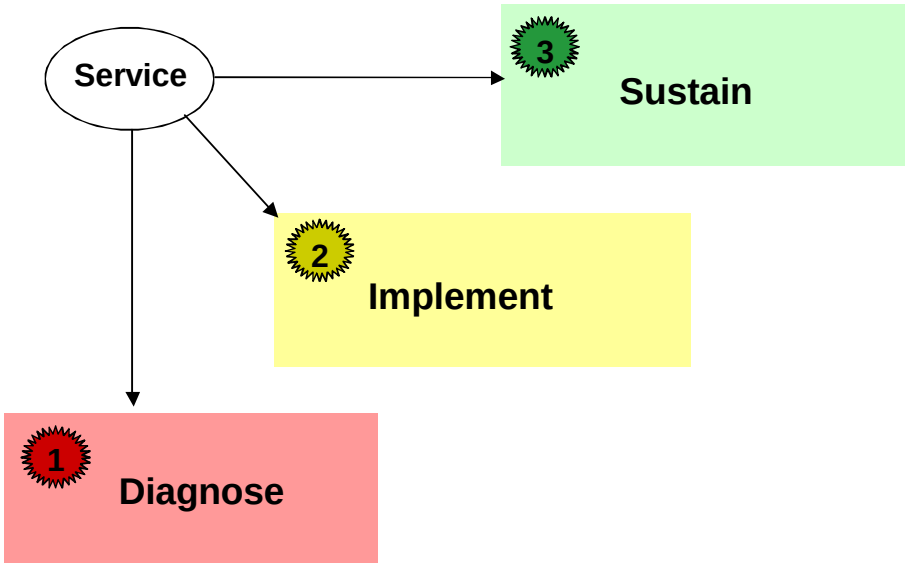
ABB Paper Automation Reinhard Amann BLED 2014

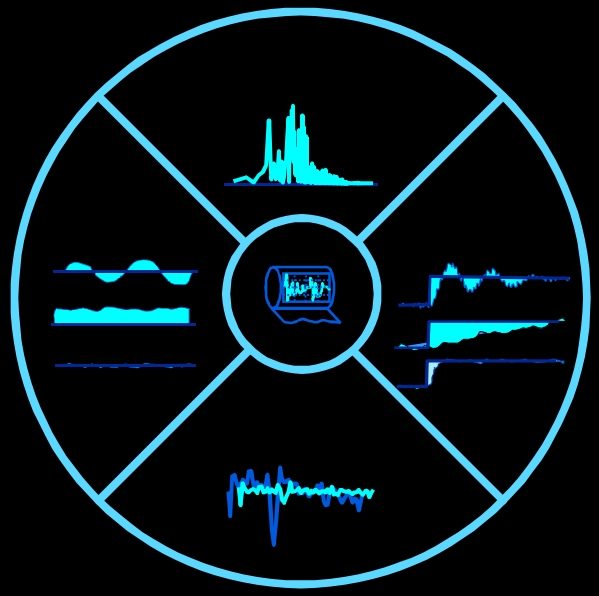
Optimization Services
Paper Machine Fingerprint
Process Fingerprint

Optimization Services
Phases

Diagnose
Implement
Sustain

- **Diagnose**
  - Measure process
  - Detailed scope with defined objectives
  - Forecast performance
- **Implement**
  - Improve performance
  - Apply corrective actions
- **Sustain**
  - Maintain performance
  - Preventative maintenance
  - Monitor machine index





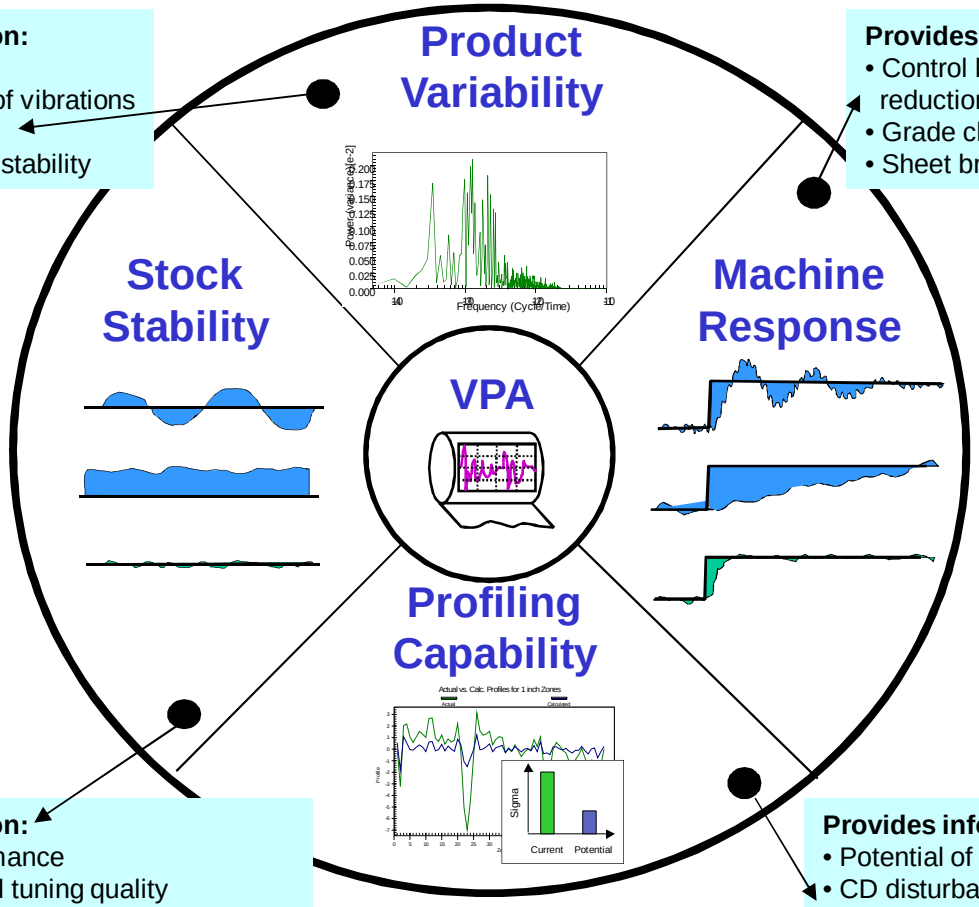
Optimization Services
Paper Machine Fingerprint

