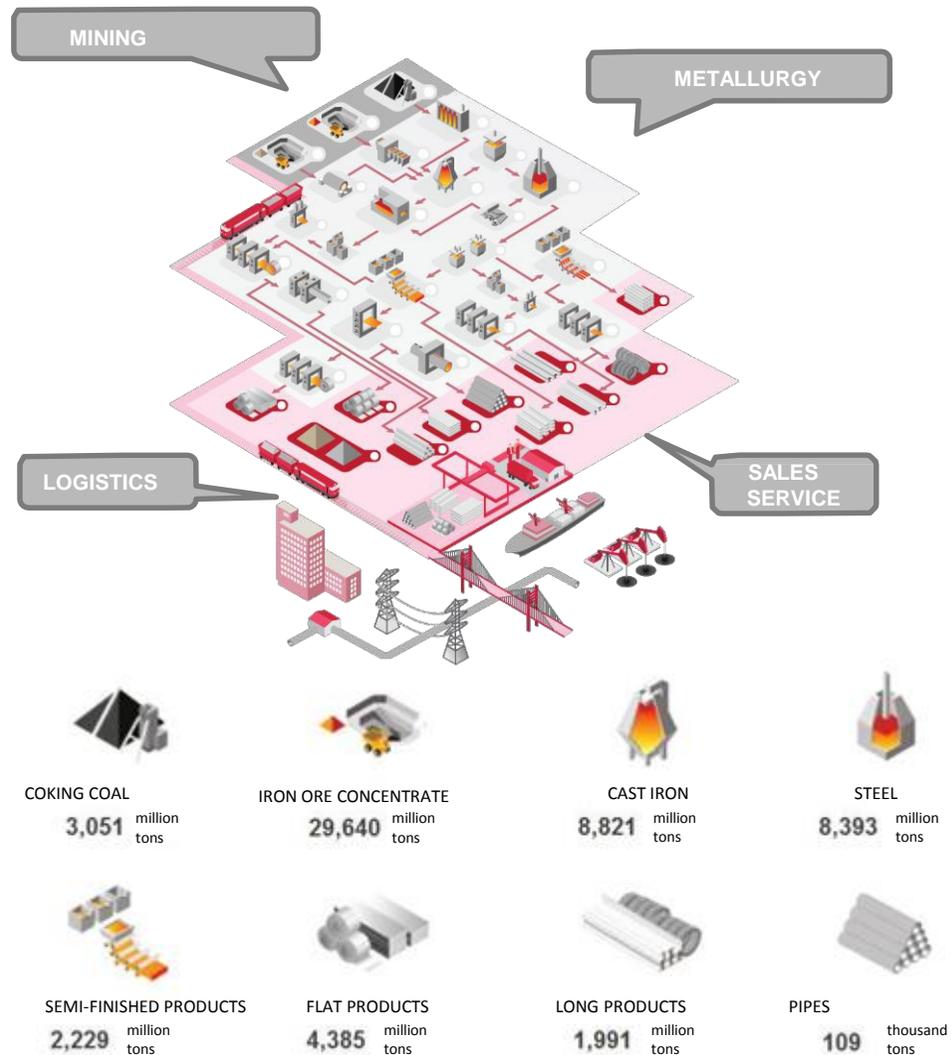
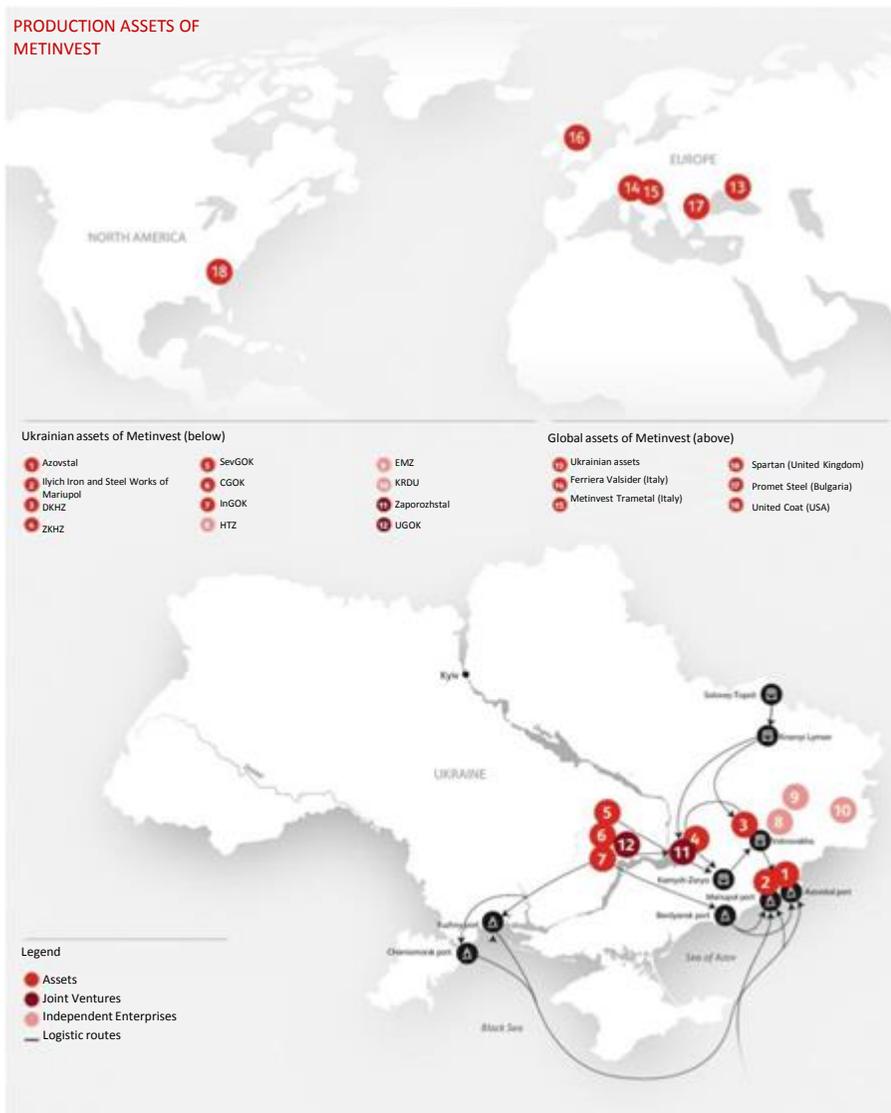


