Aerni consulting services

Cost reduction/
Cost estimating

Zürich/Maur, 2010

Content

1 **Experience and current situation**

2 Process- and 3D-object oriented cost models

3 Possible services and results

4 Comos prototype for piping estimate (enclosure)

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Experience - Support

1

- **Aerni consulting was founded in 2001, its focus is consulting in the system- and plant business**
- **Our Goal is helping companies to become more competitive**
- **Support of companies and teams with proven methods, innovations and ideas. But also with a pragmatic approach and a cross functional view of the company**
- **Or with project-/program management of defined improvement projects/programs**

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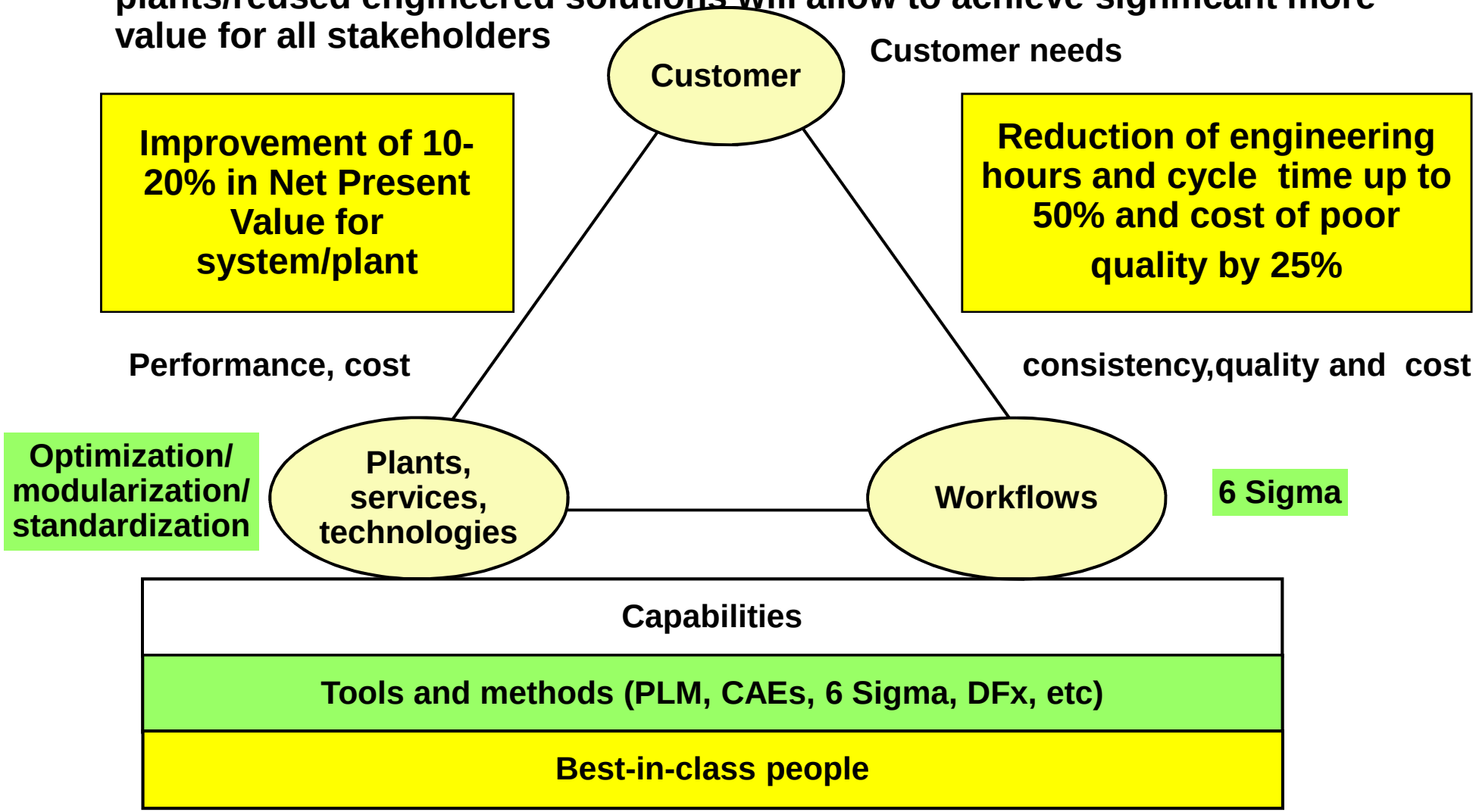
Aerni consulting has developed proprietary methods and tools in the following areas:

- Plant optimization/development and cost reduction
- Knowledge management and reuse in the engineering process, including more accurate cost estimating
- Prototype for cost estimation in Comos (piping mat, pref and erection)
- Process reengineering adapted to the plant business (6 Sigma)
- IT application benchmarks on Net Present Value basis
- Innovation (business, products and processes)

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Experience – Life Cycle Cost (LCC) reduction in the plant building industry

The thorough implementation of optimized/modularized/standardized plants/reused engineered solutions will allow to achieve significant more value for all stakeholders



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Only smart cost estimating and control models allow to support the LCC / cost reduction potential in the plant business industry

Major elements of a LCC optimization/ cost reduction program

1: Get cost transparency
- Plant / equipment / bulk cost structure
- Baseline setting

2: Set targets and Priority setting

3: Optimize process and reduce costs (LCC reduction)
- Process optimization
- Key package units/equipment / commodity strategy
- Low cost country sourcing (LCS)
- Redesign to cost and standardization

4: Measure and follow-up: Initiative monitoring and metrics

5: Apply to projects: compliance mechanisms

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Our experience is in the implementation of cost reduction and/or performance improvement of new products

- Project management for the modularisation/standardisation of steam reformers
  Improvement of plant NPV by approx.15 % in 4 months
- Modularisation/Standardisation of wet cooling towers
  The team (England, France, Germany, Belgium) developped a new family of wet cooling towers within 4 months with a cost reduction of 17%
- Modularisation/Standardisation of waste heat recovery boilers for combined cycle power plants.
  The team achieved a cost reduction of 25% within 8 months
- Development of a cost reduction methodology for the plant business and development of new cost estimating workflow for piping and civil including new structures, unit rates and calculation of norm hours for erection services
- Support in the development of a new pump family (conjoint Analysis, FMEA and modularisation)
- Voice of the customer for combined cycle power plants

