BMW Surface Technology.
Closed-loop process control in the digital paint-shop – not just a vision.
Closed-loop process control.

Content.

1. Current situation and motivation.

2. Automated measurements.

3. The customer as a sensor.

4. Automated measuring and the customer in a quality control system.

5. Potential.

6. Summary and next steps.
Closed-loop process.

1. Current situation and motivation.

Paint shop vehicle flow – inspection and finish-areas =

- pretreatment & e-coat
- oven
- inspection
- finish
- sealing
- ubs
- oven
- primer
- oven
- inspection
- finish
- top coat
- oven
- auto. control
- finish
- wax

Cost of rework
Closed-loop process control.

1. Current situation and motivation.

Current situation.

– manual inspection of the paint work – up to 75% of the rework time.

– subjective decision about the relevance of process defects.

– no automatic feedback of quality control data – extra information needs extra time.

– no correlation of quality control data with paint shop process parameters.

– colour and appearance measurements for trials and parts of production.
Closed-loop process control.

1. Current situation and motivation.

Motivation.

– automated control of paint surface quality including data saving.

– objective acquisition and evaluation of paint defects.

– target: correlation of all customer relevant surface data and paint shop process parameters.

– modification of paint shop process parameters to avoid paint defects.

– reduction of inspection time.

– reduction of costs.
Closed-loop process control.

2. Automated measurements.

colour measurement (colour, appearance, layer thickness).

detection of paint defects.

surface inspection (dirt, runs, blisters etc.).
Closed-loop process control.

3. The customer as a sensor.

Groupstandard
(target values in a closed loop process)

prediction of the customer’s paint perception by objective surface measurements

measurement of the physical properties

customer perception studies
Closed-loop process.

4. Automated measuring and the customer in a quality control system.

- Perception studies (quantification and measuring of the customer's perception)
- group standard
- Optical quality film built
- Process data (application, curing)
- Defects
- Inspection
- Intelligent process control (closed-loop process and quality control)
- Analysis
- Reception inspection
Closed-loop process control for more efficiency.

5. Potential.

- Topcoat
- Topcoat oven
- Autom. control
- Top coat sanding
- Polish

Reducing defects

75% inspection time
25% repair time

Inspection time / detection

Detection rate in %

- Automatic 60sec.
- Long Audit >20 min.
- Finish ~240sec.
- Audit 15min.

"Colour blindness":

- Automatic: 100.0%
- Human: 0.0%

- Silver: 37.7%
- Black: 17.5%
- Monochrom: 63.6%
- Monochrom II: 64.0%
- Black: 67.3%
- Silver: 49.4%
- Black: 65.3%

- Automatic: Green
- Human: Brown
Closed-loop process control for more efficiency.

5. Potential.

Strategic potential.

- reduction of process defects during paint application.
- minimise rework.
- a closed-loop process control system allows a quick analysis of trends and a correction of the process parameters.

Additional potential.

- headcount reduction in the finishing booth.
- objective determination of surface characteristics with respect to customer’s perception.
Closed-loop process control.


- Colour status average
- Appearance average 2005-2009
- Film thickness distribution
- New technologies for new processes.

<table>
<thead>
<tr>
<th>Colour</th>
<th>Film Build</th>
<th>Appearance</th>
<th>Online Thickness</th>
<th>Defect Detection (Painted Body)</th>
<th>Defect Detection (B.I.W)</th>
<th>IPC</th>
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</thead>
<tbody>
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<td>2005</td>
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- Status Farbtöne
6. Summary and next steps.

Next steps:

– automated surface inspection of all paint work.

– automated surface and geometry inspection of B.I.W.

– combination of colour and inspection data.

– correlation of surface measurements with process parameters.

– correlation of surface measurements and customer's perception.

– introduction of a closed-loop process control system.

– development of an automated system to mark paint defects.

– development of an automated rework system (sanding and polishing).
Thank you for your attention.