SAP-Based Solution for Planning of the End-to-End Production and Supply Chain of a Mining and Metallurgical Holding

1. METINVEST Group

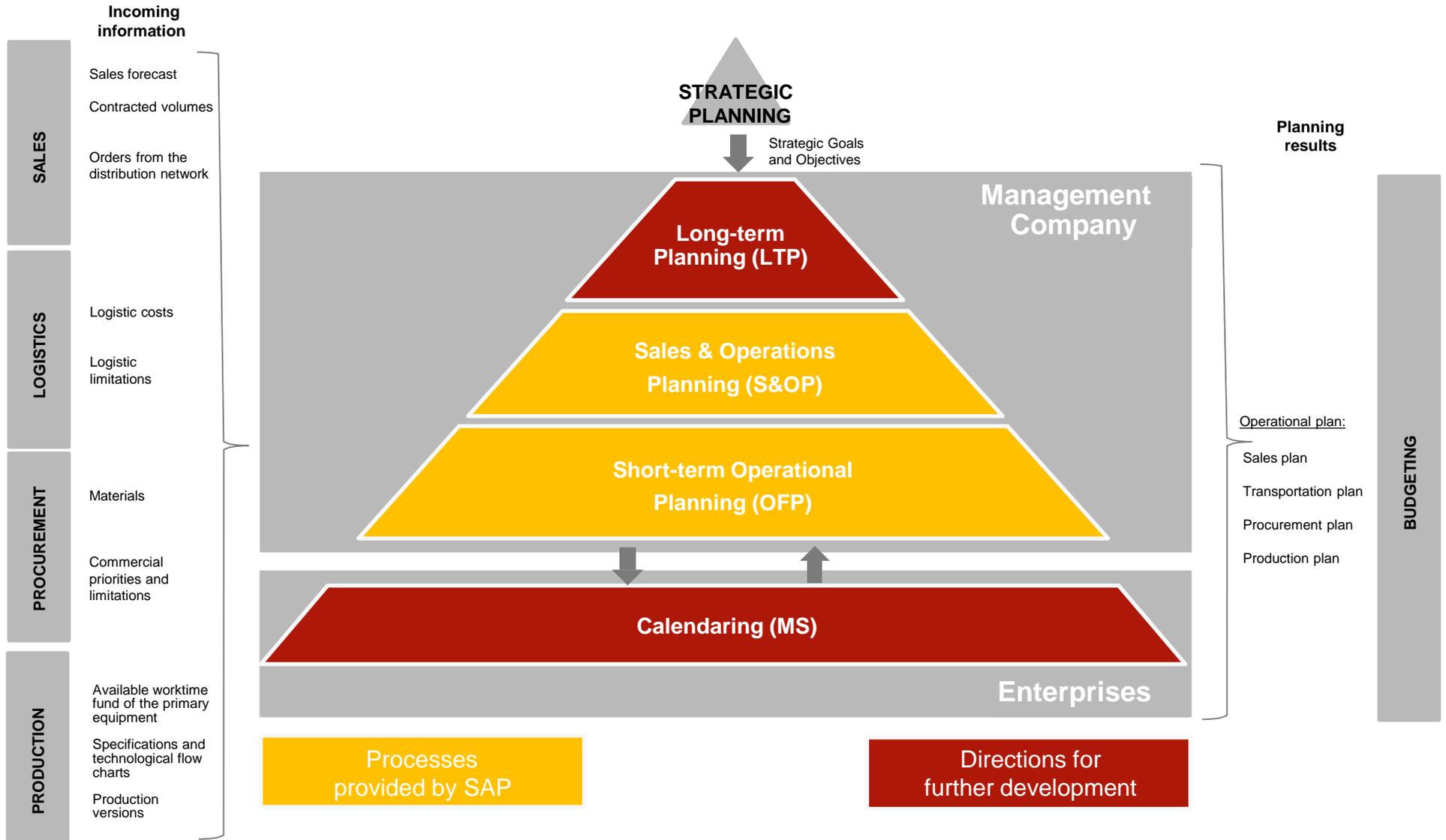
2. Supply planning powered by SAP
3. Planning mechanisms provided by SAP: limitations and course of development
4. End-to-end "coal-coke-cast iron" planning model powered by SAP
5. Course of development for the Company's integrated planning system