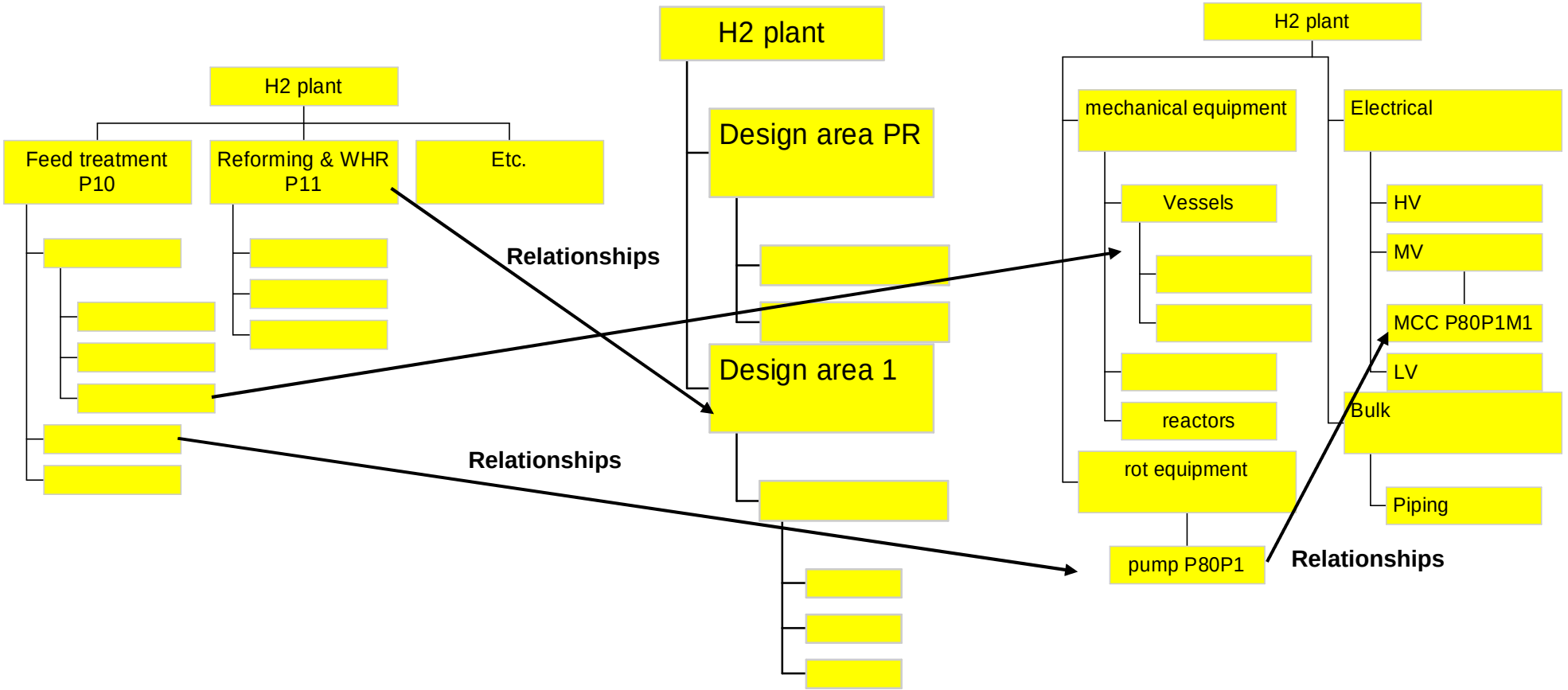
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The various structures coexist for the necessity of order execution, the relationship are not made explicit in a common data model and consistency is difficult

Functional process structure

3D structure

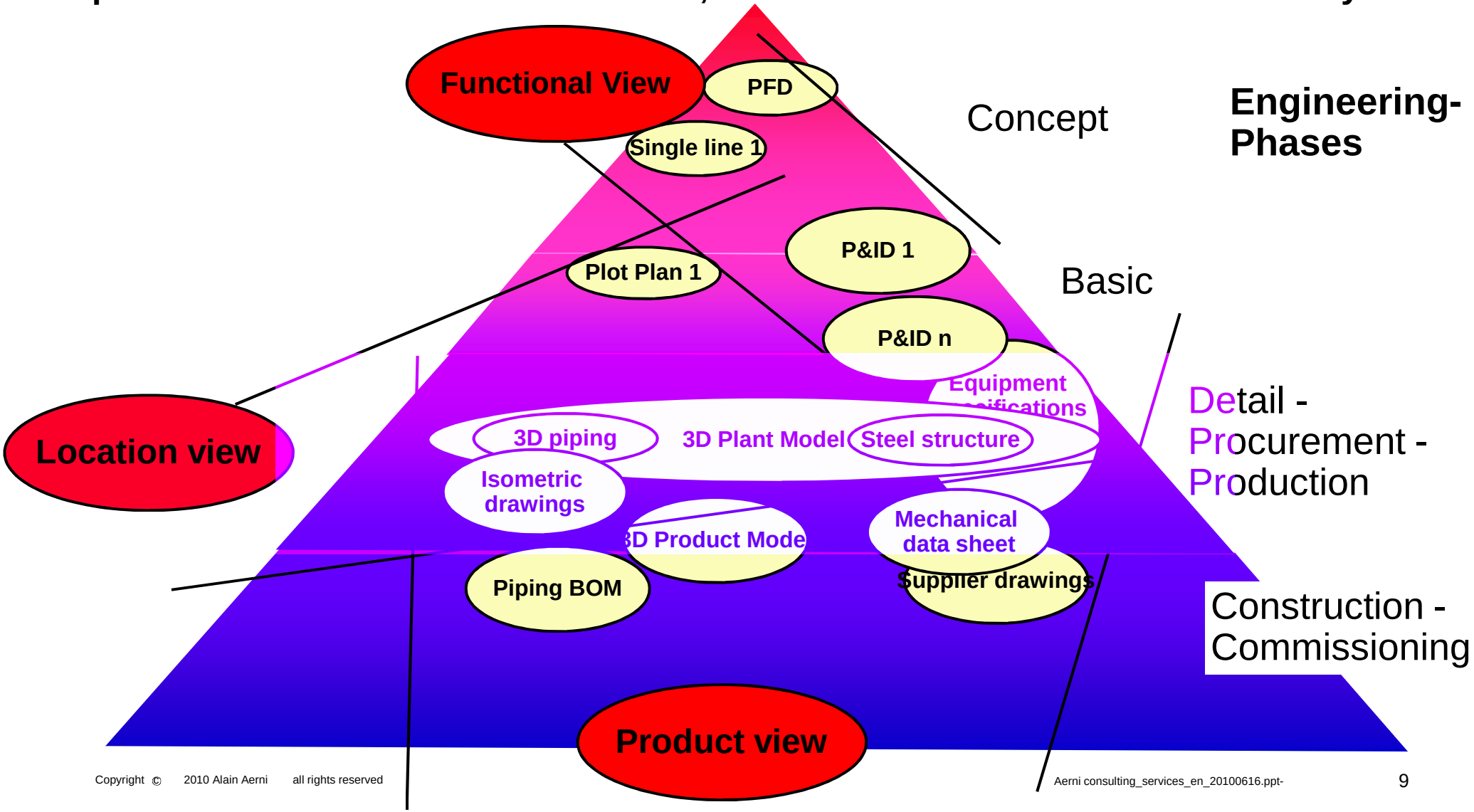
Cost structure



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Current situation

During plant development or bid/project execution, different documents are produced which show different views, abstraction levels and data redundancy



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Various tools and structures characterize often the cost estimating and cost control landscape

