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Optimization of the mid-term master production schedule using SAP-APO

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GOR-Arbeitsgruppentreffen

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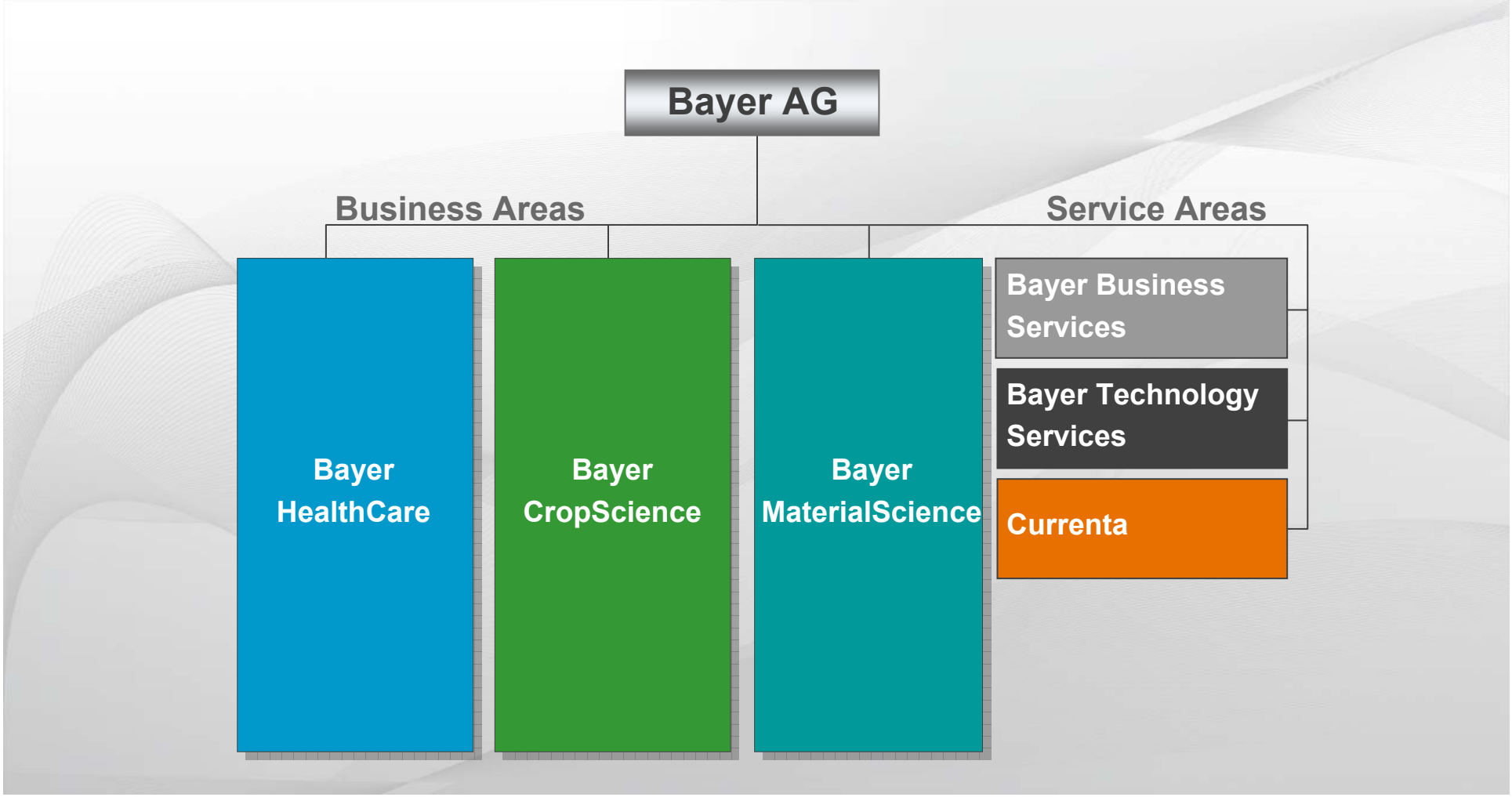
Bayer Business Services in the Bayer Group



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Our Service – Your Advantage

Bayer Business Services is the Bayer Group's international competence center for **IT-based services.**

