



QUALITY LEVEL



68th AMAP Colloquium

Dr. Michael Raus, QuinLogic GmbH



How decision-making processes and production yield can be boosted
by connecting a Quality Execution System
to a Production Data Warehouse



MY AGENDA TODAY



WHO IS QUINLOGIC?

WHAT IS QUALITY EXECUTION ABOUT?

WHAT IS THE QUALITY EXECUTION SYSTEM?

WHAT IS THE PRODUCTION DATA WAREHOUSE?

WHY IS PRODUCT GENEALOGY THE GAME CHANGER?

HOW DO CUSTOMERS ROLL OUT PDW | QES?

SUMMARY

WHO IS QUINLOGIC?

Who are we?



1



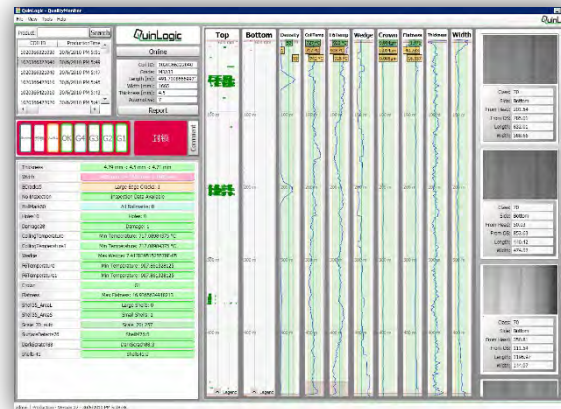
We are a highly specialized multicultural software group located in Aachen

2



The roots of our employees go back to the beginning of the Parsytec surface inspection system in 1994

3



Since 2008, we have only one focus: “Quality Assurance Software for Rolling Mills”

4



Since 2019, we are a member of the SMS group



What makes us the market leader in our field?

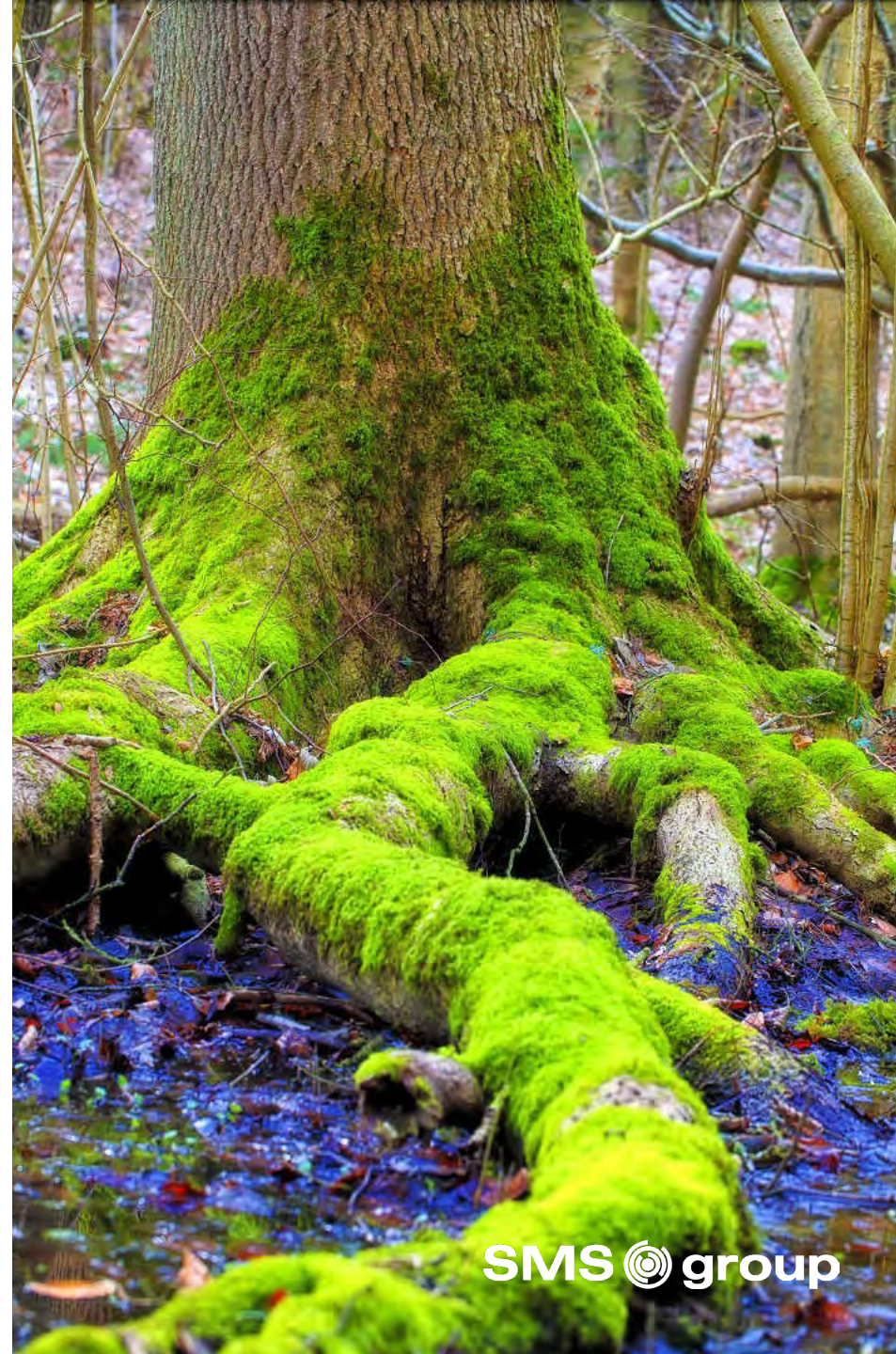


Our customers.



Our roots

- ◆ Our roots go back to the automatic surface inspection in the rolling industries
- ◆ In 15 years of SIS customer projects we had learned some lessons:
 - Surface defects have a severe influence on product quality
 - Correct classification of defects is very important but always limited without context information
 - It's difficult to trace coils correctly to compare defects from different process steps
 - For product quality, surface quality is only a part of the picture



Our dream

- ◆ At that time, we dreamed of a world where
 - our customers could just access all defect data of a coil throughout its process route
 - all other process data are just available for an advanced analysis
 - our customers could just have the whole picture of their coils' quality
 - at their fingertips
 - without deep IT & data analytics expertise
- ◆ So, we started developing a software that could make our dream reality



Living our dream

- ◆ We were sure that our clients would understand the amazing possibilities of our product
- ◆ So they would just make all this data and information available to us
- ◆ But we quickly realized that this was easier said than done
- ◆ In fact, our clients were thrilled by the opportunities, and we received the first orders
- ◆ But it turned out that this hurdle was very high for many of our customers



Clearing obstacles out of the way

- ◆ Actually, this didn't come as a surprise to us, so, we set about removing this obstacle for our customers
- ◆ We rolled up our sleeves and took the task of finding, connecting, converting data from our customers
- ◆ So, we soon realized that we could do much more for our customers
- ◆ Actually, this was the start of our

PRODUCTION DATA WAREHOUSE



Living our dream

- ◆ Today we are realizing our dream and – even better – we are making the dreams of our clients come true
- ◆ It's incredibly satisfying to see how our project partners are stunned in front of their Quality Monitor when they see all process and quality data before them for the first time ever
- ◆ And the creative energy set free by this unlimited space of opportunities is astonishing
- ◆ Only after some years we recognized that, what we actually did, was opening our customers the door for what's nowadays called

INDUSTRY 4.0



WHAT IS QUALITY EXECUTION?

How does QuinLogic support developing into “Industry 4.0?”

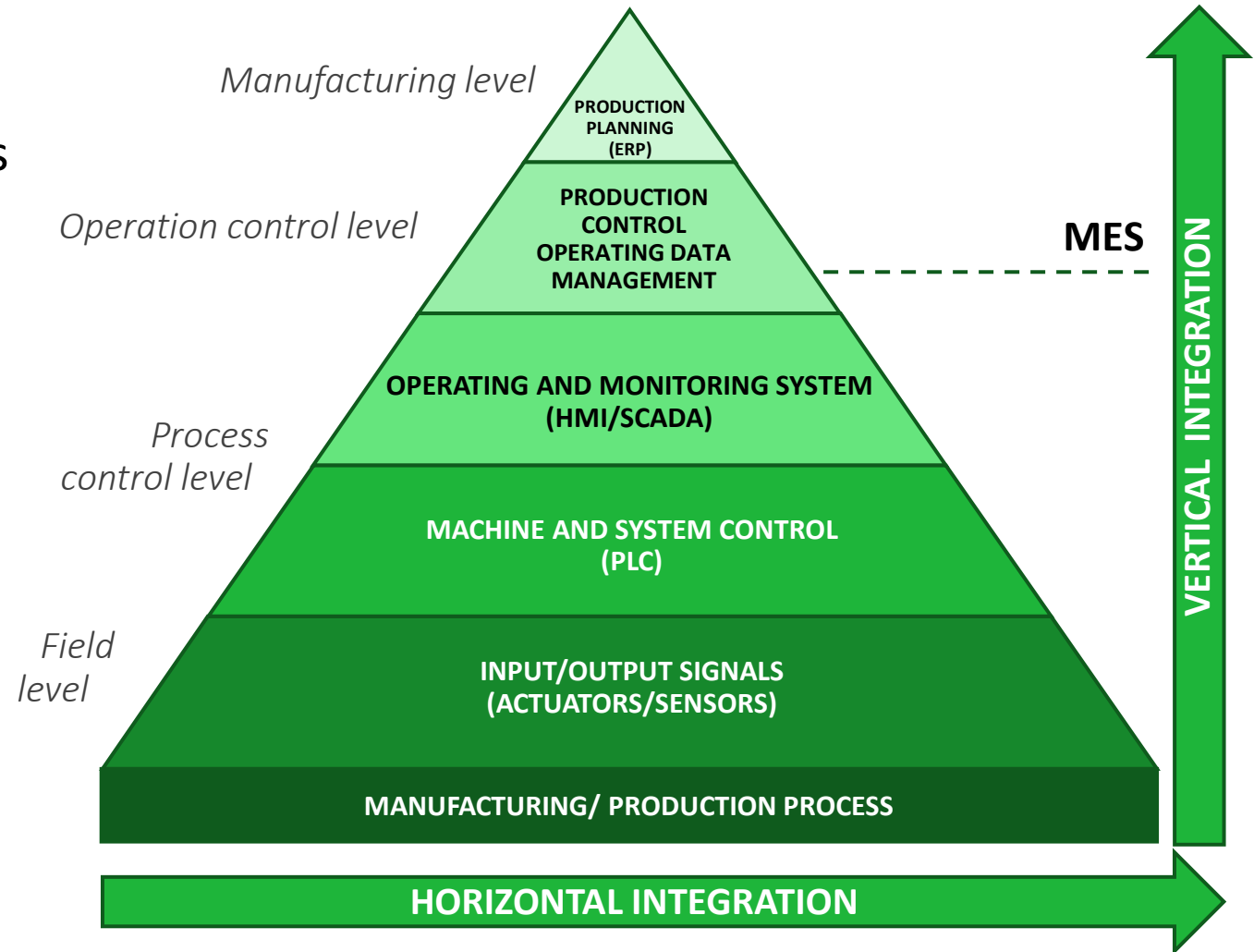


By horizontal integration:

- ◆ Networking between manufacturing sites
- ◆ Up-/downstream involved in the process
- ◆ Exchanging information throughout the value chain
- ◆ Intelligent system communication in demand, production and logistics

By vertical integration:

- ◆ Networking within the company from the manufacturing level to higher levels
- ◆ QES aggregates data from all levels



Does this look familiar to you?

ISLAND THINKING

- ◆ Multiple value-adding production steps in mostly isolated production lines
- ◆ Cumbersome to access up/downstream data
- ◆ Difficult to link finished product to production data
- ◆ Cross-facility value-adding production steps add complexity to data storage and provisioning solutions



The QuinLogic QES is building bridges

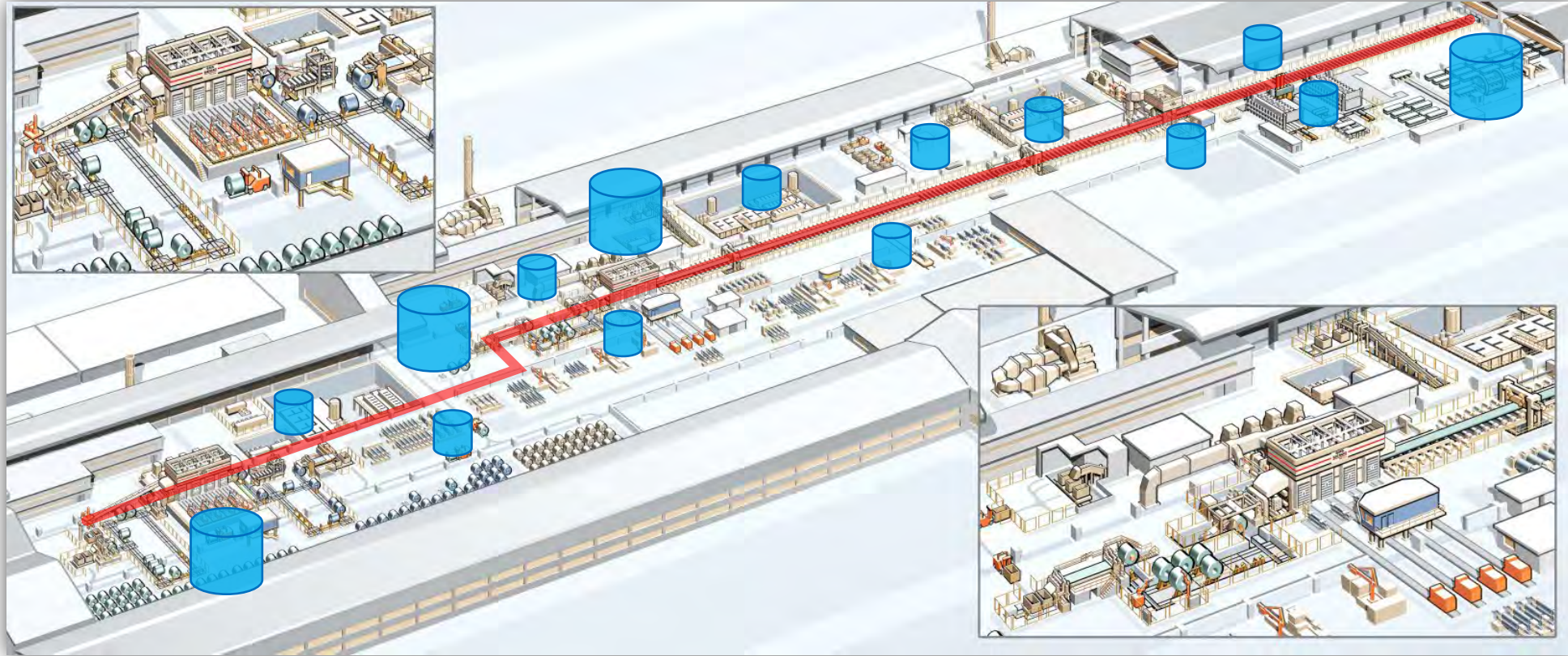
- ◆ By using the QuinLogic **PDW**, bridges are built across the chasms between isolated processing lines
- ◆ Right starting point for cleaning up an inhomogeneous data landscape



