

# Root Cause Analysis

Minitab and SPM Success Stories  
presented by ADDITIVE

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your application

# Problems Solved

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- What causes an out-of-control process?
- What causes an out-of-specification process?

# Non-disclosure Statement

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- All results and scenarios are based on the authors' actual experiences.
- Data units, variable names, etc. have been changed for confidentiality reasons.

# Pulp Bleaching Process

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Problem: What causes an out-of-control process?

A paper manufacturer needs to determine which factors are contributing to the pulp bleaching process being outside of statistical control.



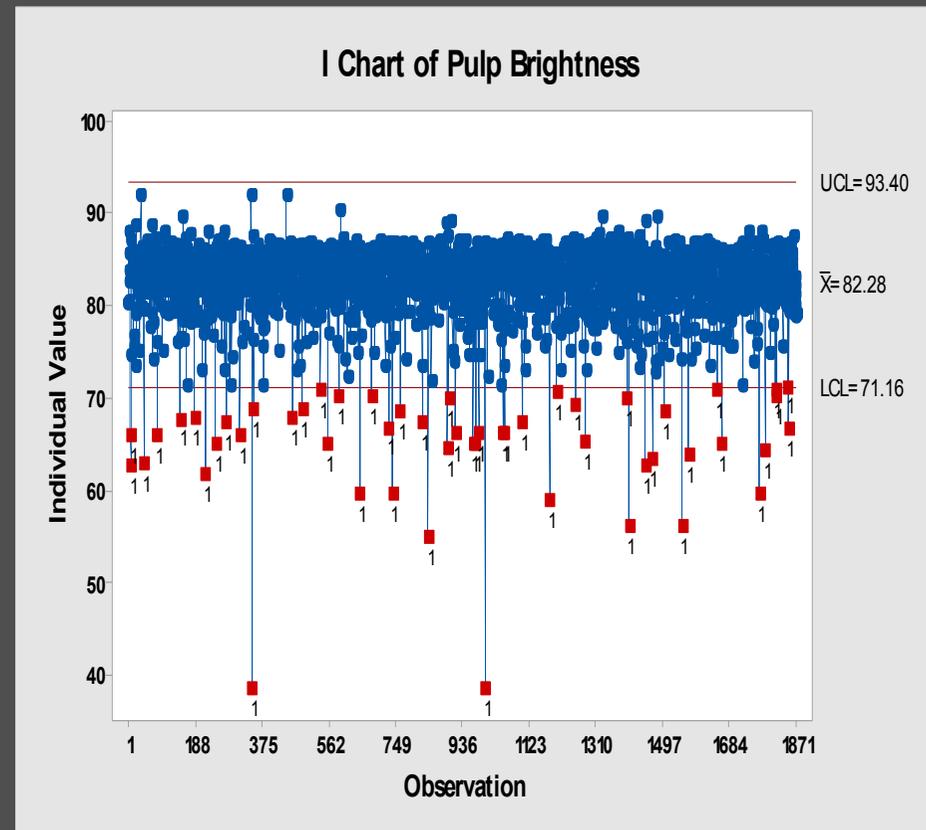
# Pulp Bleaching Process

## Analysis Step 1: What causes an out-of-control process?

Minitab's Individuals Chart indicates that the process is not stable.

A predictive model can use a binary outcome variable:

- ▶ Below LCL = 1
- ▶ Above UCL = 0



# Pulp Bleaching Process

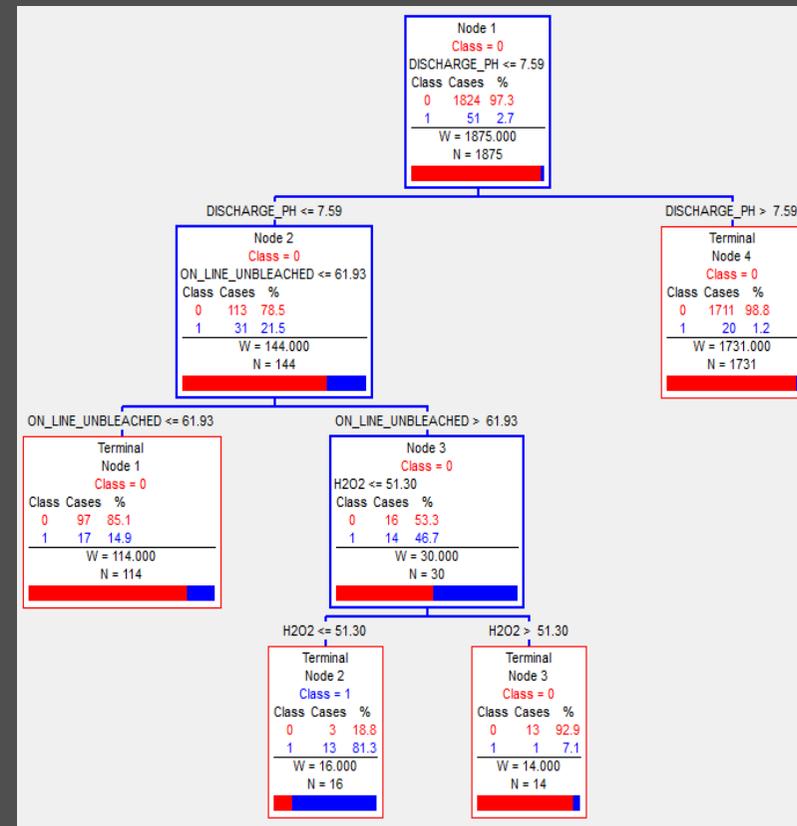
## Analysis Step 2: What causes an out-of-control process?

Salford Predictive Modeler's CART identifies the process conditions that contribute the most to pulp brightness falling below the lower control limit:

Discharge pH  $\leq 7.59$

Pre-Bleach  $> 61.93$

H2O2  $\leq 51.3$

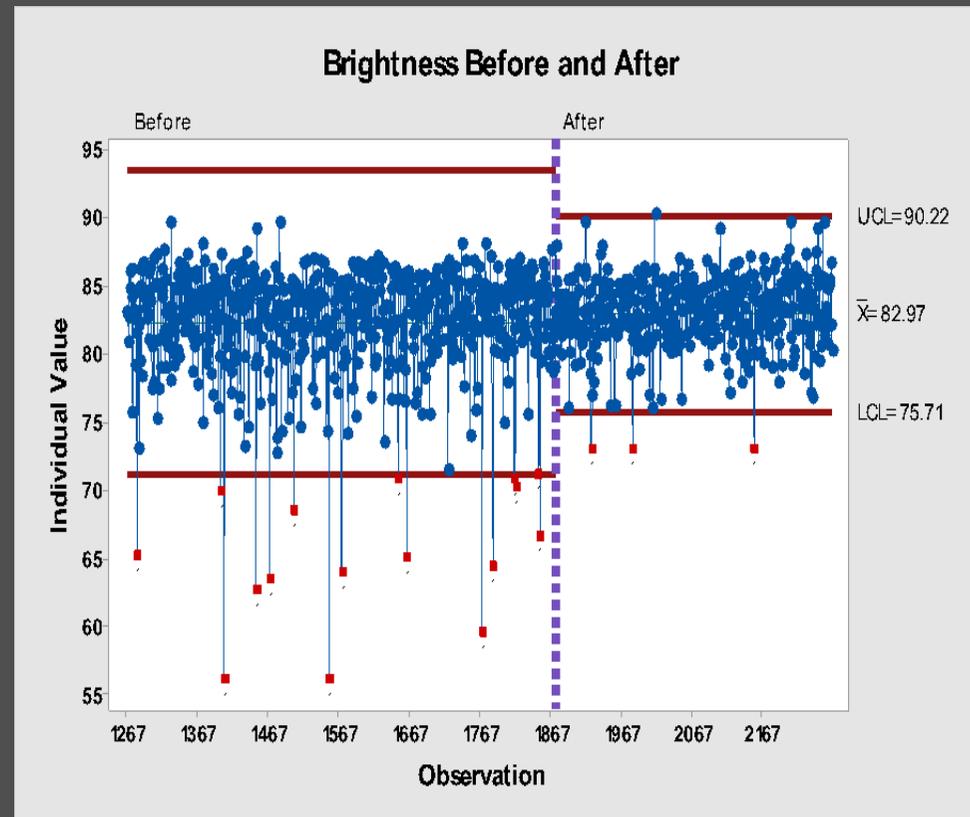


# Pulp Bleaching Process

## Solution: What causes an out-of-control process?

Engineers put controls in place to maintain process settings that greatly reduce the chance of the process drifting out of control.

The successful process improvement can be seen in Minitab's Individuals Chart with Stages.



# Water Content Loss

Problem: What causes an out-of-spec process?