- One tool to consolidate the cost from various disciplines and to calculate final price to customer (own development, SAP, MS-excel or other).
- Each discipline quantifies their Material Take-Offs (MTOs) or Bill Of Quantities (BOQs) with their unit rates (own developments, MS-excel) and enters the summary data into the above consolidation tool.
- Division of work is ensured by project management and discipline in a separate document or ev. in the cost consolidation tool.
- Data integrity between disciplines is more or less realized through equipment lists, PFDs and layout drawings
- Each main location often has its own tool/data
- Cost objects are not attached to engineering objects with the consequence that engineers would like to know the cost to optimize their plants but have seldom the information at their fingertips
- Purchase order positions in the ERPs often have a different granularity than the unit rates negotiated with the supplier

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Economies of scope and scale, cost transparency and reduction of complexity are also in the plant business important cost reduction drivers

- Plant optimization/cost reduction is not feasible without cost information
- Accuracy of cost estimation is better if a company can rely on data from past projects (BOQs and unit rates)
- Data consistency between disciplines and project phases (tendering, basic engineering, detailed eng, etc) can best be achieved by using the least amount of databases and structures/data models which ensure consistency between discipline and project phases
- Avoid if possible data duplication and ensure that data are only entered once
- Start IT projects with the big picture in mind but with a limited scope and complexity to achieve quick results

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Requirement to cost structure and estimating tool

- The process and 3D configuration of the plant shall automatically produce the necessary cost objects to ensure consistency of scope and cost (Reuse information from ongoing or closed projects in tendering and execution)
- Tool to achieve target cost in proposal and order execution
- Confidence in estimate (Goal +/- X% between as sold und as built)
- Allow management to compare BOQs and unit rates between the different projects for estimates and as built projects
- Control BOQs and unit rates from tendering to as built (status as ordered, as engineered, as procured and as built)
- Support for the optimization of technical solution(Allocation of cost to the structures of the technical solutions (Process catalog and 3D catalog)) by allowing engineers to see the cost of what they have engineered
- Show quickly and quantify precisely the effects of changes to the supply- and work-split
- Flexibility with regard to price changes (project in a different country or with other suppliers
- Allowing Bids from key suppliers with slender resources and BOQs of most expensive items
- Allocation of cost to disciplines
- Seamless transition from old cost structure to new structure

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Content

1 Experience and current situation

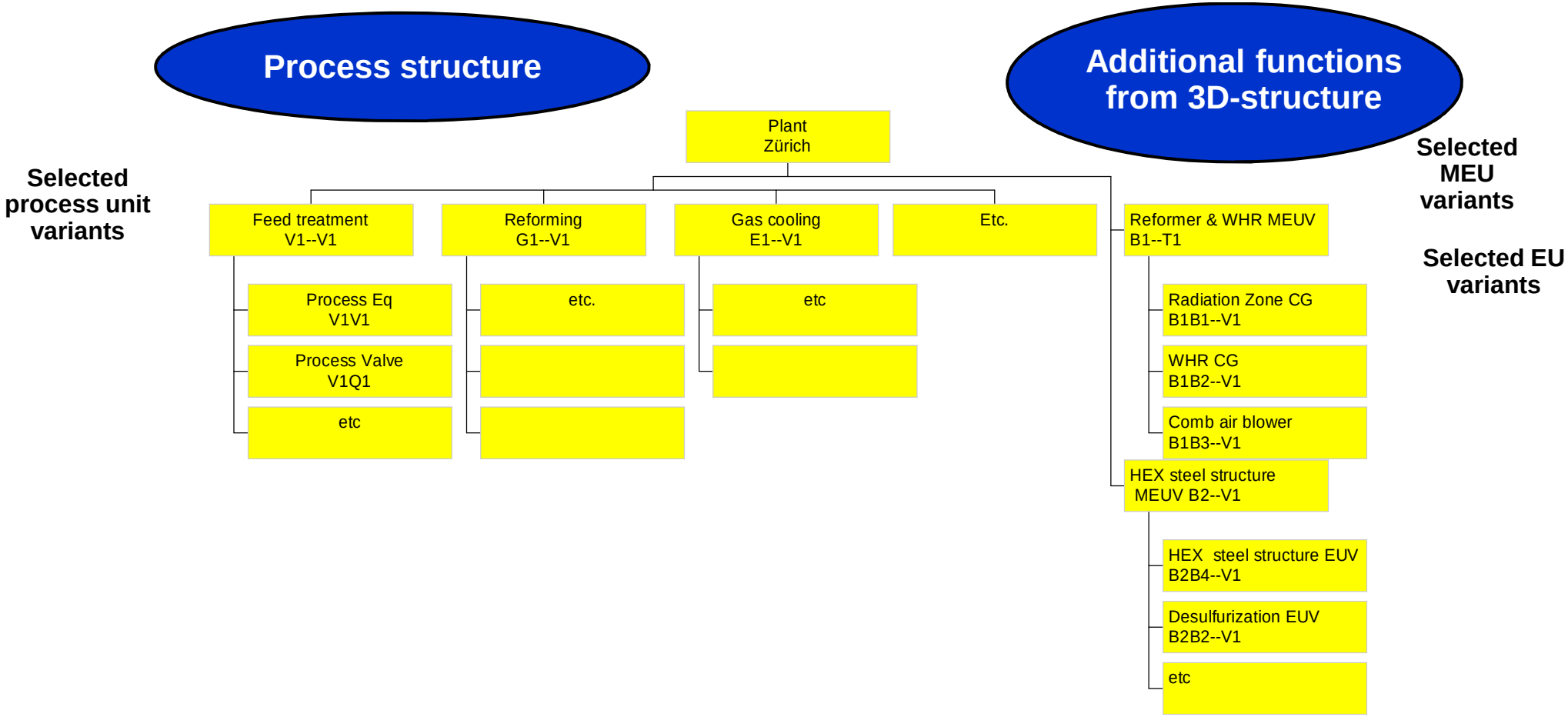
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Based on process and 3 D structure (for Budget and firm price proposal)