Grown over years but never meant to be ready for digitalization

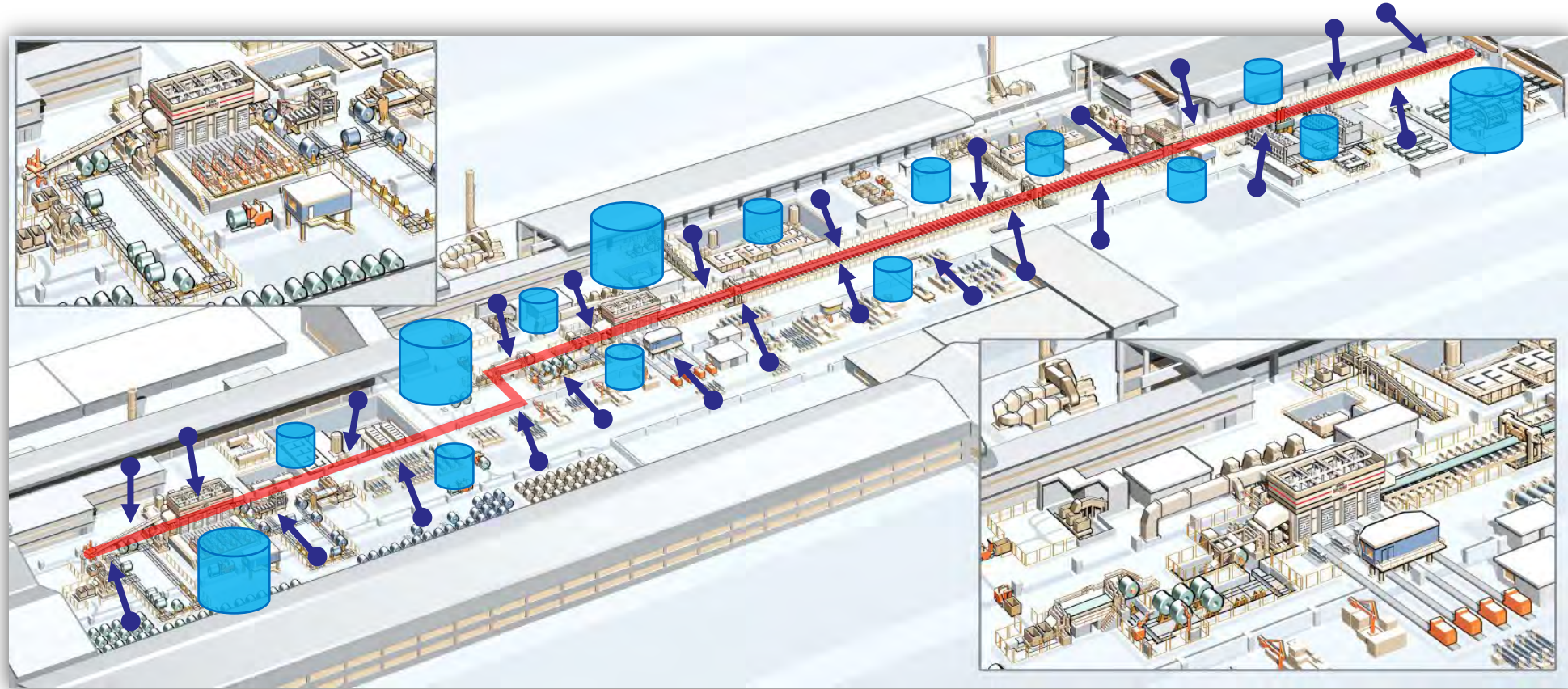


Multiple distributed data sources in the plant



- ◆ On its way along the process route each coil produces numerous pieces of data
- ◆ The coil leaves these data behind on local servers and other devices

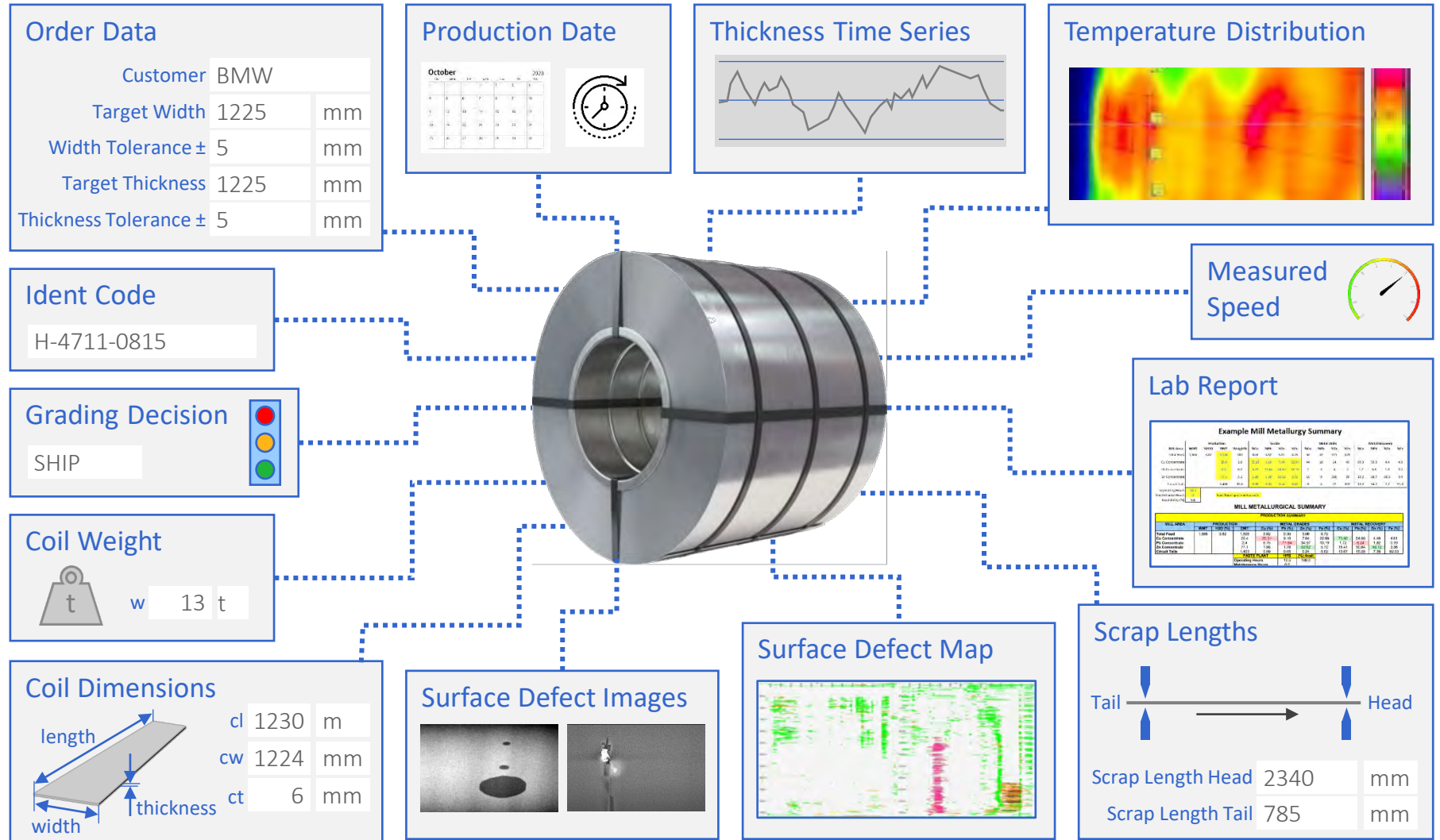
Multiple distributed data sources in the plant



◆ In addition, the coil's quality is affected by many local process parameters

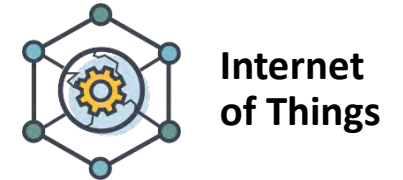
Which data determine the quality of a coil?

Each coil is represented by data from numerous data sources of the different automation levels



Representing a coil in the Internet of Things

- ◆ For bridging the physical and the virtual (digital) worlds, data has to be transmitted seamlessly allowing the virtual coil to exist simultaneously with the physical coil
- ◆ As such, it holds a comprehensive digital replica of the physical coil:



Physical Twin


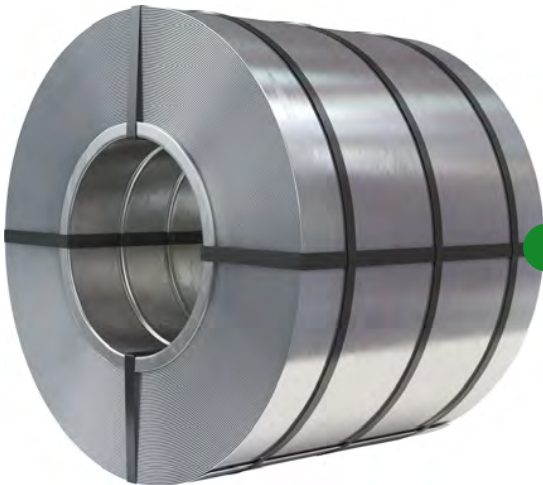


Digital Twin

Physical and digital twin



- ◆ The QuinLogic QES is able to collect, aggregate, and analyze all existing data related to a coil





Order Data		
Customer	BMW	
Target Width	1225	mm
Width Tolerance ±	5	mm
Target Thickness	1225	mm
Thickness Tolerance ±	5	mm

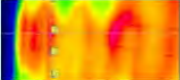
Coil Dimensions		
Coil Length	1230	m
Coil Width	1224	mm
Coil Thickness	6	mm

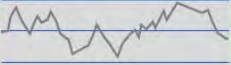
Coil Weight		
Coil Weight	13	t

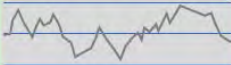
Scrap Lengths		
Scrap Length Head	2340	mm
Scrap Length Tail	785	mm

Surface Defects		
		

Lab Report		
		

Temperature		
		

Thickness Measurement Data		
		

Measured speed		
		

Ident Code
H-4711-0815

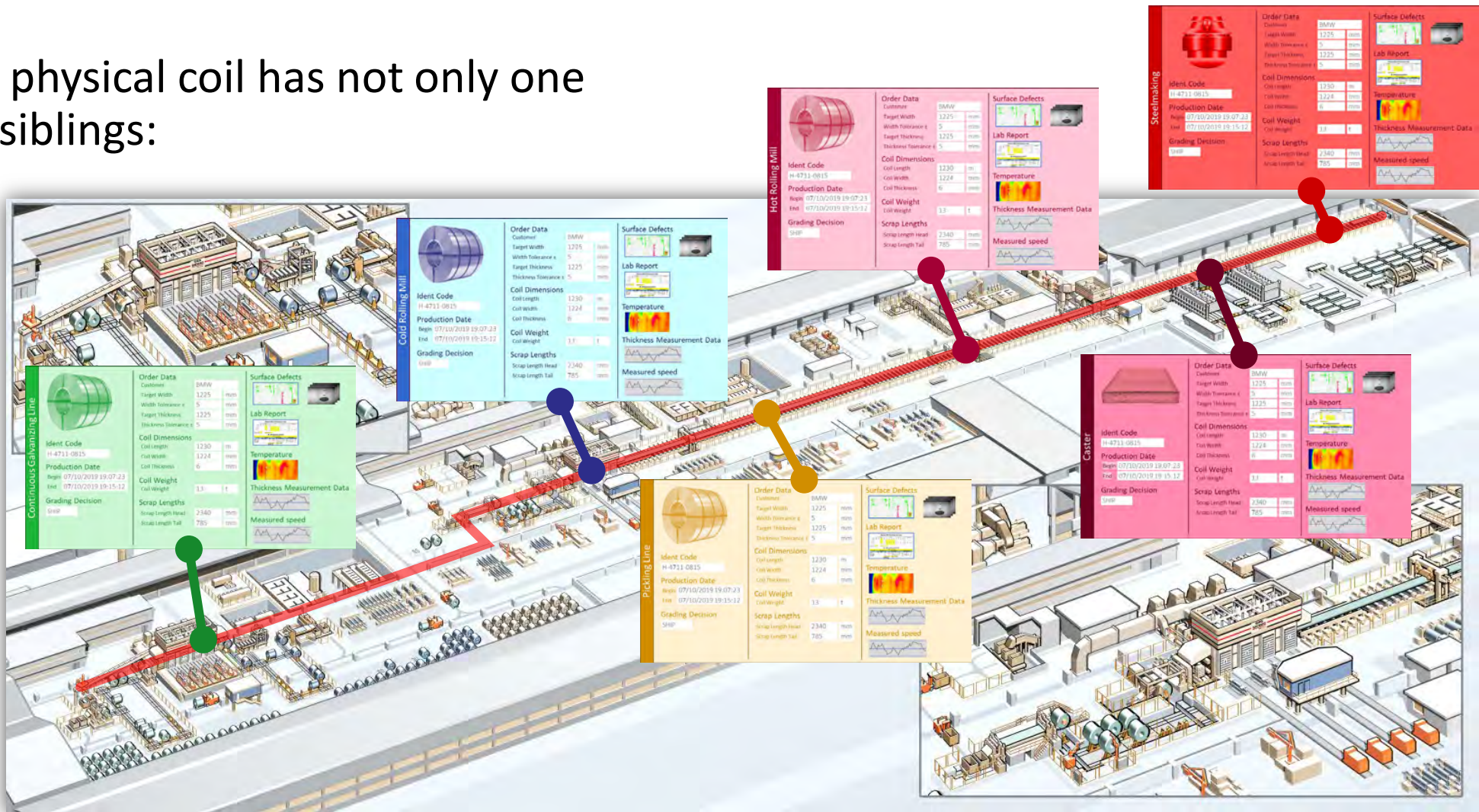
Production Date
Begin 07/10/2019 19:07:23
End 07/10/2019 19:15:12

Grading Decision
SHIP



Digital twin and its digital siblings

One and the same physical coil has not only one but several digital siblings:



Digital family:
All data that contain information about a coil's evolution and final status

QES – The Smart Assistant System



- ◆ Explore quality relevant data from all process steps

The screenshot displays the QuinLogic QualityMonitor interface. At the top left is a table of coil data:

Coil	SIS ID	SIS StartTime	Customer	Proc.	#Def
46045	5/21	10:56:21am	POB	599	
46044	5/21	10:52:16am	POB	429	
46043	5/21	10:48:25am	POB	624	
46042	5/21	10:44:10am	POB	403	
46041	5/21	10:39:16am	POB	442	
46040	5/21	10:36:11am	POB	578	
46039	5/21	10:30:12am	POB	562	
46038	5/21	10:27:00am	POB	578	
46037	5/21	10:17:55am	POB	805	
46036	5/21	10:13:44am	POB	441	
46035	5/21	10:08:56am	POB	883	
46034	5/21	10:01:23am	1IRA	1754	

Below the table are control buttons: Alarm, Warning, Ok, Alarm, and a Comment field. The main area contains several charts and panels:

- Coil Details:** Shows parameters for Coil ID, Customer, Material (9), Usage Group (POB), Length (1506.86 ft), Width (66 in), Thickness (0.136 in), Weight (46029.55 lbs), and Tracking (543929).
- Process Maps:** HSM Bottom, PKL2 Bottom, HSM Images, and PKL2 Images. These maps show defect locations on a grid with vertical coordinates from 200ft to 1400ft.
- Alarm Indicators:** Sliders for Topside Lam Count, Bottom Lam Count, Topside Sliver, Bottom Sliver, Top Cells Sliver Length, and Bot Cells Sliver Length. Some show warning or alarm states.
- Pop-up Windows:** Two detailed pop-up windows are shown, one for 'Hot Rolling Mill' and one for 'Pickling Line', providing further technical data and reports.