 PASC – Optimization Services_EN_RevC 2013-04-10 |

Optimization Services
Phase 1: Diagnose - Paper Machine Fingerprint

- Diagnose
- Implement
- Sustain

Provides information on:
- Controllable energy
- Mechanical pulsations of vibrations
- Process disturbances
- Benchmark of machine stability



Provides information on:
- Control behavior (disturbance reduction, responsiveness)
- Grade change recovery
- Sheet break recovery

Provides information on:
- Stock approach performance
- Controllable energy and tuning quality
- Oscillation sources

Provides information on:
- Potential of CD controls
- CD disturbances
- CD control quality and tuning
- Mapping problems

Paper Machine Fingerprint
Module 1: VPA (Variance Partition Analysis)

Diagnose

Implement

Sustain

- Analysis of reel report data and comparison to empirical targets

TOT in % vom Mittelwert	
Flächengewicht	< 1.7%
Atro	< 1,5%
Feuchte	< 10%
Dicke	< 1%
Asche	< 4,5%

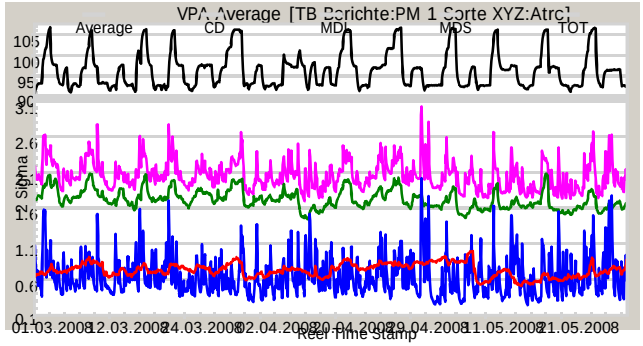
→ MDS = 70%

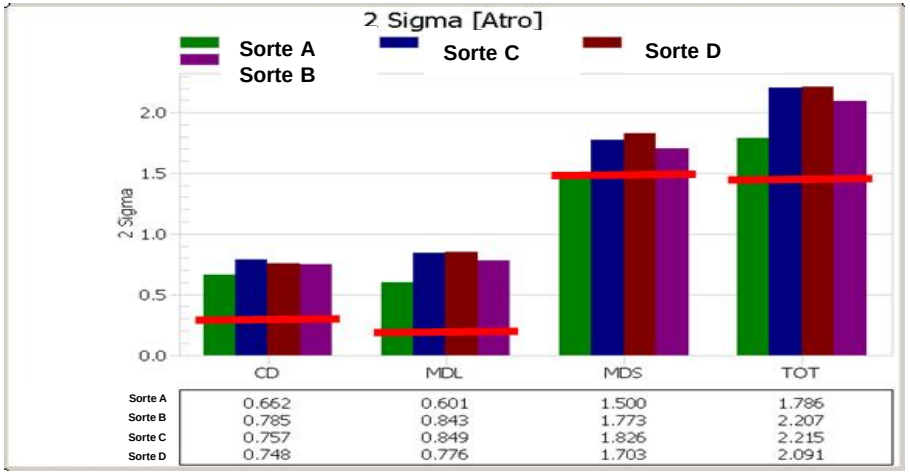
→ MDL = 10%

→ CD = 20%

- Analysis of variance distribution

	Sensor	Goal	Raw Stock Bone Dry	Raw Stock Moisture	Reel Bone Dry	Reel Moisture
PM 11	MDS	< 70	78.73	36.03	73.19	38.6
	MDL	< 10	9.25	9.45	8.59	13.74
	CD	< 20	7.38	46.56	13.62	40.13
PM 10	MDS	< 70	80.81	70.62	73.11	51.83
	MDL	< 10	9.1	10.58	8.05	6.43
	CD	< 20	7.73	12.74	15.34	31.95





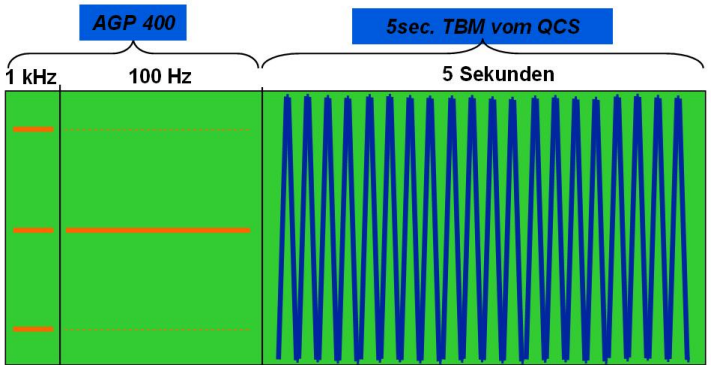
Paper Machine Fingerprint
Module 2: Product Variability

Diagnose

Implement

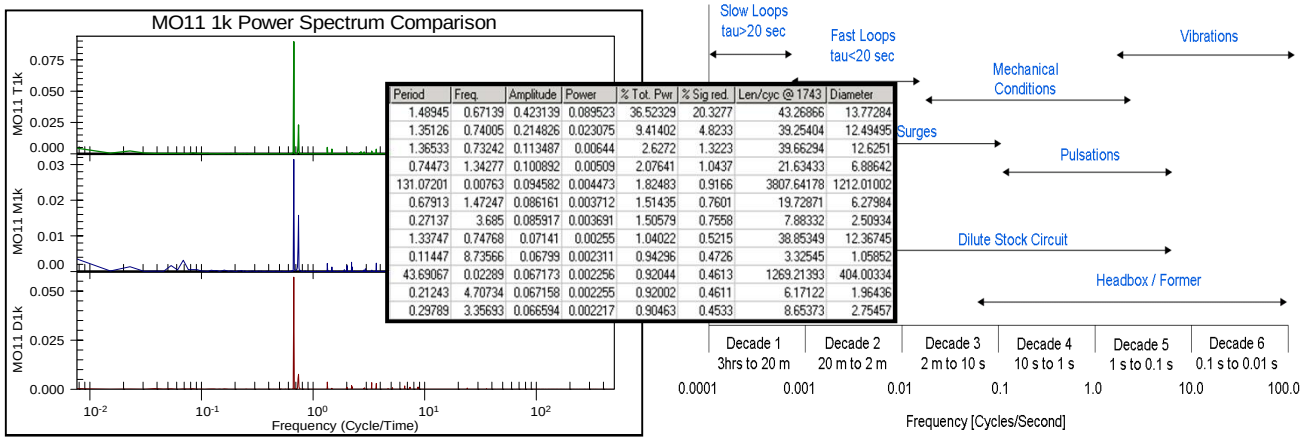
Sustain

- High-frequency data collection in different frequency bands



- Frequency analysis to identify possible root causes

A frequency analysis (FFT) determines frequencies contained in the signals and localizes causes of disturbances.