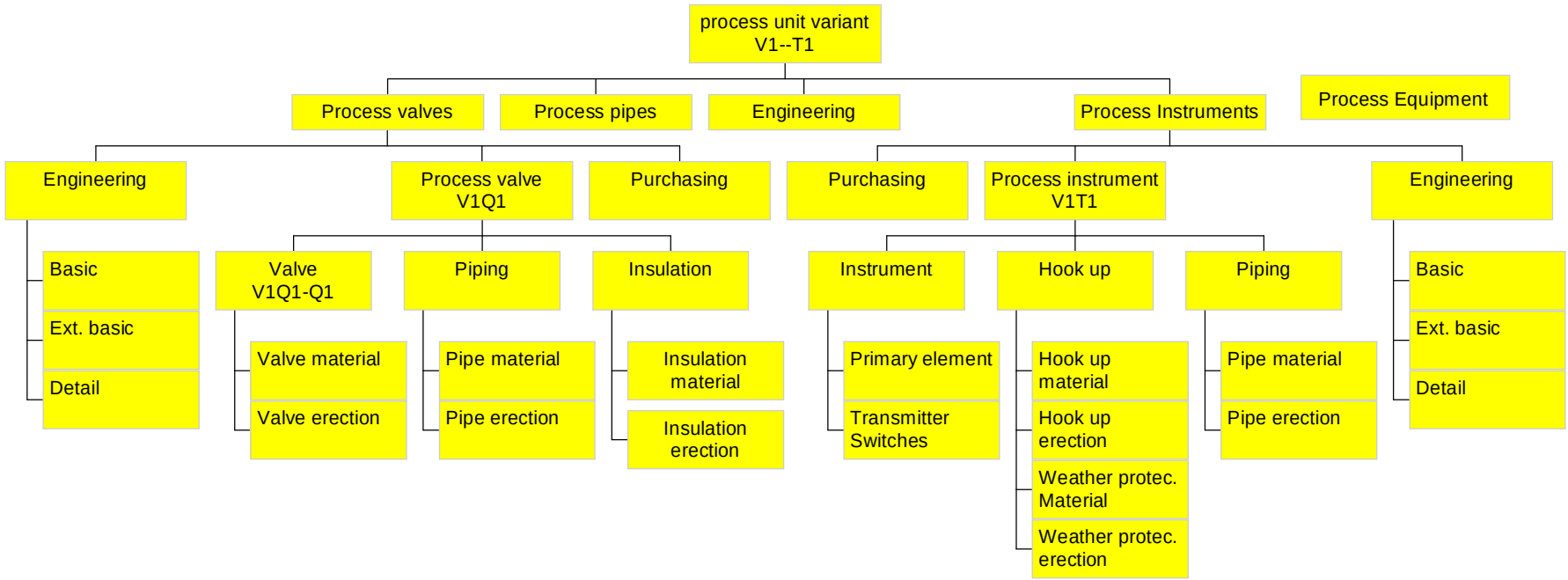
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Example of a process oriented cost model

Illustrative

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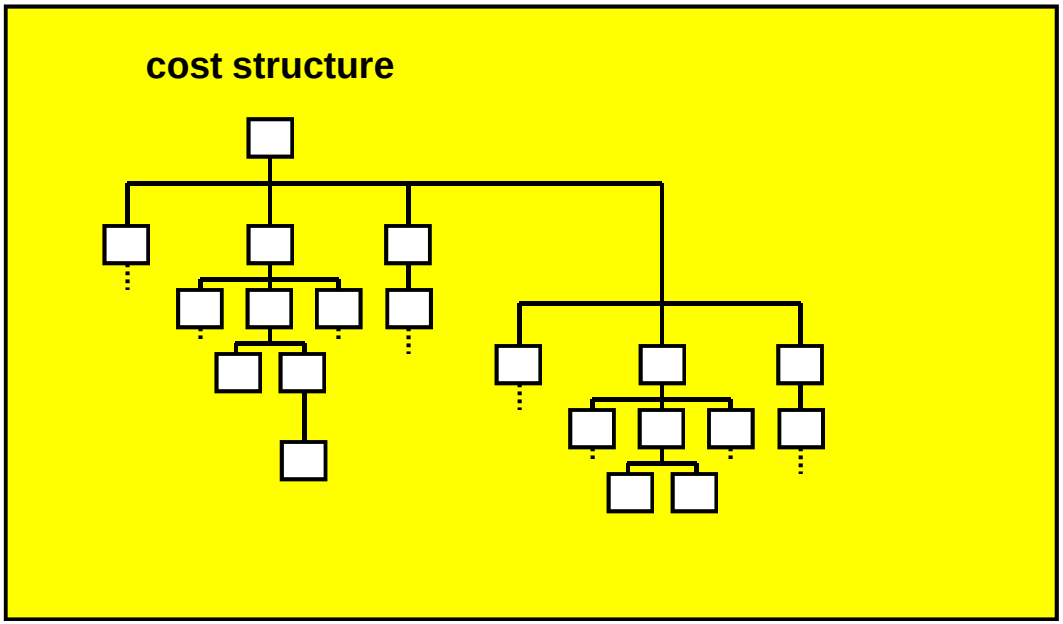
View level 5 is a quantification of Bill Of Quantity (BOQ) linked to unit prices per BOQ-type and elements

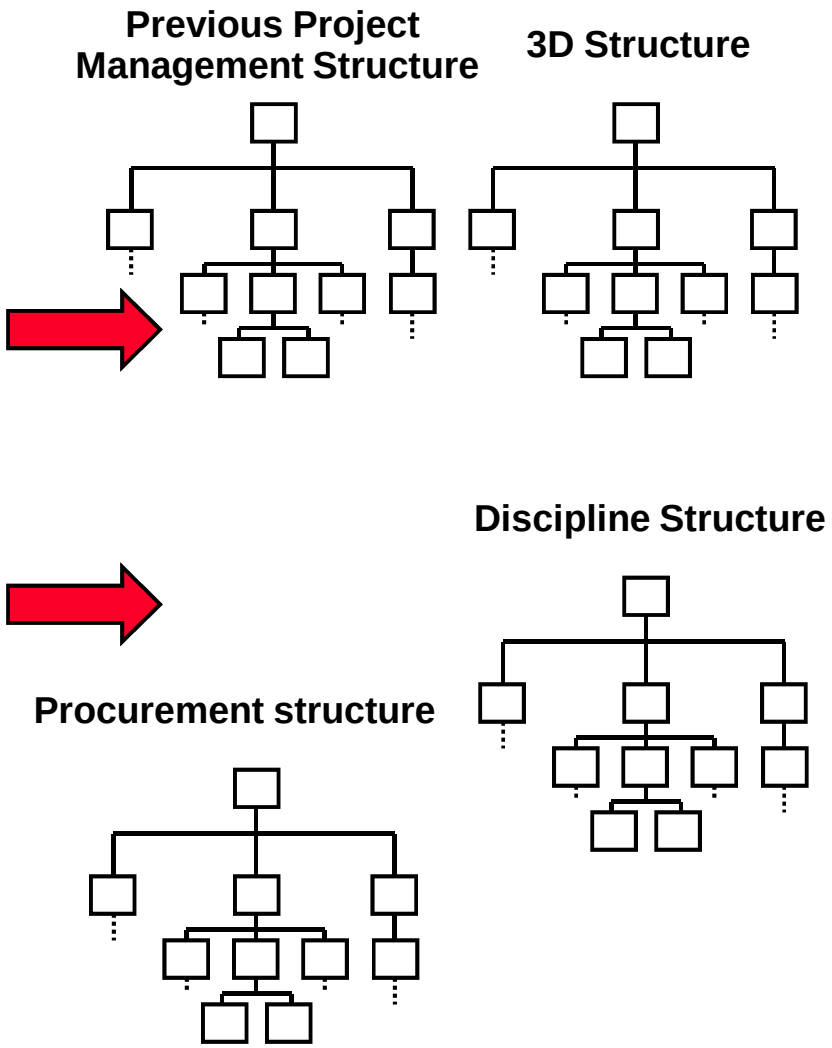


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The structure of the cost model allows an evaluation of BOM and cost according to different views

Cost model





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The estimate is configurated by the choice of process and 3D structure elements with additional scope of work and delivery

Functional Scope

Functional view	Customer request	Linde Request	Not required	Scope Linde	Scope customer	Scope split
Gaseous Feed Handling		x				x
Feed Compression	x					x
Feed Purification		x				x
H2 Recycle		x				x
Liquid Feed Handling	etc.					
MEA Washing						
Reformer						
Steam System						
Fuel System						
Prereformer						
Etc.						