METINVEST Group, a vertically integrated group of steel and mining companies

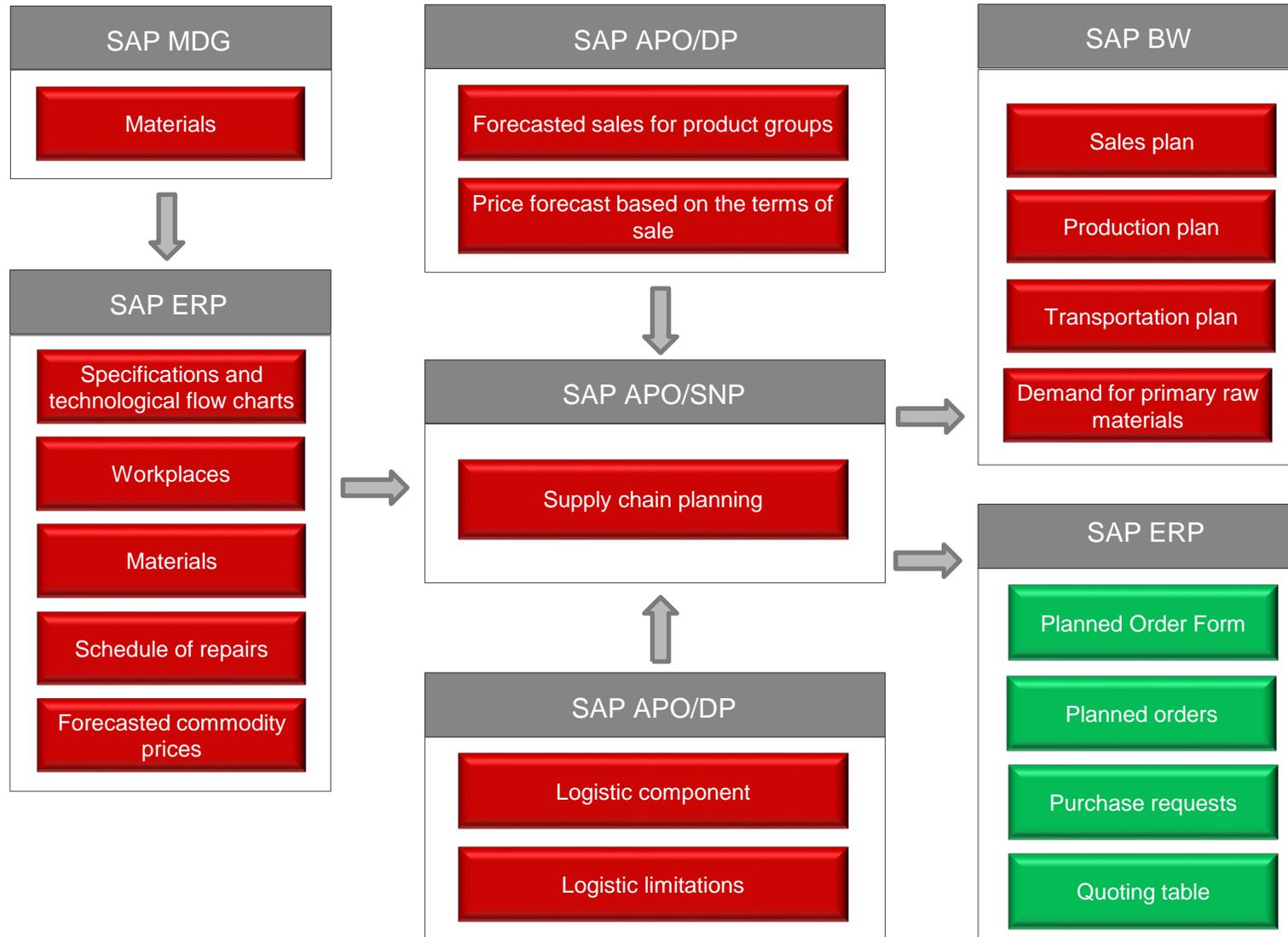


* These data refer to 2016.

Operational Planning Business Model at METINVEST



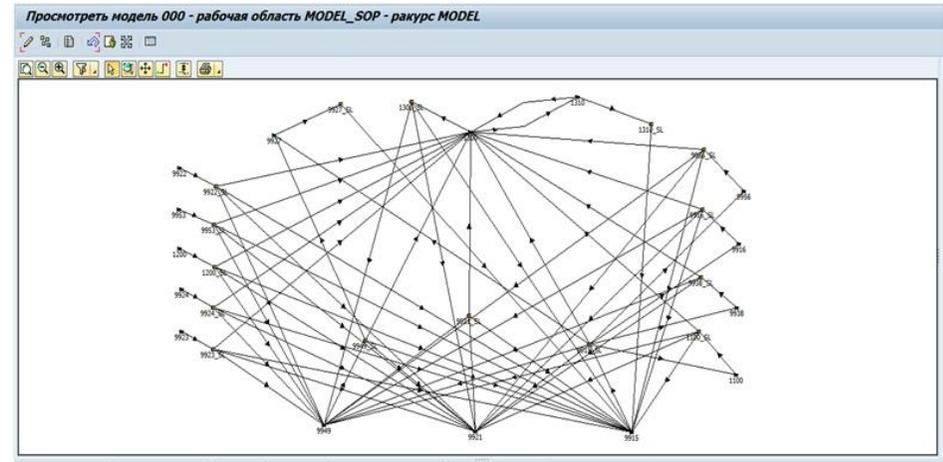
Architecture of the Solution for Implementing Planning Processes in SAP



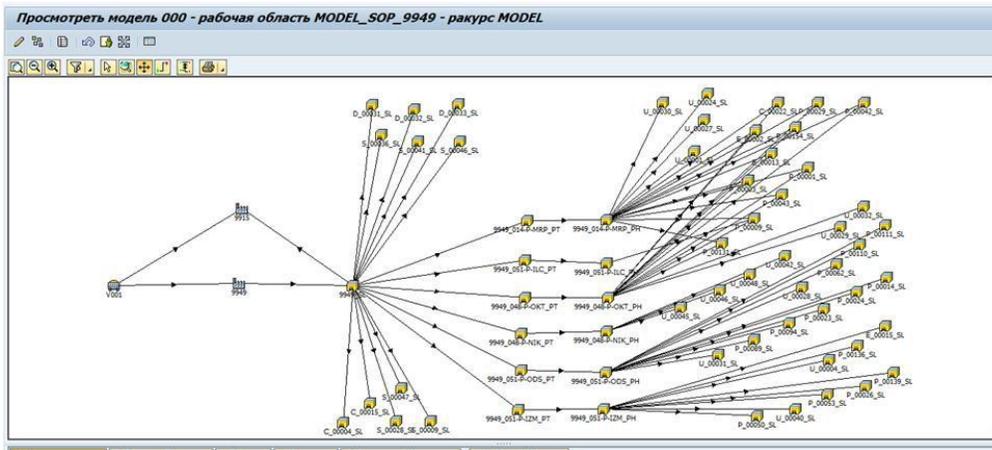
Supply Chain Planning Model at METINVEST

