

Manufacturing Systems Modeling

KSEE 2011



Volvo Group 2010

Turnover: 265 billion SEK

Number of employees: 90,400

Volvo Trucks



Renault Trucks



Mack Trucks



UD Trucks



Buses



Construction Equipment



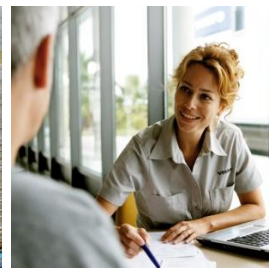
Volvo Penta



Volvo Aero



Financial Services



Volvo Aero



Components for aircraft engines and gas turbines



Military aircraft engines



Sub systems for rocket engines



Engine Services

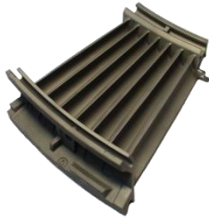


Turnover: 7,7 billion SEK

Number of employees: 2880

Volvo Aero Norge AS

- Vanes



- Shafts



- T-cases



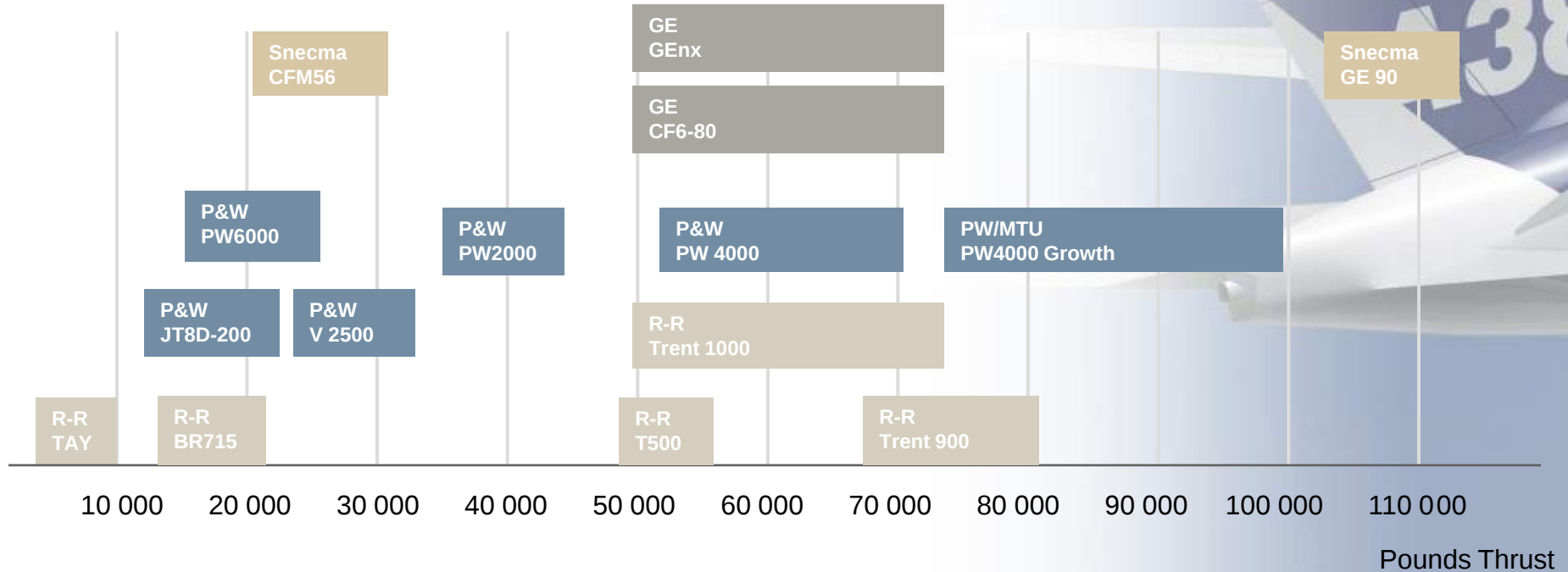
- X-Cases



Volvo Aero Norge AS

VOLVO AERO

Volvo Aero is a partner in several commercial aircraft engine programs

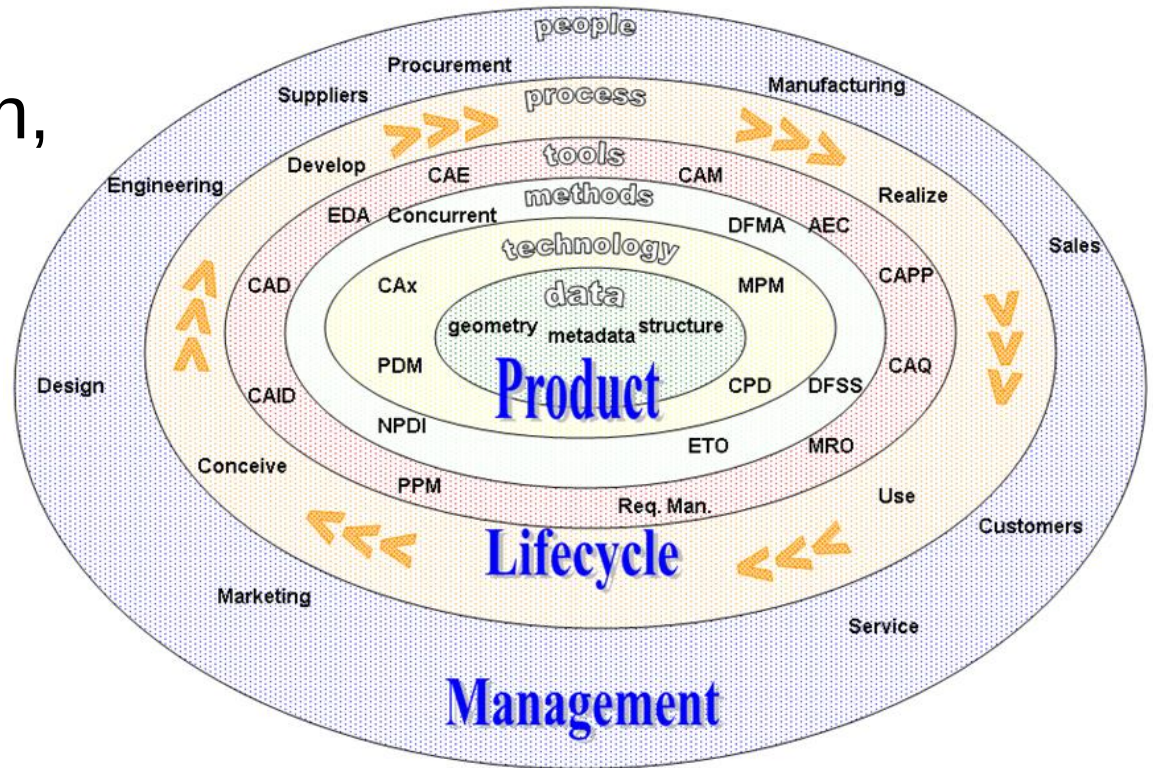


Background

- Product Lifecycle Management (PLM)

Managing the entire life-cycle of a product from its conception, through design and manufacture, to service and disposal

Wikipedia



Why Architecting - why modeling?

- Products

- Business processes (VPL)

