Plastics 4.0: How intelligent machinery is optimizing production

Dr. Hans Ulrich Golz, KraussMaffei Technologies, 07.02.2017
Leading manufacturer of plastic and rubber machinery with 3 strong brands

- **KraussMaffei**
- **KraussMaffei Berstorff**
- **Netstal**

### Injection Molding Machinery
- **KraussMaffei**
- **KraussMaffei Berstorff**

### Extrusion Technology

#### Leading market position

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
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<tbody>
<tr>
<td>Group sales</td>
<td>1,112 Mrd. EUR</td>
<td>1,212 Mrd. EUR</td>
</tr>
<tr>
<td>Incoming orders</td>
<td>1,127 Mrd. EUR</td>
<td>1,263 Mrd. EUR</td>
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#### Worldwide key indicators

<table>
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<tr>
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<th>~ 1.200</th>
<th>~ 4.500</th>
<th>~ 60</th>
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</thead>
<tbody>
<tr>
<td>Patents</td>
<td></td>
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<td></td>
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<tr>
<td>Number of employees</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Locations worldwide</td>
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</table>
Injection Molding Machinery
Technology leadership by outstanding products and applications

**KraussMaffei**

<table>
<thead>
<tr>
<th>Hydraulic</th>
<th>Electric</th>
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<tbody>
<tr>
<td>CX Series</td>
<td>New electric platform PX</td>
</tr>
<tr>
<td>MX Series</td>
<td>EVOS series</td>
</tr>
<tr>
<td>GX Series</td>
<td>ELION series 500 – 4200kN</td>
</tr>
<tr>
<td>Automation</td>
<td></td>
</tr>
<tr>
<td>Linear robots</td>
<td>New electric platform Elios 4500-7500kN</td>
</tr>
<tr>
<td>Industrial robots</td>
<td></td>
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</tbody>
</table>

**PET**

- PET-LINE series

**Applications**

- Automotive
- TEC
- Logistics Pack
- Med
- PAC
- PET
- CAP

**Service**

- Automation
- Service
Plastics 4.0: Our response to Industry 4.0 for our customers

- Improving communication between machines for better productivity and energy efficiency
- Self-aware and self-adjusting machines for stabilized production quality
- More than eliminating downtime with predictive maintenance
Under „Plastics 4.0“ we are developing solutions related to Industry 4.0

- Self-aware and self-adjusting machines for stabilized production quality
- Improving communication between machines for better productivity and energy efficiency
- More than eliminating downtime with predictive maintenance

- Integrated Production
- Intelligent Machines
- Interactive Services
- APC Plus
- DataXplorer
- Analytics
- OPCUA
- E-Service
- Remote Support
Self-aware and self-adjusting machines for stabilized production quality
**APC plus machine function**

Self-aware and self-adjusting machines that can stabilize production quality

Next generation intelligent injection molding
- more precise, easy to use and sophisticated -
**APC plus case study: comparison with position based switch over**

- **Machine:** AX100-380D40
- **Component:** Circular disk (D=200mm, d=1mm)
- **Material:** PA6GF30

**Variation coefficient for this test series:**
- Screw position based switch over: 0.132%
- APC plus based switch over: 0.034%
More than eliminating downtime with predictive maintenance.
E-Service-Platform – Customer Dashboard
Bundling all customer data and service information
E-Service Platform – Easy to access with QR-Code

1. **STATIC**
   - QR-Code on spare part

2. **STATIC**
   - QR-Code on machine

1. **DYNAMIC**
   - QR-Code generated by machine control
E-Service-Platform – Machine dashboard
Bundling all machine and process data
Improving communication between machines for better productivity and energy efficiency
KraussMaffei Analytics: Analyze all injection molding machines related data to improve the production process
Mobile control room for your mold shop

Under Development
Launch in 2017
KraussMaffei Analytics – Dashboard: Performance overview of all machines

Analyze all injection molding machines related data to improve production process

**ANALYTICS DAHSBOARD**

**Performance Indicators**

- **Stability**: 92%
- **Productivity**: 89%
- **Energy**: 1 kWh

**Power Consumption – Total Overview**
KraussMaffei Analytics – Dashboard
Detailed information for all machines available

Under Development
Launch in 2017
KraussMaffei Analytics
Machine Dashboard
Detailed information per machine

Under Development
Launch in 2017
DataXplorer (DX)
Collection, analysis and documentation of process data

Integration in MC6

Key features
- New data collection and analysis system for KraussMaffei IMM
- 20 - 520 signals (curves) available in IMM
- Data of last 7 days is stored in the machine
- Export of data with software from partner iba AG to MES or “BigData” applications

Benefits
- Monitoring and documentation
- Optimization of processes
- Easier troubleshooting and diagnostics
- Connection to the digital data world
DataXplorer (DX): Process and machine data logging/recording and analysis

- Webserver on the injection molding machine to access visualization from all network devices
- Mobile access gives full transparency
DataXplorer (DX): Traceability inclusive

Key features
- Connecting of relevant process data with quality data
- Saving selected process data and providing it via an link in a QR-Code on each part
- Backtracking individual properties of each part by scanning QR-Code

Benefits:
- Highest transparency
- Precise identification of (reject) parts ➔ Traceability
- Reduction of costs for product recalls
Data Interface OPC UA: Improving communication between machines for better productivity and energy efficiency
Scenario 1 - Smart production start up

Weekly Timer:
- Planned start of production 7:00am
- Machines starts independently starts preheating at correct time

- Easy (local) scheduling of production
- Machine and Feedstock are automatically available on time and simultaneously
- Reduced energy consumption due to “perfect timing” in system
- No overdried Feedstock – time and bin size perfectly matched to demand

Automatic adaption:
- Start of drying process at 5:30am
- Gives feedback to machine
**Data Interface OPC UA**

Scenario 2 - smart mold change / smart stop of production

**Batch counter:**
- 9,900 parts of 10,000 are produced
- Shot weight and cycle time are known

**Automatic adaption:**
- Stop of drying more feedstock
- Stops delivering of new feedstock

- No need to backhaul feedstock from machine to storage
- Easy and fast change of feedstock type
- Best in energy efficiency – only needed amount of feedstock is dried
- No unnecessary conveying of feedstock
Data Interface OPC UA
Scenario 3 - Smart alarms

MC6 display shows:
- Warning in case of problem with supply
- Gives information of remaining production time

Automatic calculation:
- Recognizes problem within the materials handling
- Give information remaining time to connected molding machine

- Problems within the materials handling are shown where they are seen
- Shortages in materials handling can be corrected before machine stops
- Remaining time for running production is shown
Data Interface OPC UA
Seamless communication between injection molding machine and periphery

- K-Show CX 300 and materials supply from motan colortronics were connected
- First installations of system at customer shop floor in 2017
- KraussMaffei drives VDMA (Euromap) to establish technology as a new standard in the market
My pressure sensor needs to be calibrated.

Have a problem with the material supply - stop in 4 minutes!

My linear guides need to be lubricated soon.

I will go to standby mode - job completed.

I will need a new box for transport soon.

Big efficiency potential in the networked self optimizing production
Thank you very much for your attention