~ EUR 1 billion in sales*

~ 5,000 employees*

* 2007 globally

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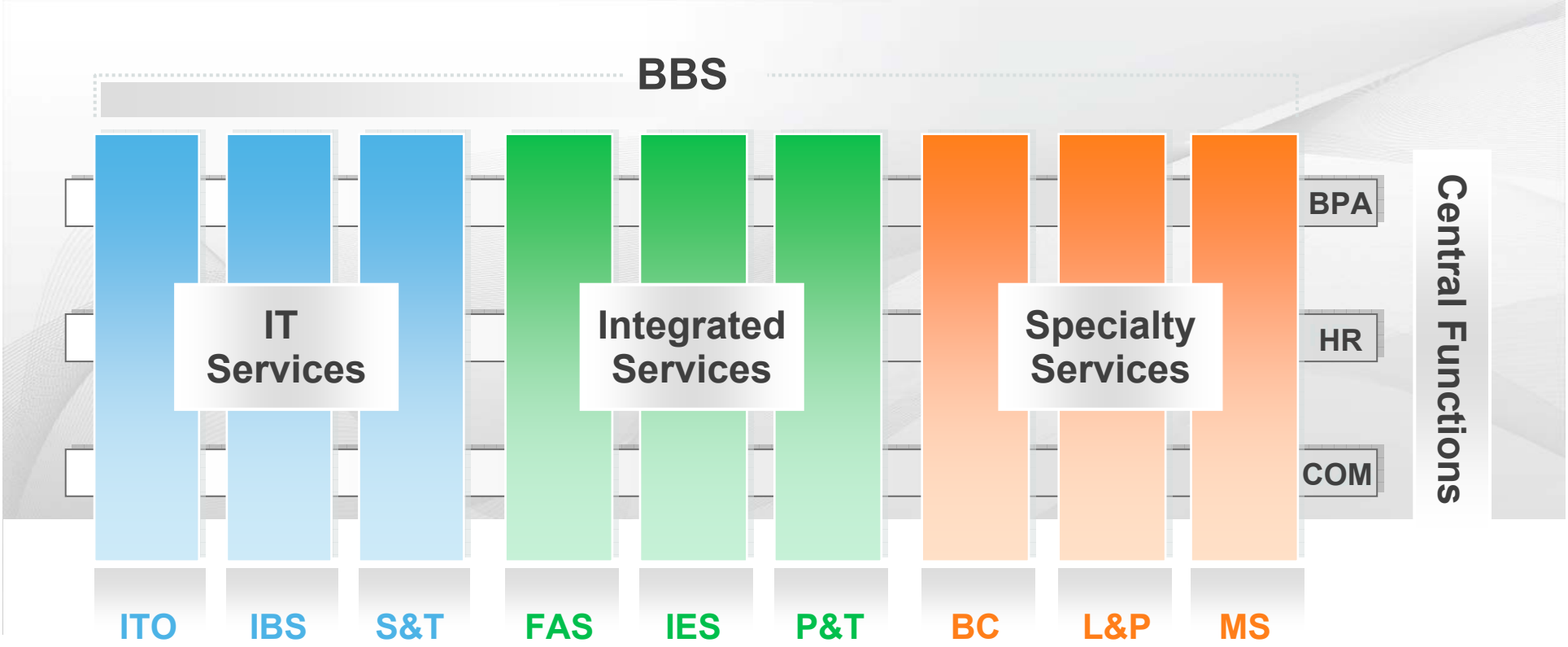
BBS GmbH Struktur



ITO	= IT Operations	**FAS**	= Finance & Accounting Services	**BC**	= Business Consulting	**BPA**	= Business Planning & Administration
IBS	= IT Business Solutions	**IES**	= Integrated Employee Services	**L&P**	= Law & Patents	**HR**	= Human Resources
S&T	= Science & Technology	**P&T**	= Procurement & Transport	**MS**	= Media Services	**COM**	= Communications

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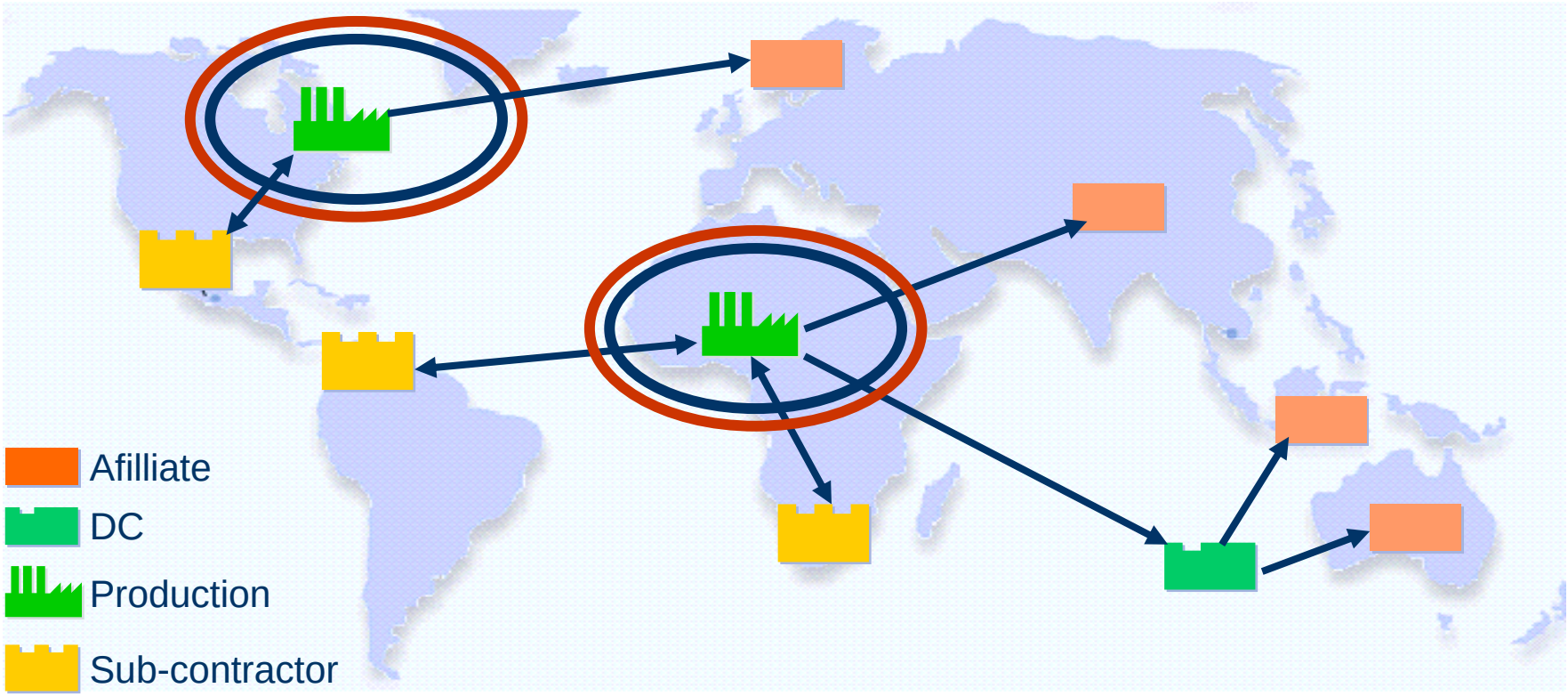
Introduction

- **Environment:**
  - Pharmaceutical industry
  - Capacitated lot sizing
- **Horizon:**
  - up to 36 months
- **Scope:**
  - API-production → **Formulation → Packaging**
- **Tool:**
  - SAP SCM 5.0 → SNP-Optimizer

