Industry 4.0 at a paper machine
Koehler Paper Group

- Koehler Paper Group – one of the very few independent and family owned paper groups in Europe

- 7 paper machines and 1 board machine at 4 locations

- Sales Volume 2014: 500,000 t
- Employees 2014: 1,694
Koehler Paper Group - Products
Industry 4.0 for the Koehler Paper Group?

Requirements ➔ production process information

- automated operating and machine data logging
- relate to the economic documents
- easy and fast analysis

Advantage of Industry 4.0

- real time information
- predictive quality
„Industry 4.0“ for the Koehler Paper Group?

Prototyp Project

„Production Analysis & Quality“ (PAQ)

feasible viable desirable
Paper Machine 6
Related Systems

87 parameter values in a 3 second intervall
Related Systems

*PCO = SAP Plant Connectivity  **ESP = SAP Event Stream Processor
4 Month Data

<table>
<thead>
<tr>
<th>Production process values</th>
<th>Handling Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 320 Mio.</td>
<td>• 5 Tsd.</td>
</tr>
</tbody>
</table>

Today

87 parameter ➔ data factor 64,000

Planned

500 parameter ➔ data factor 370,000
Predictive Quality?

- What parameter influences the target?
- How intensive is the influence?

- What will be the target result at the actual parameter setting?
## Predictive Quality?

<table>
<thead>
<tr>
<th>Build predictive model</th>
<th>Apply model into the data stream</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Historical Information</strong></td>
<td><img src="https://via.placeholder.com/150" alt="Diagram" /></td>
</tr>
<tr>
<td>Production process values vs. Quality inspection result</td>
<td>1. Parameter Value</td>
</tr>
<tr>
<td><strong>Model Training</strong></td>
<td>2. Parameter Value</td>
</tr>
<tr>
<td>check causality</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td>quality result</td>
</tr>
</tbody>
</table>
Why Predictive Quality?

with in-process-controll

higher precision

without in-process-controll

realtime in-process-controll
Why Predictive Quality?
There is more in Predictive quality!

**correlation**
- What parameter influences the target?
- How intensive is the influence?

**prediction**
- What will be the target result at the actual parameter setting?

**simulation**
- What will be the target result when the parameter setting is changed?

**optimization**
- How to adjust the parameter setting to reach the target result?
Feasible

- systems
- all systems are connected and working
- improvement & expandability
- continuously
- know how
- interdisciplinary team
Viable

setup time
less standby time for quality information

scrap reduction
continuous process monitoring

customer satisfaction
continuous quality monitoring

ressource usage
inprocess comparison with the best process
Desirable

- 
  - **operational availability**
  - the operator stays in control

- 
  - **data security and information integrity**
  - we meet our company standards

- 
  - **reliability of results**
  - all analytic results are recorded for verification
Conclusion of „Industry 4.0“ for the Koehler Paper Group

- define your own „Industry 4.0“
- remain the process-control at your operators
- the value of prediction is not predictable