- Change processes

- Rework (MRB, ...)

- Machines / Workcenters

- Tools, Gauges

- Fixtures

- Heat Treatment procedures

- NDT

- Robots

- Quality standards (AS9100)

-

PLM involves a multitude of people, processes, tools, methods, technology and data

Systems Architecture interconnects complex, fully or partly independent systems

Interoperability is a quality and needs to be approached as part of architecture development

Dr. Mark W. Maier

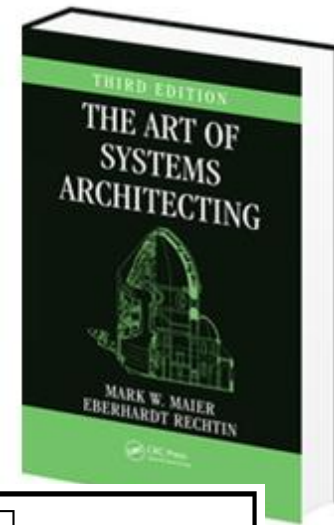
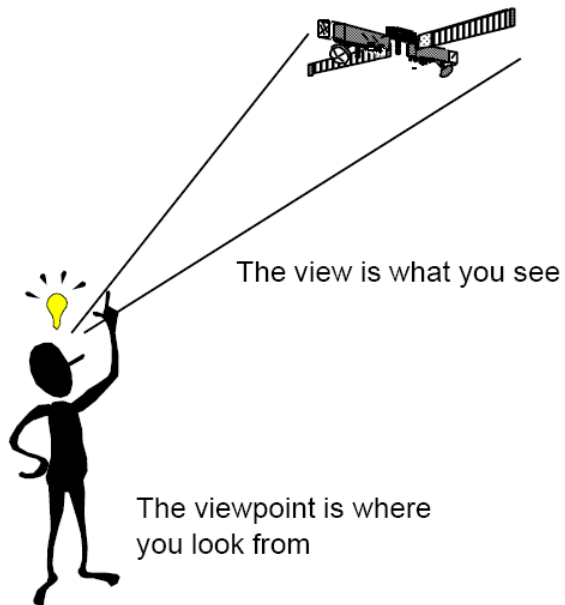
Four Traditional Methods of Architecting:

- Normative
 - Hard rules are provided, success is defined by following the rules
- Participative
 - Solution from group process / group consensus
- Rational
 - Solutions derived from objectives
- Heuristics
 - Develop solutions from lessons learned (guidelines, rules of thumb, ...)

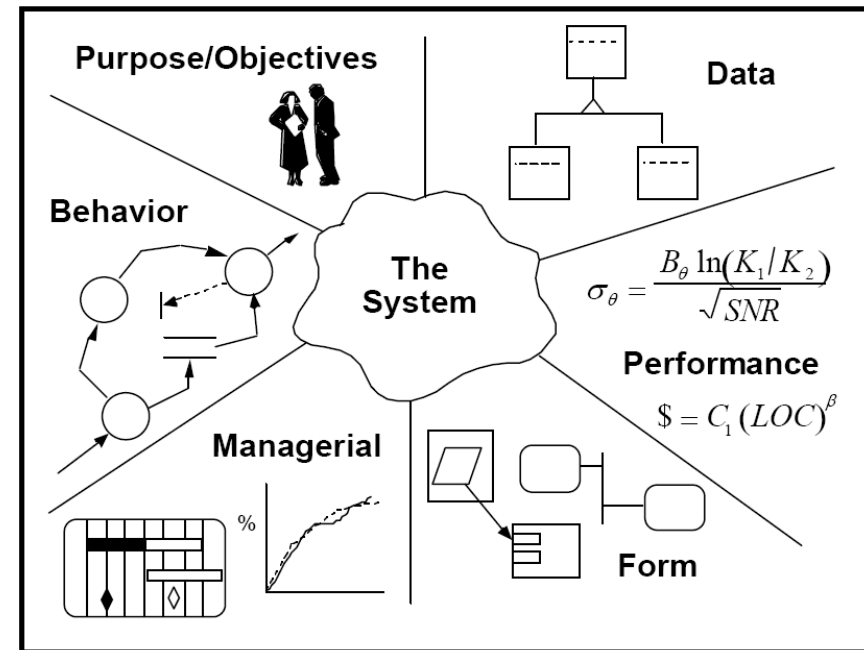
In practice, successful architecting is a mixture of rational and heuristic methods, with some participative and normative used in particular situations