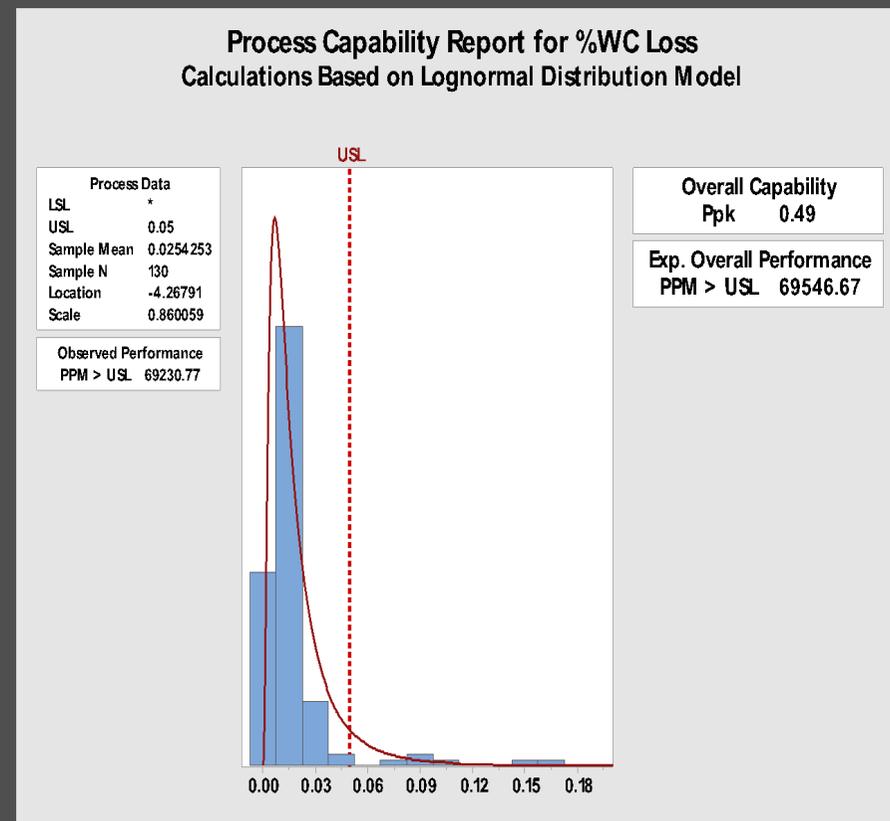
A pharmaceutical company needs to determine the root cause of excessive water loss occurring in a specific chemical formulation.



# Water Content Loss

## Analysis Step 1: What causes an out-of-spec process?

Minitab's Capability Analysis indicates that too much water loss is occurring and this process is not capable of meeting specification.



# Water Content Loss

Analysis Step 2: What causes an out-of-spec process?

| Variable Importance |        |   |
|---------------------|--------|---|
| Variable            | Score  |   |
| ANALYSTS_INITIALS\$ | 100.00 |  |
| FLOW__L_MIN_        | 62.59  |  |

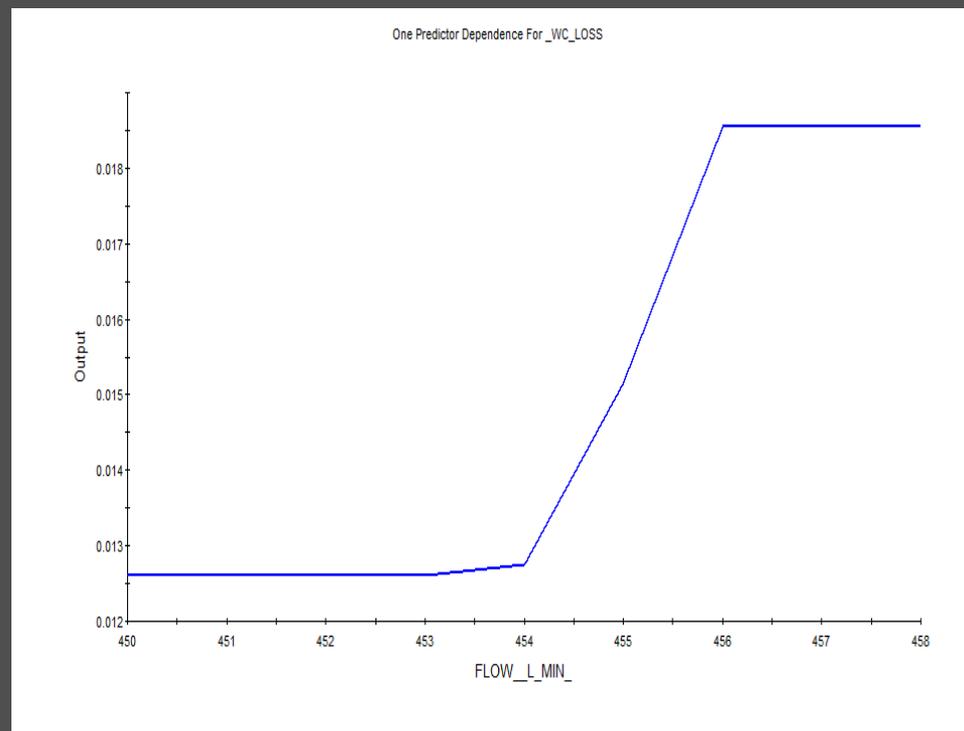
SPM's TreeNet indicates that the largest contribution to excessive water loss was actually the analyst that performed the measurement.