At the bottom, the status bar reads: admin | PKL2-QualityRules - Version 14 - 6/27/2013 11:52:45 AM



QES – The Smart Assistant System



- ◆ Explore quality relevant data from all process steps
- ◆ Analyze the evolution of quality degradation

The screenshot displays the 'QualityMonitor: Continuous Coating' software interface. It features a navigation menu at the top with options like 'Overview', 'Dashboard', 'Cleaner', 'Coating', 'AMETEK SIS', 'Slitting Application', 'Defect Flagging', and 'Defect Statistics'. The main area is divided into several sections:

- Table:** A table listing quality events (QES) with columns for QESId, CoilID, Grade, Bay, and DateTime. The data includes entries for coils like AJ017205, AJ018210, and AR019225.
- Process Flow Diagram:** A visual representation of the production process, showing stages from 'Slab' to 'Coil' with associated equipment icons.
- Quality Metrics:** A section with buttons for 'Hold', 'Repair', 'Inspection', 'Review', and 'Ok', along with various status indicators for 'Shapes', 'Scratches', 'Weld Holes', etc.
- Temperature Graphs:** Two line graphs showing temperature profiles for 'Max Temp in Pot (Main Pot)' and 'Max Temp in Pot (Premelt Pot)' over time.
- Defect Analysis Graphs:** Three graphs at the bottom: 'Surface Defects Cold Mill', 'Surface Defects Hot Mill', and 'Caster Events', each plotting defect density or event frequency against length.



QES – The Smart Assistant System



- ◆ Explore quality relevant data from all process steps
- ◆ Analyze the evolution of quality degradation
- ◆ Back and forward tracing for eliminating infected products

The screenshot displays the QuinLogic QualityMonitor interface. On the left, a table lists production data:

COILID	ProductionTime
1020366321030	30/6/2010 PM 5:51
1020366322040	30/6/2010 PM 5:49
1020366321040	30/6/2010 PM 5:47
1020366422010	30/6/2010 PM 5:45
1020366421010	30/6/2010 PM 5:43
1020366422020	30/6/2010 PM 5:41

Below the table, a 'Report' section shows coil details: Coil ID: 1020366322040, Grade: M3A33, Length [m]: 491.7008666992, Width [mm]: 1665, Thickness [mm]: 4.5, Automotive: Y.

The main area features a production flow diagram with nodes for CCA, HSM, and PKL, connected by red arrows. A central table lists coil data:

MS Weight	CCA Weight	HSM Weight	PKL Weight	CMJ Weight
585842-1	40817	39641.55	105-23	1105-15
585842-2	41093	39812.7	105-15	1105-15
585842-3	41027	41095.56	105-15	1105-15
585842-4	40970	40610.23	105-14	1105-16
585842-5	40959	40749.84	105-17	1105-17
585842-51	46434	45578.32	173-01	1121-01
585842-52	46835	45480.75	966-16	1121-01
585842-53	46763	46334.26	292-02	1292-02
585842-54	46758	46441.47	292-01	1292-01
585842-55	46724	46248.03	181-02	381-03
585842-56	46565	46248.03	181-03	381-03

At the bottom, a series of smaller panels show detailed views of individual coils and their quality metrics.



What is a Quality Execution System?

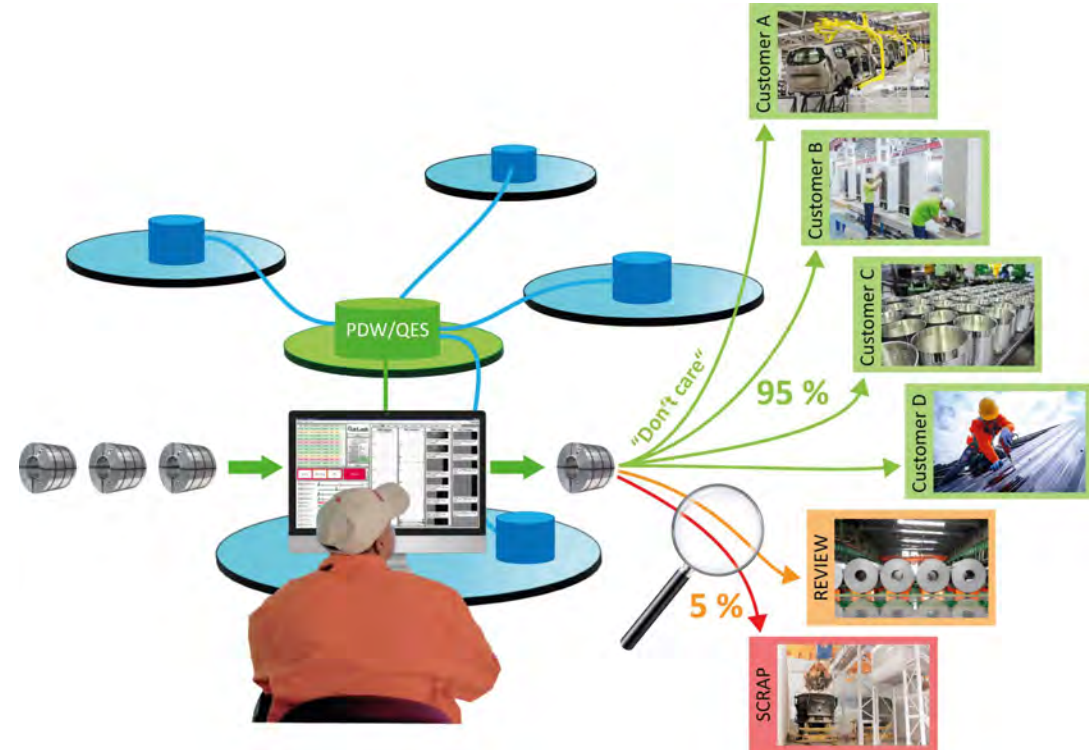
- ◆ **Quality execution** means not only **managing** quality, but:
 - actively **improving** quality
 - quickly identifying causes of quality fluctuations
 - getting the best out of quality deviations
- ◆ Quality and process experts are not replaced or ignored, but actively involved
- ◆ Expert knowledge is mapped by an efficient, powerful control process
- ◆ Objectified approval decisions for products are generated automatically

Go the extra mile
It's never crowded



Why objectified automatic decisions?

Making better decisions



WHAT IS THE QUALITY EXECUTION SYSTEM?

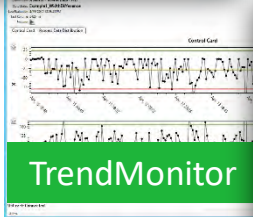
Customizable standard product



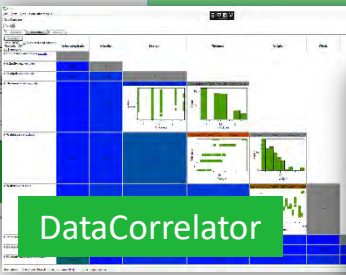
Quality Execution System (QES)



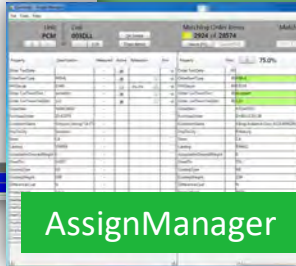
WebReports



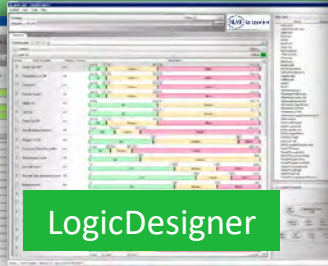
TrendMonitor



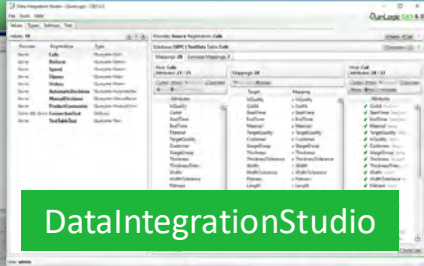
DataCorrelator



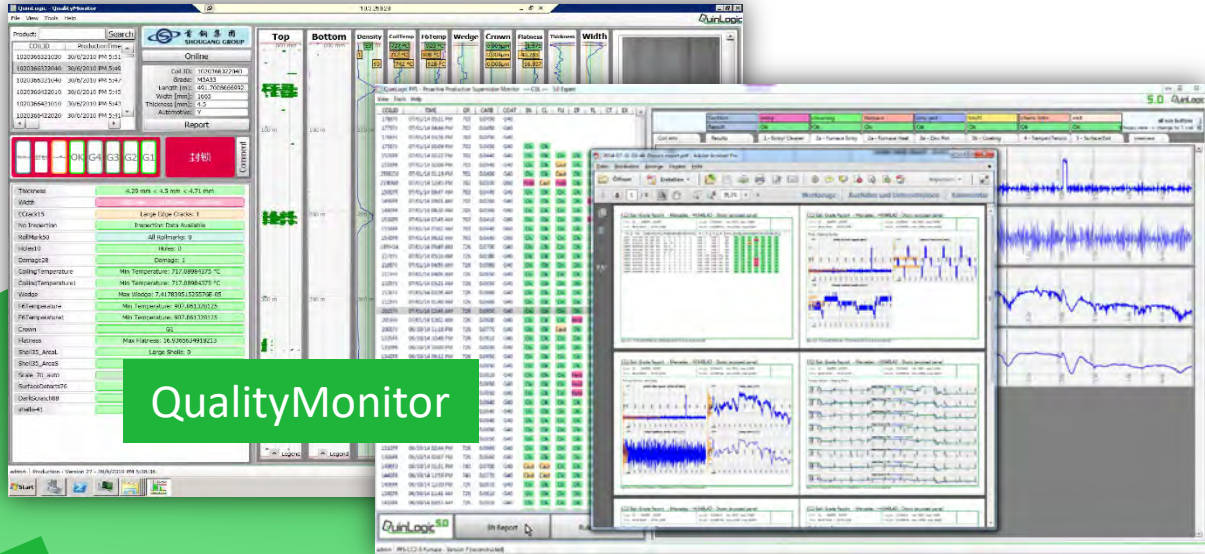
AssignManager



LogicDesigner



DataIntegrationStudio



QualityMonitor



Regular software updates

Task ID	Name	Description	Status	Progress
1	Task 1	Description 1	OK	100%
2	Task 2	Description 2	Review	80%
3	Task 3	Description 3	Block	50%
4	Task 4	Description 4	Review	30%
5	Task 5	Description 5	Block	10%

- Quarterly updates
- One major release per year

11.3

Lively user community



- Annual user meeting
- Presentation of new release
- Feature request sessions
- Helpdesk

Learning & Development

QuinLogic Corporate Learning

Webinar 1: 09.04.2020 - 3:30 pm CET

Complex tables in the Dashboard

Content Info

Thank you for participating in our webinar

Webinar recording

- Monthly user webinars
- Online and classroom courses
- Certified trainer
- Online learning platform

What is our product about?