Mark W. Maier

Model organization



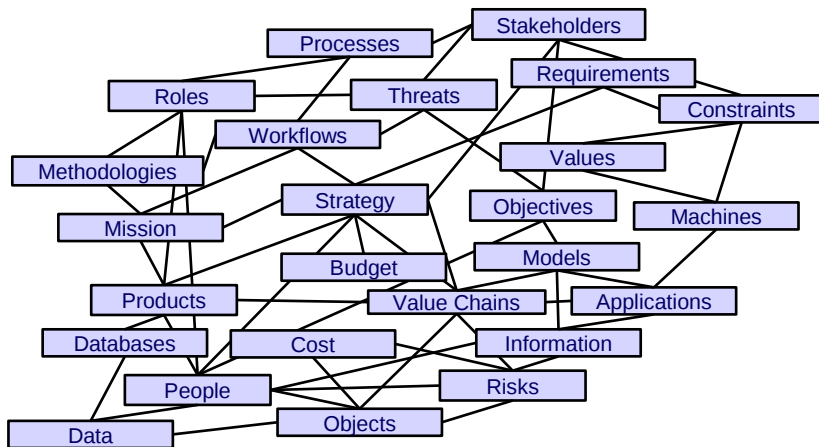
Six-View Modeling



Maier, M. W., Integrated Modeling: A Unified Approach to System Engineering, *Journal of Systems and Software*, 32:2, Feb. 96

Two opposite approaches to modeling

The Bottom-Up approach



**A Model is an
abstraction of
Reality**

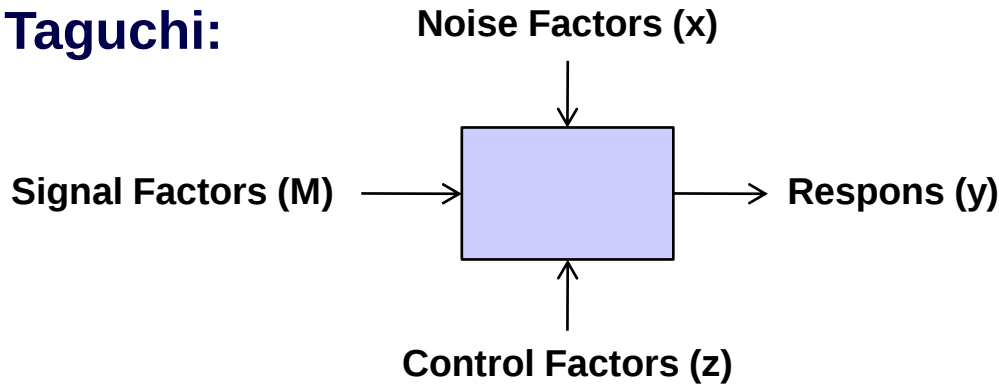
The Top-Down approach



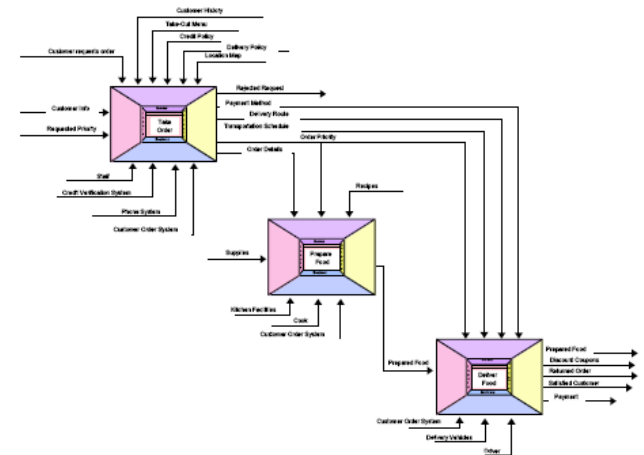
The Top-Down approach

Selected view and level of abstraction depends on the "viewpoint"

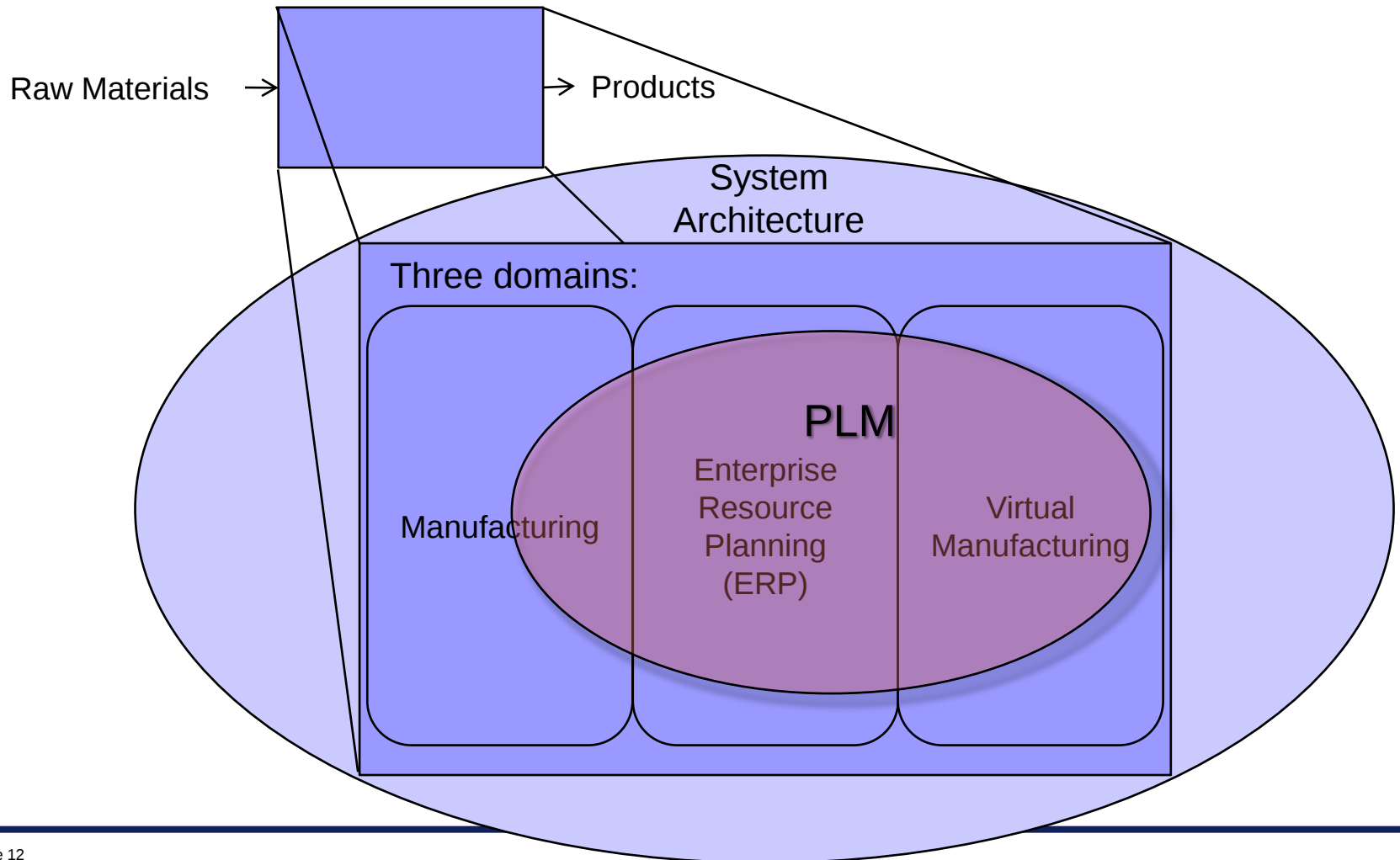
Taguchi:



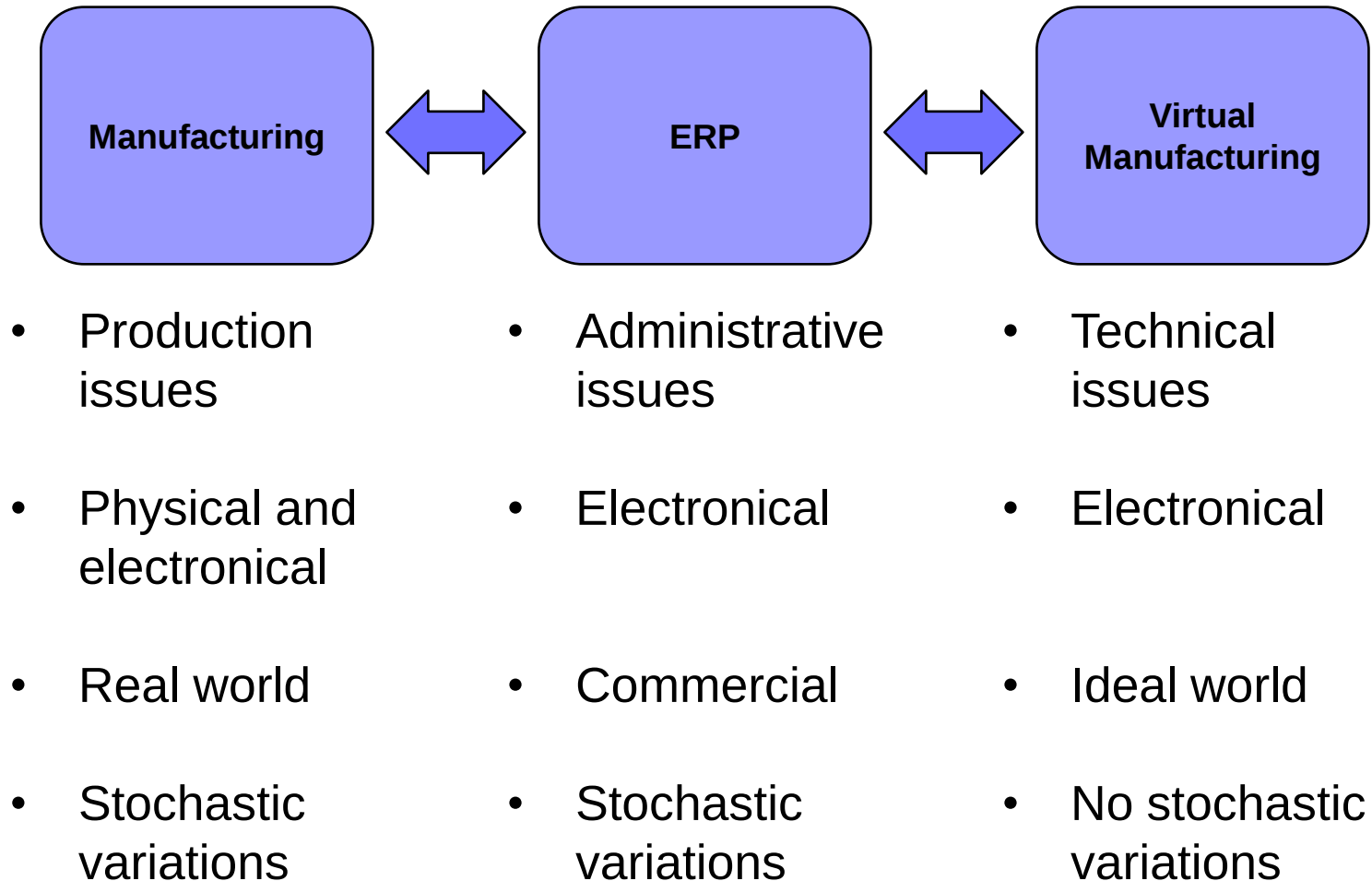
Burlton's IGOE:



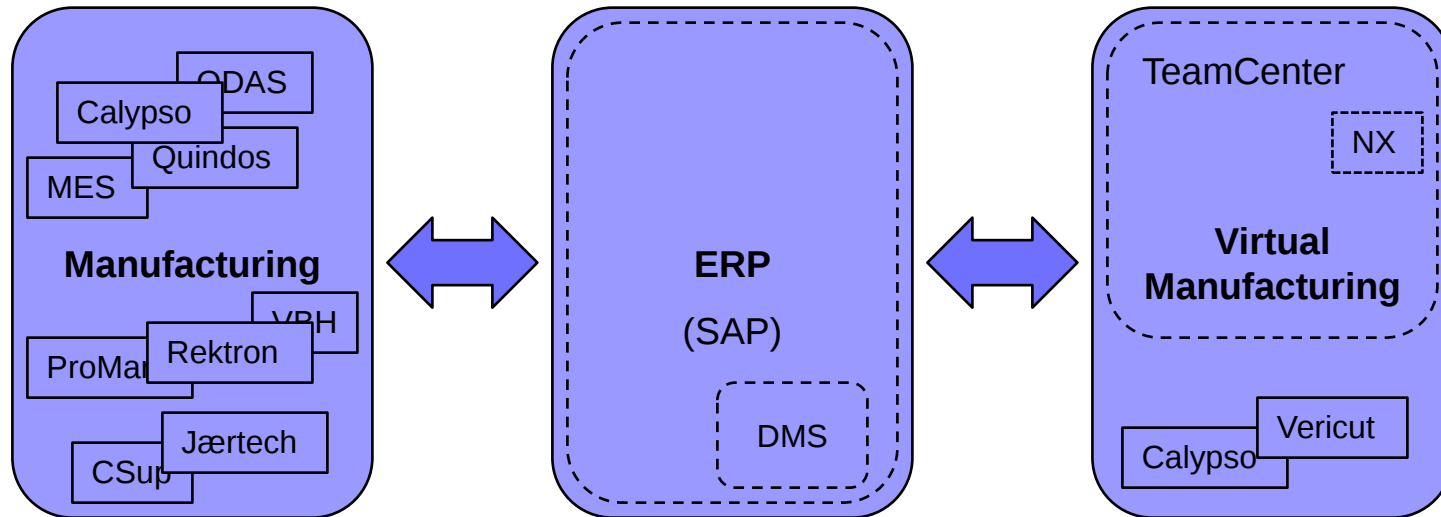
"Viewpoint": Product Lifecycle Management



Characteristics of the System Domains



System Architecture - System of Systems

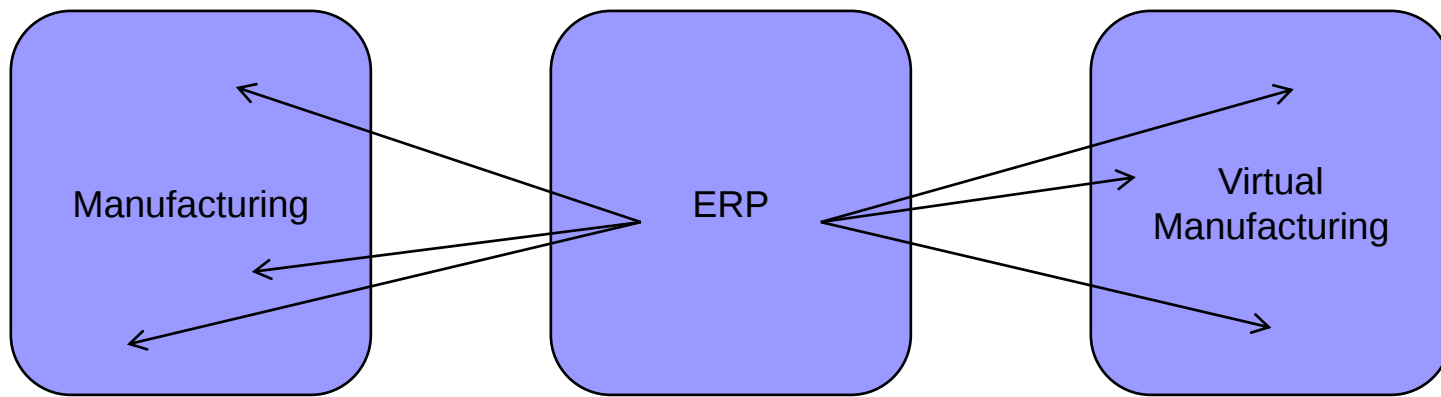


- Software in Manufacturing should be selected based on functionality - not their "affinity" to SAP
- Preferred system elements in manufacturing have high internal complexity and low external complexity (high cohesion and low coupling)

