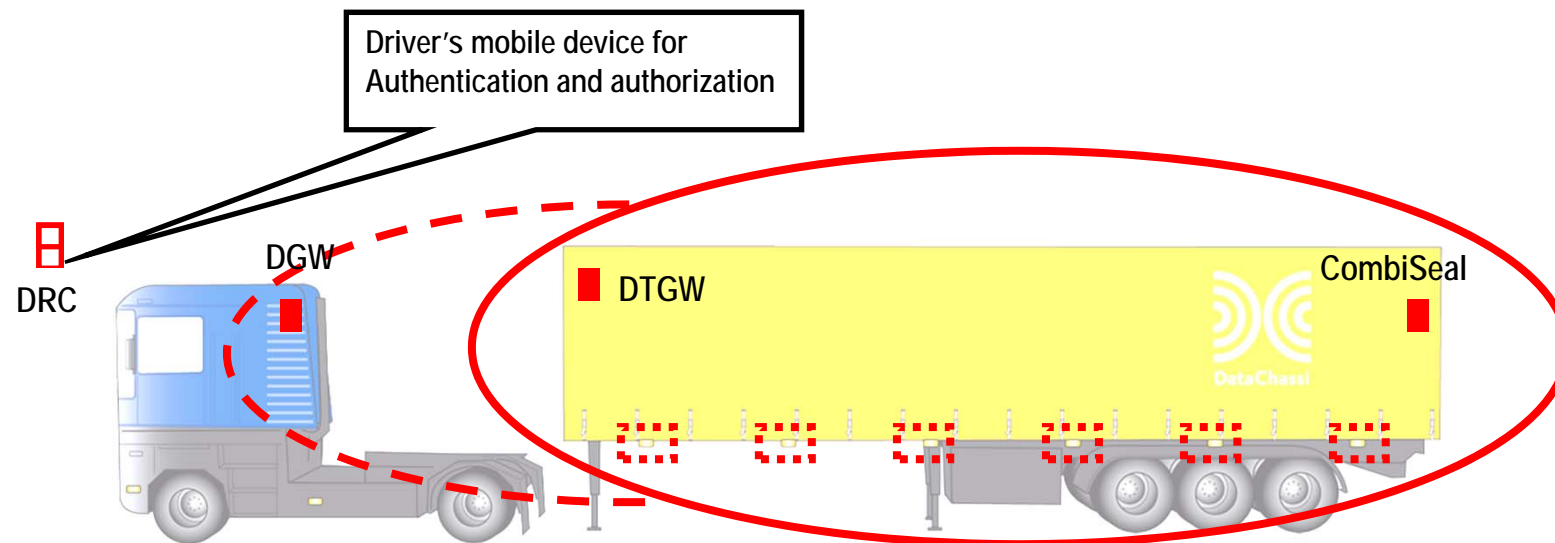
An Example for Enterprise Modeling

Industrial Case from Transportation



Courtesy of and (c) by DataChassi AB, Sweden

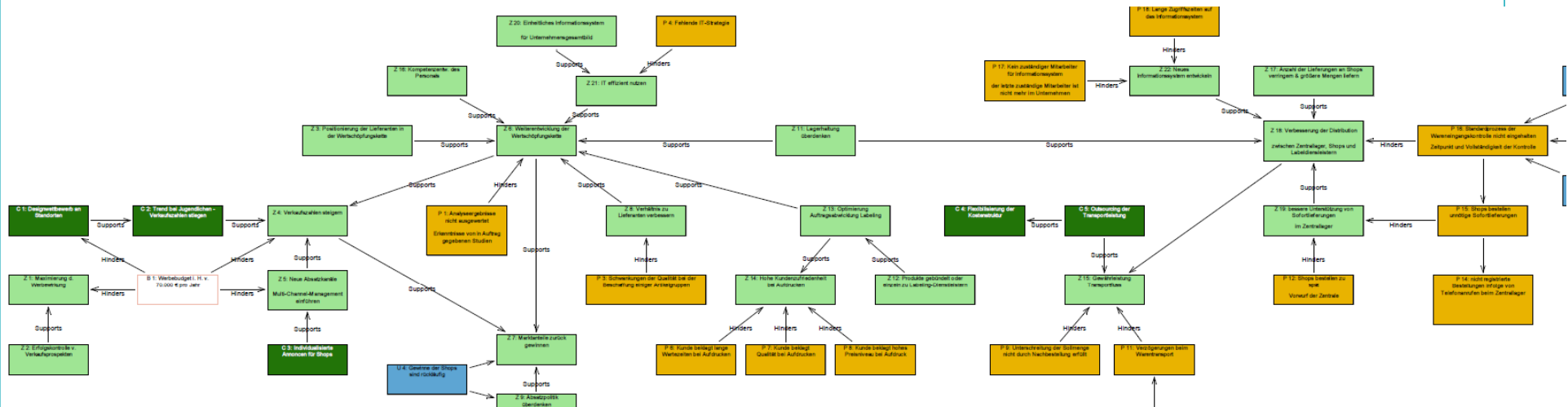
Focus of the example: Trailer Theft Control Service



Trailer theft control service

- The protection service is booked by the trailer owner.
- The trailer is parked, i.e. not moving.
- The protection mode is activated for the trailer.
- A truck driver sends the “unlock” request.
- The authorization process of the truck driver is successful
- The driver is in the close vicinity of the trailer.