Period	Freq.	Amplitude	Power	% Tot. Pwr	% Sig red.	Len/cyc @ 1743	Diameter
1.48945	0.67139	0.423139	0.089523	36.52329	20.3277	43.26866	13.77284
1.35126	0.74005	0.214826	0.023075	9.41402	4.8233	39.25404	12.49495
1.36533	0.73242	0.113487	0.00644	2.6272	1.3223	39.66294	12.6251
0.74473	1.34277	0.100892	0.00509	2.07641	1.0437	21.63433	6.88642
131.07201	0.00763	0.094582	0.004473	1.82483	0.9166	3807.64178	1212.01002
0.67913	1.47247	0.086161	0.003712	1.51435	0.7601	19.72871	6.27984
0.27137	3.685	0.085917	0.003691	1.50579	0.7558	7.88332	2.50934
1.33747	0.74768	0.07141	0.00255	1.04022	0.5215	38.85349	12.36745
0.11447	8.73566	0.06799	0.002311	0.94296	0.4726	3.32545	1.05852
43.69067	0.02289	0.067173	0.002256	0.92044	0.4613	1269.21393	404.00334
0.21243	4.70734	0.067158	0.002255	0.92002	0.4611	6.17122	1.96436
0.29789	3.35693	0.066594	0.002217	0.90463	0.4533	8.65373	2.75457

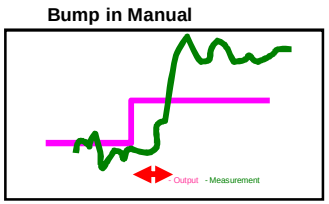
Paper Machine Fingerprint
Module 3: Machine Response

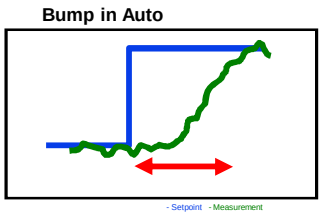
Diagnose

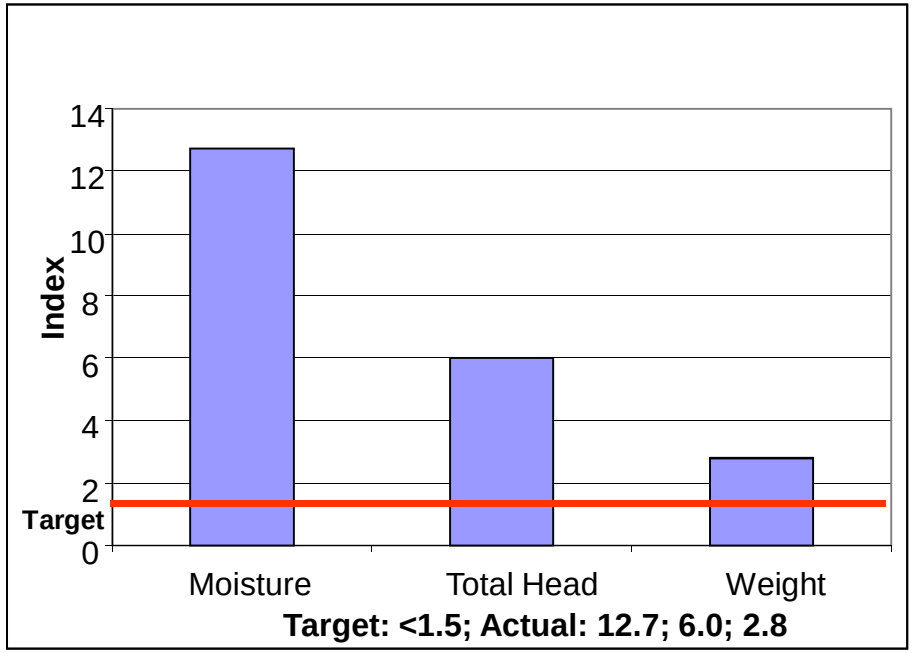
Implement

Sustain

- Based on bump tests of the QCS controls in Manual and Auto, time constants are determined and compared.
- The relation between Manual and Auto represents an index that indicates the performance of the control. A Value of 1.5 is the target based on experience. Results of the machine response analysis:
- Comparison of the responses in Manual and Auto
- Additional findings:
  - Wrong process model parameters in the QCS
  - Improvements with or without feed-forward controls
  - Bad control parameters in QCS
  - Performance of DCS loops (Level 1)







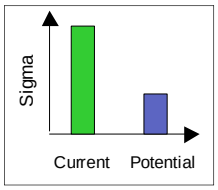
Paper Machine Fingerprint
Module 4: Profile Capability