Supply Chain Planning Process



Step 1: (SNP heuristics)
Step 2: (SNP optimization)
Step 3: (PPDS)
Step 4: (SNP deployment)

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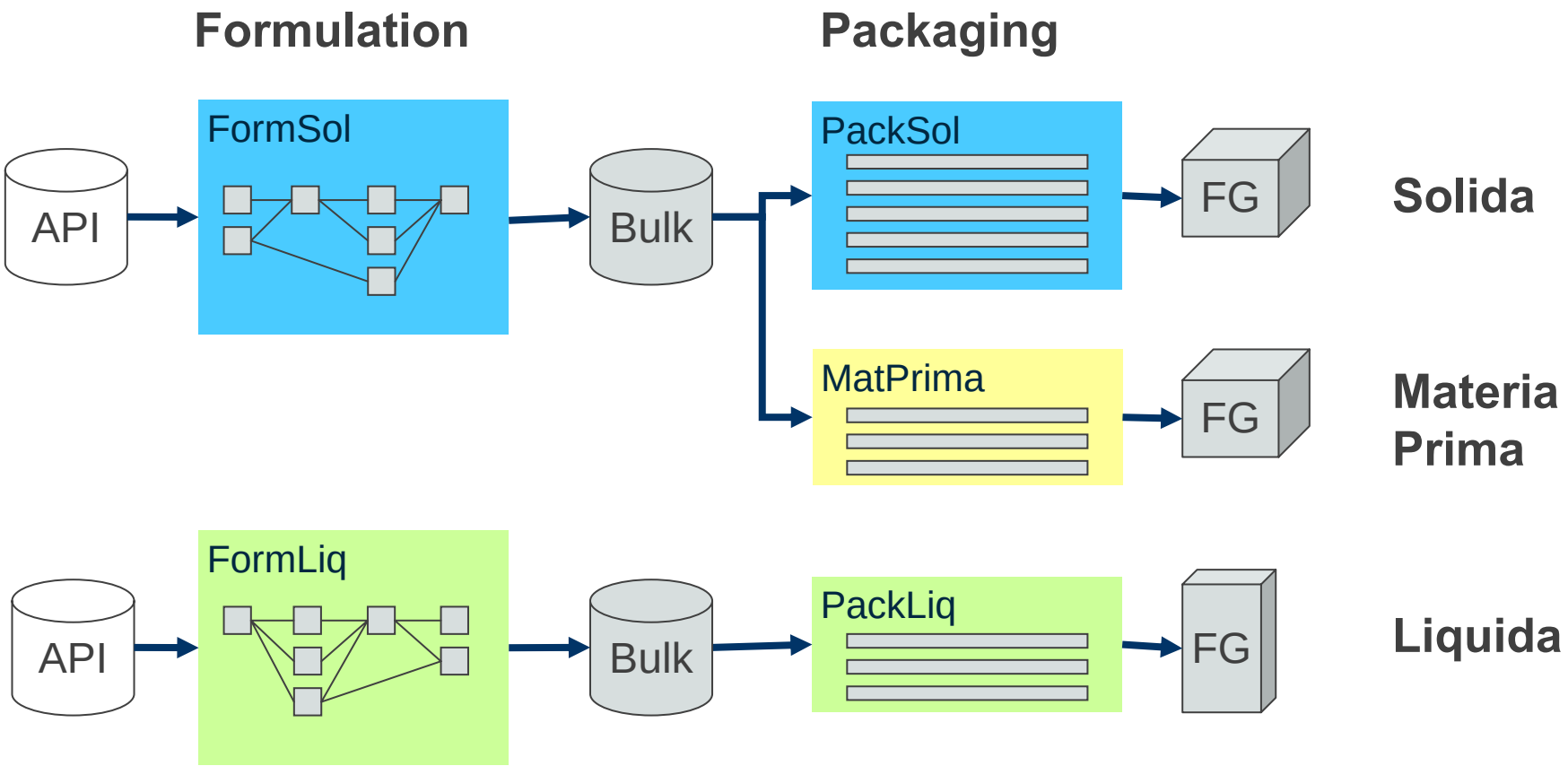
Structure – Production Plant



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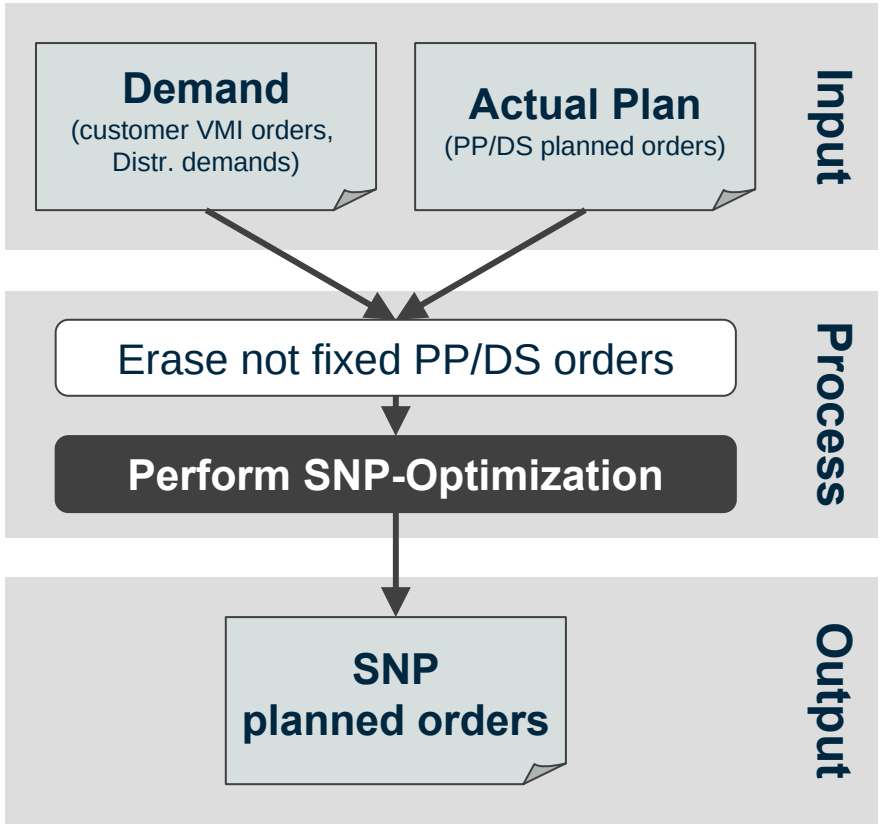
SNP optimization - Overview