Heuristics

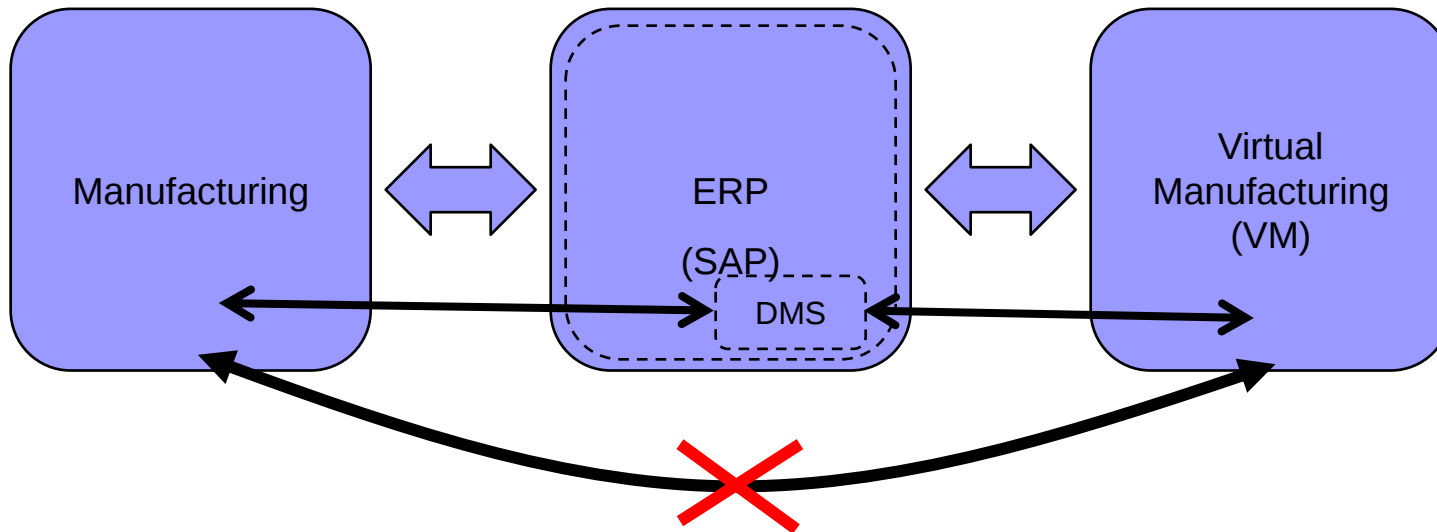
Heuristics: Datastructures

Examples: Materials, BOMs, Processes, WorkCenters, Machines, People, Organization, ...



The ERP system (SAP) should define the structures and export them to the other domains

Heuristics: Information flow



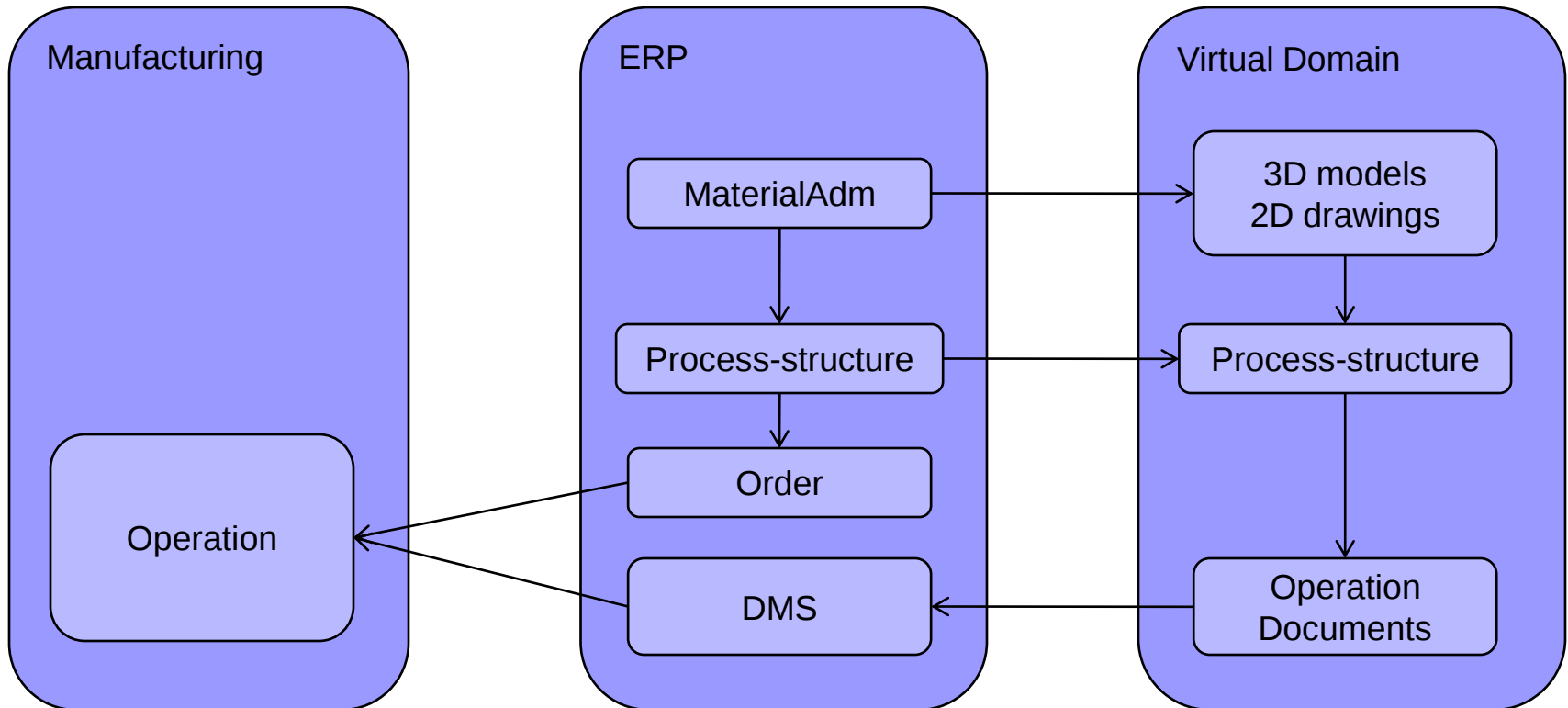
In order to control the information flow, let it flow through the ERP system

Information flow & "Mapping"