Goal Model

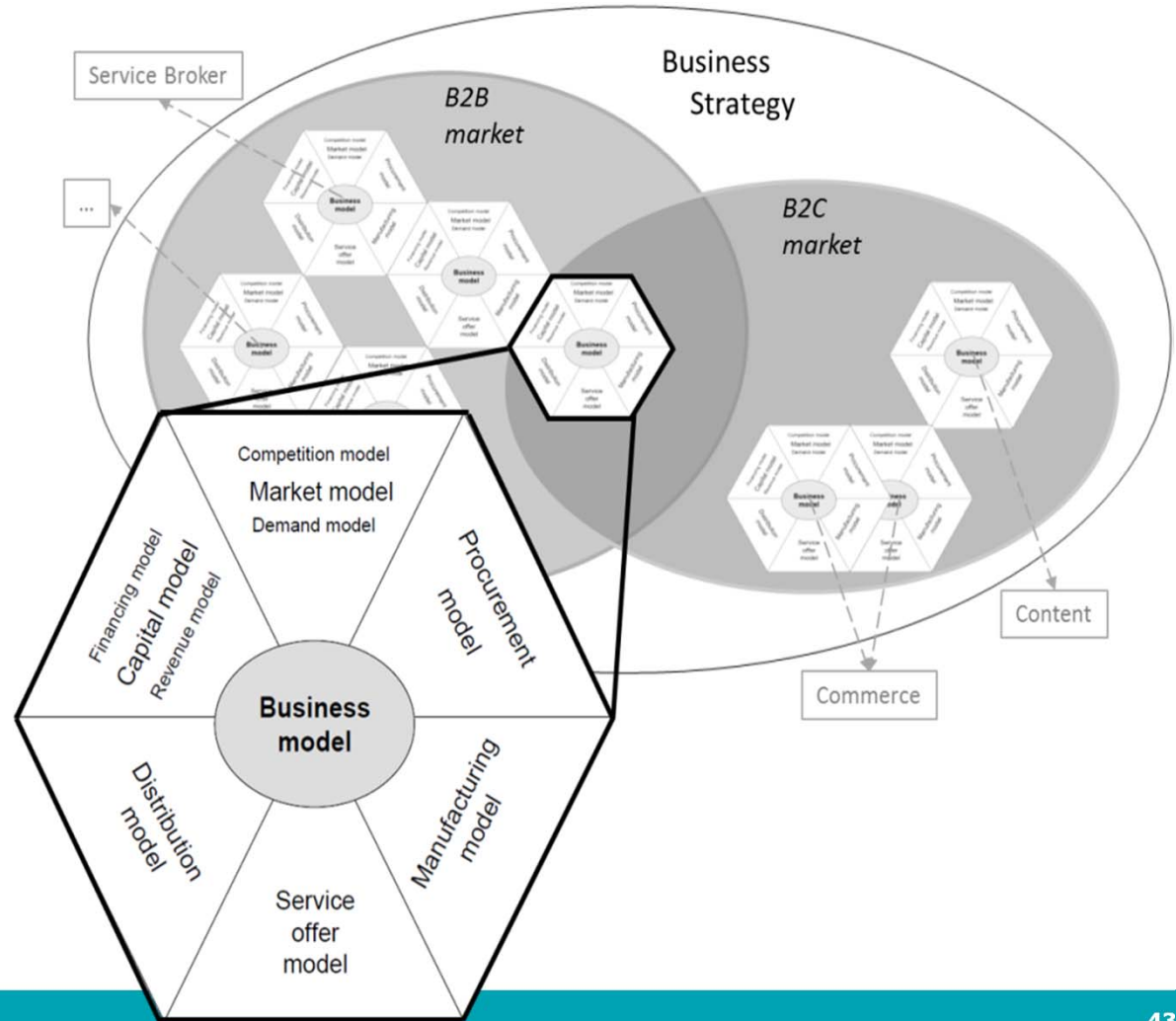


Developed in a participatory modeling session

Priority Goal:

- To establish STAC service for medium-sized and large haulers operating substantial fleets of trailers
- within the next 3 years reaching at least 500 installations
- based on own sidemarking light hardware and back-office, trailer gateway and back-office infrastructure

Business Model – Different Perspectives [Wirtz 2011]



Partial Business Model for Trailer Theft Control (1)

Partial models of business model		Business model of trailer theft control
Market model	Demand model	Main target group are medium-sized and large haulers operating substantial fleets of trailers. Within this group, different segments have to be distinguished, like soft-shell trailers for electronic fence products.
	Competition model	For transport access control, conventional secure parking areas and security services can be considered as competition. The offered IT service as such up to now is unique on the market.
Procurement model		<p>Different elements of the services are contracted to service providers:</p> <ul style="list-style-type: none"> • authentication of the truck driver: provided by trust center • communication between gateway and back-office: provided by telco • security service in case of security incident, e.g. attempt of theft: provided by security provider

Partial Business Model for Trailer Theft Control (2)

Partial models of business model	Business model of trailer theft control
Manufacturing model	The general administration services, operational services and control services all are provided from the own back-office of the enterprise using own IT hardware and software systems
Service offer model	The transport access control service is offered as stand-alone IT service or as "security bundle" with the services "electronic fence" and "electronic seal".
Distribution model	Distribution is based on the (mobile) communication channels offered by telco. Additionally Service delivery depends on the customer's ability to provide an appropriate operating environment for the back office applications needed.