The Quality Execution System



monitors



documents



safeguards

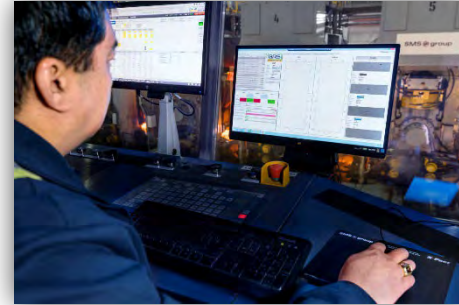
- ◆ process and product quality
- ◆ from the start of the process chain
- ◆ down to the finished product

- ◆ All relevant production and process data are recorded and analyzed by rules
- ◆ The system provides quality decision support based on **Automatic Product Grading**
- ◆ It also monitors process data and – in case of deviations – issues instructions for action

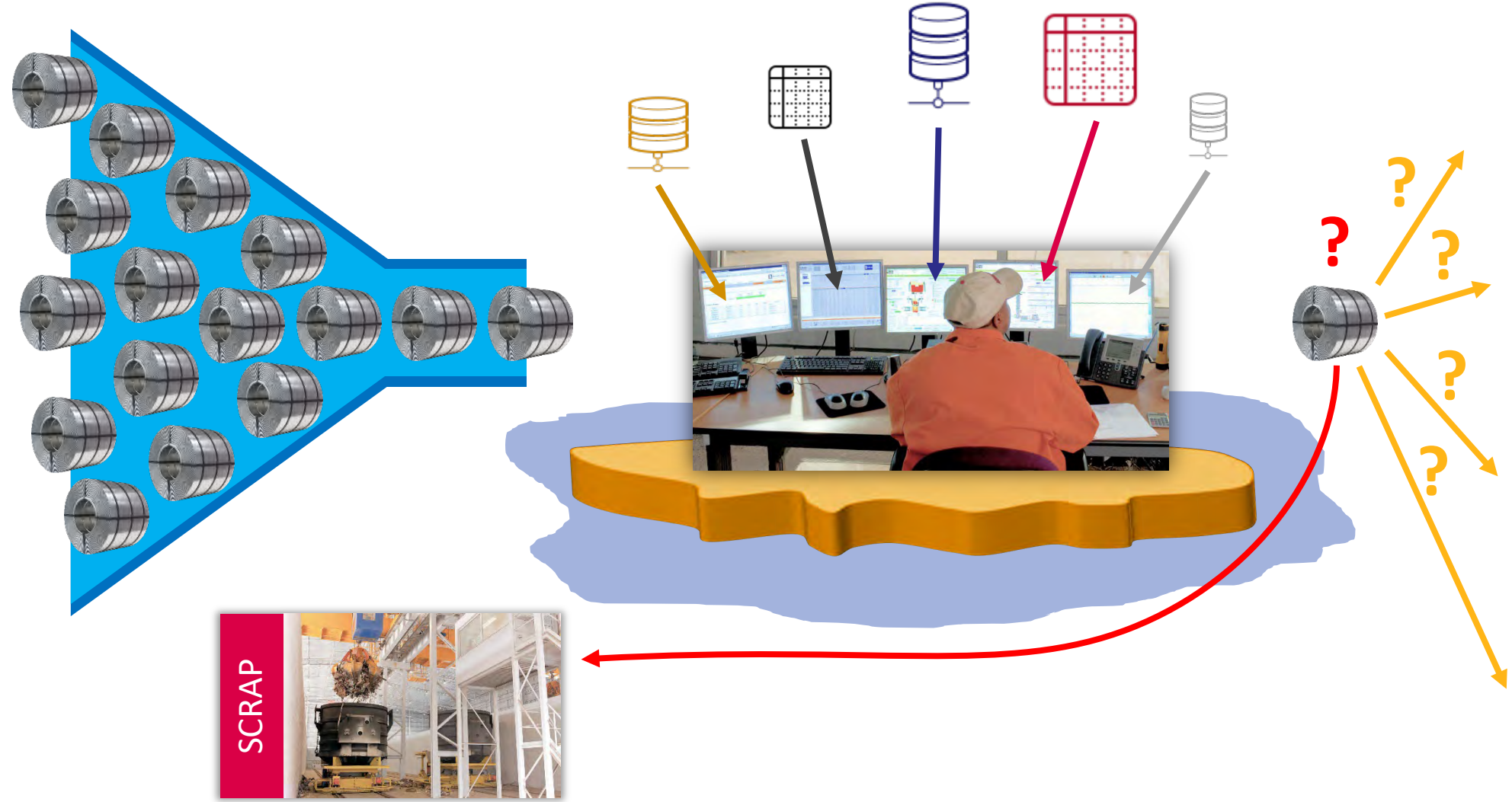
QualityMonitor Dashboard



- ◆ The **QES Dashboard** concept empowers the QES users to adapt the QualityMonitor and make it their own
 - According to their individual needs
 - At any time
 - Without QuinLogic support needed
- ◆ Data from various lines can be visualized and analyzed on the same screen
- ◆ Arbitrary number of **Dashboard** reports can be shown in parallel on split screens
- ◆ User, role and line specific **Dashboard** reports



Does this remind you of something?

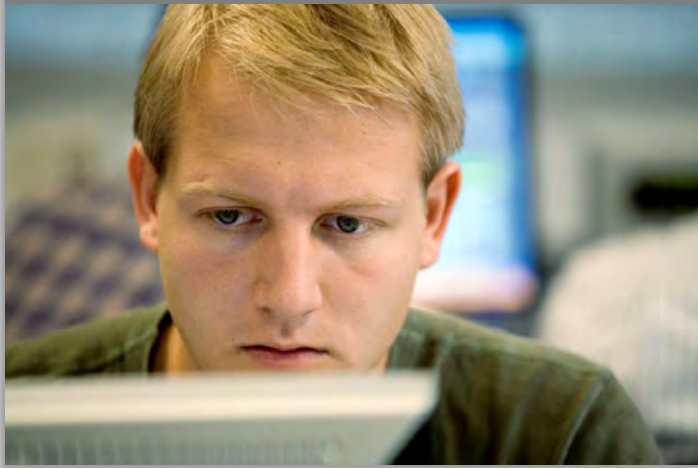


Manual product grading – key drawbacks

◆ What are the main drawbacks of this approach?

Your quality experts are fed up with routine work

→ Less time for pro-active measures



The grading decision is based on incomplete data

→ Limited reliability
→ High claim rate



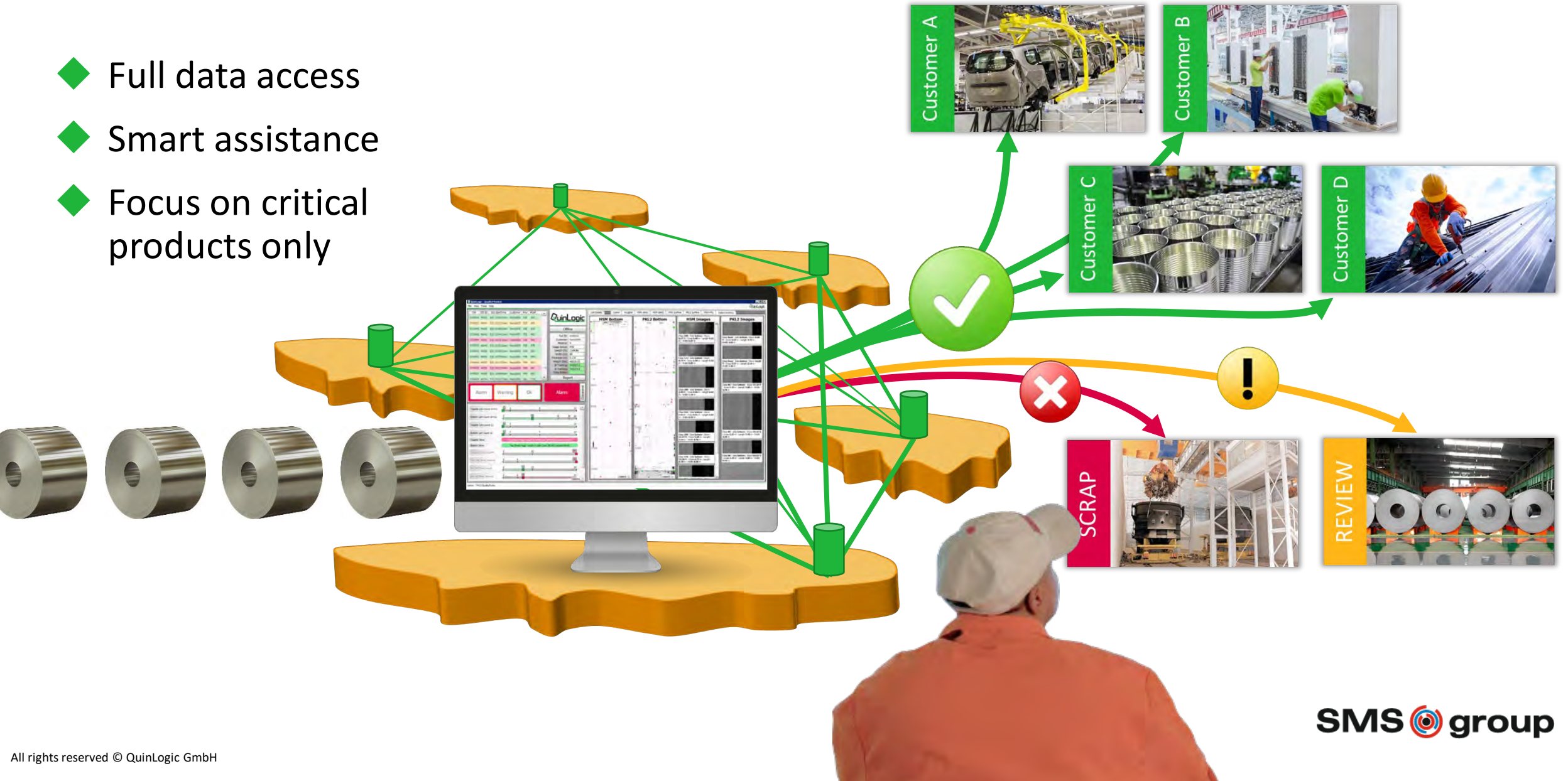
High number of products with unclear grading status

→ Blocked warehouse capacity



The QES Automatic Product Grading application

- ◆ Full data access
- ◆ Smart assistance
- ◆ Focus on critical products only



Automatic product grading – key benefits

◆ What are the main benefits of this solution?

Your quality experts are freed from routine work

→ More time for pro-active measures



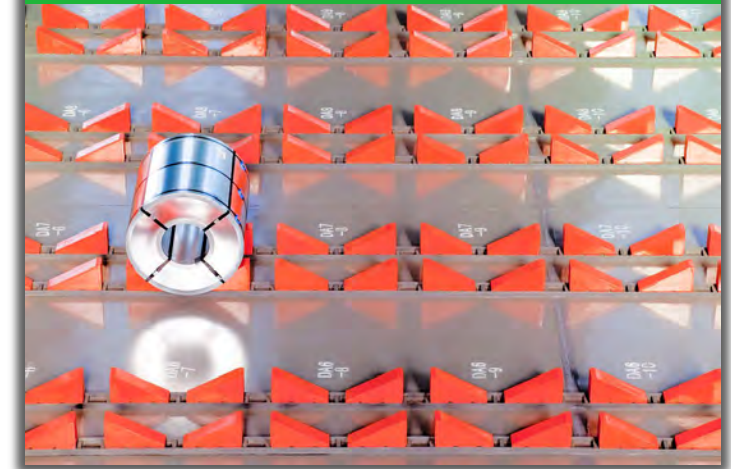
All quality and process data available for grading

→ High reliability
→ Lower claim rate

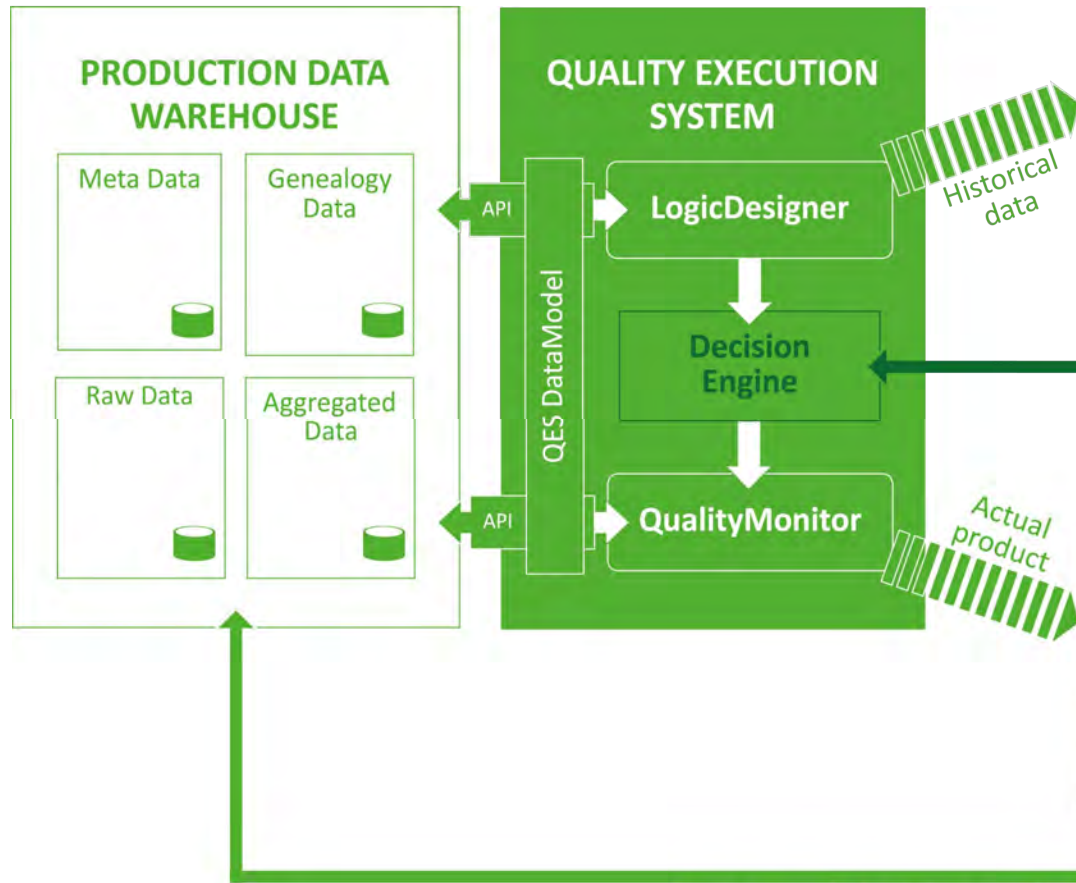


Less products with unclear grading status

→ Free warehouse capacity

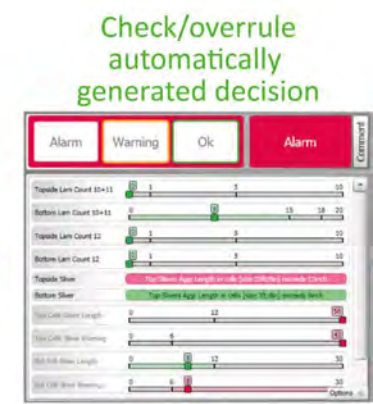


The QES is learning from you



Analyze overruled decisions, derive new rule or rule update and test with historical data