Function

- Bucket based rough cut planning
- Determine optimized campaign sizes (considering setup-, inventory holding costs)

Features

- Monthly buckets
- Multi-level simultaneous (formulation, packaging)
- Dynamic (real demands)
- Finite capacity planning
- Only bottleneck resources and major items considered
- Usage of alternative resources
- No rounding values and minimal lot sizes



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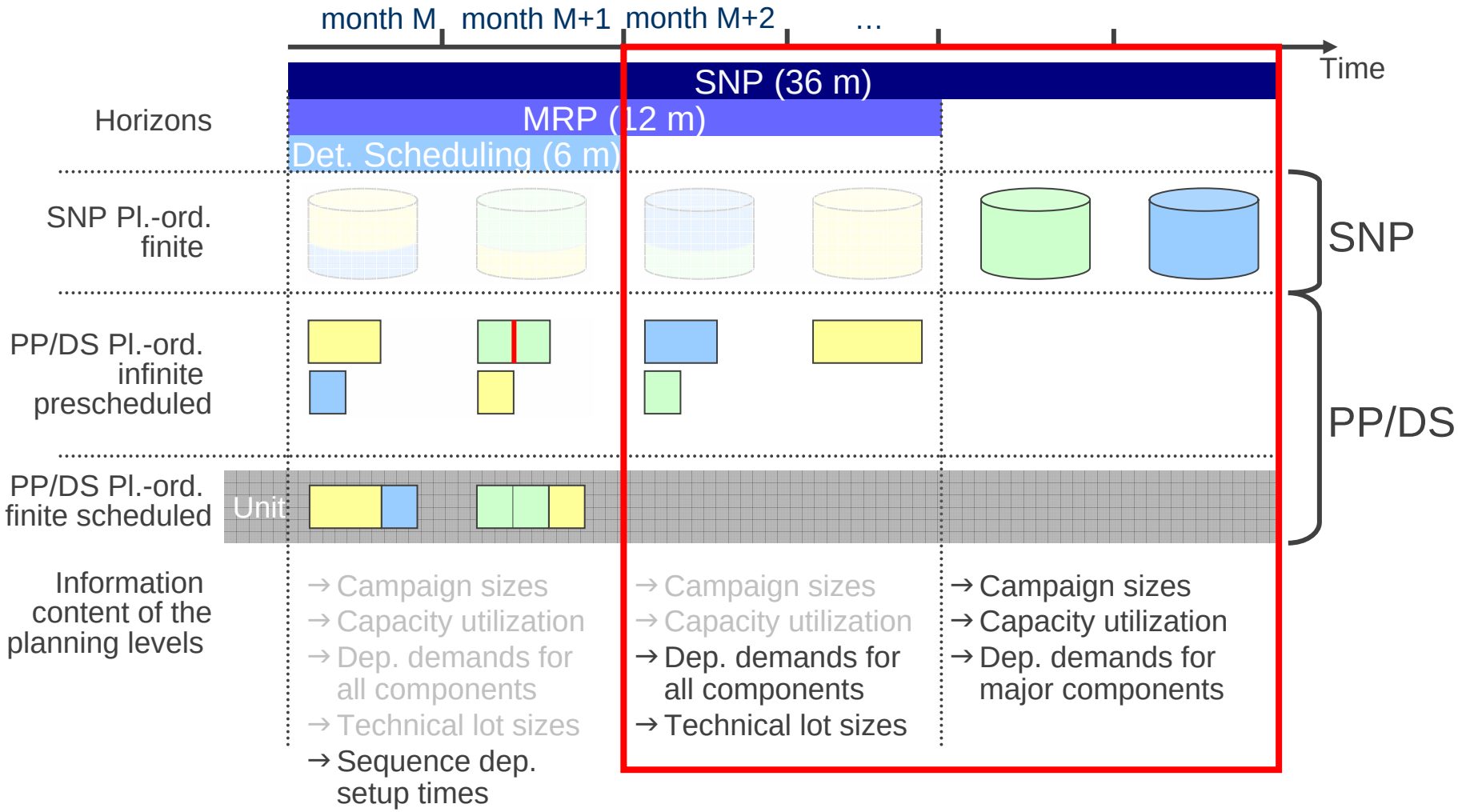
Hierarchical planning approach



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Former methodology

- **Annually determination of the „optimal" lot-size based on Andler**
  → Used as fixed lot size in MRP
- **Assumptions:**

	Andler	SNP-Opt.
Demands	Constant rate	Real demands → i.e. seasonal fluctuations
Set-up costs	Average value (product specific)	Average value (product specific)
Storage costs	Capital lockup (product specific)	Capital lockup (product specific)
Production process	Single-level	Single- or Multi-level
Products	One	N
Resources	Infinite	Finite
Receipts	Date: Depending on demands Quantity: Fixed	Date: Depending on demand/capacity Quantity: Dynamic
Determination	Iterative	Simultaneous