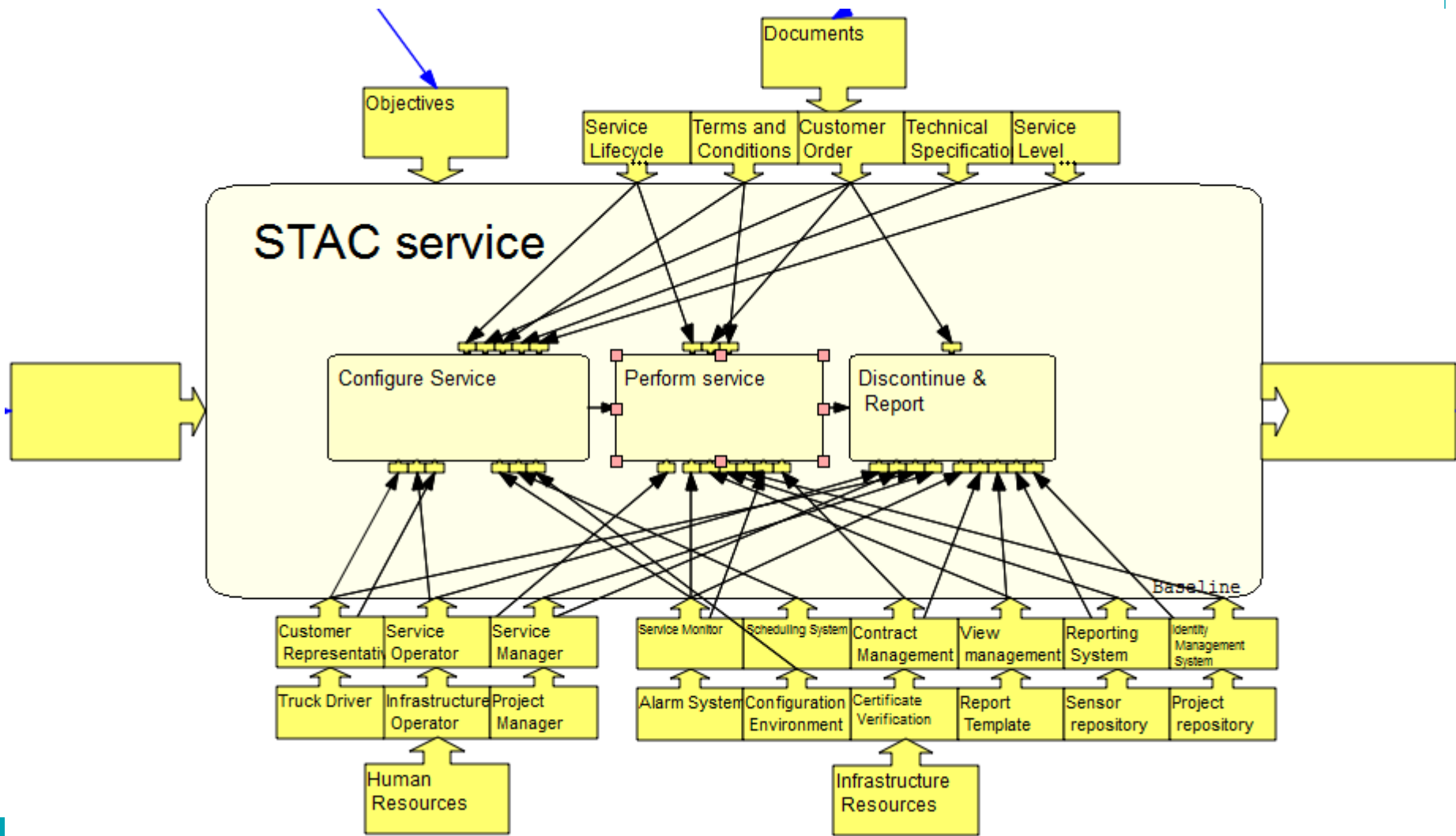
Partial Business Model for Trailer Theft Control (3)

Partial models of business model		Business model of trailer theft control
Capital model	Financing model	Operating costs are financed by internal funds of the enterprise.
	Revenue model	<p>The pricing for the service includes a basic fee for each hauler depending on the size of the fleet. Furthermore, for each trailer to be supervised, an additional fee is charged, which is calculated based on the duration of the protection.</p> <p>In case the service is bundled within the security package, the basic fee is the same as for a single service, but the trailer-based fee is higher.</p>