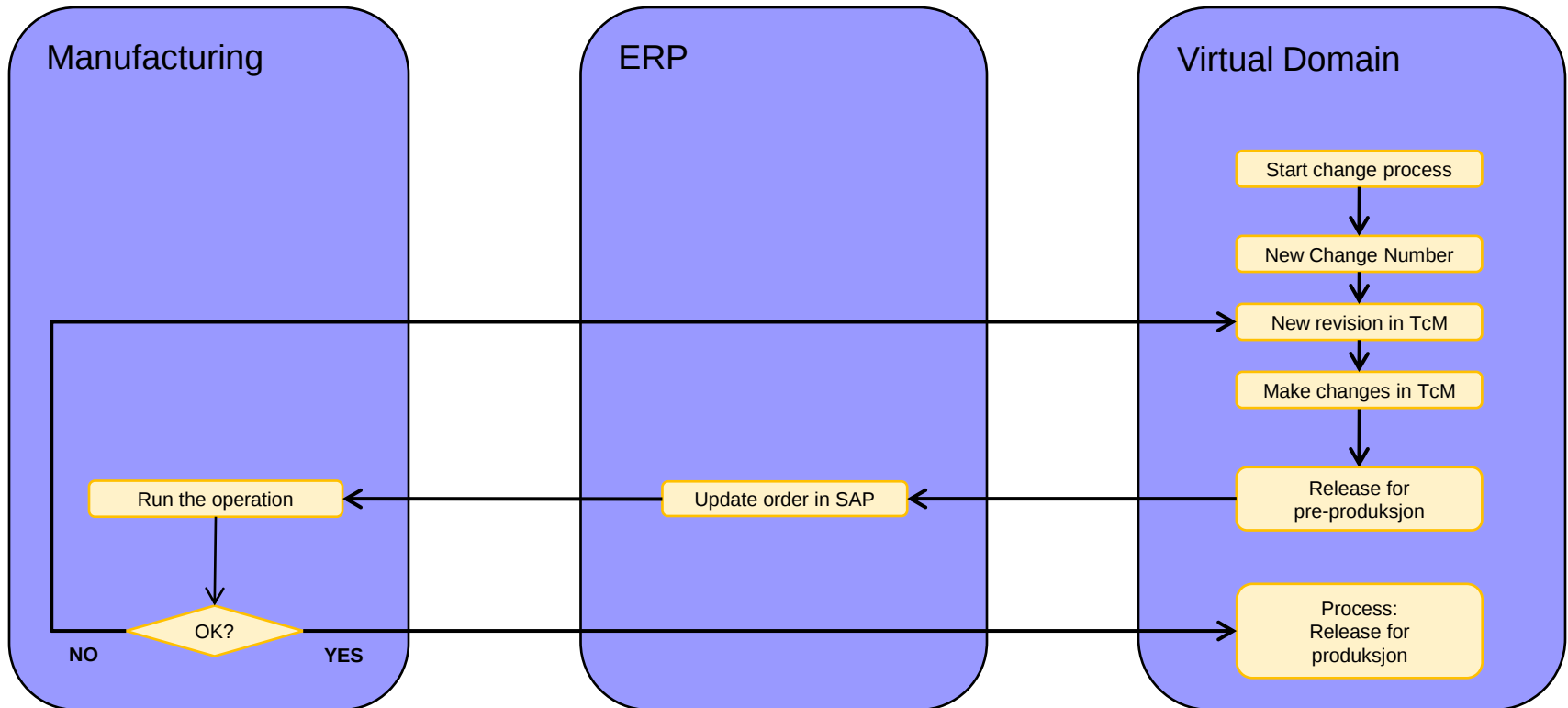
The ERP/DMS system maps information from the virtual domain to the manufacturing domain, and vice versa.

Information flow: Change Operation



Process:

"Change Operation for pre-production"