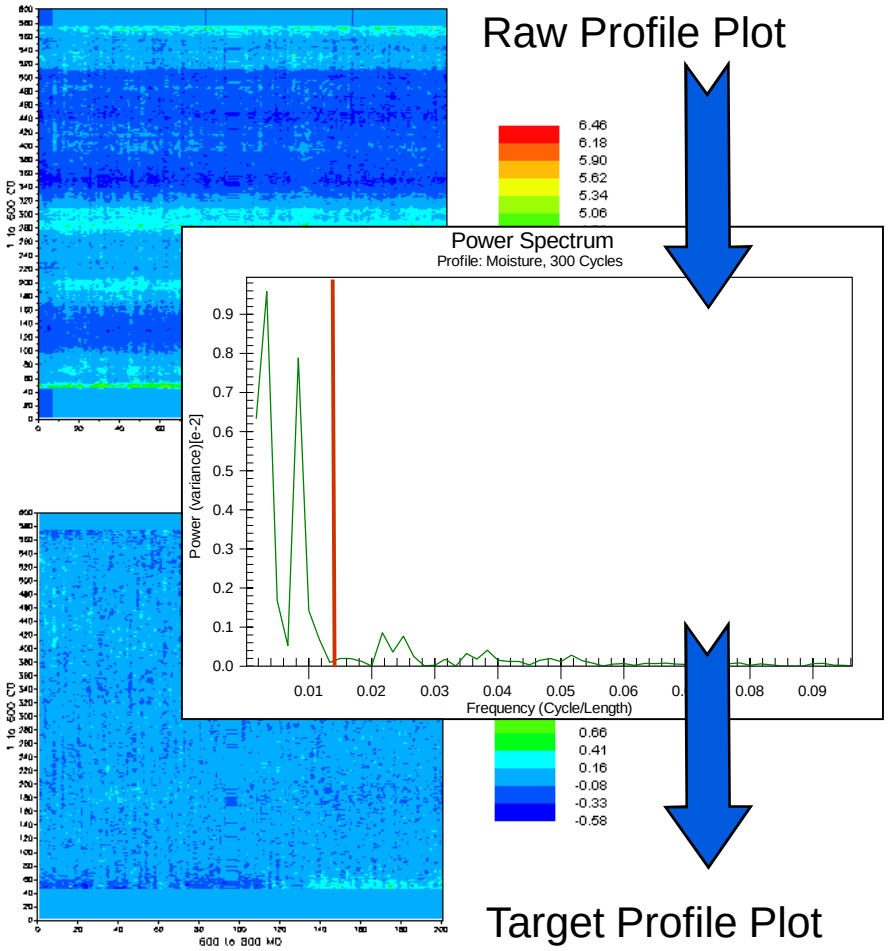
Diagnose

Implement

Sustain

- Analysis
  - The controllable frequencies and with that a residual goal plot are determined from the raw profiles with Fourier analysis (FFT)
- Findings
  - Edge problems
  - Mapping problems
  - Wrong process models
  - Bad control parameters
  - Actuator problems
  - Influences from wires and felts
  - Control behavior after breaks and shutdowns
  - Grade-dependent tuning





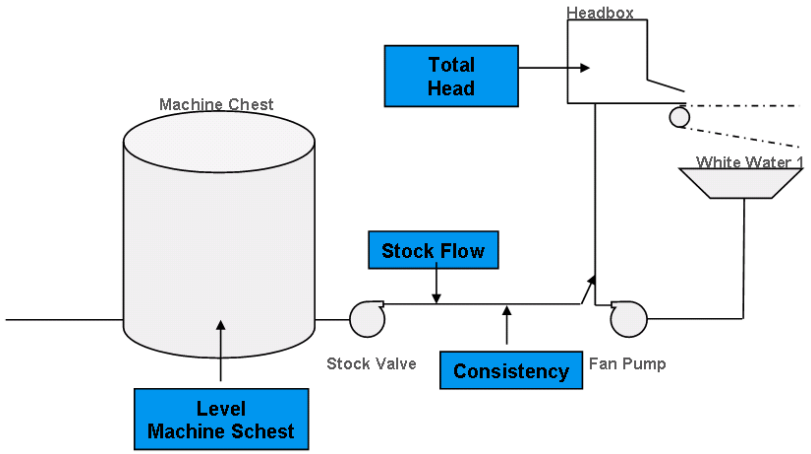
Paper Machine Fingerprint
Module 5: Stock Stability

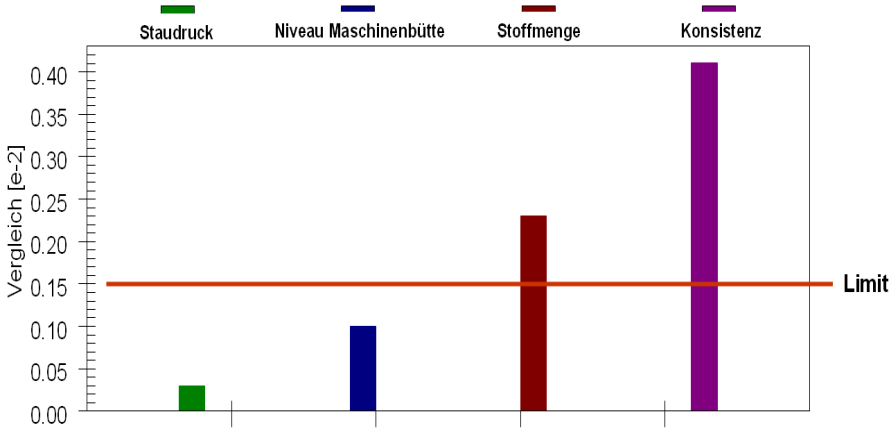
Diagnose

Implement

Sustain

- Analysis
  - An index is calculated based on comparison of measured values and setpotints. It shows the quality of the process variable.
- Findings
  - Indices are compared to target values
  - Improvement potential is revealed

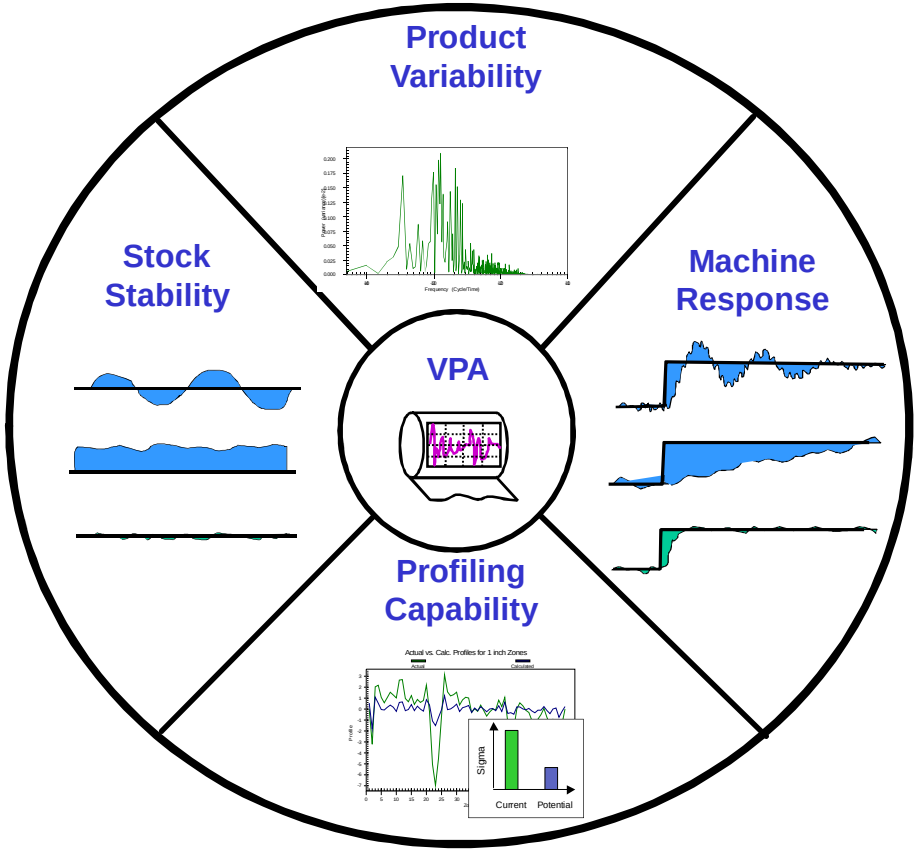




Paper Machine Fingerprint
Summary

- Diagnose
- Implement
- Sustain

- Results of the Paper Machine Fingerprints:
  - Daily detailed report of the accomplished analysis
  - Index-based summary of KPI‘s
  - Summary of critical areas
  - Implementation plan to improve the machine performance
  - Return on investment (ROI) forecasts