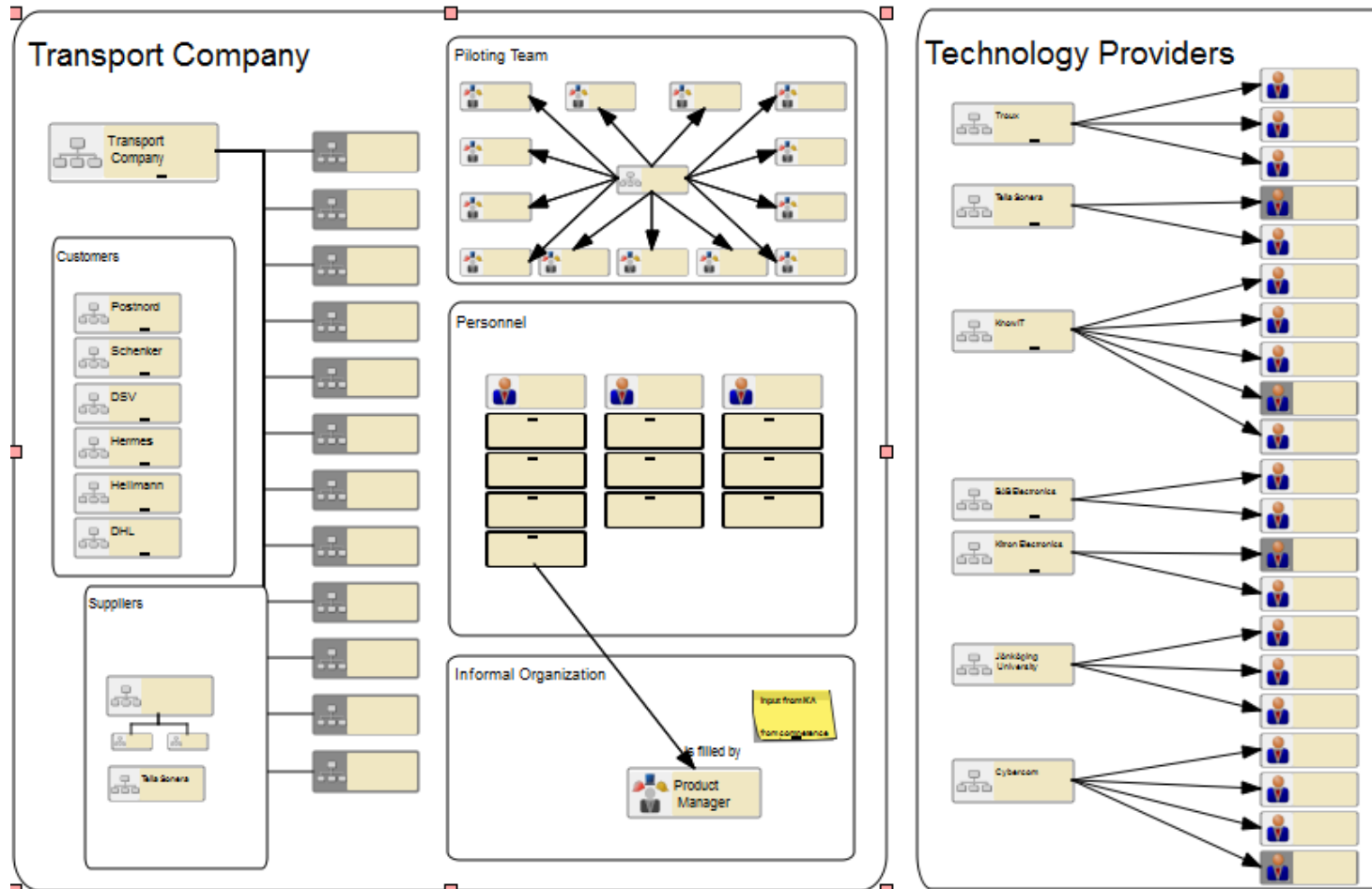
POPS Perspectives of Enterprise Model

- Development of an enterprise model
 - Processes: product-in-use and back-office
 - Organisation: roles involved
 - Product: general service product structure
 - System: technology required

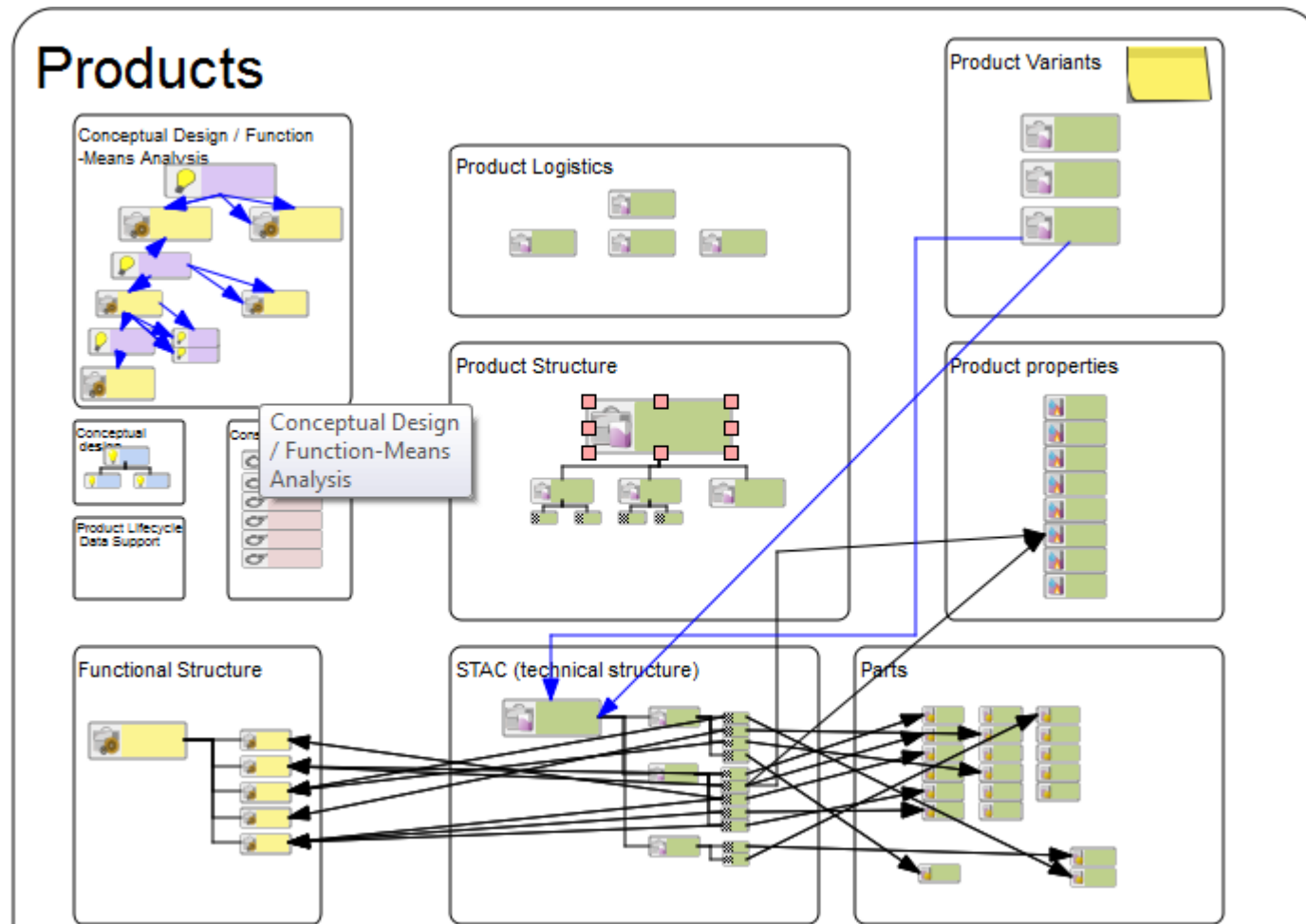
Business Process Perspective (Excerpt)