Activate new or updated rule



Check/overrule automatically generated decision

Store overruled grading result and operator comment

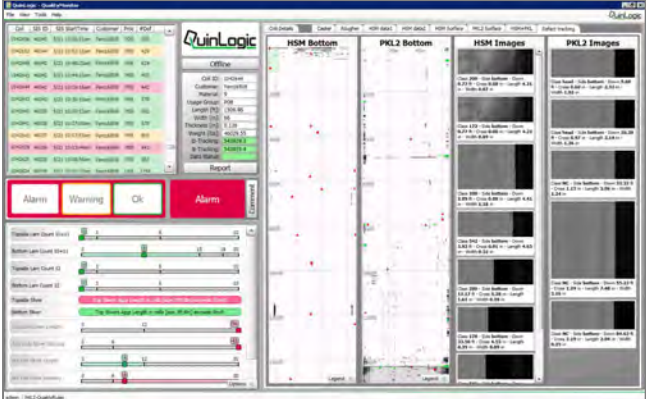
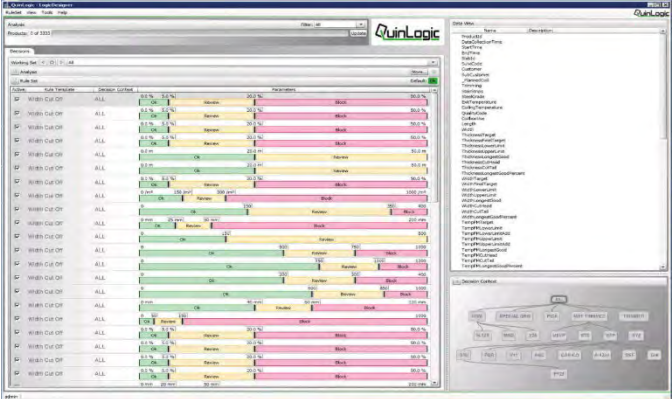
Optimizing the release rate



OPTIMIZATION OF THE GRADING RULE SET

	true	false	
Released	60%	0%	= CLAIMS
Blocked	25%	15%	= TIME

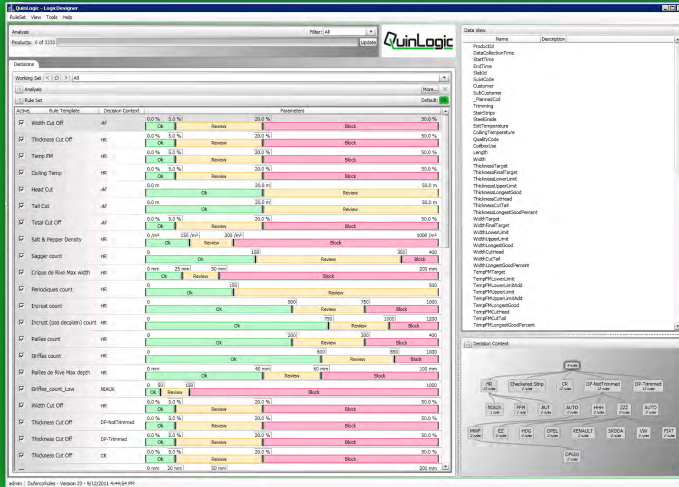
	true	false
Released	75%	0%
Blocked	20%	5%



The QES Rule Management & Data Analytics tool set

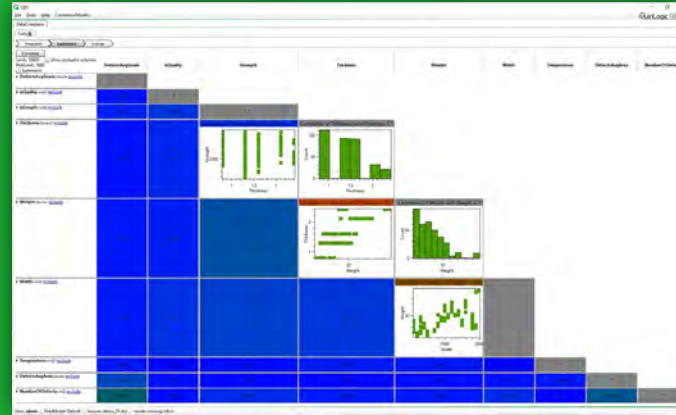


LogicDesigner



- Rule definition
- Rule management
- Rule set evaluation

DataCorrelator



- Data selection & preparation
- Correlation analysis
- Exploration

TrendMonitor



- Statistical process control
- Control cards
- Monitoring and alarming

QuinLogic LogicDesigner



- ◆ User-friendly, intuitive tool for the creation of rule sets
- ◆ Direct access to PDW data
- ◆ Management of rule sets for various product contexts
- ◆ Analysis of new rules using archive data

The screenshot displays the QuinLogic LogicDesigner interface with four key panels highlighted in green:

- Rule Set Analysis:** Located at the top, it shows a filter set to 'All' and a 'Products: 0 of 3333' indicator.
- Rule Set:** The central panel is a table listing various rules with their parameters and status. The table has columns for 'Active', 'Rule Template', 'Decision Context', and 'Parameters'. Each row includes a progress bar indicating the status of the rule (Ok, Review, or Block).
- Connected Data:** A panel on the right showing a list of data fields such as ProductId, DataCollectionTime, StartTime, EndTime, SlabId, SuivCode, Customer, SubCustomer, PlannedCoil, Trimming, StairStrips, SteelGrade, ExitTemperature, CoilingTemperature, QualityCode, CoilboxUse, Length, Width, ThicknessTarget, ThicknessFinalTarget, ThicknessLowerLimit, ThicknessUpperLimit, ThicknessLongestGood, ThicknessCutHead, ThicknessCutTail, ThicknessLongestGoodPercent, WidthTarget, WidthLowerLimit, WidthUpperLimit, WidthLongestGood, WidthCutHead, WidthCutTail, WidthLongestGoodPercent, TempFMTarget, TempFMLowerLimit, TempFMLowerLimitAdd, TempFMUpperLimit, TempFMUpperLimitAdd, TempFMLongestGood, TempFMCutHead, TempFMCutTail, and TempFMLongestGoodPercent.
- Data Context:** A panel at the bottom right showing a hierarchical tree structure of data context nodes, with a root node '4 rules' and several child nodes representing different rule sets.



Rule building – simple as drag & drop



- ◆ Rule templates for new rules
- ◆ All stored data items from the PDW available for rules
- ◆ Drag a data item and drop it on a new rule

The screenshot displays the QuinLogic software interface for rule building. A central dialog box titled "Shell (Sliver) Length - Rule Template" is open, showing the following settings:

- Name: 35 - Shell (Sliver) Length
- Execution Pass: 1
- General settings: Contributes to final result; Error result: Default
- Value Expression: =!"Shell_sis".Columns.SizeMD.Max
- Minimum Value: 50
- Maximum Value: 1000
- Small Change: 1
- Decimal Places: 0
- Unit: mm
- Reverse initial order:

A green arrow points from the "Data View" panel on the right to the "Value Expression" field. The "Data View" panel shows a list of data items, including "DefectId", "Class", "Grade", "Side", "PositionMD", "PositionCD", "SizeCD", "SizeMD", "Double", "Min", "Max", "Sum", "Avg", "Host", "Period", and "Count". The background shows a "Decision Sheet" with various rule settings and a "Release" button.



Explorative data analysis – Turning data into insights

◆ What causes products to have more defects?

▶ Root Cause Analysis



◆ Did we really get less defects with method A than with method B?

▶ Comparative Analysis

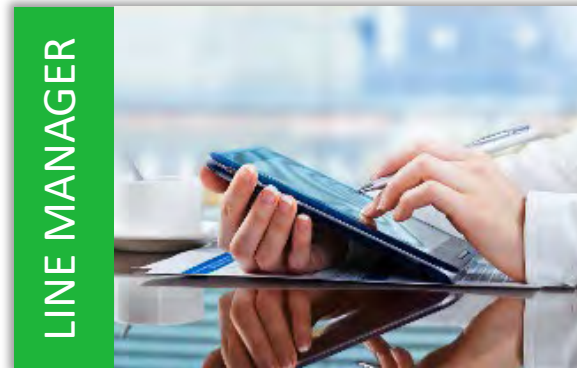
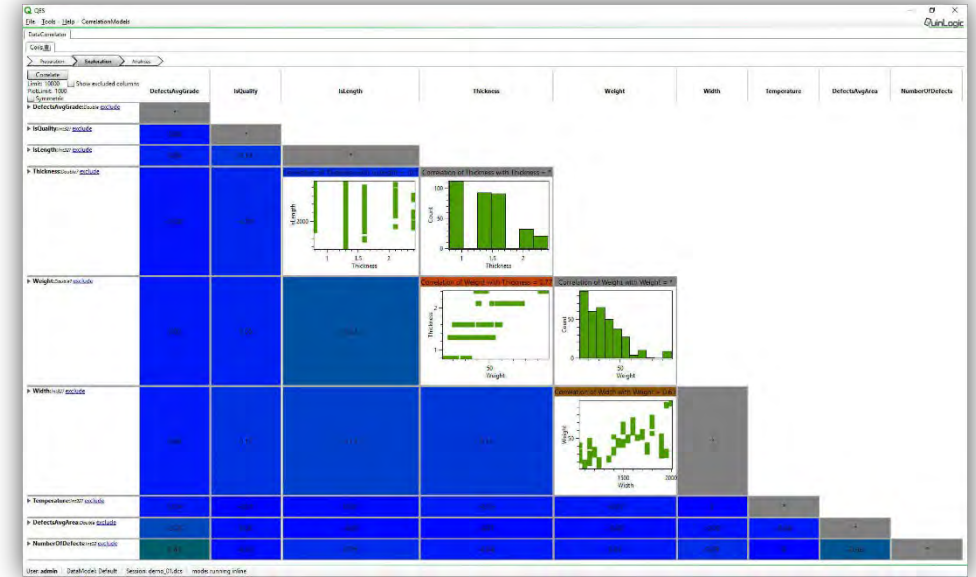
◆ If we have data about line X can we know already something about quality at line Y?

▶ Predictive Models

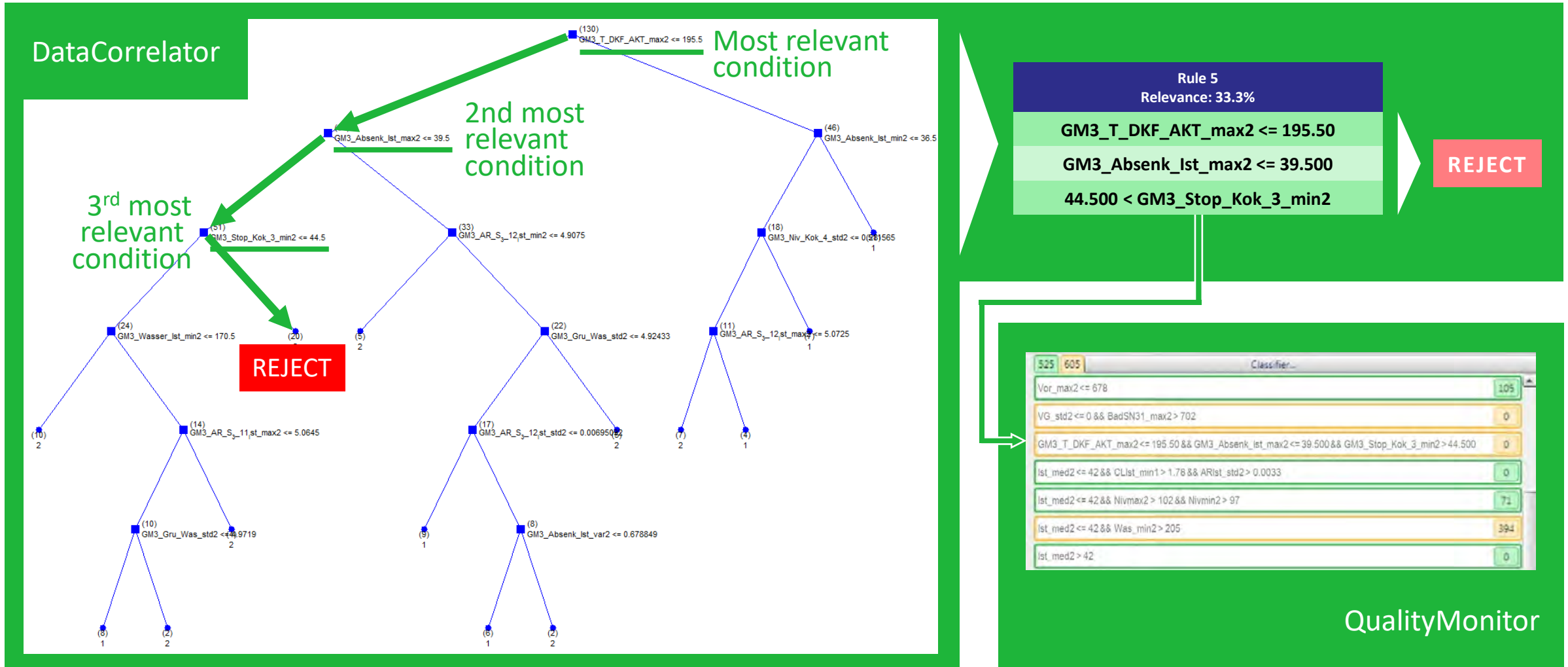


QES DataCorrelator

- ◆ The QES solution for explorative data analysis integrated in the QES environment offers
 - Easy data access and preparation
 - Easy export of results, e.g. in form of rules for the LogicDesigner
- ◆ Provides a set of well-designed functions that are useable without a data science background
- ◆ Targeted users are domain experts, e.g.