Phase 2: Implement
Example

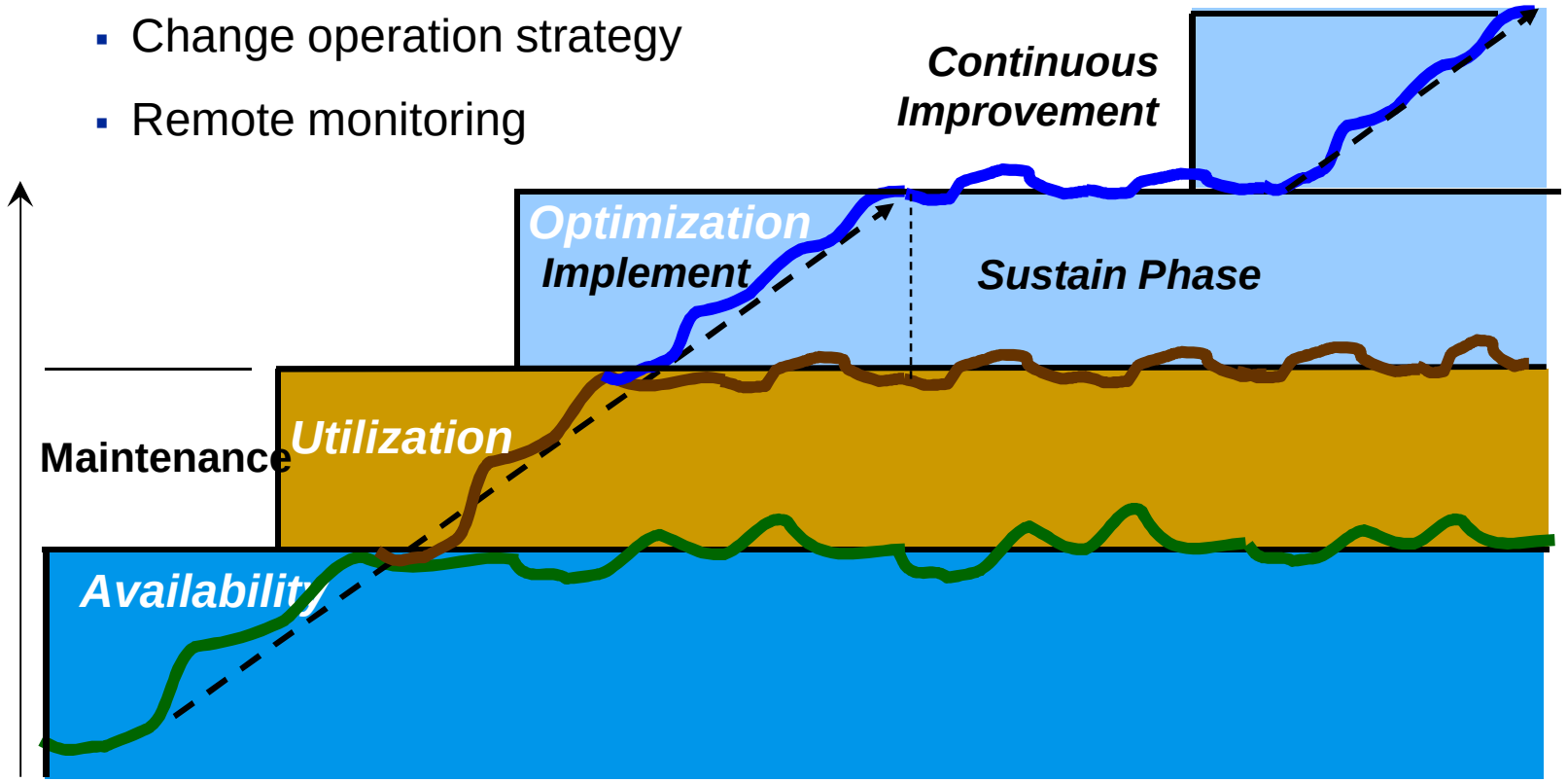
Diagnose
Implement
Sustain

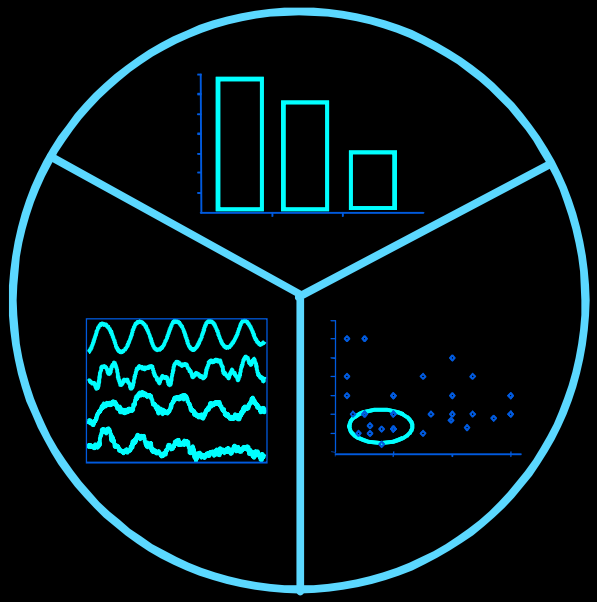
- Example for proposed improvements for a medium mill:
  - **Target shift: Weight**
    - A 0.1lb shift in basis weight can be made. This results in savings of **$116.500**.
  - **Target shift: Moisture**
    - A 0.1% moisture target shift (i.e. 8.9 to 9.0) can be made. If speed limited the savings would be **$40.600.**
  - **Sheet break recovery, number of breaks and faster startup**
    - A 5 min improvement after a break and less breaks represent **$264.300** in savings.
  - **Reduced rejects and customer returns**
    - Improvement in quality results in savings of **$4,180.**
- **Total benefits**
  - If the recommendations are followed, the savings as a result of the project will be **$425.580**.