Organisation Perspective



Product Perspective

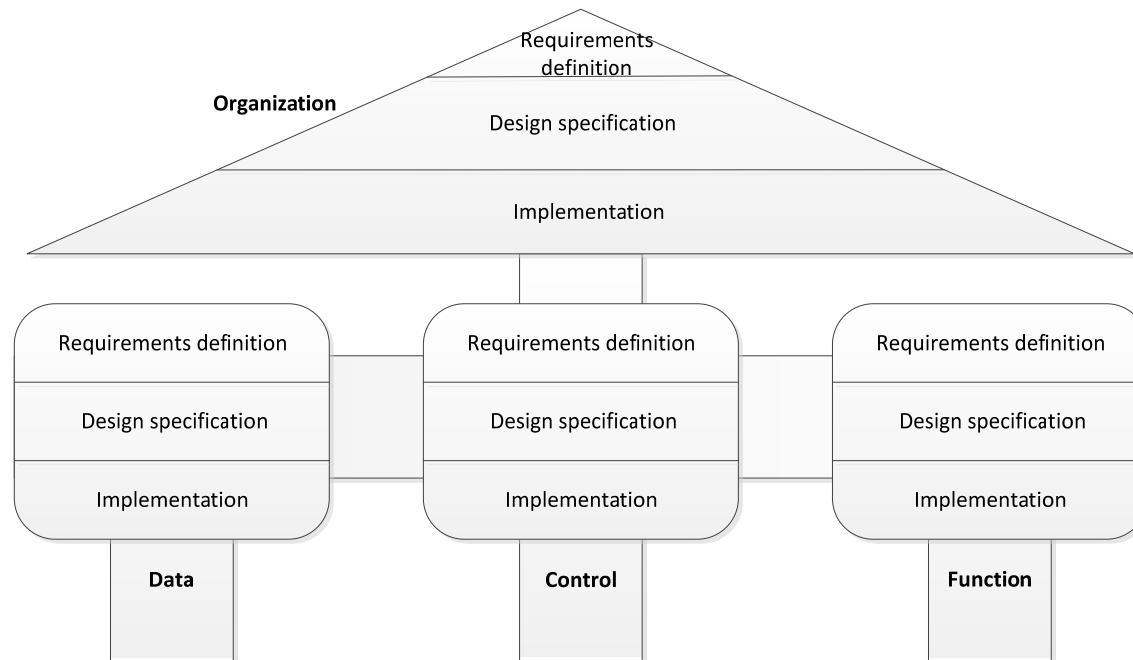




Enterprise Modeling Methods

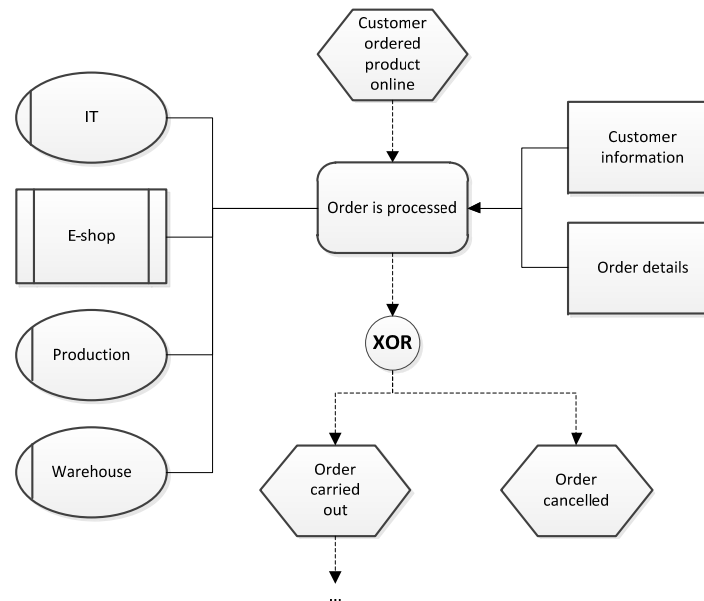
ARIS – Architecture of Integrated Information Systems

- One of the first multi-perspective enterprise modeling approaches presented by August-Wilhelm Scheer in 1990



ARIS – Elements of the Approach

- ARIS provides a methodological framework to support process modeling activities, which also offers the possibility to describe the dynamics of the business processes. A modeling language known as Event-driven Process Chains (EPC) is part of ARIS. EPC are widely used in industry and supported by a large number of modeling tools.