The second largest contribution was the flow rate process variable.

# Water Content Loss

## Analysis Step 3: What causes an out-of-spec process?

Partial Dependency plots from SPM's TreeNet show the impact of flow rate on the water content loss.

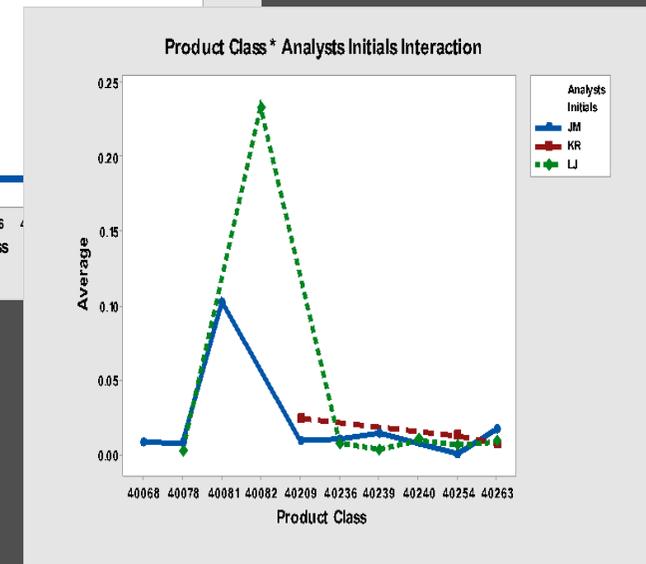
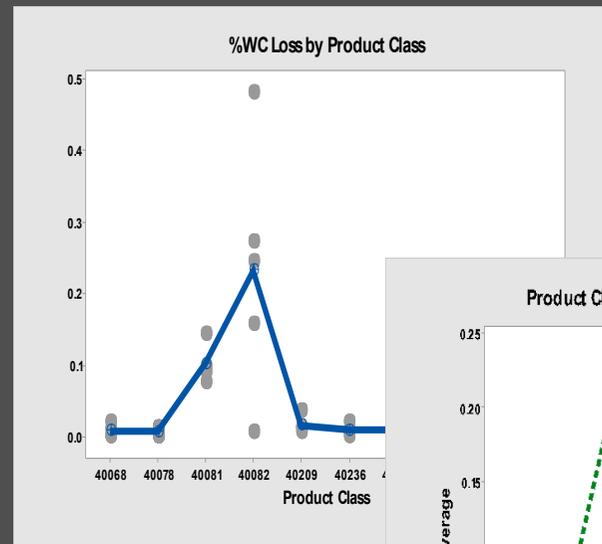


# Water Content Loss

## Analysis Step 4: What causes an out-of-spec process?

Minitab's Gage R&R was used to further investigate the validity of the measurement system itself.

Specifically, the large affect due to Analyst was a measurement system problem; not a process problem.



# Water Content Loss

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## Solution: What causes an out-of-spec process?

- ▶ Further operator training ensured that the water content loss measurement was accurate.
- ▶ Flow rate was monitored in real-time so that adjustments could be made when flow-rate reached a value likely to lead to water content loss to exceed specification.

# ADDITIVE your partner

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Sample datas available call  
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application !

- ▶ Contact our Team...
- ▶ E-Mail: [spm@additive-net.de](mailto:spm@additive-net.de)
- ▶ Phone: +49- 6172-5905-30
- ▶ Web: [www.additive-net.de/spm](http://www.additive-net.de/spm)

ADDITIVE Soft- und  
Hardware für Technik und  
Wissenschaft GmbH  
Max-Planck-Straße 22b  
D-61381 Friedrichsdorf