Scope of the supply chain planning model at METINVEST:

- 12 manufacturing enterprises
- > 700 locations of demand
- > 3,000 transportation relations



Fragment of the logistical model of the intragroup cooperation at METINVEST

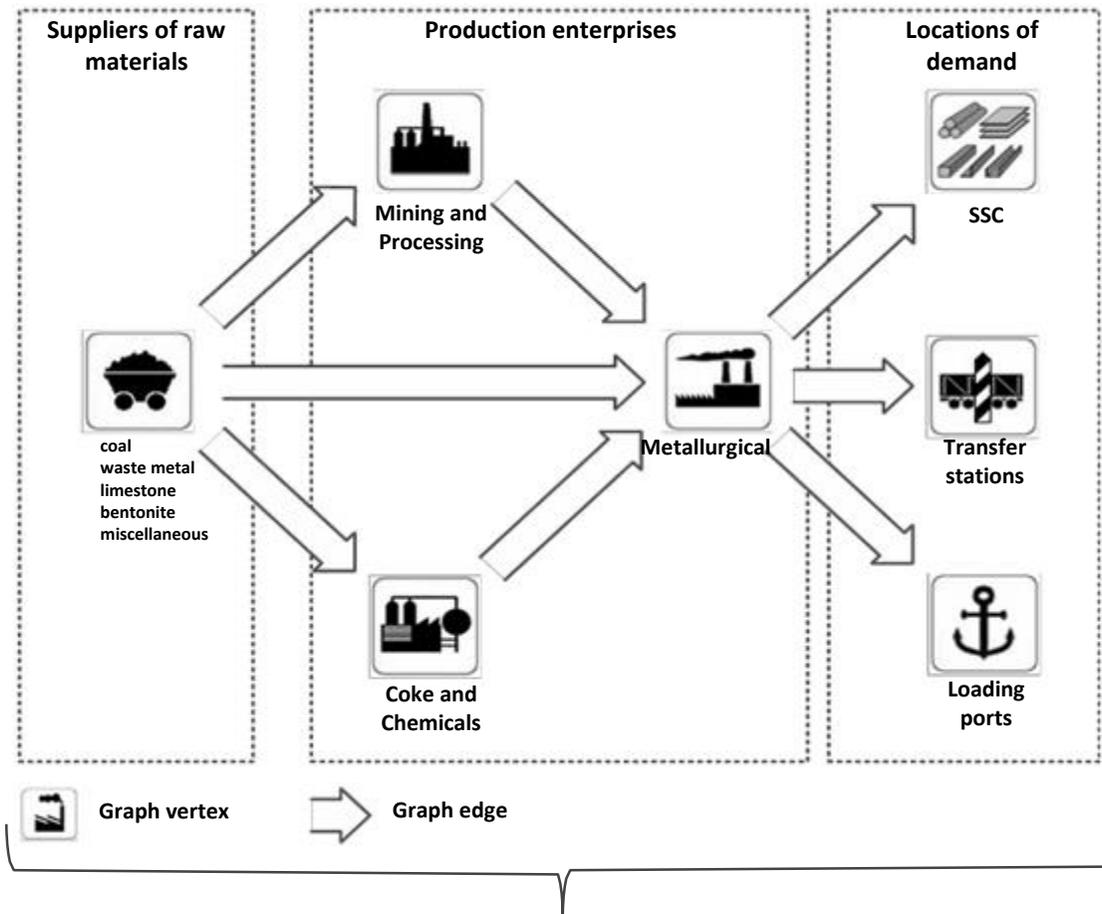


Fragment of the logistic model of commodity delivery from metallurgical enterprises to the locations of demand

Structure of the supply chain planning model at METINVEST:

- *Logistic model*
- *Production planning models*

Logistic model in SAP APO SNP



SAP APO SNP

Logistic model:

Graph vertices:

- *locations of demand*
- *suppliers*
- *load transfer point*
- *manufacturers*

Graph edges:

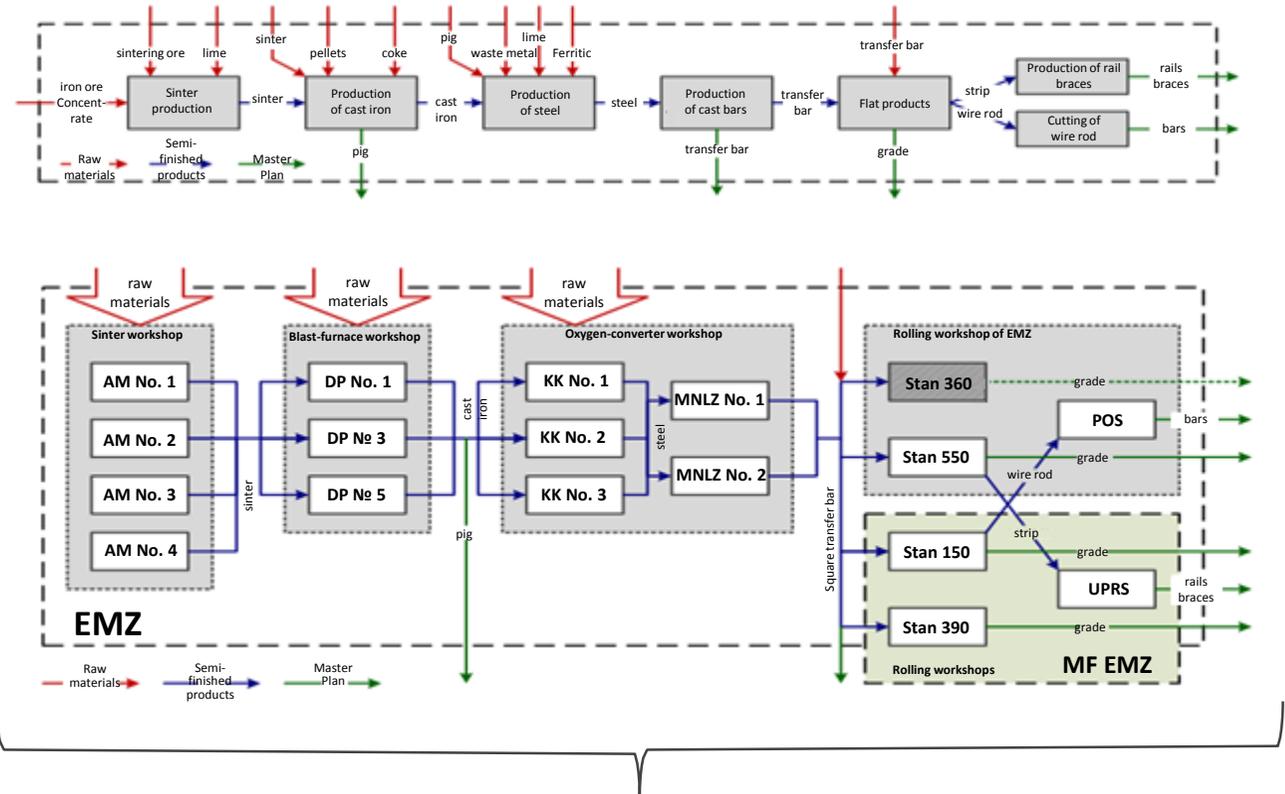
- *transportation relations*

Production planning models powered by SAP ERP

The capacity of the production vertices on the graph is determined by production planning models

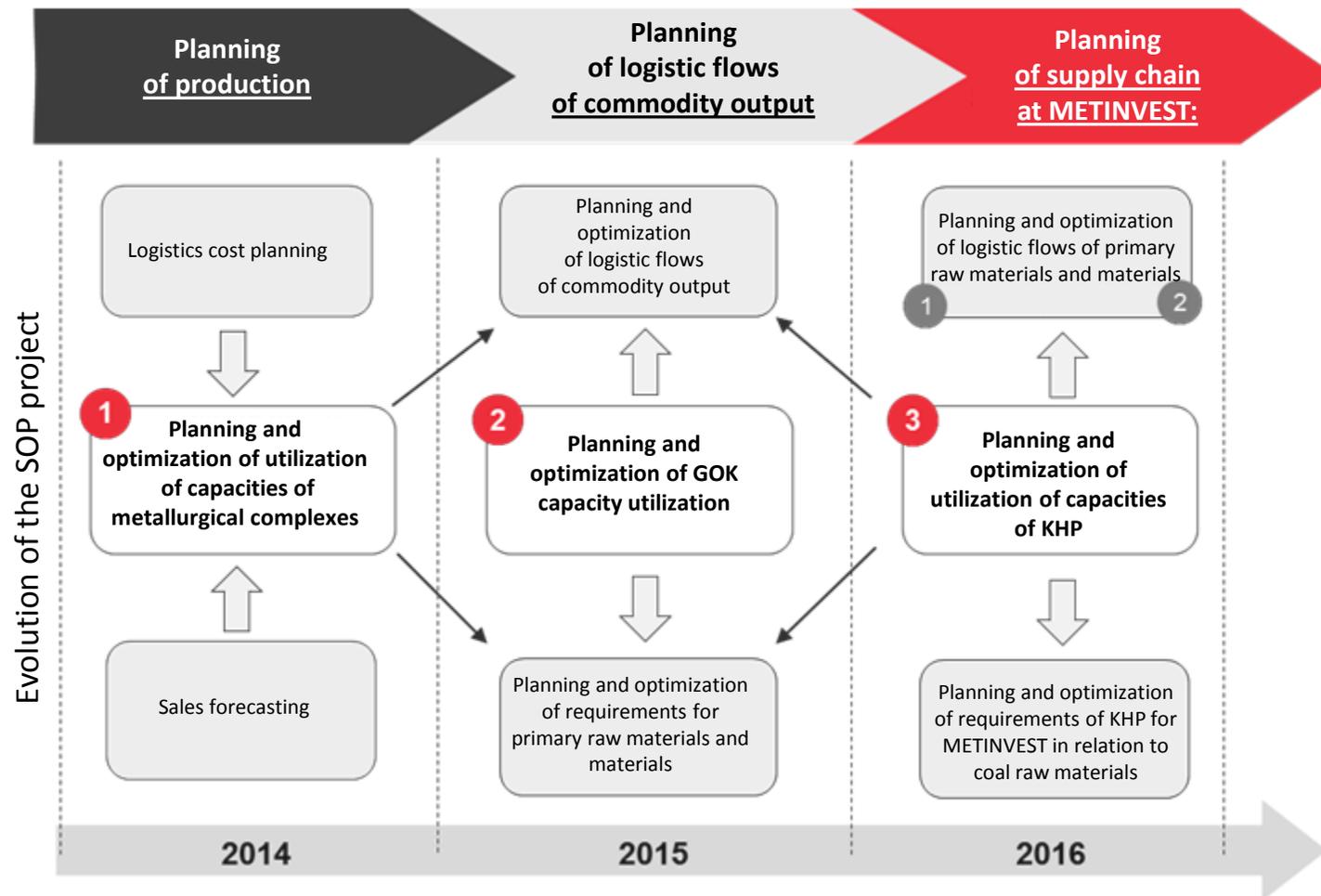
Production model:

- workplaces
 - *production machines*
- Materials Master Record
 - *manufactured products*
- master data
 - *specifications*
 - *technological flow charts*
 - *production versions*



SAP ERP

Implementation of SOP on the Basis of SAP



Production planning mechanism in SAP SNP



Determination (selection) of the most expedient (optimal) version of the manufacturer from the many versions loaded into the system