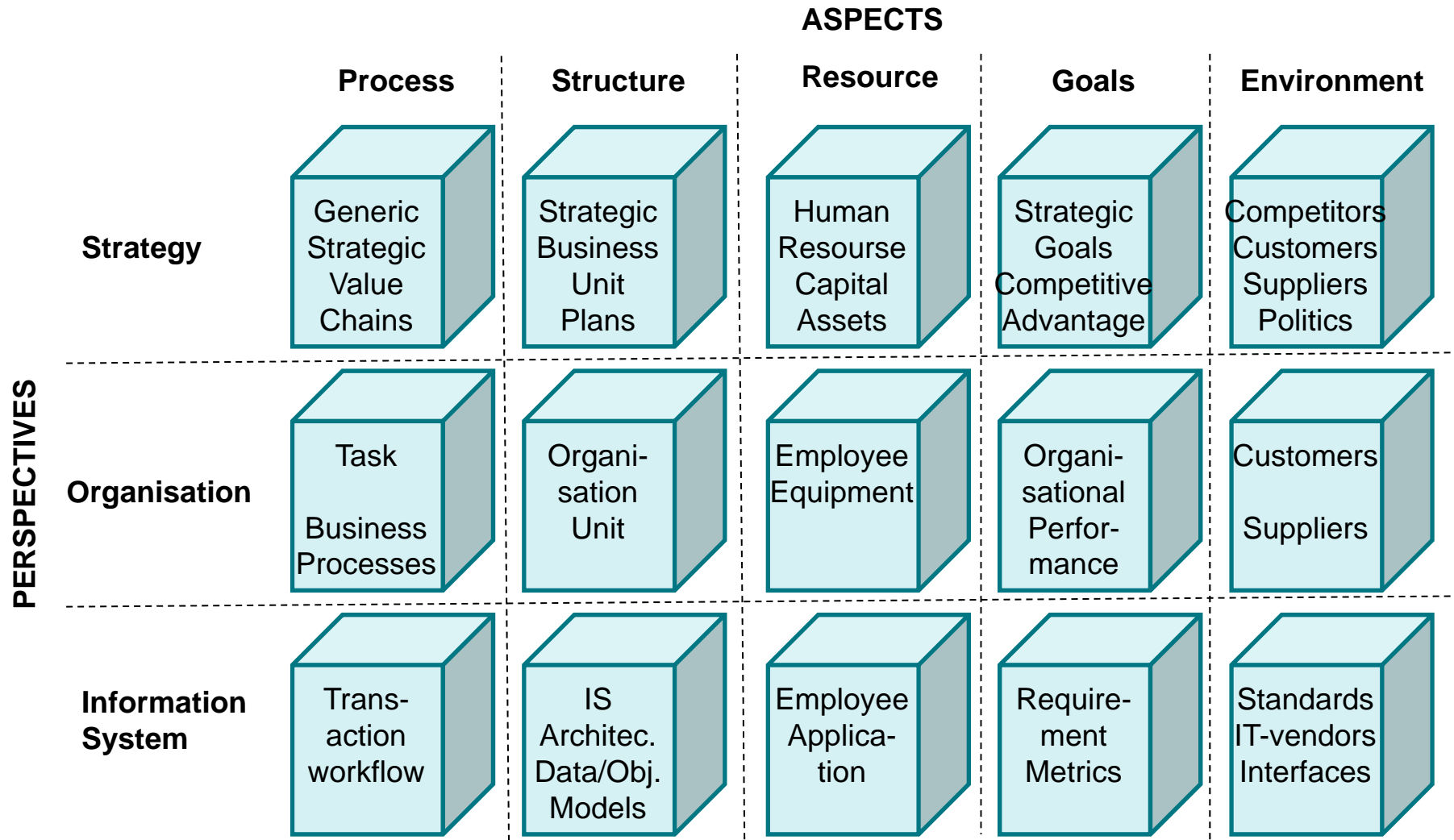
ARIS – Elements of the Approach

- ARIS distinguishes between four different views:
 - *Function View*: ARIS distinguishes between two possible representations: function tree and goal diagram. A function tree is responsible for indicating the complexity and hierarchy of objects and corresponding relationships. In comparison, the goal diagram defines different business goals and creates a hierarchical structure among these.
 - *Data View*: This view contains two content perspectives: information and data. The elements of this view are usually modeled by using entity relationship models (ERM) with their components: Entities, Attributes and Relations.
 - *Organization View*: The organization view of ARIS focuses on the organizational structure of an enterprise describing how the parts of the enterprise, the organizational units, are organized and how they are related to each other.
 - *Control Process View*: This view captures connections between events and functions representing the flow of the process. In contrast to the static functional and data models, the control view focuses on procedural (time-based, logical) aspects describing coherences of functions.

