

Vortrag in der 75. Sitzung der AG „Praxis der Mathematischen Optimierung“ der GOR:

Optimization Under Uncertainty in Real World: Suppress Uncertainty or Do Not Optimize at All

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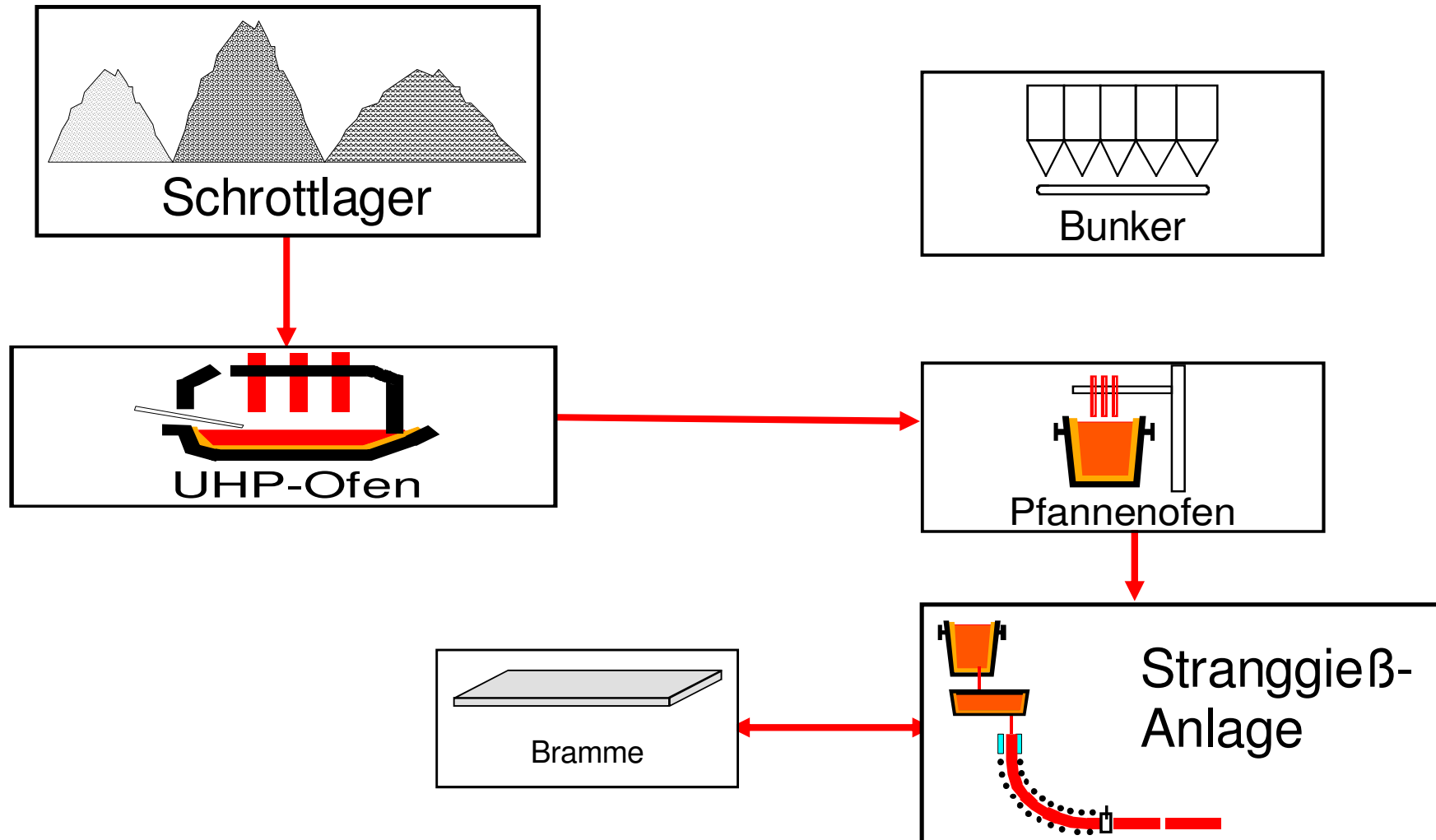


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Introduction & Warming Up

- Two Simplified Examples of Optimization Problems in the Steels and Metals Industry
- Problems affect People preparing the Production Process and People on the Floor executing it
- Users are aware of Uncertainties, but they either Suppress the Uncertainties, or Give up the Optimization at all
- To the Audience: How can we motivate Users to deal with Uncertainties ?

Production in a Steel Melting Shop



#1: On Line Alloy Calculation with a Copper Max

- Calculate the Alloys Required to Melt (right now) a “Charge” of 100 Tons of Liquid Steel with a Copper Content not exceeding 0.15 %
- Copper Content of the Alloys:
 - Exactly Known
 - Probability Distribution (Mean, Standard Deviation)
 - Somewhere between ... and ...
- Users perform a **Deterministic Optimization** with a Lower Copper Limit (**0.12 %**)
- Why Not Using the (known) Probability Information of the Copper Content ?
- Why Not Considering the Cost of Violating the Copper Max of 0.15 %

#1: On Line Alloy Calculation (cont.)

- “Our” Users are not familiar with the idea of “Calculations with Stochastic Input Data”
- They wish to understand the Optimization Algorithm before they accept the Optimization Model and the Solutions
- They request a simplified version of the Optimization Algorithm for emergency situations („I can do this calculation myself whenever the computer fails or ...“)
- The Users on the production floor want to meet the target „Copper shall not exceed 0.15“ at any cost. Their optimum is most likely not the best solution for the company.

#2 Monthly Raw Material Planning

- Determine the best mix of Raw Materials (Scraps, Ferroalloys) which shall be purchased on the Market for the planned Steel Production for the next Month (Nov05)
- Optimization done by Raw Material Purchase Department, Production Department, Logistic Department
- After the Nov05-Production, compare the Total Cost for Raw Materials from the Optimization with the actual Total Cost spent: **How do we explain the difference ?**
- How compares the solution from the Optimization Run (in Oct05, based on (partially) forecasted numbers) with the solution from a Optimization Run „after the fact“ (in Dec05, based on actual numbers) ? **Are they close enough („or shall we give up“)** ?

#2 Monthly Raw Material Planning (cont.)

Possible Reasons for differences:

- Other Steel Grades produced than planned and other Quantities
- Raw Materials not purchased as planned
- Raw Materials not used as planned
- Some Raw Materials Analysis defer from the forecasted values
- Change of Production Methods: Use more Carbon (than before) for Oxidation and save Electrical Energy and Chromium
- Change of Rules such as “Not more than 5% Turnings !“