Optimization Services
Phase 3: Sustain

Diagnose
Implement
Sustain

- Goal: Sustain the reached performance improvements
  - Adapt service procedures
  - Change operation strategy
  - Remote monitoring



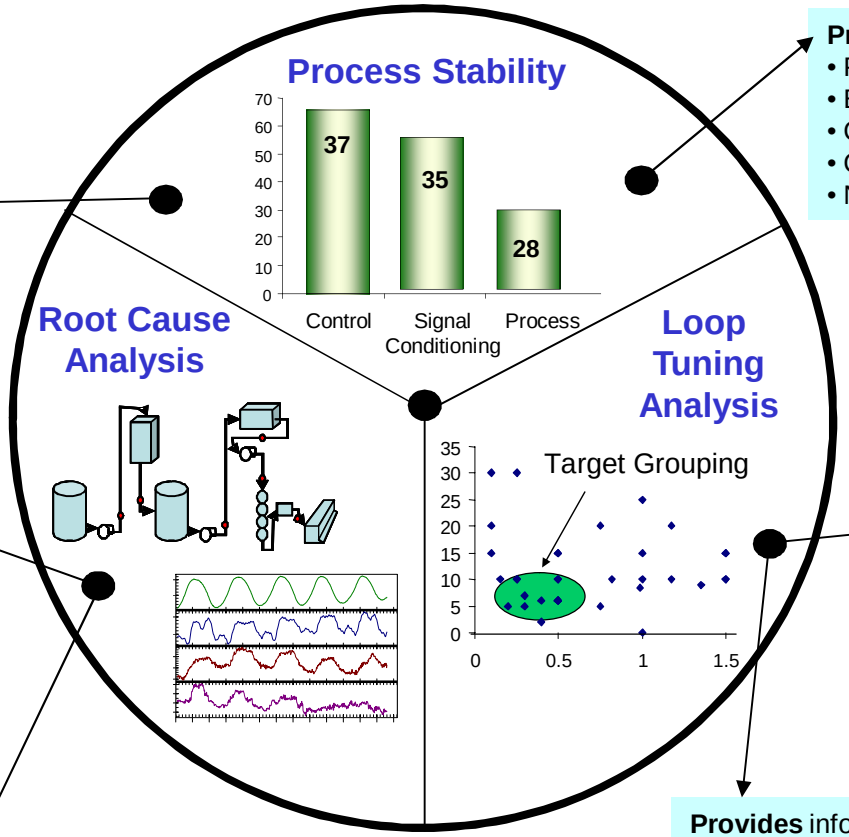


Optimization Services
Loop Performance Fingerprint

Optimization Services
Loop Performance Fingerprint

- Diagnose
- Implement
- Sustain

Evaluates: Loop Performance - Control loops are priority sorted based on issues related to Control, Process, or Signal conditioning issues.



Provides information on:
- Process upset response
- Bad Valves
- Over filtering
- Quantized signals
- Noisy signals

Evaluates: Root Causes - Process and control loop interactions. Identifies true source of process disturbances.

Provides information on:
- Process and interactions
- Raw material supply

Evaluates: Loop Tuning numbers - Used to benchmark DCS control tuning setup.

Provides information on:
- Tuning clusters versus process type.
- Default tuning
- Tuning history
- Frequent changes

Loop Performance Fingerprint
Module 1: Process Stability

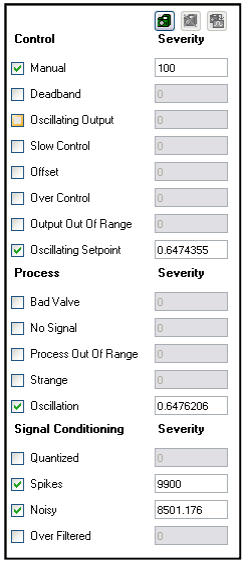
- Diagnose
- Implement
- Sustain

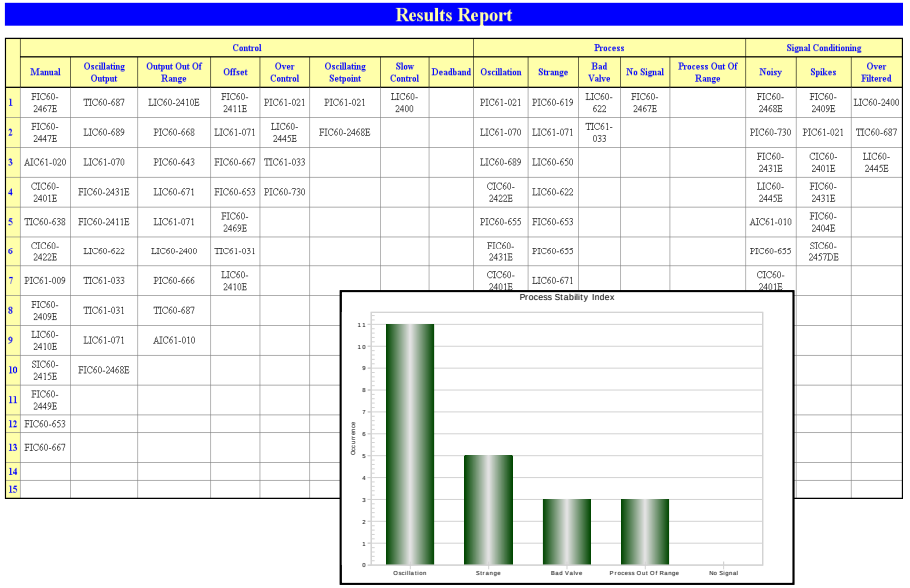
Analysis

- Assessment of control quality in DCS-based analysis of data logs (12-24h with 5s) and
- Calculation of performance indices for the areas Process, Control and Signal Conditioning.

Information about:

- Tuning problems
- Process upset response
- Bad valves
- Over filtering
- Quantized signals
- Noisy signals
- etc.