Multi-Perspective Enterprise Modeling (MEMO)

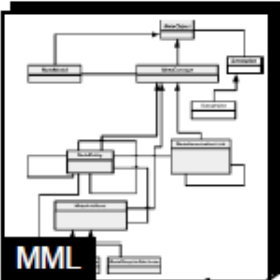
- *Methodical modeling framework* developed by Ulrich Frank (now Uni Duisburg-Essen) at the beginning of 1990s
- originally for administrative parts of enterprise only
- Approach to model information systems from multiple perspectives
- Subdivided into three perspectives with each covering five similar aspects of information systems
- Offers a modeling language for each perspective covering one or more aspect(s)

MEMO Framework

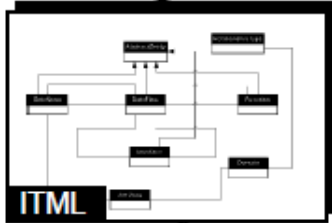
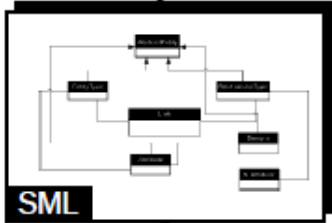
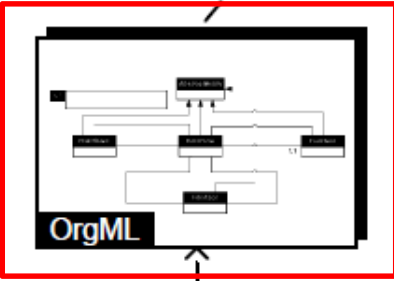
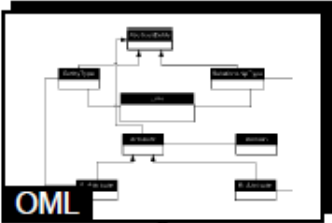


MEMO Language Layers

Meta Meta Model

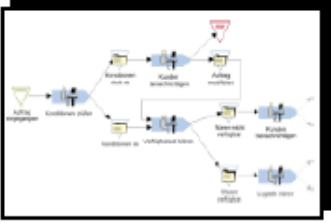
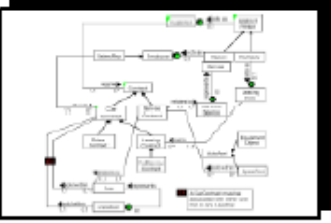


Meta Models



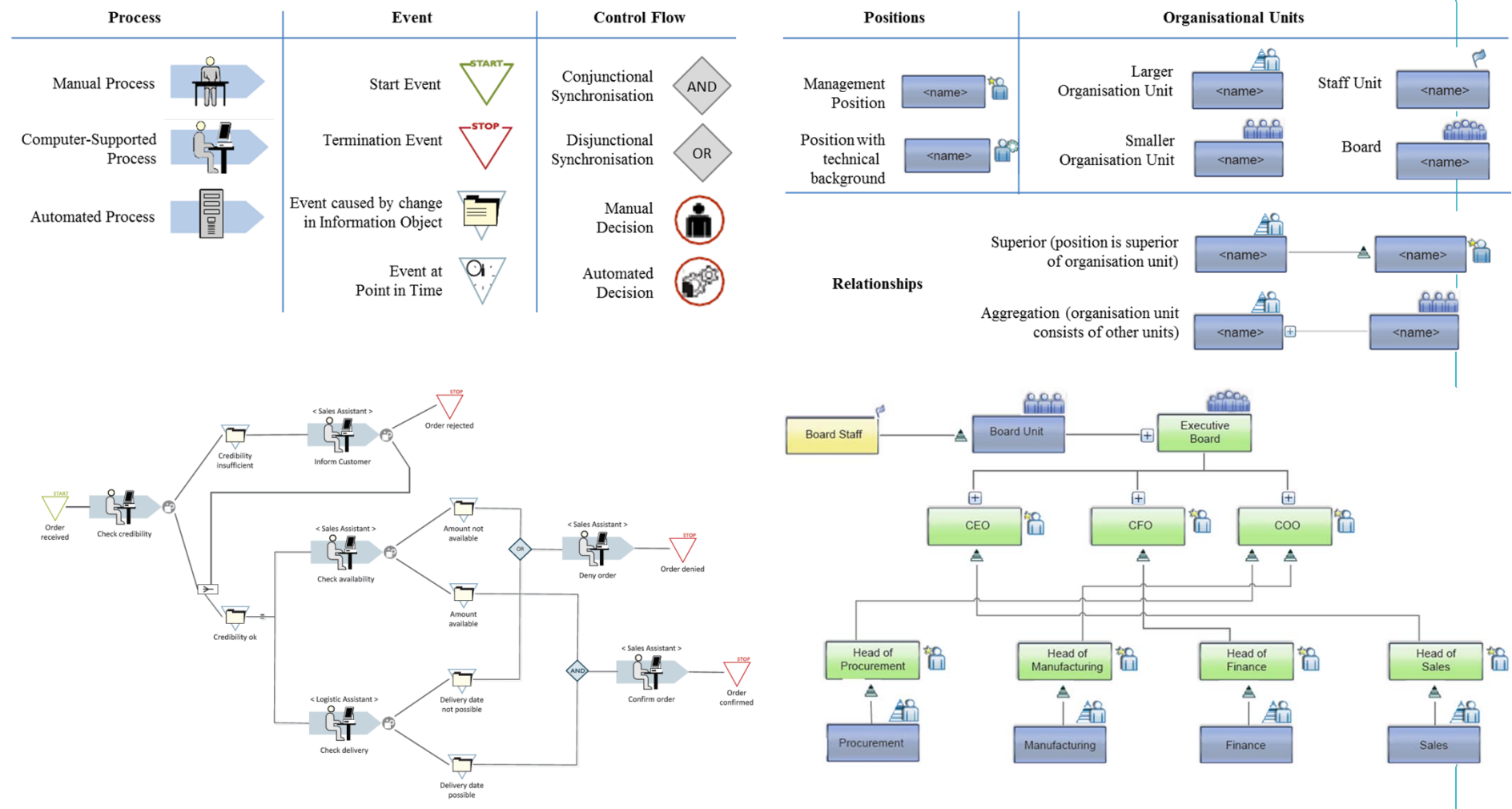
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Models