Scope of Work

Work category	Scope Linde	Scope customer	Scope split
Project management			
Conceptual engineering			
Basic engineering			
Extended basic			
Detail engineering			
Procurement			
Material supply			
Transport			
Erection supervision			
Erection			
Commissioning			

Scope of Work detail

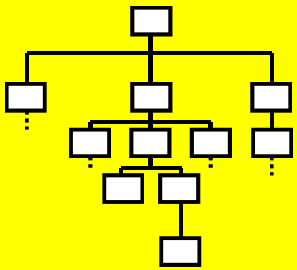
Functional scope	Project management	Conceptual engineering	Basic engineering	Extended basic	Detail engineering	Procurement	Material supply	Transport	Erection supervision	Erection	Commissioning
Gaseous Feed Handling	L	L	L	L	L	L	L	L	L	C	L
Feed Compression	L	L	L	L	L	L	C	C	C	C	L
Feed Purification	L	L	L	L	L	L	L	L	L	C	L
H2 Recycle	L	L	L	L	L	L	C	C	C	C	L
Liquid Feed Handling	etc.										
MEA Washing											
Reformer											
Steam System											
Fuel System											
Prereformer											
Etc.											

L: Linde
C: Customer

Scope of delivery

Delivery	Scope Linde	Scope custom	Scope split
Columns	x		
Adsorbers	x		
Reactors	x		
Vessels			x
Tube type heat exchangers			x
Tanks		x	
Oil separators	x		
Etc.			

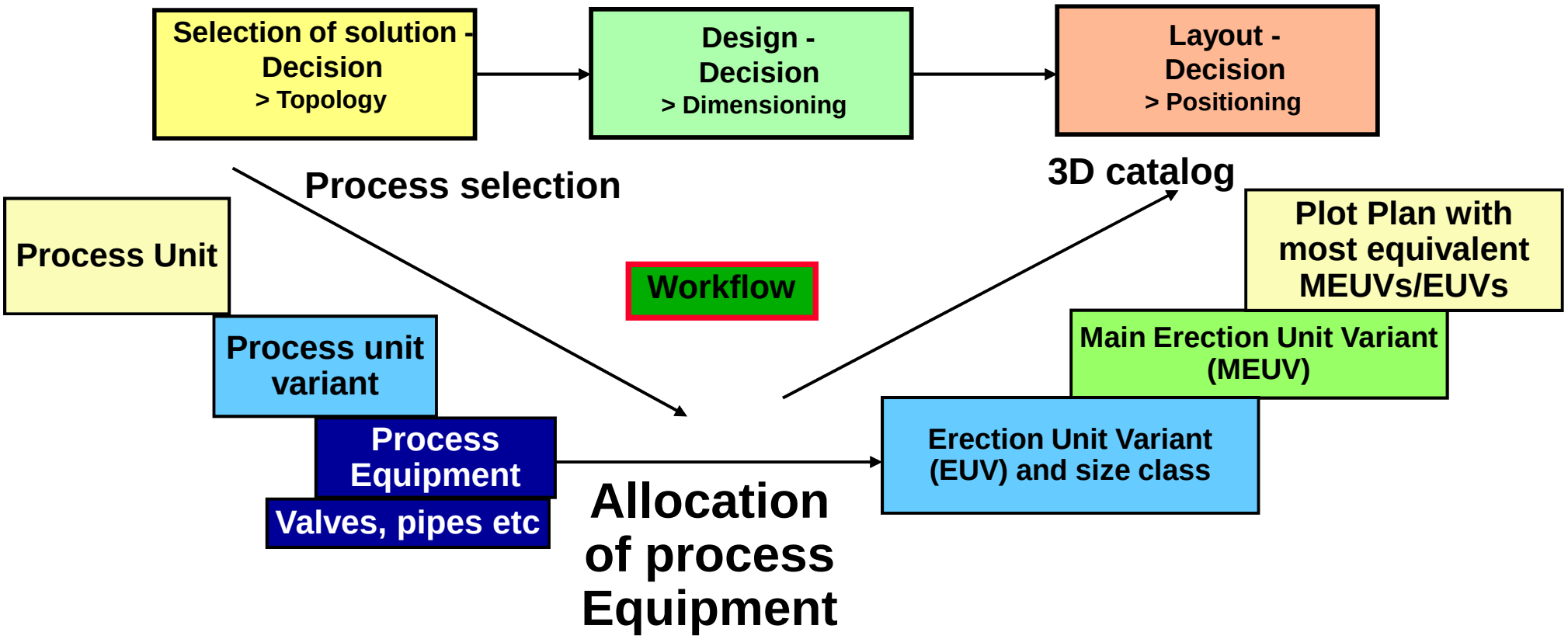
Cost Model



Workflow from process selection to plot plan

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For reuse to happen from functional solution decision to layout decision, the data must flow accross functional borders and across executed projects



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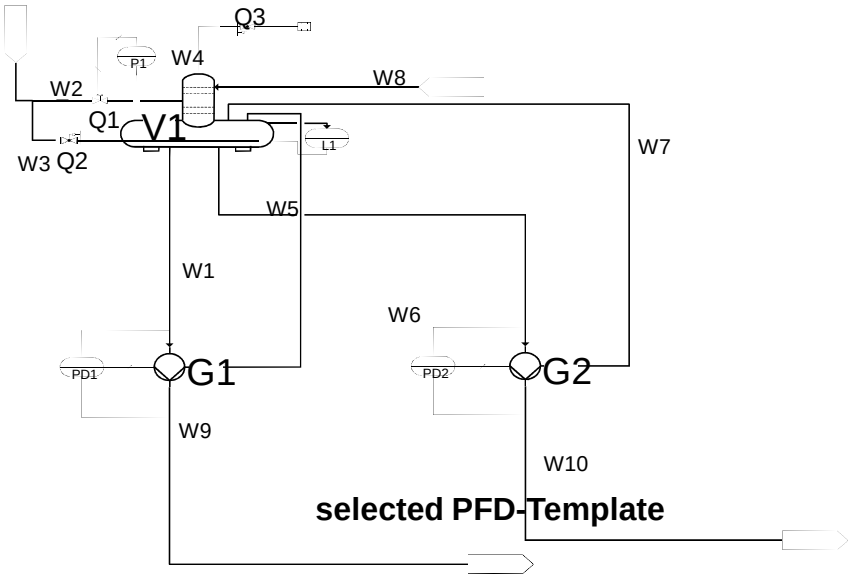
For reuse to happen, the plant needs to be structured into process units, process units variants and execution options for Equipments