Area/Graphic Name	Rank	Loop	Desc.	Action	Comment
PPU					
PPU Caustic	Medium	LIC84806	P200LF1	N/A	Dead signal
		LIC84824	P200LF2	Tune	Valve saturates low
Deethanizer	High	FIC84041	Feed	OK	Response is a little slow
		FIC84073	Reflux	Tune	Strong oscillations
		PIC84071B	Ovhd. Pressure	Tune	Offset, probably P-only control, very slow
		LIC84054	Bottoms Level	OK	Response is a little slow
		FIC84055	Bottoms Flow	Tune	1 minute cycles
C3 Splitter	High	FIC84097	Bottoms Flow	OK	Stays close to SP, bottoms level runs flooded
		LIC84153A	Reflux Drum	Tune	Oscillates, but control is not that tight
		FIC84154	Reflux from Drum	OK	Tracks SP OK, signal noisy
		FIC84114	Reflux from Exchgr.	Manual	Flow drifts
		LIC84150	Condenser	Tune	Slow, then oscillates 5% at 40 sec cycle
		PIC84144	Drum Pressure	Tune	If PIC84177A in manual, column on this pressure
Arsine Remv.	High	FIC84129	Feed rate	OK	Follows setpoint change, good setpoint crossing

Loop Performance Fingerprint
Module 2: Loop Tuning Evaluation

Diagnose

Implement

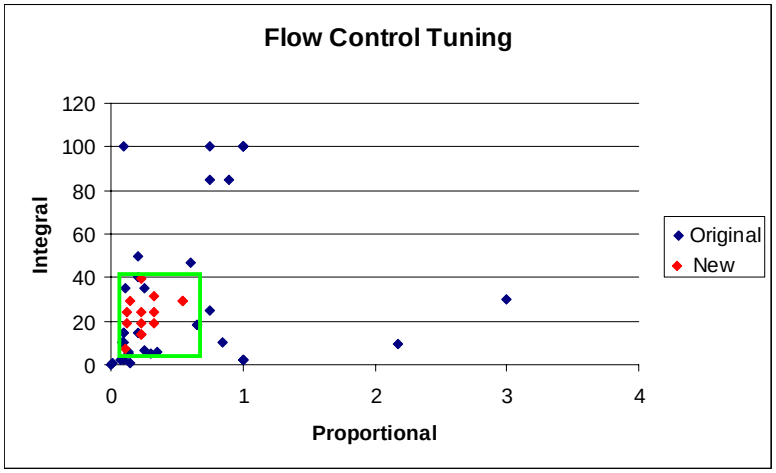
Sustain

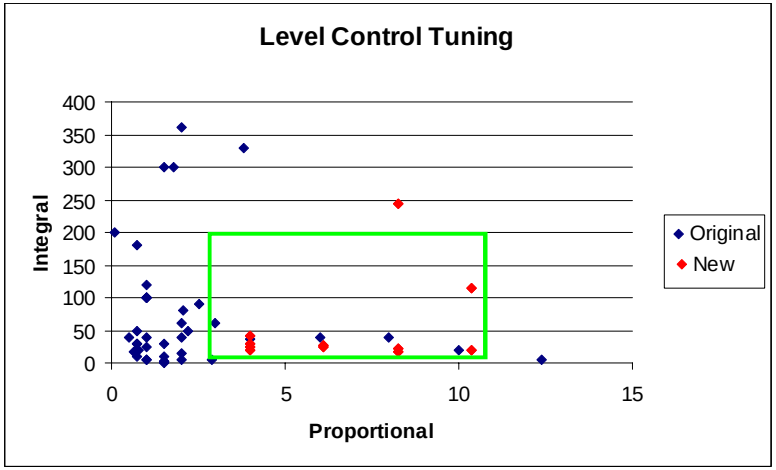
Analysis:

- Benchmarking of DCS control loop tuning through analysis of tuning parameters
- Cluster analysis: Comparison of current and expected tuning per process area
- For like processes, tuning should be similar

Information about:

- Validity of tuning setup
- Tuning clusters vs. process type
- Default tuning
- Tuning history
- Frequent changes





Loop Performance Fingerprint
Module 3: Root Cause Analysis

- Diagnose
- Implement
- Sustain

Analysis

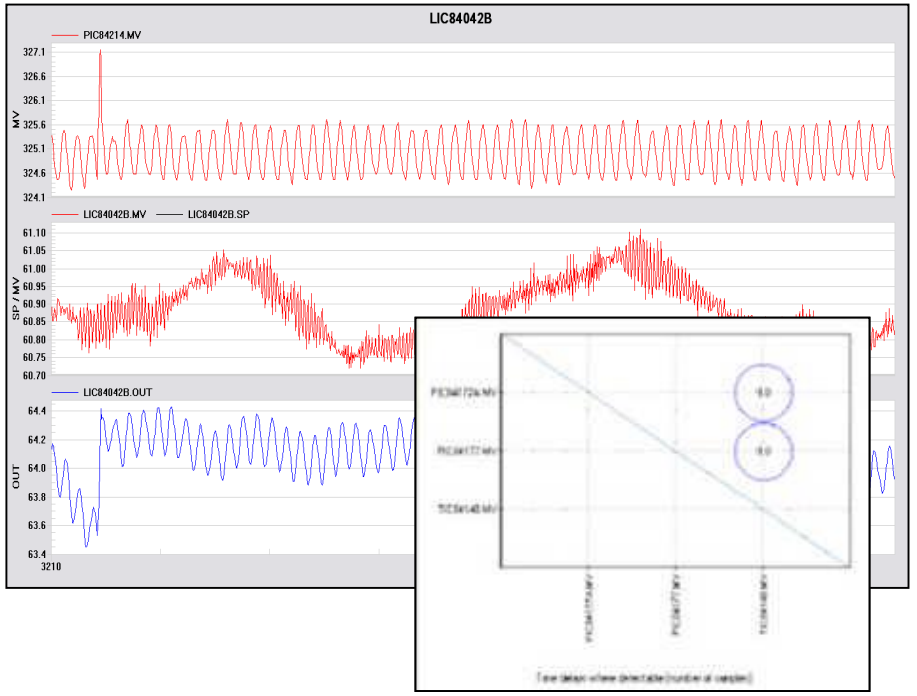
- Assessment of process and control loop interactions through analysis of historical data
- Identifies true source of process disturbances.