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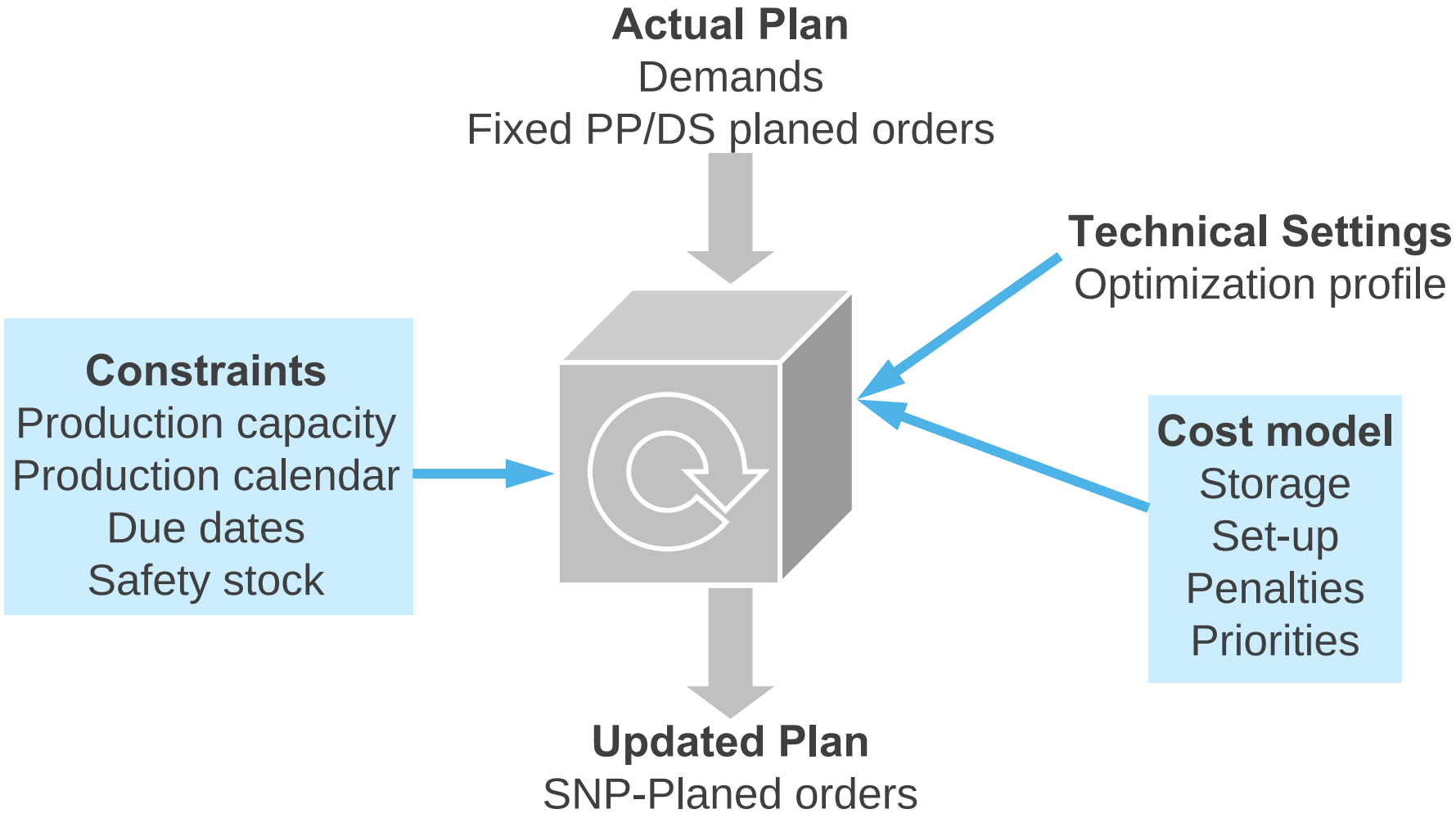
Overview: SNP optimization



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SNP optimization - Constraints

Constraints to be taken into account:

Hard

- Production capacity
- Calendar

Pseudo Hard

- Material availability

Soft

- Due dates (demand)
- Safety stock
- Shelf life

SNP cost profile

The following cost model is used

1) inventory holding cost
(based on standard price R3)

2) fixed production cost
(based on cost calculation for setup / cleaning / qc)

