

Tools: Simulation

Thinking Ahead
instead of
Fixing Afterwards



Today we will talk about

Preconditions

Areas of Use

Process

Examples

of Simulation in Manufacturing



Preconditions

Simulation can produce valuable insights for:

- **variable Process Times** of products or stations
- **discontinuous Material In- and Outflows**
- **sophisticated material flows**, specifically the combination / assembly of parts
- **variable work contents** for stations
- **break-downs** of components or stations



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Examples

of Simulation in Manufacturing



Supporting Investment Decisions

Operator

- Understanding of the Project
- Proof of Performance
- Audit of internal Planning
- Lot Optimization
- Early Checks of Performance

Understand Line Dynamics before Investments

Provider

- Clear Communication
- Improved Designs
- More Iterations of Ideas
- Less Fixing after Implementation
- Less Surprises

Cost Reduction



Proof of Performance

Without Simulation

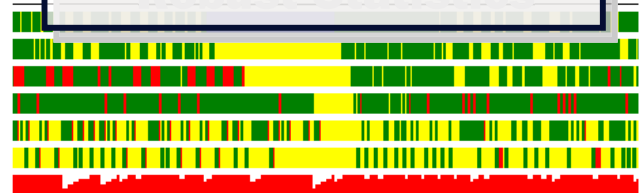
Simple Additions

HS1	00:27	00:17	00:28	00:27			00:40	00:23
HS2	00:27	00:12	00:34	00:06			00:40	00:23
US1	00:45	00:14	00:44	00:27	01:20	02:00		
US2	00:45	00:14	00:20	00:49	01:02	02:00		
OS1	00:27	00:12	00:34	00:06			00:40	00:23

- General Work Times
- No detailed distributions
- No analysis of break-downs or other special situations

With Simulation

Robust Statistics



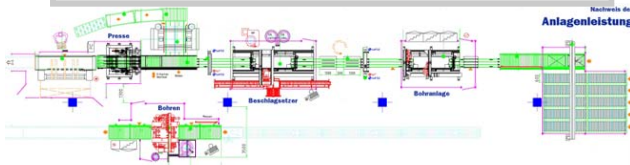
- Statistical distributions of times
- Inclusion of random break-downs and operator availability
- Hardening of the system by probing extreme scenarios



Communication

Without Simulation

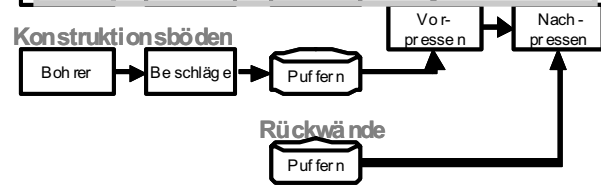
Layouts



- Focus on mechanical solution; flows are not directly shown
- System dynamics, especially the interplay of different stations, cannot be shown

With Simulation

Material Flows



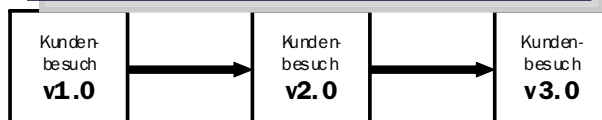
- Focus on material flow
- System dynamics are central to the experiments
- Detailed data about work times are a auditable part of the model



Design Process

Without Simulation

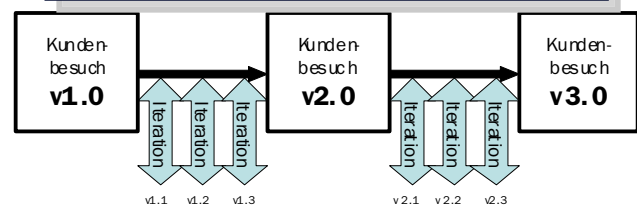
Few Milestones



- Few changes, usually triggered by the customer
- Focus on technical drawing

With Simulation

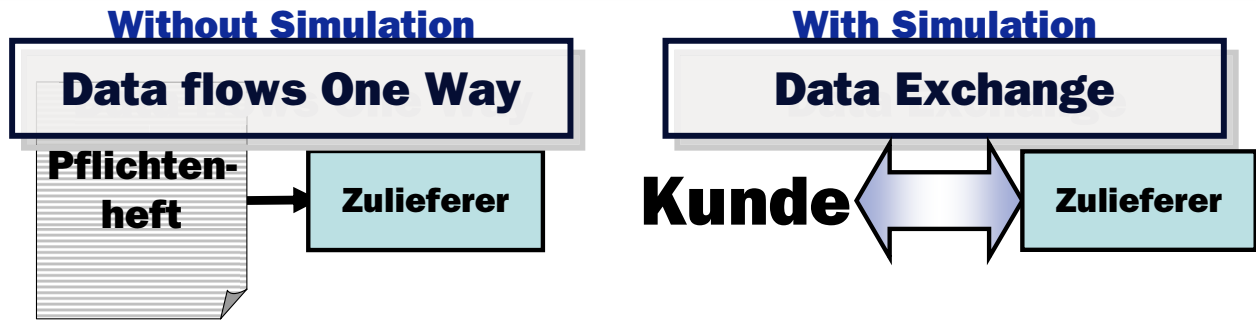
Frequent Iterationen



- Geared towards Observation and Learning
- Iterations: „Dive into the Data“
- Targeted hunt for optimization opportunities



Cooperation



- Narrow understanding of collaboration: *Delivery of a Manufacturing System*
- Focused on a part of the manufacturing task, not the total process
- Expanded collaboration between customer and supplier
- Information concerning the process, e.g. lot improvements



Optimization of existing Assets



Effects of new Products

- **New Products** might change:
 - Work contents
 - Work times
 - Material In- and Outflows
- Simulation can examine how the line **reacts** to the new products



Break-Even Analysis partial Investments

- **Numerical Analysis** of existing bottlenecks
- **What-If Analysis** of potential changes to remove the bottleneck:
 - Work Times
 - Work Contents
 - Material Flows
 - Buffer Capacities
- Simulation can yield the **key specifications** necessary to make a partial replacement investment worthwhile