Different level of reuse

Process unit — **Feedwater treatment**

Process unit variant — **2 pressures with 2*100%, 2*100%**

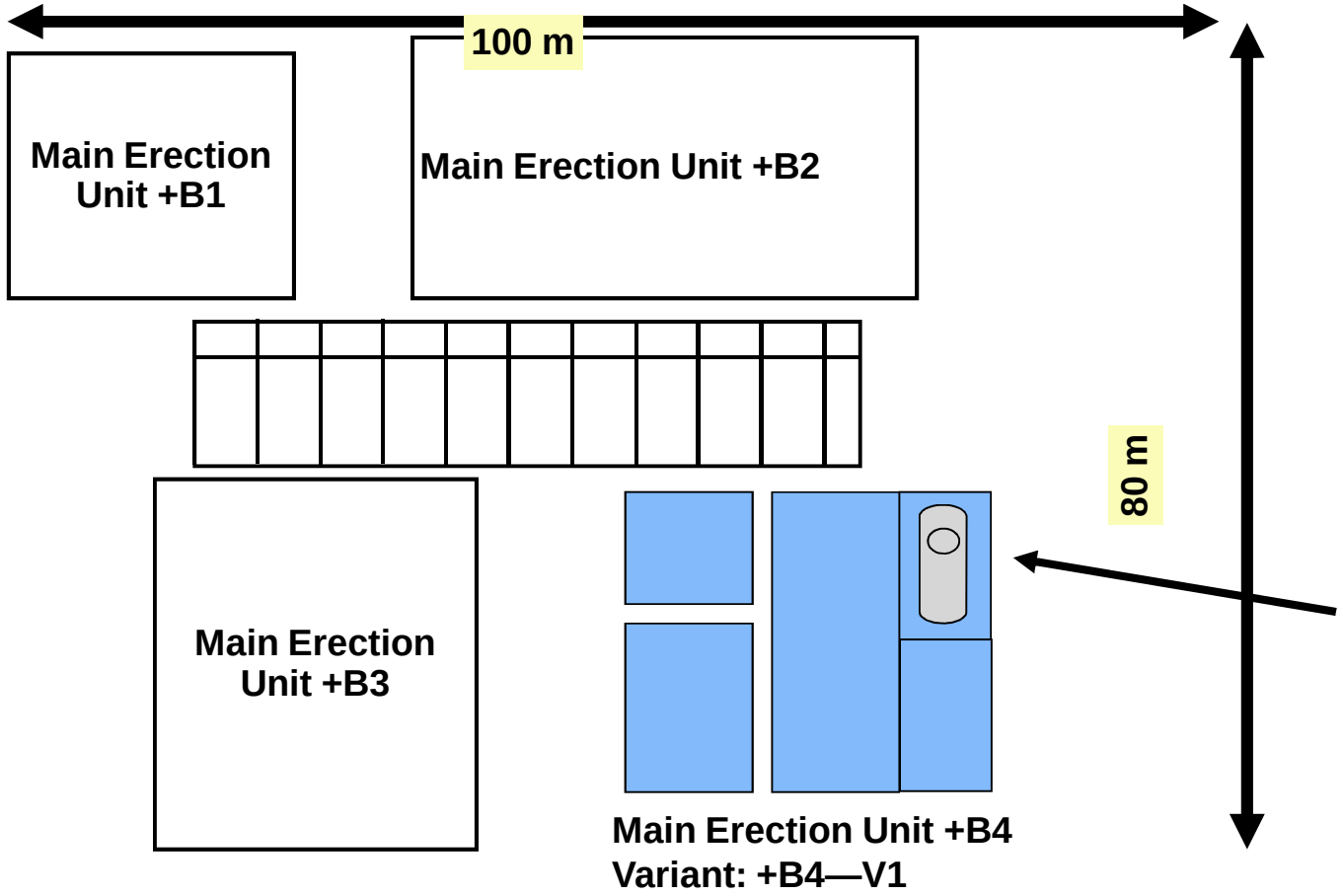
- **Process Equipment**
- **Execution options**
- **Process Valves**
- **Process Pipes**



selected PFD-Template

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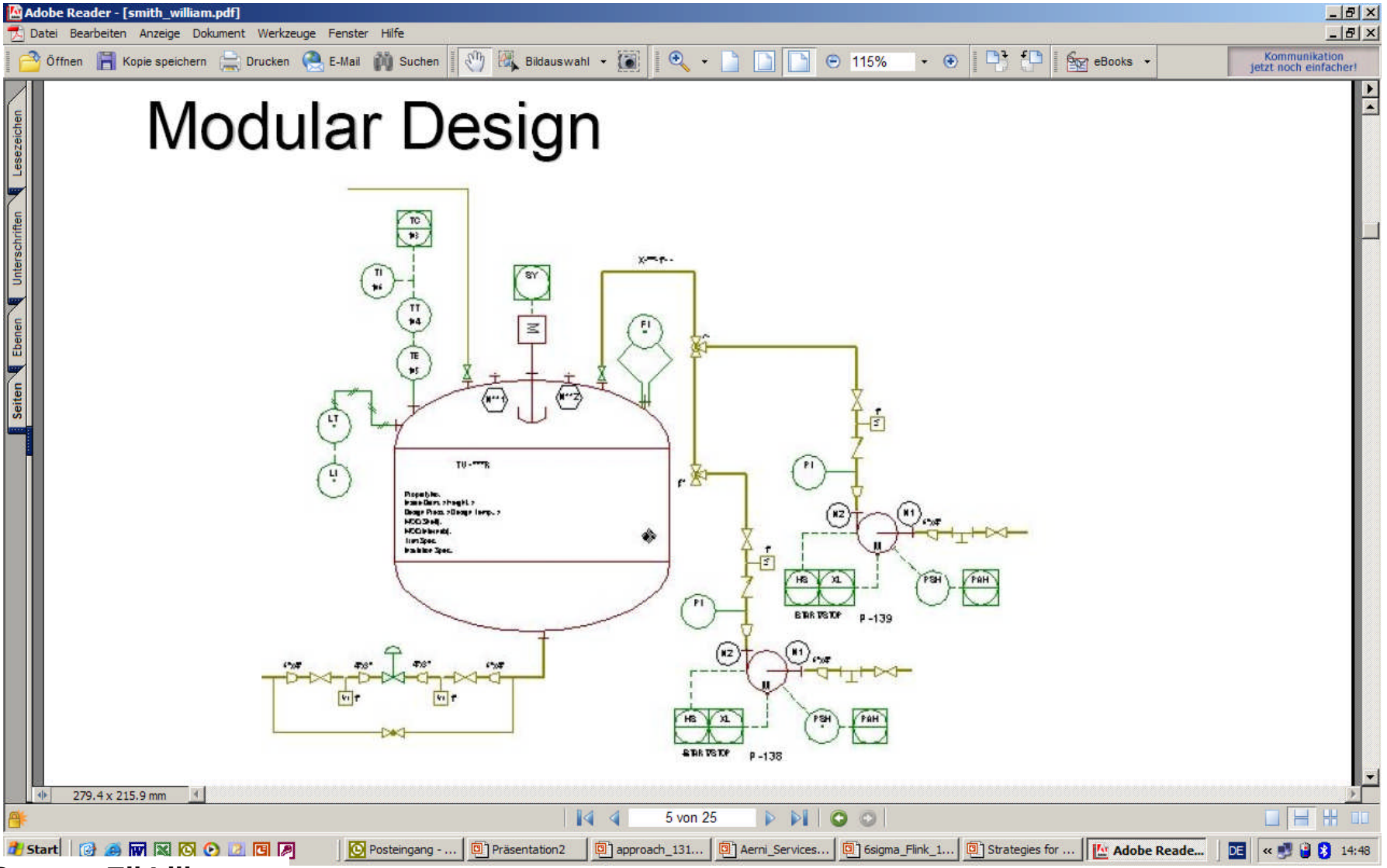
Selection of Plot Plan template having the most equivalent MEUVs and EUVs as starting point for the design of the plot plan