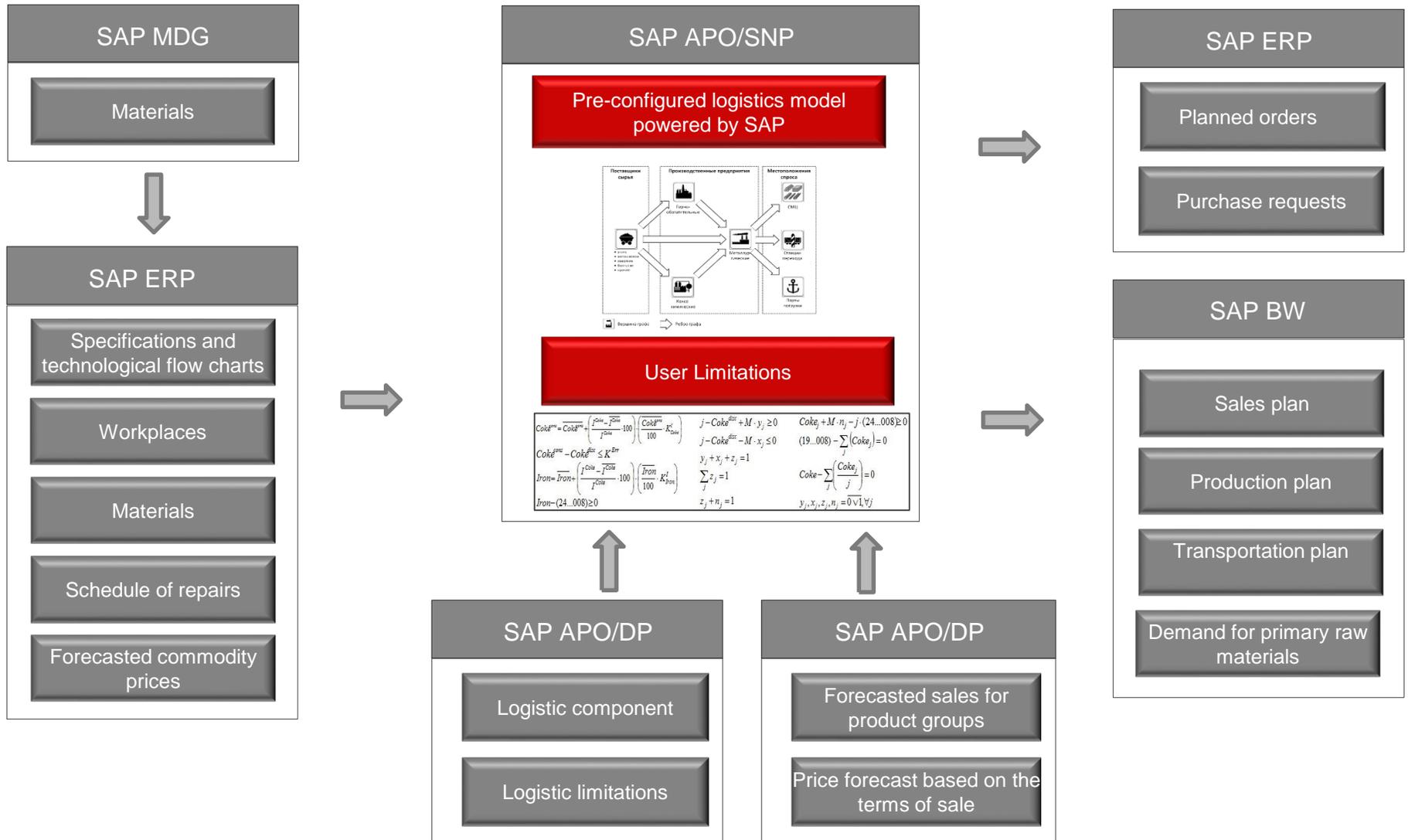


Applicability

-  – concentrating and burning capacities of GOKs
-  – steelmaking capacities of metallurgical enterprises
-  – rolling capacities of metallurgical enterprises
- 
-  – coke and chemical plants
-  – agglomeration and blast-furnace processing at metallurgical enterprises