Information about

- Process couplings and interactions

Goal

- Define disturbance root cause
  - Non-linear theory
  - Phase theory
  - Logical clusters
- Group of like cyclic components
- Group like time signal signatures



Benefit

- Isolate problem areas
- Quickly determine disturbance source
- Remove disturbance rather than to tune around it

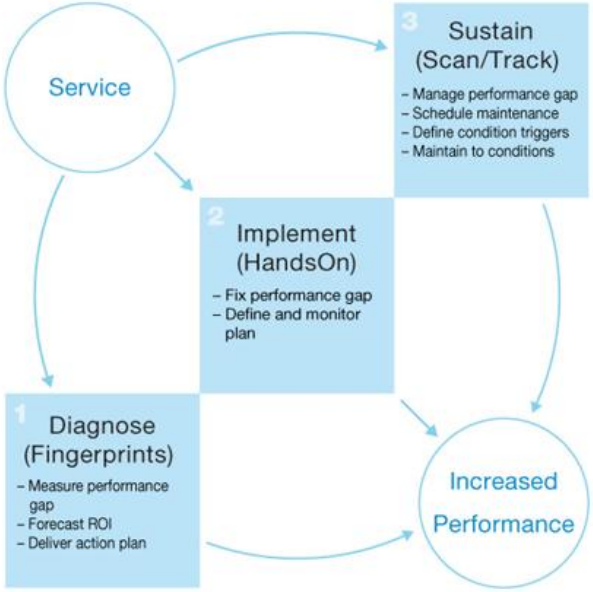
Loop Performance Fingerprint
Loop Performance Channel in ServicePort

Diagnose

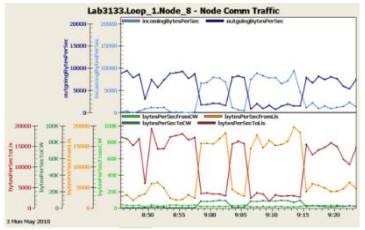
Implement

Sustain

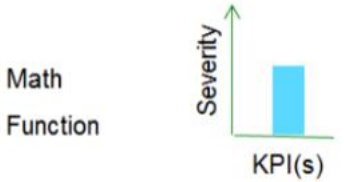
- ServicePort is a **service delivery platform** which customers and ABB experts can securely access.
- Loop Performance Channel supports optimization:



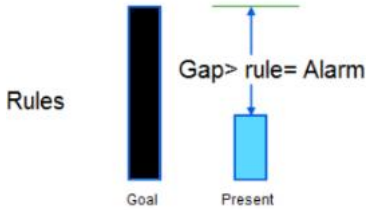
- **View** (real-time) shows raw data associated with each control loop



- **Scan** (scheduled) presents KPIs generated from raw data through periodic diagnostic monitoring



- **Track** (event-triggered) continuously monitors between Scans and generates notifications based on predefined KPIs



Optimization Services
ABB Remote Access Platform

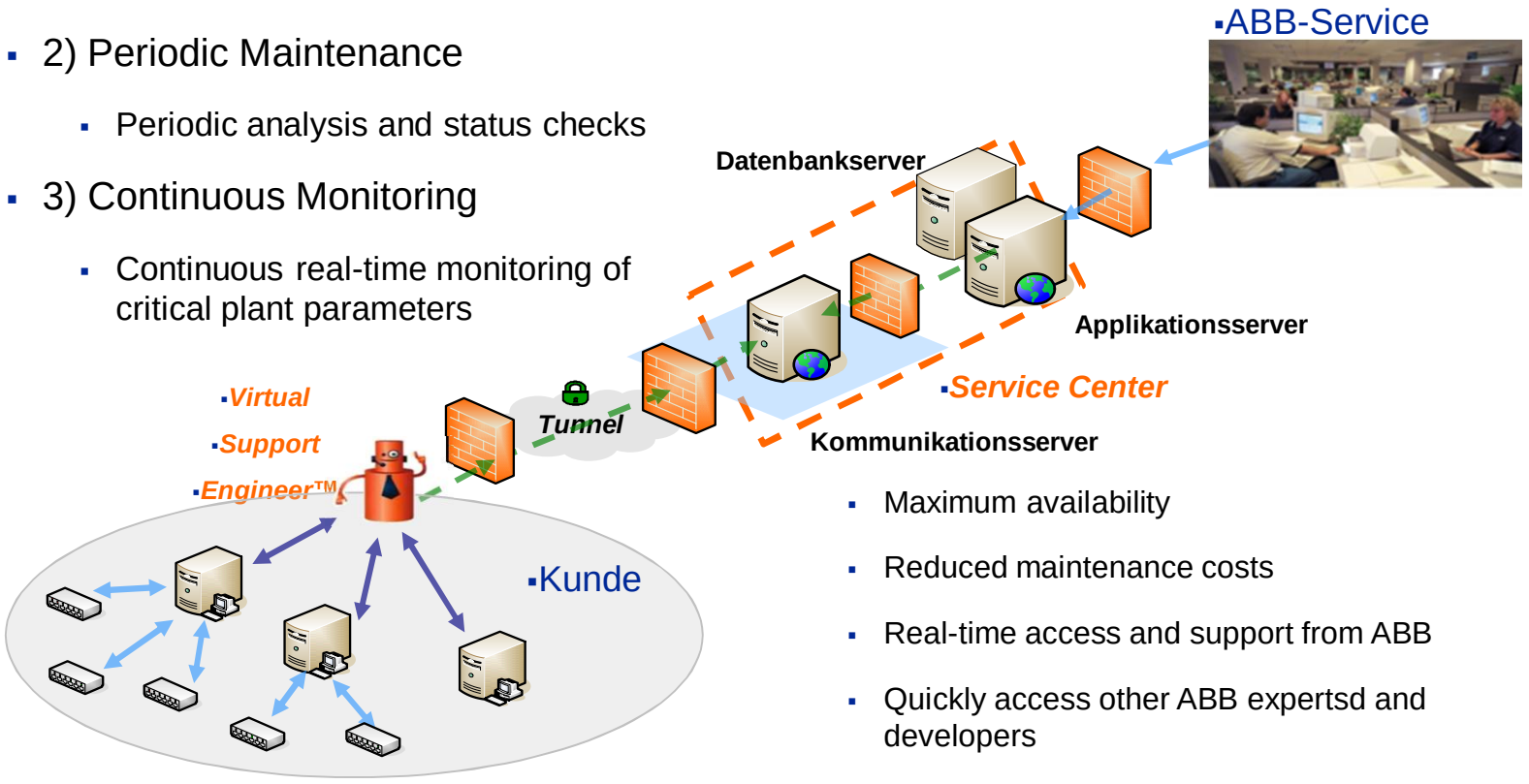
Optimization Services
ABB Remote Access Platform

Diagnose

Implement

Sustain

- 1) Trouble-shooting
  - Remote access on demand for fault analysis and trouble-shooting
- 2) Periodic Maintenance
  - Periodic analysis and status checks
- 3) Continuous Monitoring
  - Continuous real-time monitoring of critical plant parameters



- Maximum availability
- Reduced maintenance costs
- Real-time access and support from ABB
- Quickly access other ABB expertsd and developers
- Faster and partly automated exchange of information

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