The following additional penalties are considered

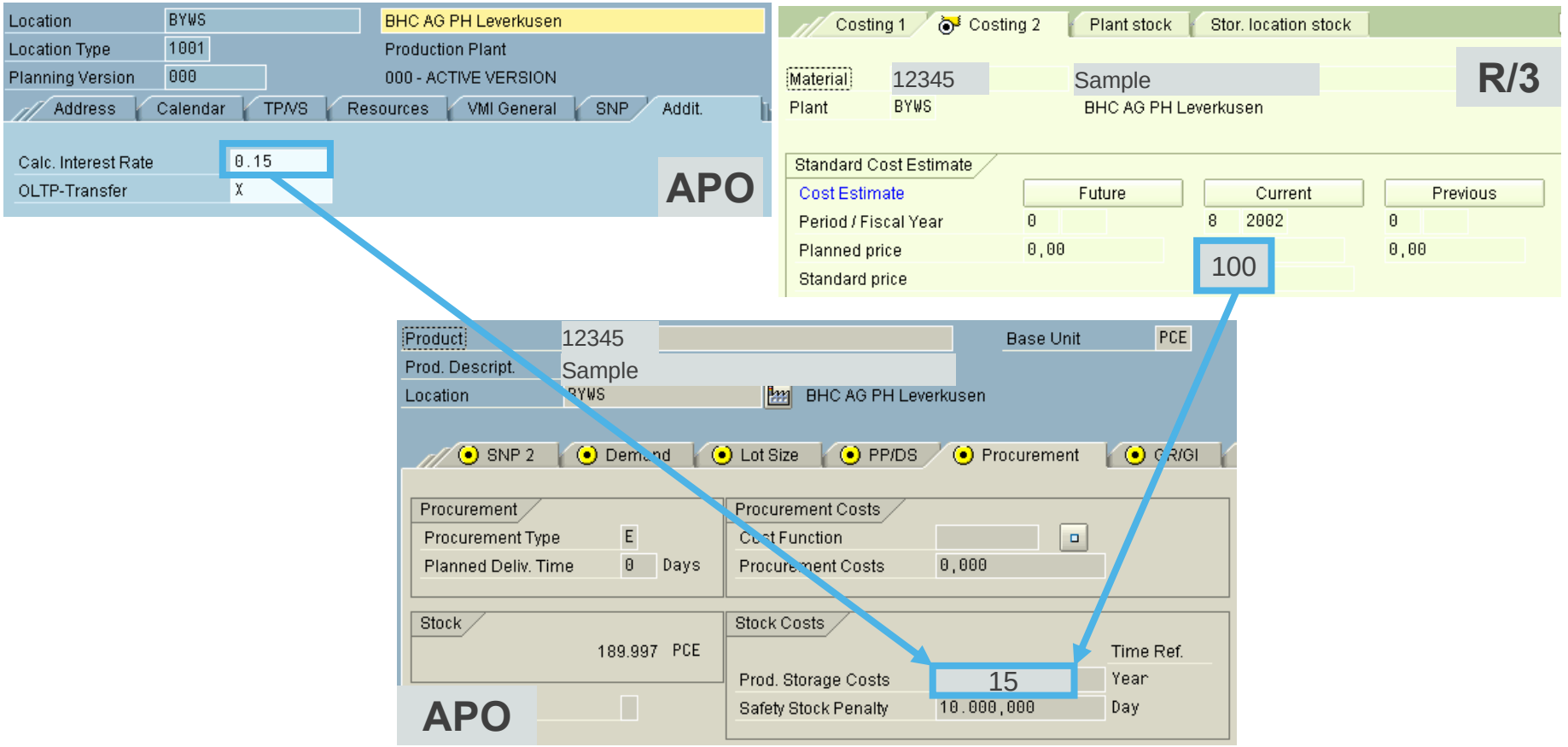
3) penalty for safety stock violations

4) penalty for non delivery

5) penalty for shelf life (maximum range of coverage)

Storage cost

Inventory holding costs based on standard price R3 for plant location product



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Setup cost

- Calculate set-up costs, using cost estimation for each material, based on the standard production version
- Identify relevant cost elements by a set of activity types (per plant)
- Product calculation (R/3):

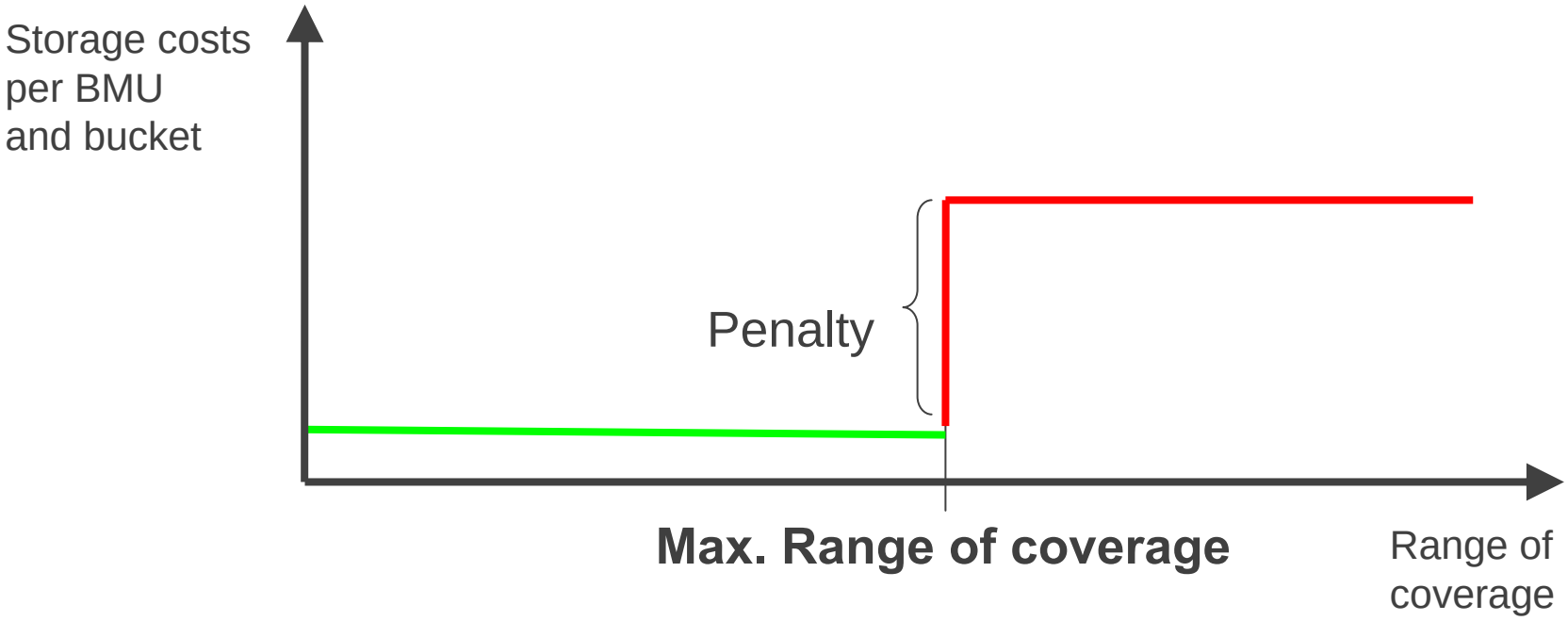
Itm...	Resource	Resource (Text)	Σ Total Value	Currncy	Quantity	
1	EE20608760 074 900200	IMA C90	207,03	EUR	62,000	**Machine set-up**
2	EE20608760 074 900201	IMA C90	62,31	EUR	18,845	
3	EE20608760 074 900202	IMA C90	140,70	EUR	0,700	**Mach. clean-out**
9	EE20607470 PER747 900100	Personal Betrieb 747	168,59	EUR	3,617	**Pers. set-up**
10	EE20607470 PER747 900101	Personal Betrieb 747	51,22	EUR	1,099	
11	EE20607470 PER747 900102	Personal Betrieb 747	114,19	EUR	2,450	**Pers. clean-out**
12	EE20607420 FGK747 900500	Fertigungsgemeinkosten 747	701,60	EUR	1	
13	EE20622420 BY622420 740110	**Sample** 49 ST - Qualitä	199,64	EUR	130,000	**QA**