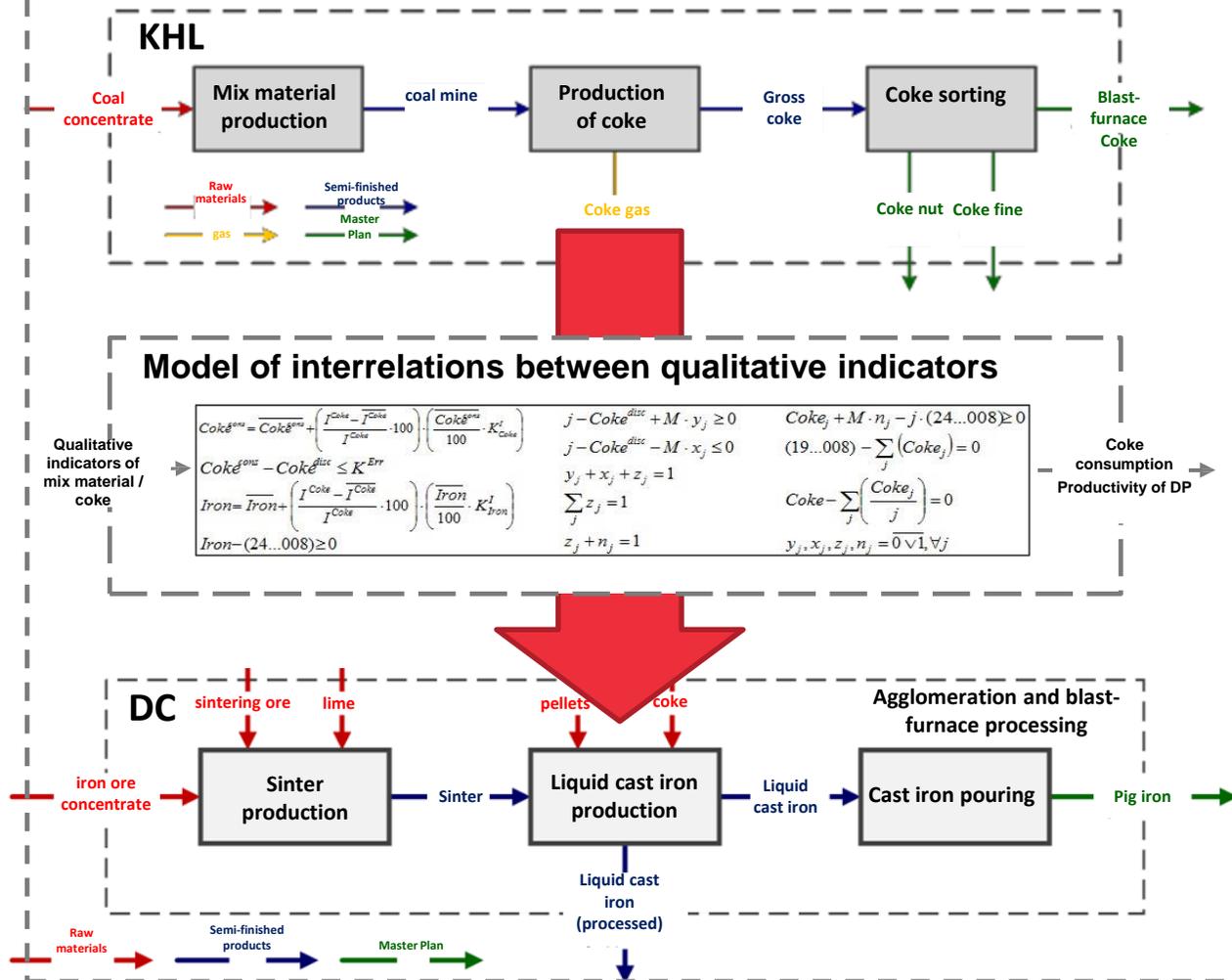


User Limitations



Architecture of the Solution for the End-to-End Planning of the "Coal-Coke-Cast Iron" Technological Chain

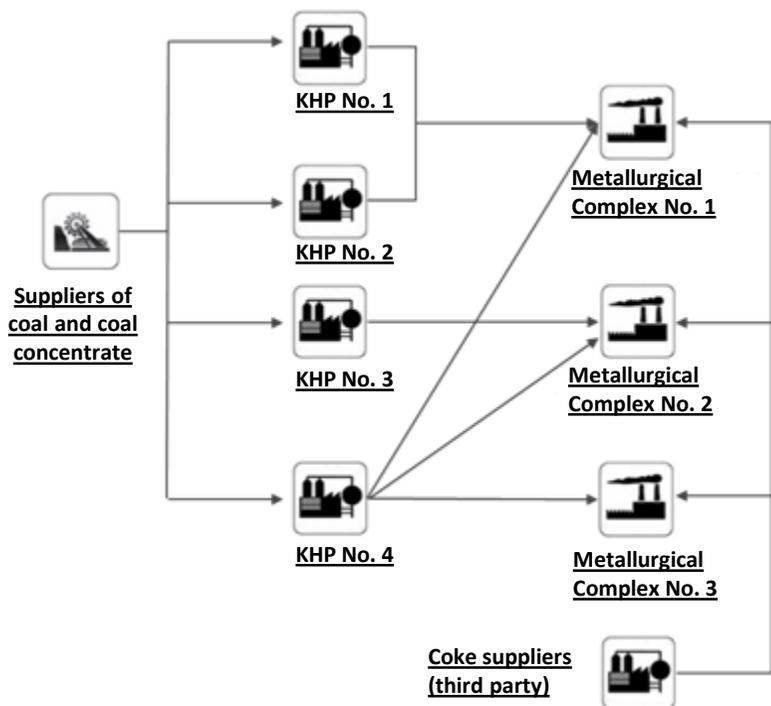
The end-to-end planning model consists of three modules:



Results of Testing the Prototype of the Solution for the End-to-End Planning of the "Coal-Coke-Cast Iron" Technological Chain

Solution scope

- **4** coke and chemical plants
- **3** metallurgical enterprises
- **≥ 60** suppliers of coal and coke

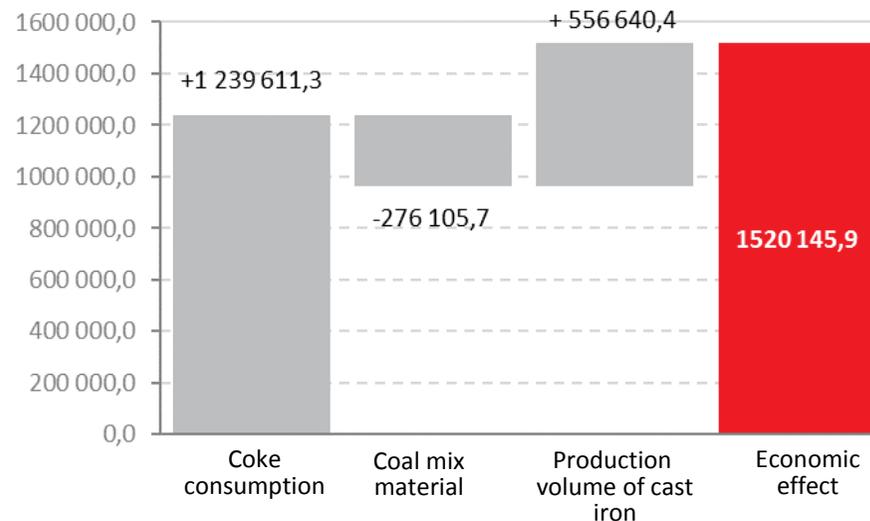


Results of testing



Cost of coal mix material	+0.2%
Specific coke consumption	-2.6%
Production volume of cast iron	+1.5%