Typical DataCorrelator analysis outcome



Increasing the rate of automatically released products



Quality and process data

Reject information

Logic Designer

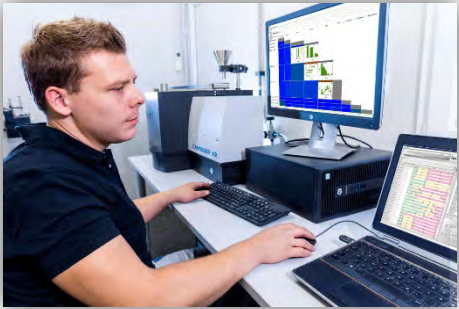


Decision Service
Quality Monitor

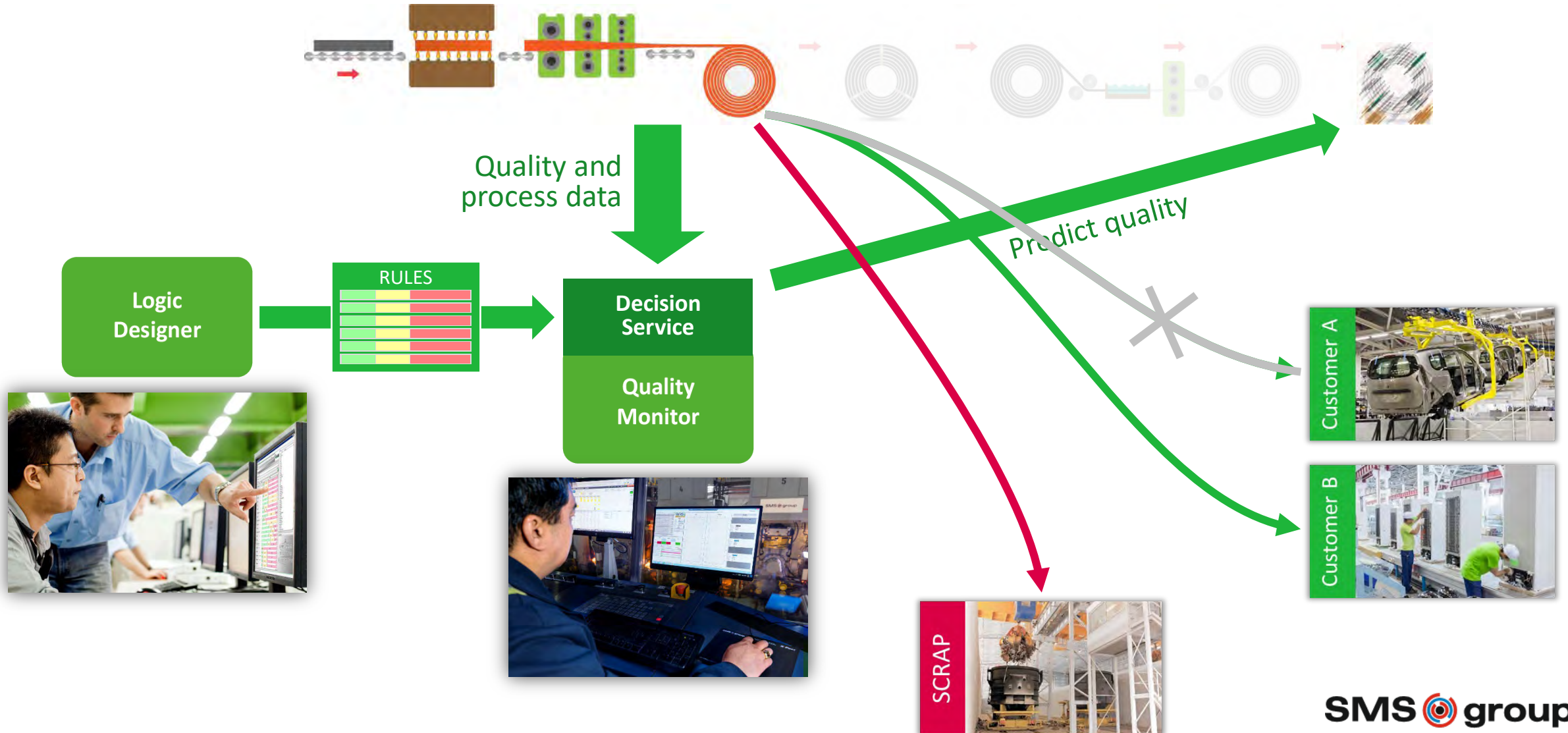


Data Correlator

Derive rules from the analysis of data



Avoiding putting more money on a "dead" product



TrendMonitor

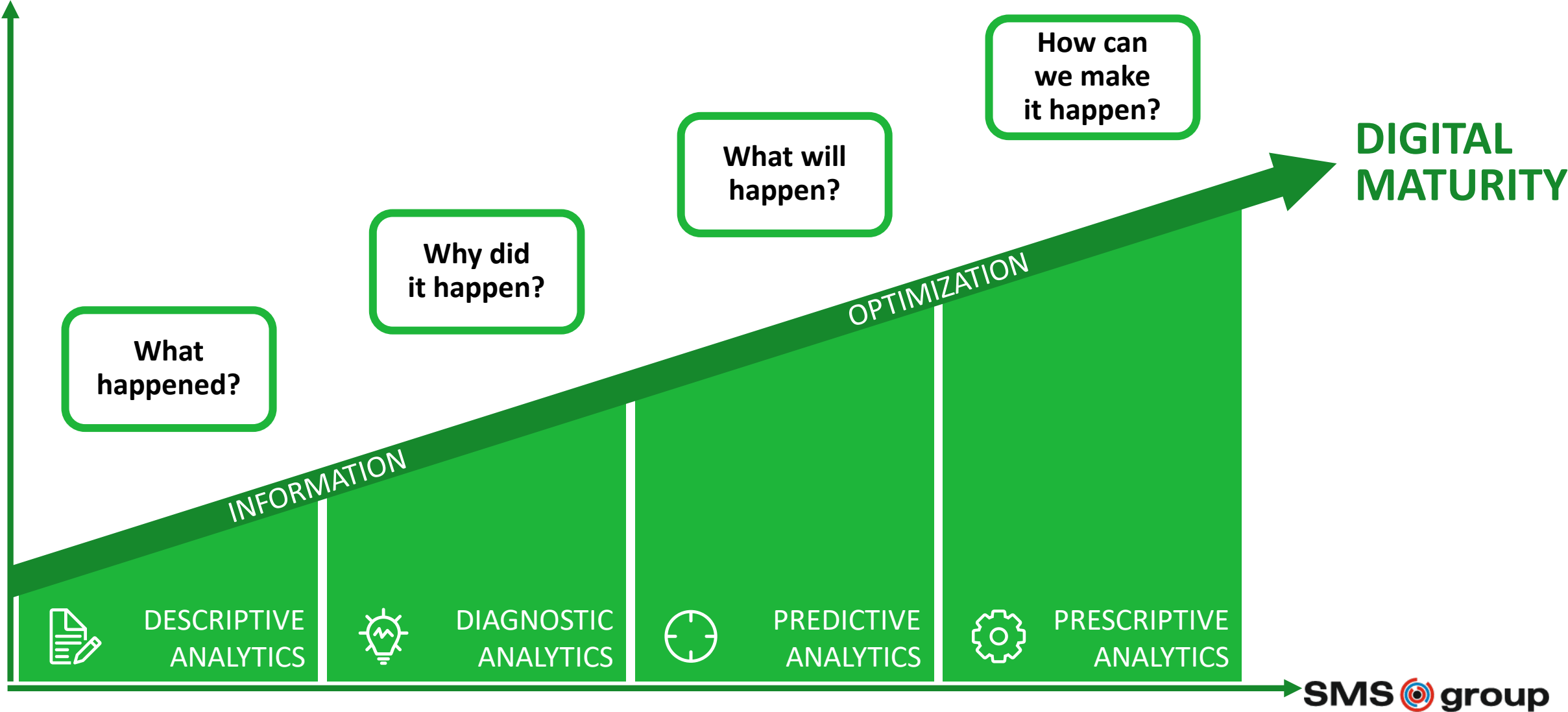
- ◆ Process control cards with calculated limits
- ◆ Predefined, time-controlled notification triggers:



- ◆ Any number of control cards in parallel
 - various control card types
 - different analyzers

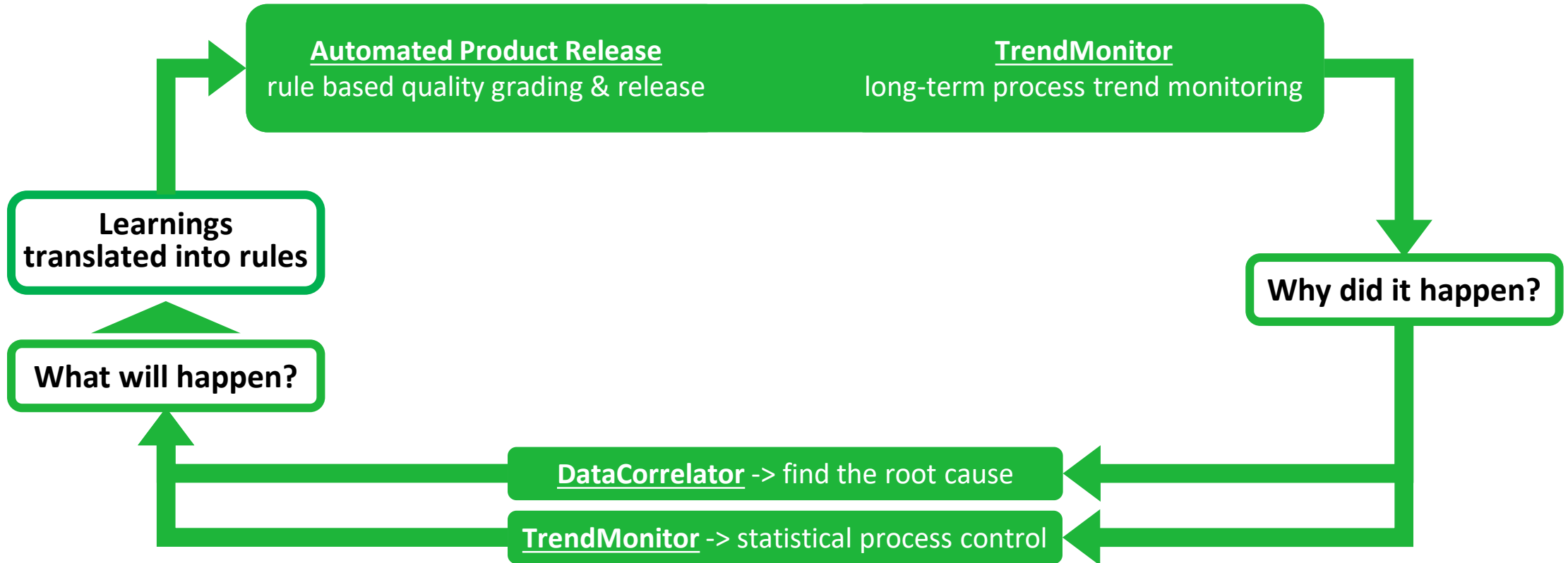


Gartner Analytics Maturity Model



What happened?
Deviation? Trend?

Intelligent Monitoring of the Quality and the Process



WHAT IS THE PRODUCTION DATA WAREHOUSE?

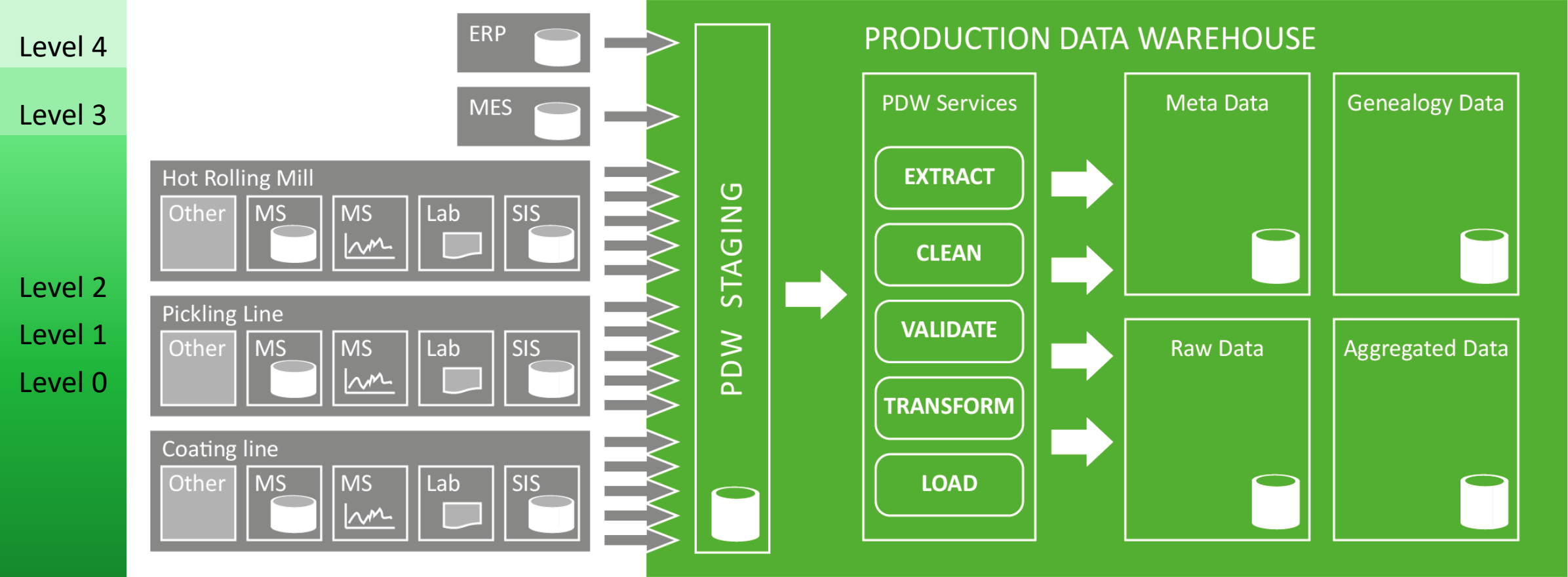
Access to the digital family in the QES

The QuinLogic **Production Data Warehouse** (PDW)

- ◆ collects all relevant mill data
- ◆ represents the robust foundation for long term storage
- ◆ provides the source for all data driven applications