AS9100C - Process Approach

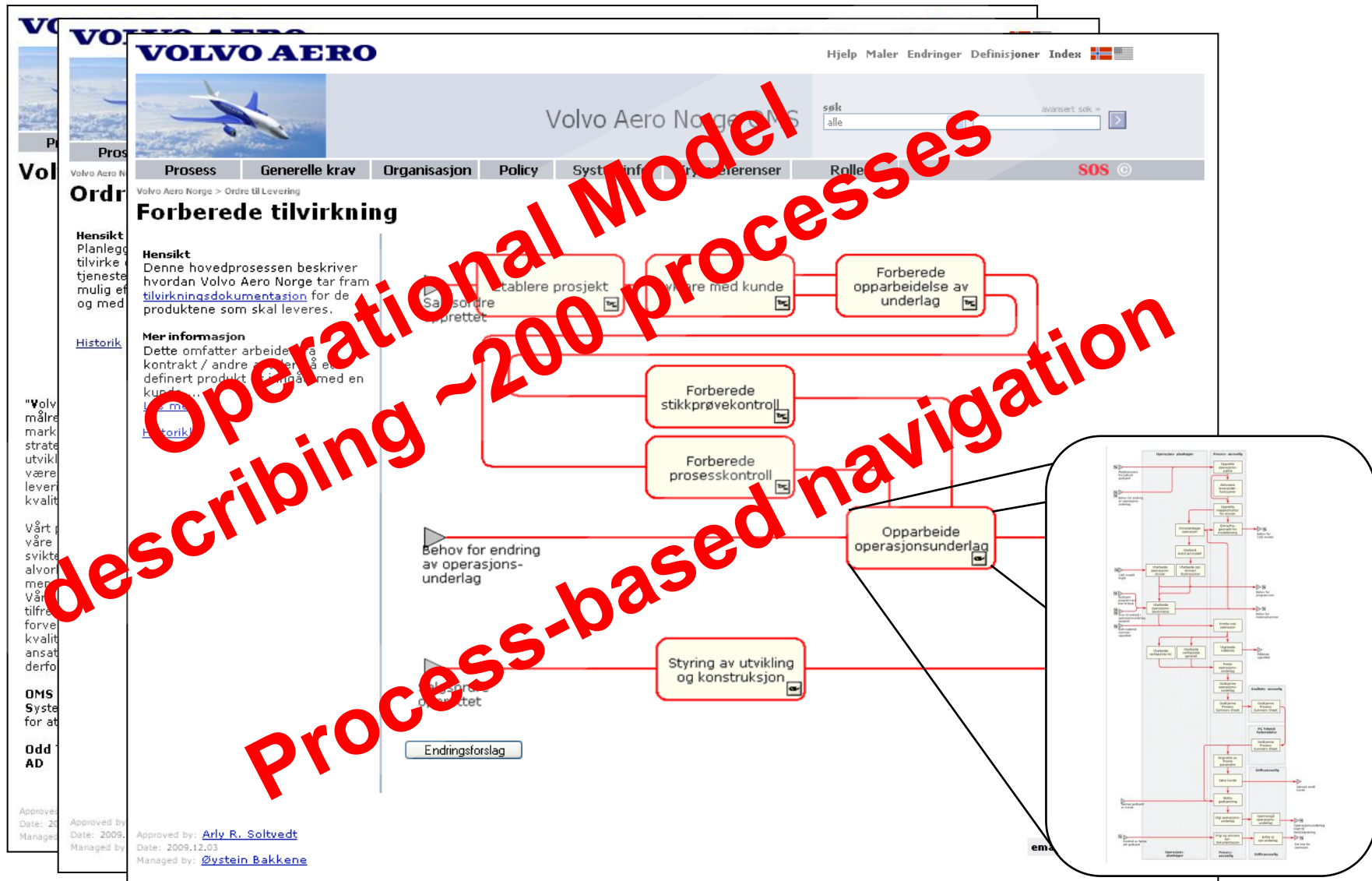
0.2 Process Approach

This International Standard promotes the adoption of a process approach when developing, implementing and improving the effectiveness of a quality management system, to enhance customer satisfaction by meeting customer requirements

What is a process?

- One or more activities in sequence
- Have a defined customer
- Uses resources in the organization
- Transforms "inputs" to "outputs"
- "Outputs" from one process is often "inputs" to other processes
- A process can be integrated in other processes

OMS - Operational Management System



Process based navigation

- Difficult to navigate
- Unclear structure for users
- Difficult to integrate or connect processes
- Varying levels of abstraction
-



Object based navigation

- An alternative to Process based navigation
- Identifies objects in the manufacturing system
- Assumes that each object has
 - Attributes describing the object
 - Methods associated with the object (create, change, ...)
- iPhones, iPads, ... use object based navigation!



New OMS at VA

PROTOTYPE 1

Products



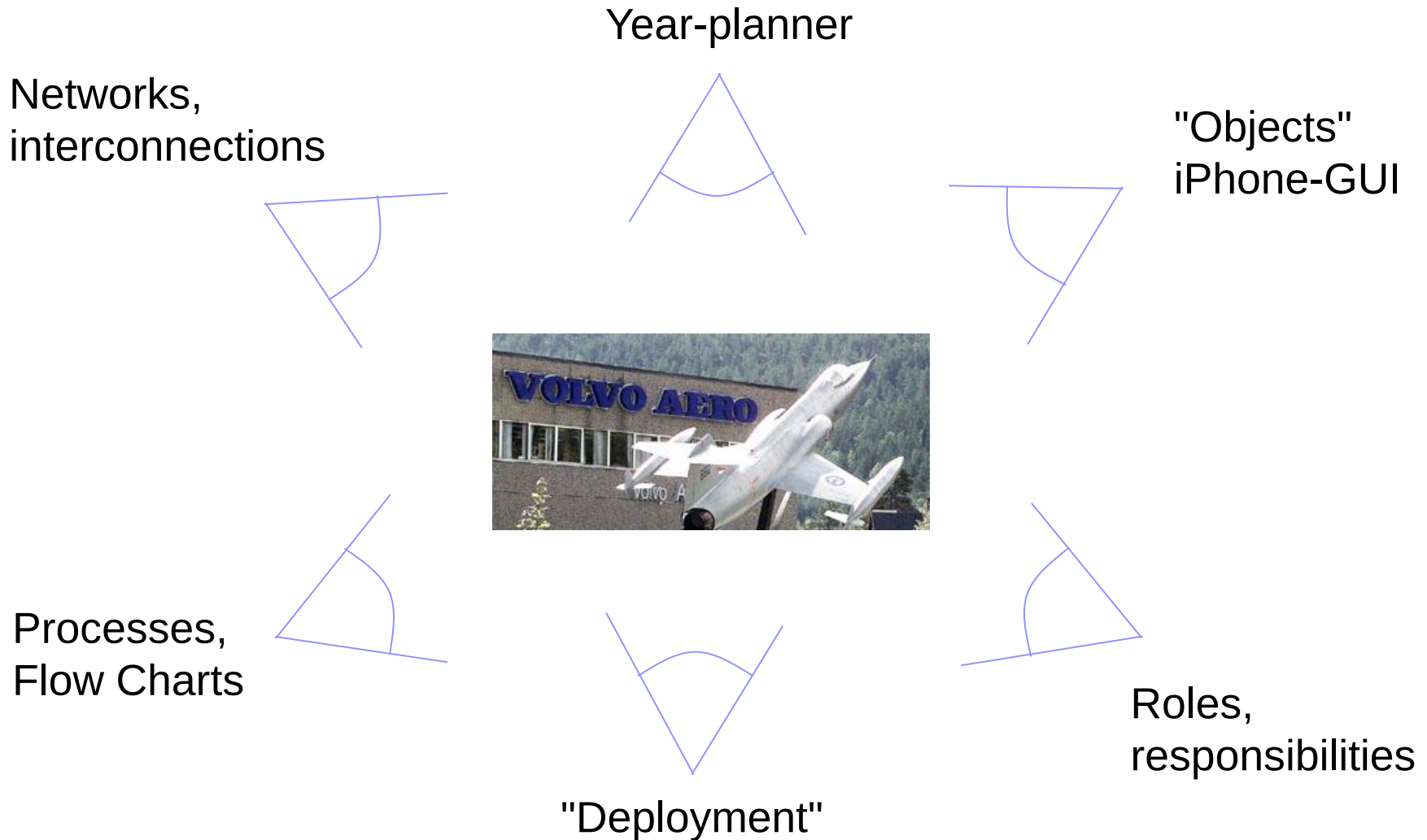
Business-support



General support



OMS - different "views"



Questions?