Structure of the economic effect, \$



Computational performance

**Direct
calculation
process**



Interrelations model
(27,882 x 80,507)

$j - \text{Coke}^{\text{disc}} + M \cdot y_j \geq 0$ $j - \text{Coke}^{\text{disc}} - M \cdot x_j \leq 0$ $y_j + x_j + z_j = 1$ $\sum_j z_j = 1$ $z_j + n_j = 1$	$\text{Coke}_j + M \cdot n_j - j \cdot (24 \dots 008) \geq 0$ $(19 \dots 008) - \sum_j (\text{Coke}_j) = 0$ $\text{Coke} - \sum_j \left(\frac{\text{Coke}_j}{j} \right) = 0$ $y_j, x_j, z_j, n_j = 0 \overline{\vee} 1, \forall j$
--	---

restrictions

variables



SAP APO SNP



Calculations > 72 hours

Two-stage calculation process

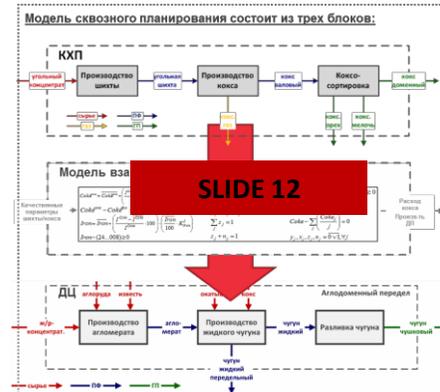
Basic SOP solution
(without the Interrelations model)

Key parameters



Permissible tolerances

Integrated Solution
(Database + Interrelations model)



SAP APO SNP

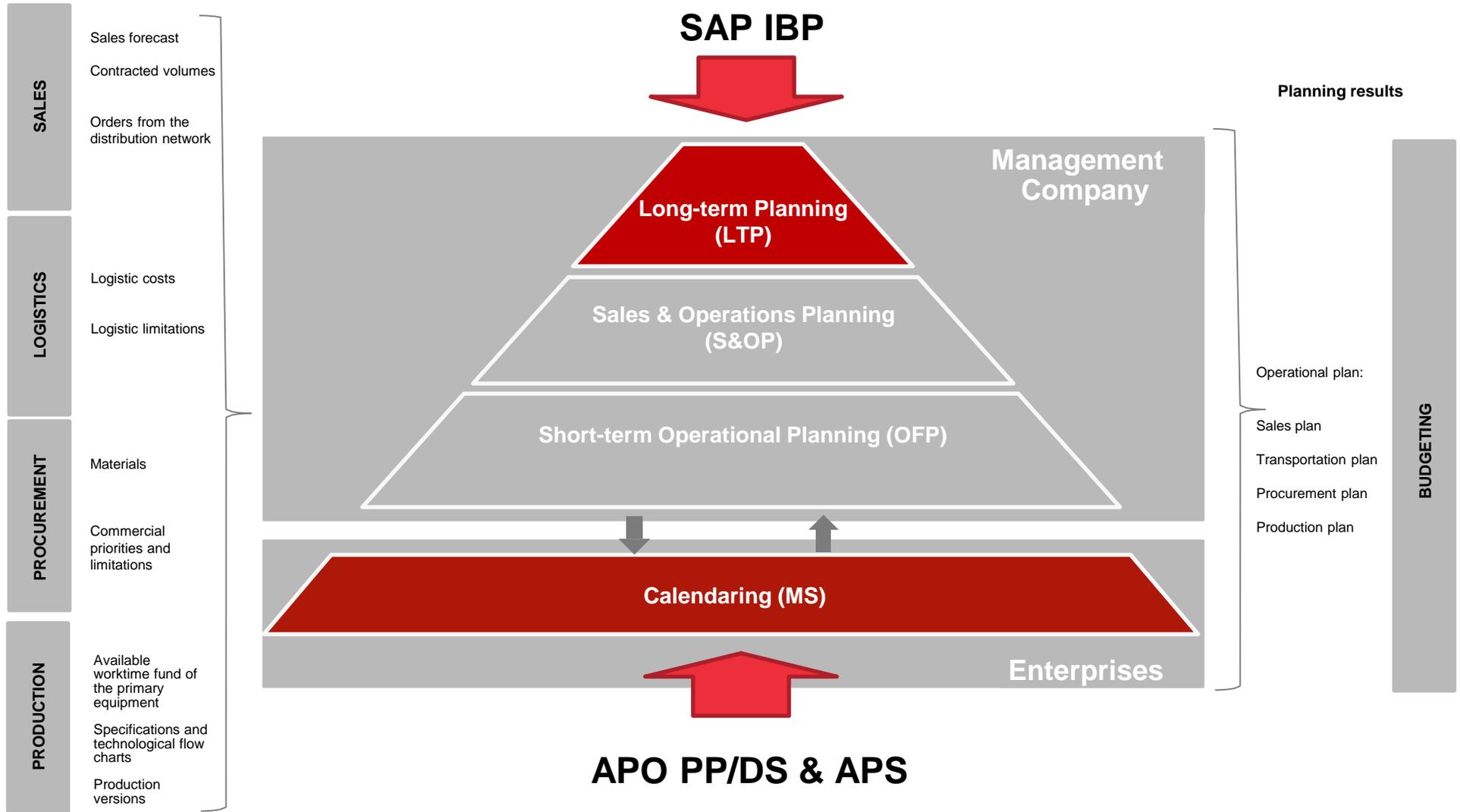


Calculation ~ **2 hours**

Data uploading – **1.5 minutes**
Calculations – **15 seconds**

Model loading **15 minutes**

Directions for the Further Development of the Integrated Supply Chain Planning System at METINVEST



Thank you.