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Modularization/standardization

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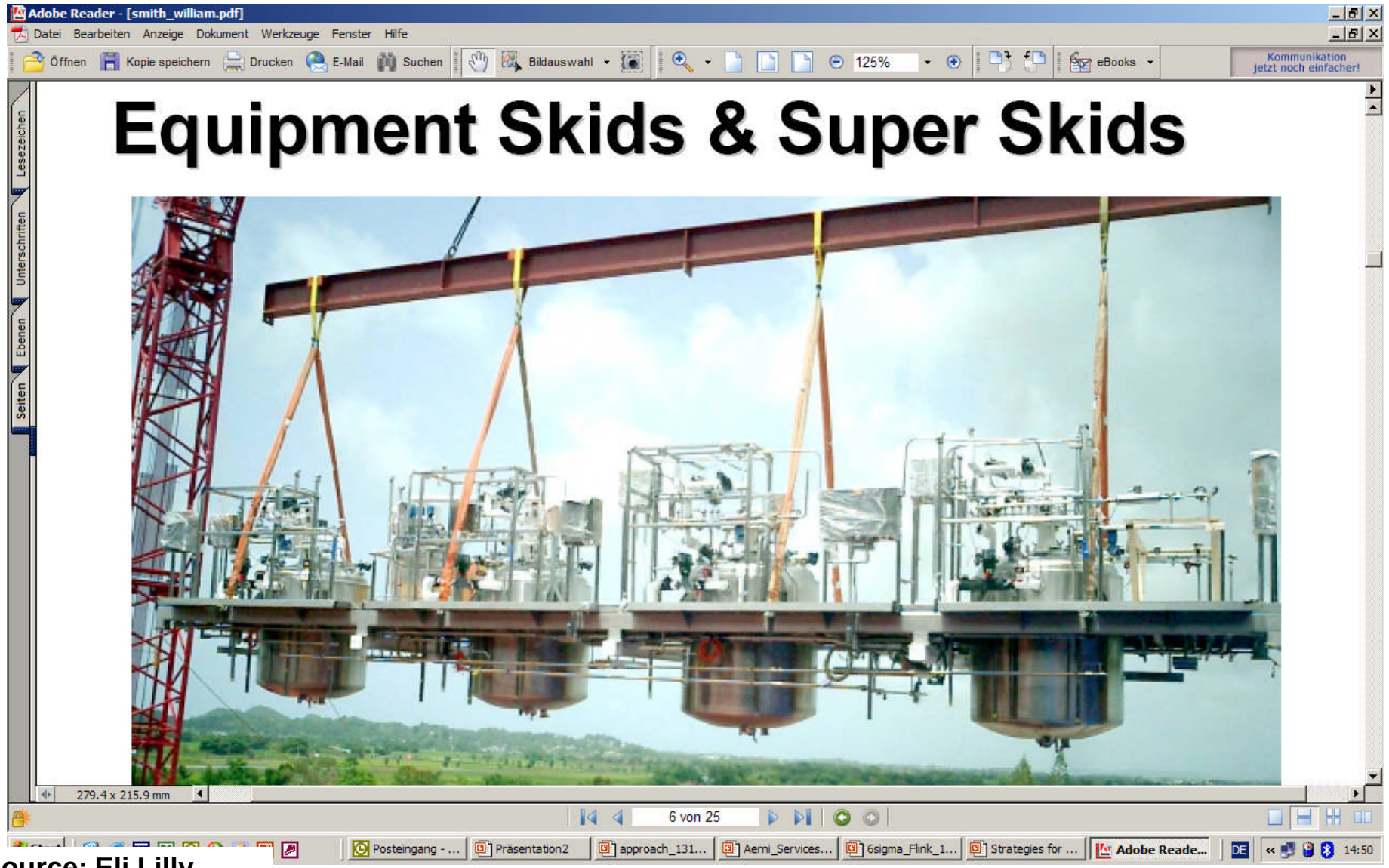


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Modularization/standardization

2



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Modularization/standardization