- Changeover-costs (APO):

Material Number	Amount
SAMPLE	830,15

Maximum range of coverage

Soft shelf life (with continued using of expired product)



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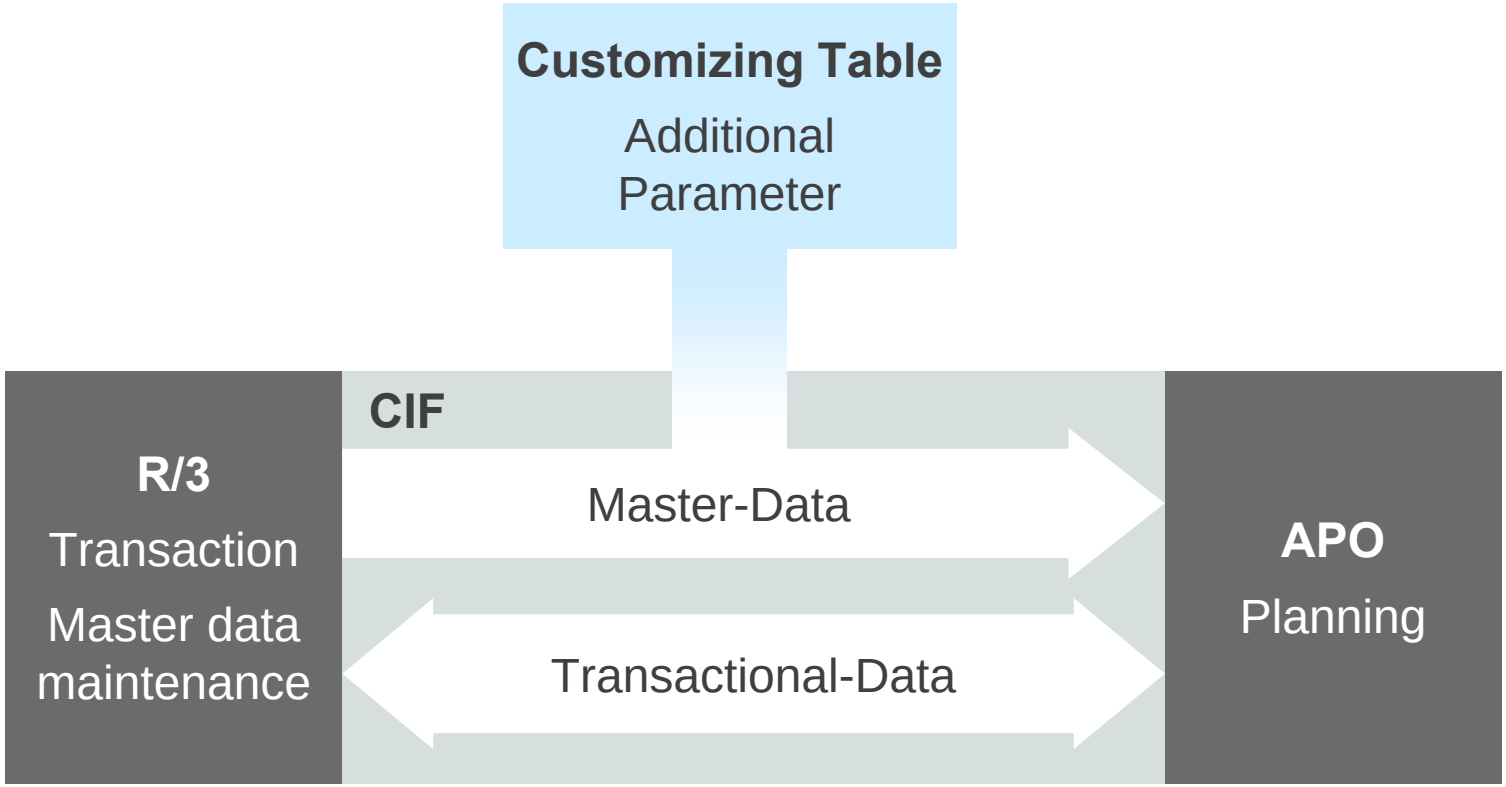
Supply of relevant costs (1)



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Supply of relevant costs (1)

Cost element	Source		Supply		Detail
	R/3	Cust. table	Automatic (CIF)	Manually (Mass)	
Set-up	X	X	X		Location product
Storage	X		X		Location product
Non Del.		X	X	X	Plant Location product
Shelf Life		X	X		Product group
Safety stock		X	X	X	Plant