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MEMO – Model Example





AKM

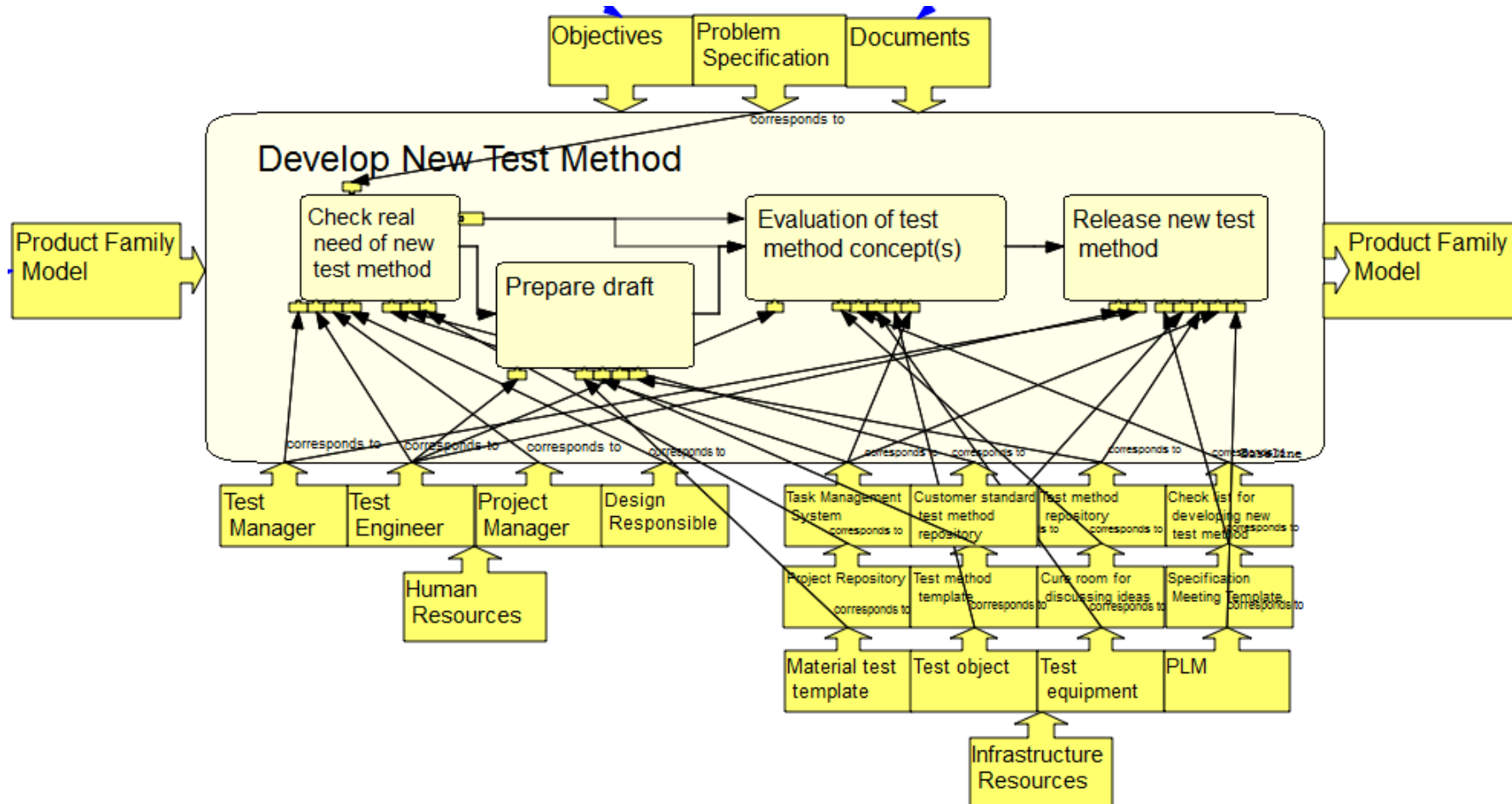
- Active knowledge modeling aims at supporting work in enterprises with executable solution models which can be updated while working in order to always reflect the current status of enterprise knowledge

AKM – Elements of the Approach

- C3S3P Modelling Methodology

- **Concept Study:** pre-studies are performed to investigate whether EM is a suitable and accepted way of developing executable solutions
- **Scaffolding** aims at creating shared knowledge and understanding among the participants of the project
- **Scoping (aka Scenarios):** creation of models for a defined scope including all relevant dimensions required, like process, product, organization or IT-systems
- **Solutions Modelling:** refining the scoping model by integration personnel, product structures, document templates and IT systems required for using the enterprise model in an actual project
- **Platform Configuration:** configure the solution models for use by connecting the enterprise model to the platform used
- **Platform Delivery:** encompasses the roll-out of model-configured solutions
- **Performance Improvement** by capturing indicators for process and product quality and using adequate management instruments.

AKM – Model example



Additional Literature

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Thank you for your time and attention!

Questions?

Contact:

Prof. Dr. Kurt Sandkuhl

Phone: (0381) 498 7400

kurt.sandkuhl@uni-rostock.de