Source: Eli Lilly

Modularization/standardization

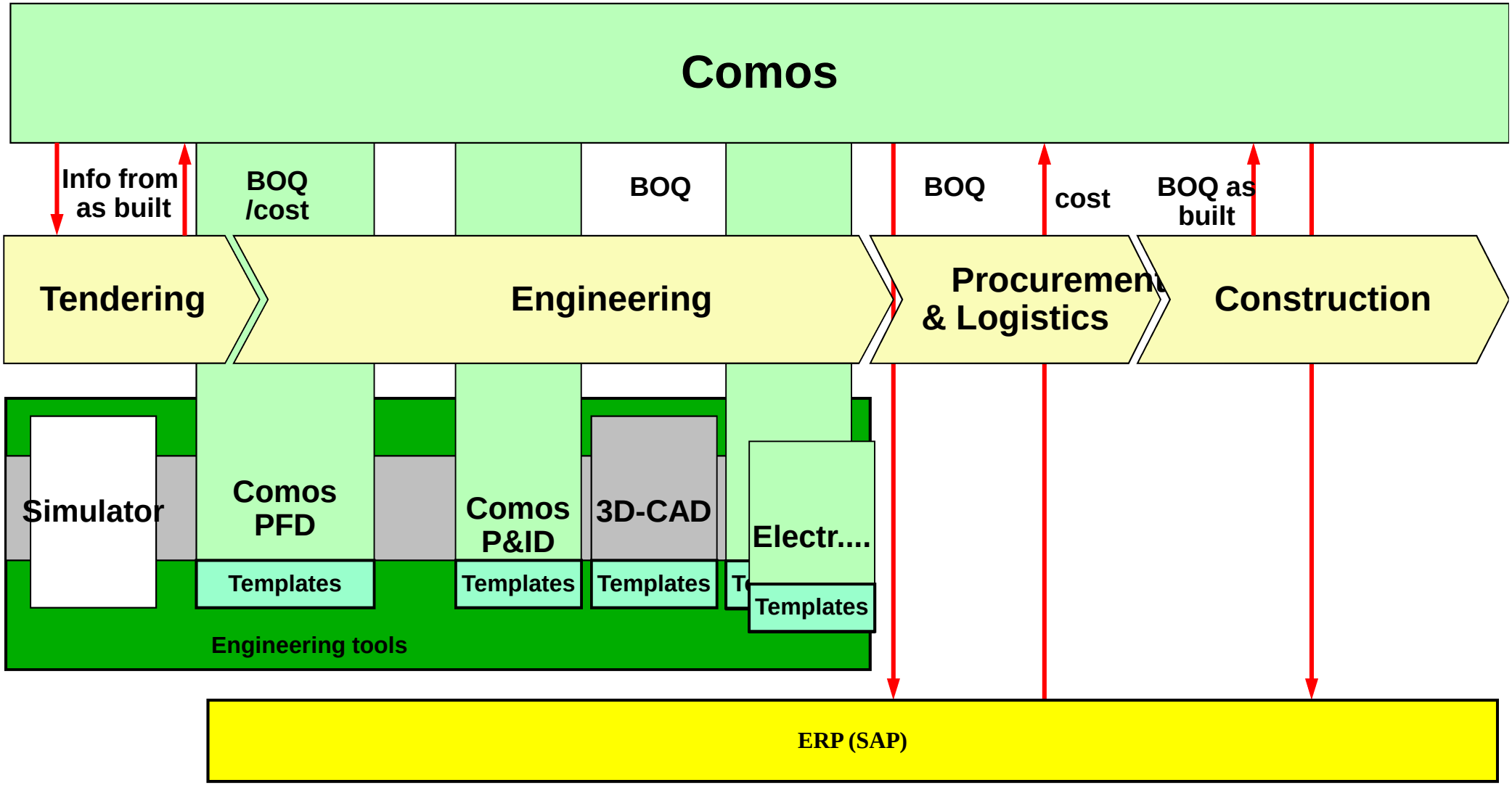
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Source: Technip PELC 2005

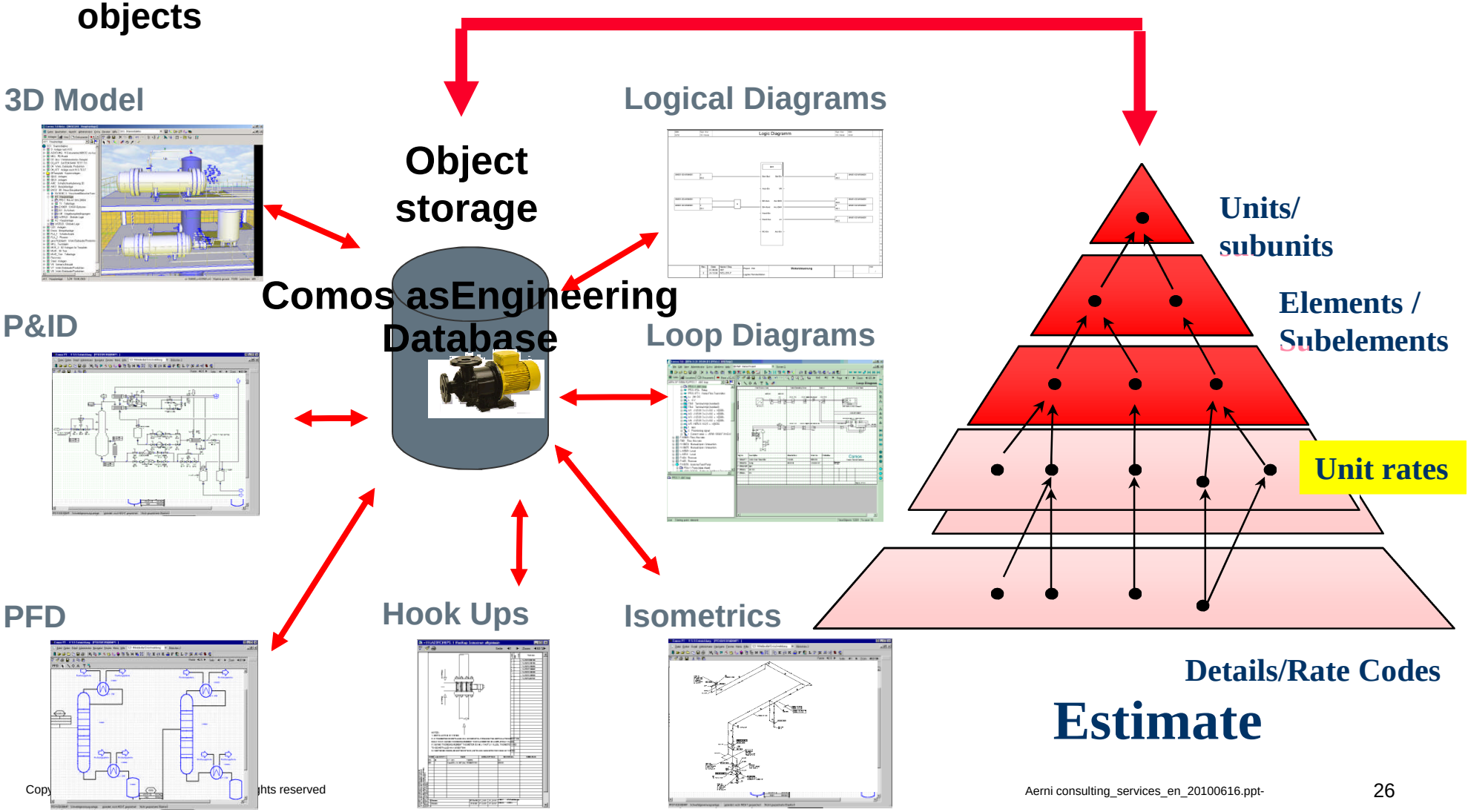
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System and process map



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Exchange of data between engineering tools and cost estimating is not necessary anymore as the cost objects are attached to the engineering objects



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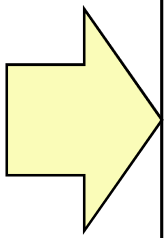
Possible Aerni consulting services and results

3

The deliverables are optimized for quick results by selecting first a reduced scope (discipline and product line) and a meaningful work split

Deliverables of Aerni consulting:

- Project Management or consulting of Client project manager
- Design of a new integrated estimating workflow
- Defining unit rates and and rate codes
- User requirement specification,
- System specification, design specification, implementation (ev worksplit between Client, Aerni consulting and Comos),
- Formatting, assembling and loading of necessary historical data
- Installation and module testing
- Training of workflow with lead users



Results:

Short term

- New estimating workflow for a discipline in one product line
- Process catalog with BOQs and cost in Comos to estimate cost and prices for one discipline and product line

Medium term

- New estimating workflow
- Process catalog with BOQs and cost in Comos to estimate cost and prices

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