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01 Introduction

02 Planning problem

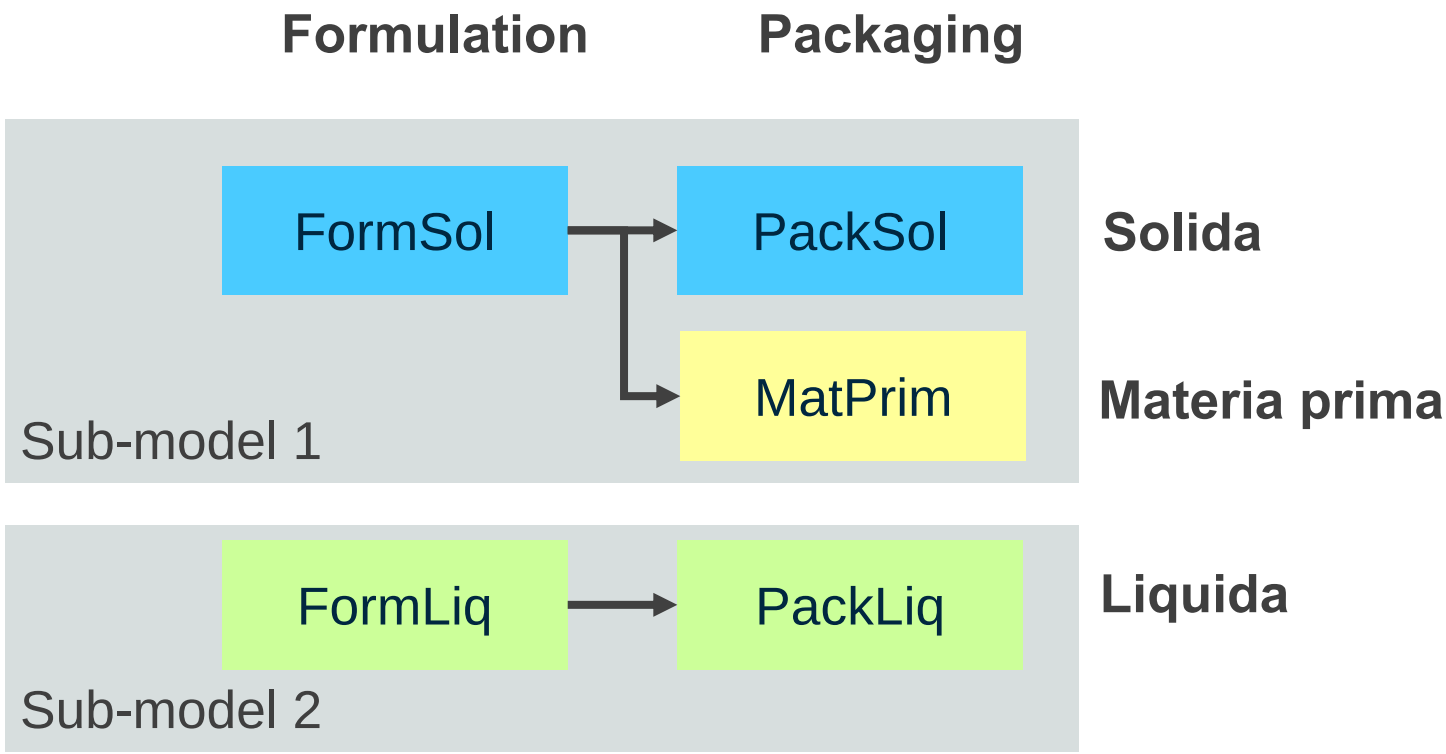
03 Model overview

04 **Numerical results**

05 Conclusion

Decomposition sub-plants

Parallel processing of disjunctive sub-models:



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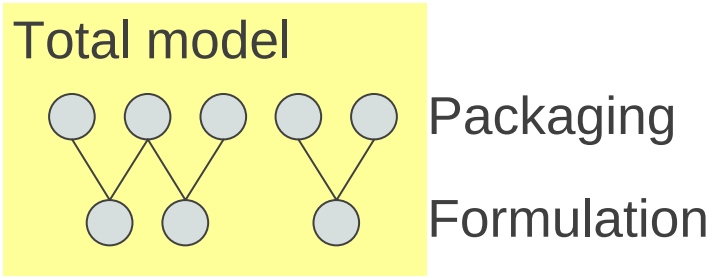
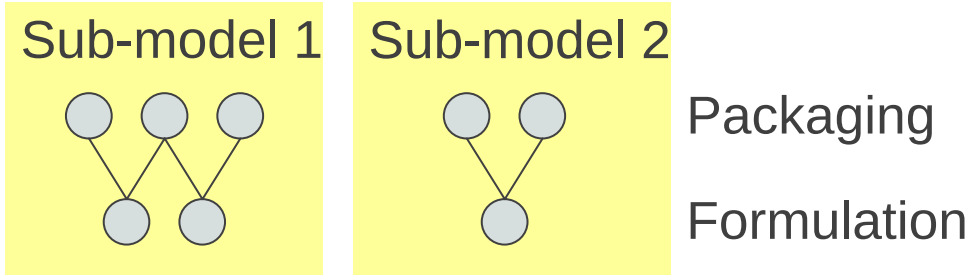
Product-Decomposition

- **Solution step 1**
  - Determination of the global solution
  - → Pre-allocation
- **Solution step 2**
  - Definition of sub-models for connected components
  - Sequential solution of the sub-models
  - → Local optimization





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Numerical results Solida

Model data

Sub-plants	SolPack +SolForm +MatPr
Products	2.148
PDSe	3.978
Demands	14.081
Resources	63
Horizon (Months)	24
Binary variables	64.371

Solution indicator

CPU	Intel Xeon (Netburst) 4 X 3 Ghz
CPU-time (h)	~ 2:50
Planned orders	1.688
Service level	~ 98 %
Opt. Gap	~ 0,005 %
Opt. Gap*	~ 3,3 %

*(Based on production-/storage costs)

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Benefits

- **Capacitated, dynamic lot sizes**
  - Based on real demands
  - Consideration of production capacities
  - Multi level optimization (packaging <> formulation)

→ **Generation of a feasible and optimized medium term plan**

→ **Reduction of manual planning activities**

→ **Alert based planning**

- **Decision support**
  - Capacity planning
  - Material requirements planning

Challenges

- **High expectations**
  - Short term planning horizon
  - Optimization based on real costs
- **User acceptance**
  - Transparence of solution
  - Global vs. local view
- **Quality of input data**
  - Master data → Reviewing process
  - Transactional data
- **Problem complexity**
  - CPU-time vs. level of detail
  - → Appropriate modeling approach

Vielen Dank für Ihre Aufmerksamkeit

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