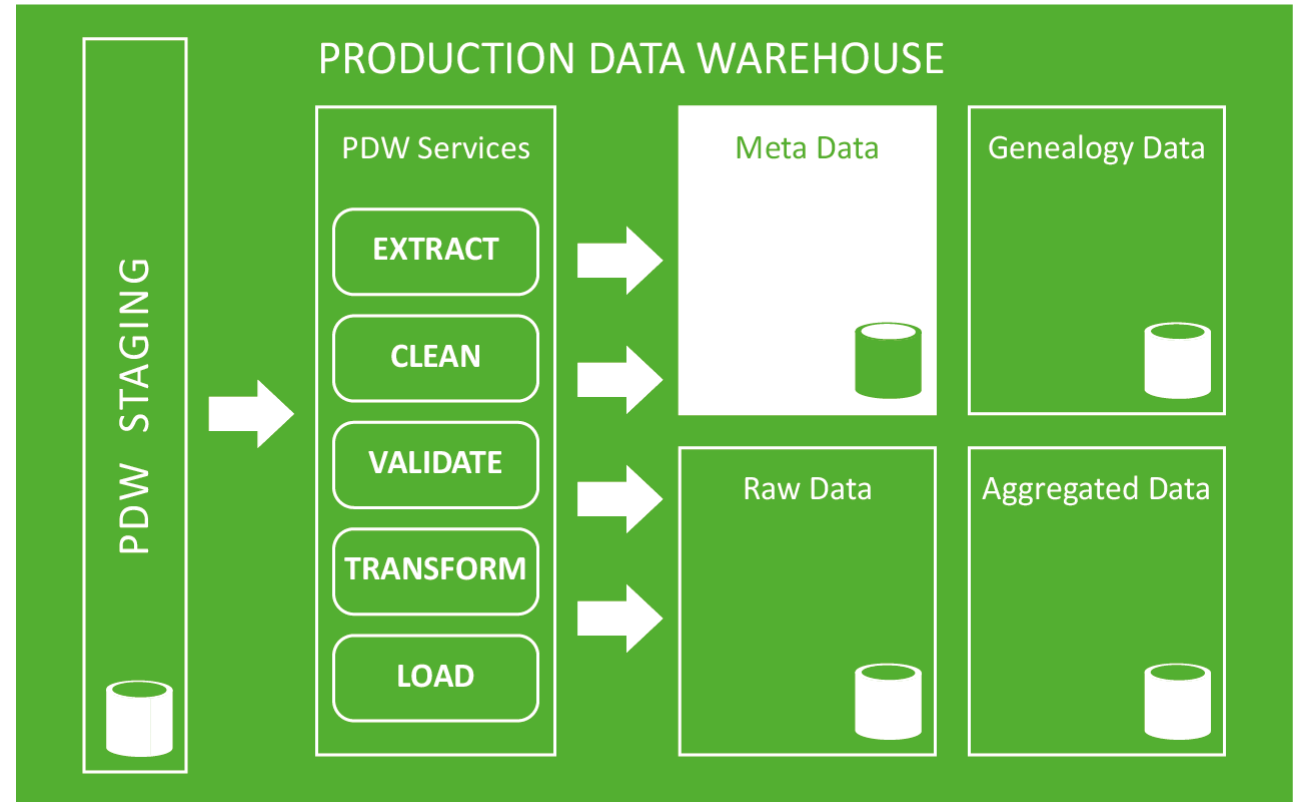


PDW: All product, process, and quality data in one place



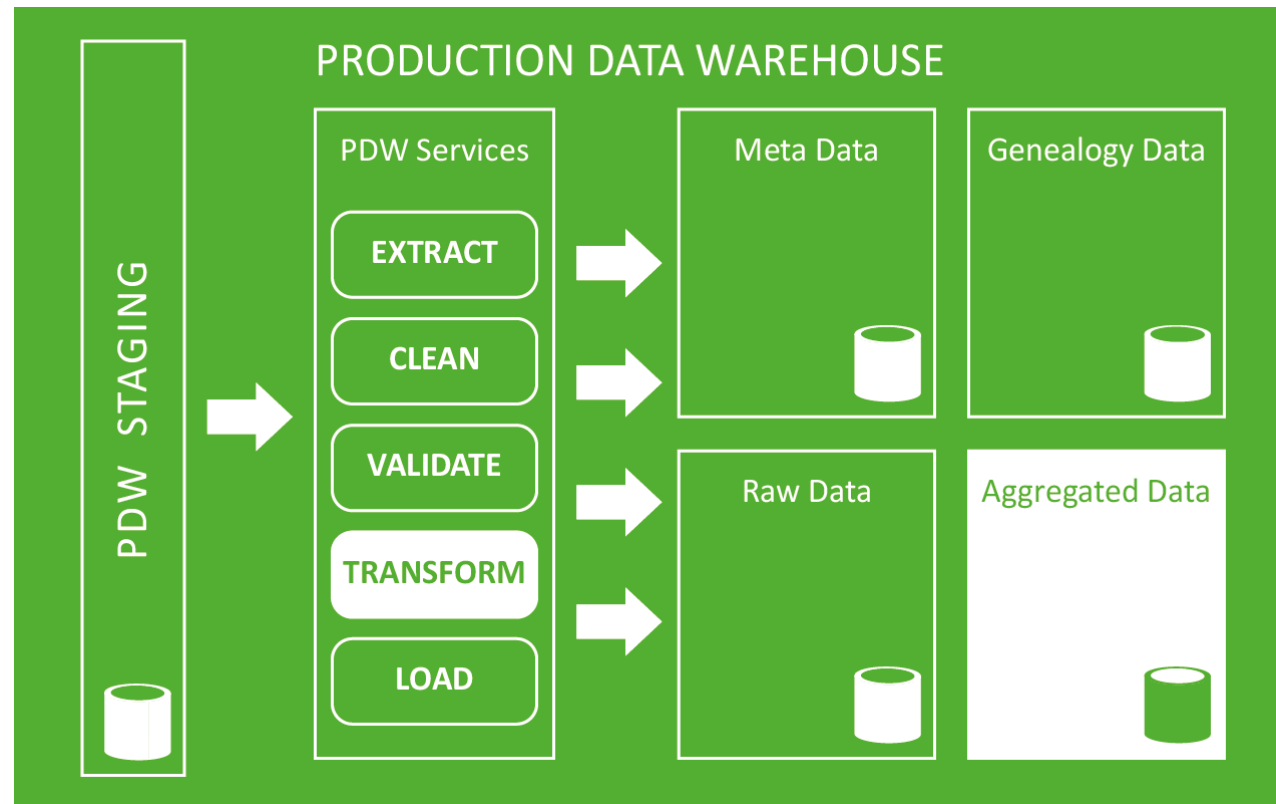
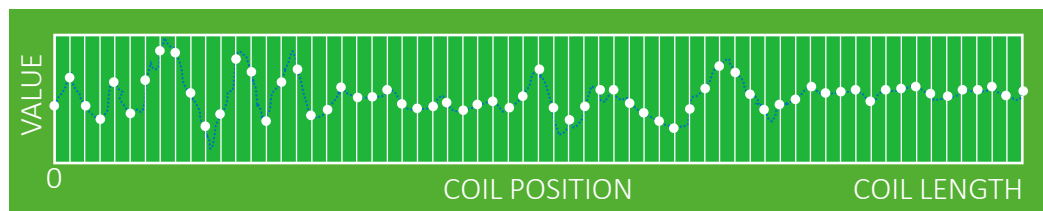
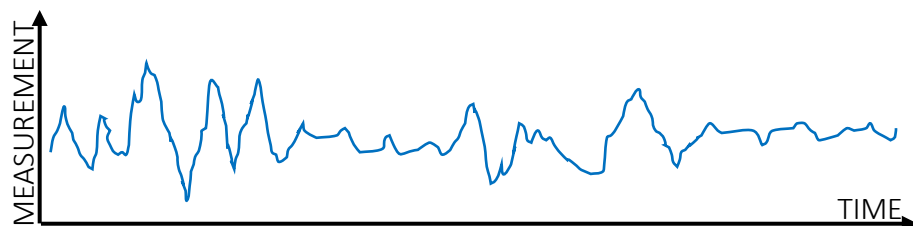
Meta data management

- ◆ Hierarchical alias naming scheme
 - ➔ Absolutely essential to deal with 20k+ parameters
- ◆ Attribute descriptions
- ◆ Measurement units
- ◆ Limits
- ◆ Raw materials supplier
- ◆ Other semantic information



Pre-calculation / aggregation of data

- ◆ Unit conversion, e.g. [mm] → [m]
- ◆ Pre-filtering of relevant defects
- ◆ Grouping of defect classes
- ◆ Calculating positions by speed profile integration
- ◆ Time-to-length recalculation

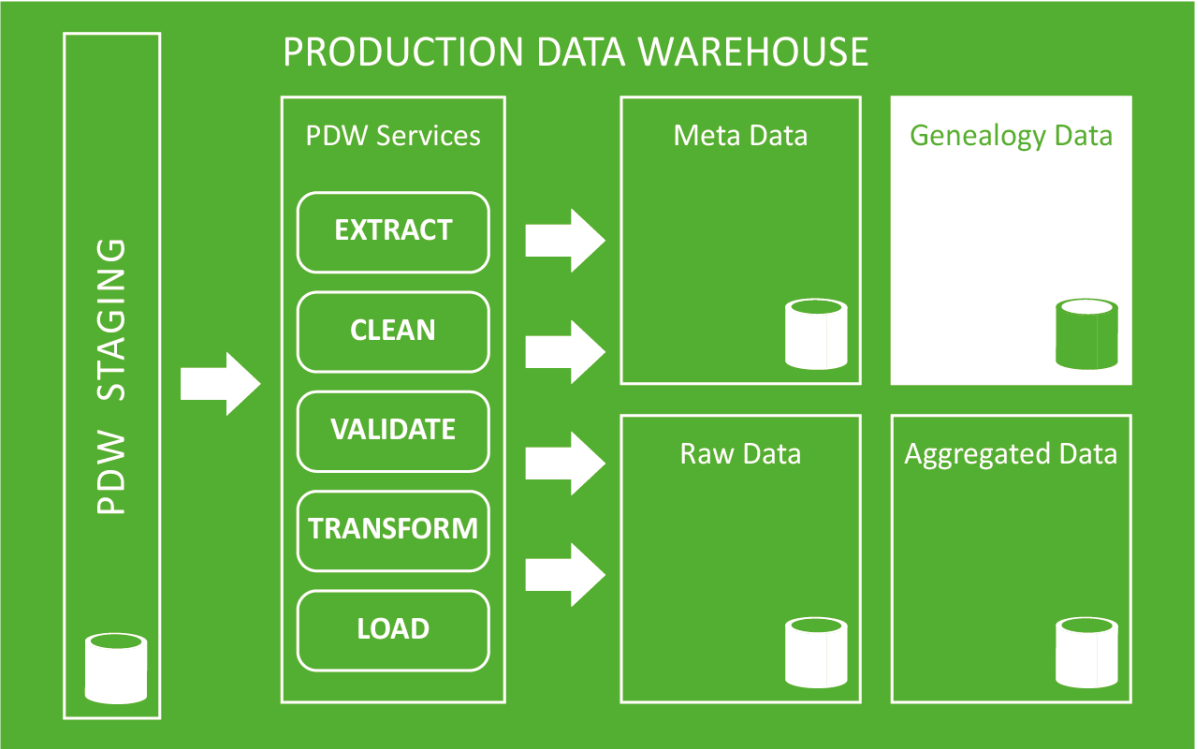
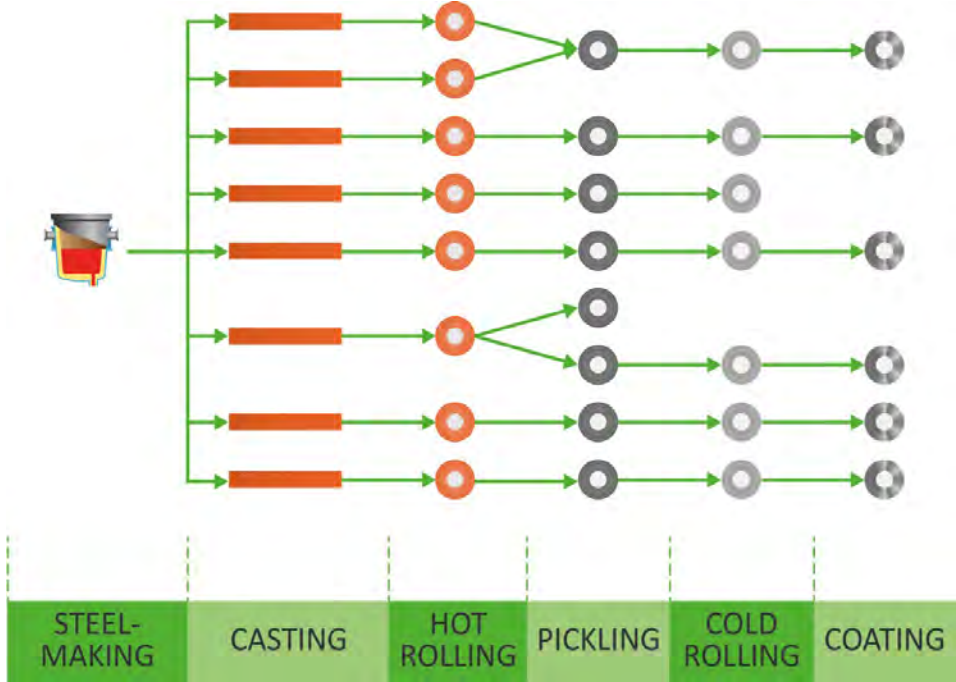


WHY IS PRODUCT GENEALOGY THE GAME CHANGER?

Fully support of product tracking and genealogy features



Modeling of the production plant in terms of material flow among plant's facilities:

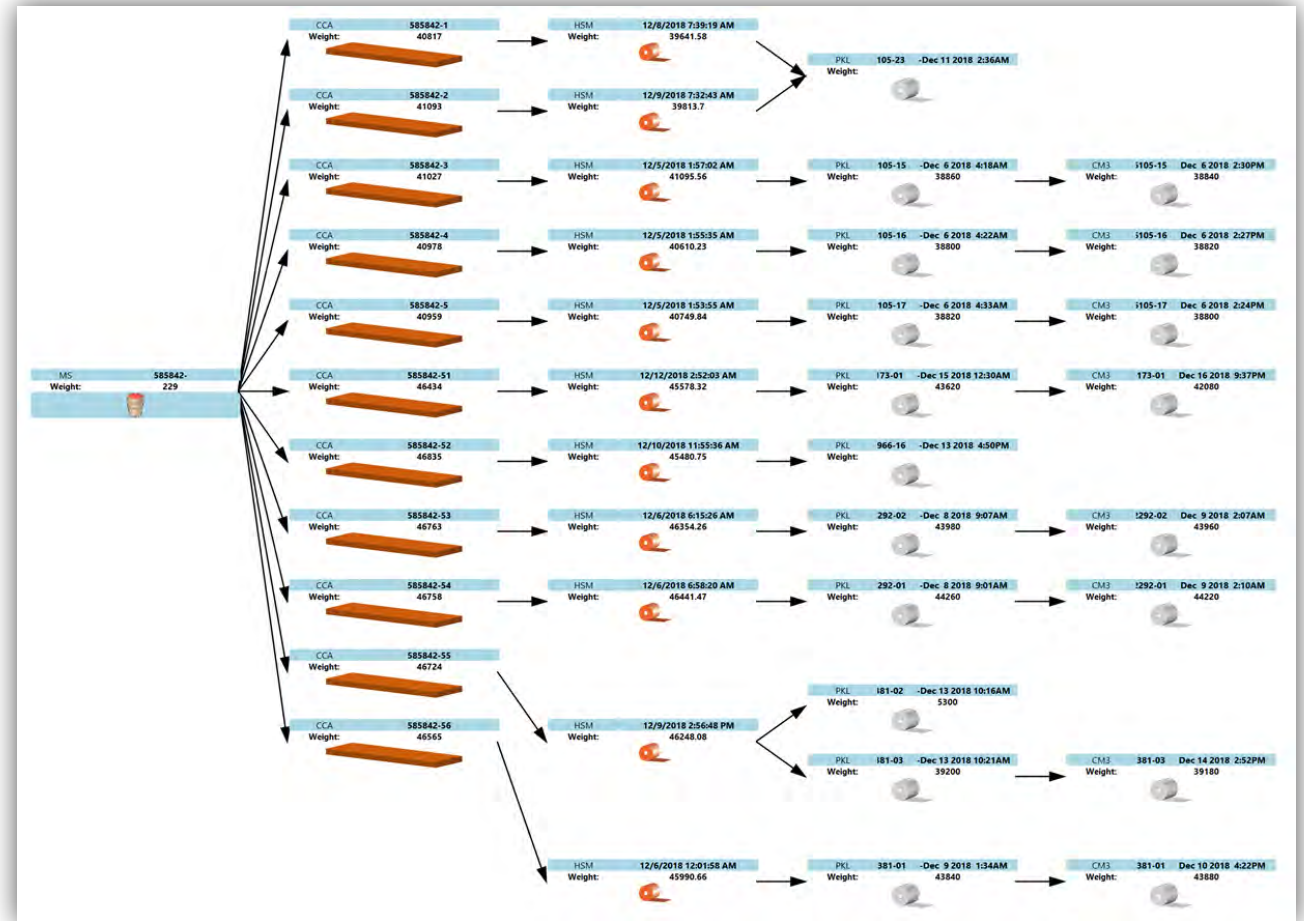


◆ Utilizes PDW global unique product identification



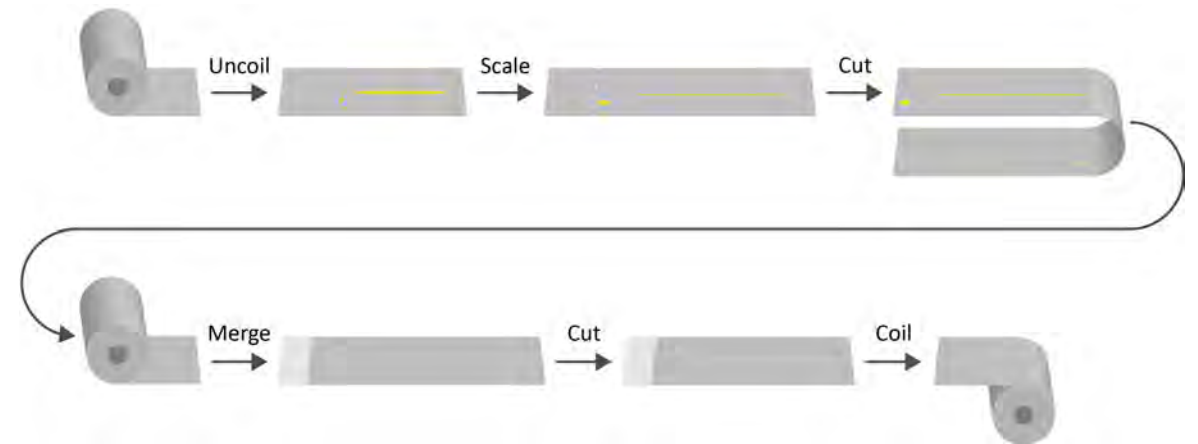
Every product clearly identifiable in every process step

- ◆ Product path can be traced along entire production and processing chain
- ◆ Branches are known and resulting products are identifiable, e.g.
 - by producing several products from one basic product like several slabs from the same heat
 - through product divisions (transverse cutting or longitudinal slitting)



All manipulations of products are known:

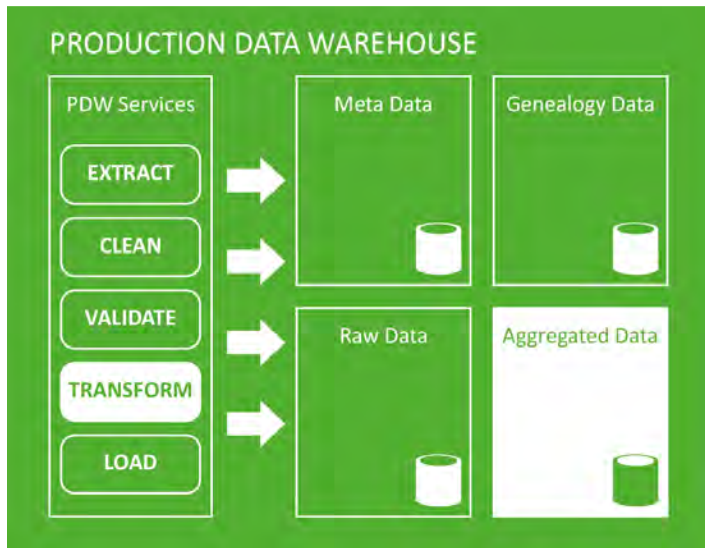
- reversal of direction through repeated recoiling
- surface flipping by repeated recoiling
- elongation and change in width due to rolling processes
- side trimming
- cutting sections of scrap
- product division by transverse cutting
- product division by longitudinal slitting
- product connection by welding/tacking
- ...



Automatic alignment of data from subsequent process steps



In the QES, these effects are “normalized” by the PDW TRANSFORM process:



QuinLogic - QualityMonitor

File View Tools Help

Coil	SIS ID	SIS StartTime	Customer	Proc.	#Def
46045	5/21 10:56:21am	POB	599		
46044	5/21 10:52:16am	POB	429		
46043	5/21 10:48:25am	POB	624		
46042	5/21 10:44:10am	POB	403		
46041	5/21 10:39:16am	POB	442		
46090	5/21 10:36:11am	POB	578		
46039	5/21 10:30:12am	POB	562		
46038	5/21 10:27:00am	POB	578		
46037	5/21 10:17:55am	POB	805		
46036	5/21 10:13:44am	POB	441		
46035	5/21 10:08:56am	POB	883		
46034	5/21 10:01:23am	1IRA	1754		

Coil Details

Offline

Coil ID: 46090
 Customer: POB
 Material: 9
 Usage Group: POB
 Length [ft]: 1506.86
 Width [in]: 66
 Thickness [in]: 0.136
 Weight [lbs]: 46029.55
 Tracking: 543929
 Data Status: OK

Report

Alarm Warning Ok Alarm

Topside Lam Count 10+11: 0 1 5 10 15 18 20

Bottom Lam Count 10+11: 0 1 5 10 15 18 20

Topside Lam Count 12: 0 1 5 10 15 18 20

Bottom Lam Count 12: 0 1 5 10 15 18 20

Topside Sliver: Top Slivers Aggr Length in cells [size 3ft;8in] exceeds 42inchi

Bottom Sliver: Top Slivers Aggr Length in cells [size 3ft;8in] exceeds 9inch

Top Cells Sliver Length: 0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120 126 132 138 144 150 156

Top Cells Sliver Warning: 0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120 126 132 138 144 150 156

Bot Cells Sliver Length: 0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120 126 132 138 144 150 156

Bot Cells Sliver Warning: 0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120 126 132 138 144 150 156

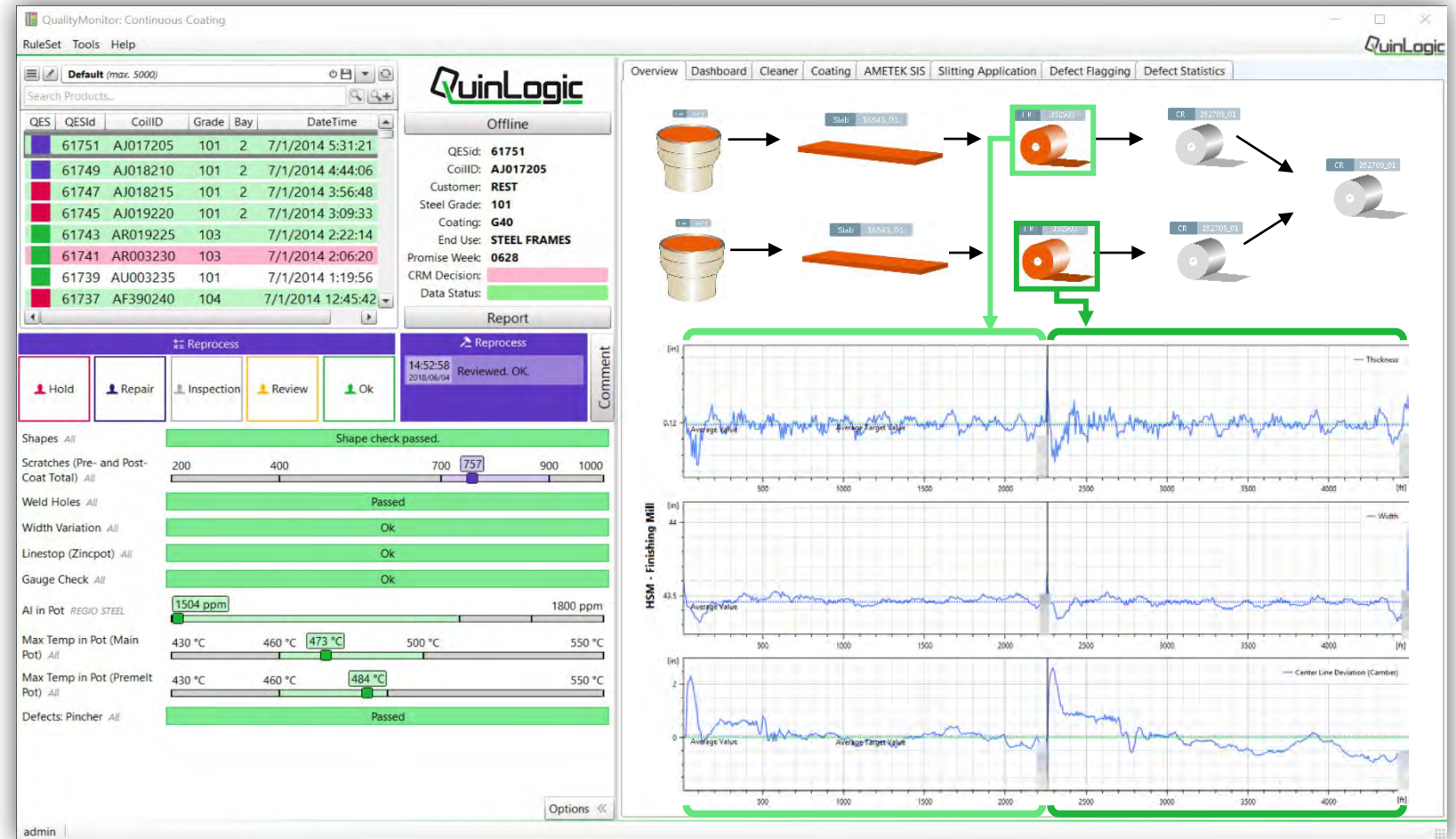
Options

admin | PKL2-QualityRules - Version 14 - 6/27/2013 11:52:45 AM



Example: Product merging

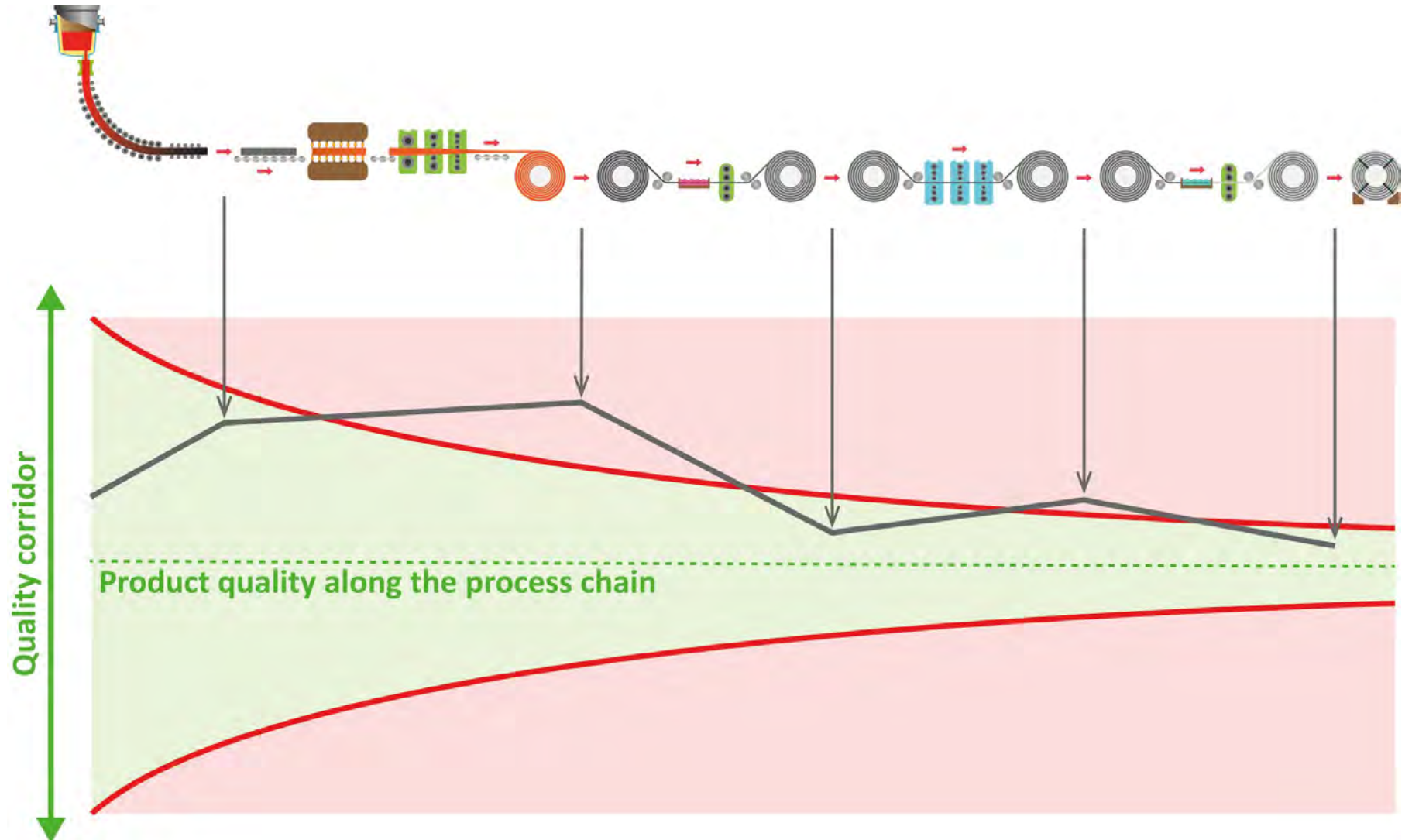
- ◆ Describing a product completely, always includes looking at it's genealogy
- ◆ For a merged daughter product, the QES puts together the relevant sections of its two mothers



HOW DO CUSTOMERS ROLL OUT PDW | QES?

Avoiding scrap and increasing yield

- ◆ Control products along the process chain
- ◆ Get data- and rule-based decision support
- ◆ Reroute or stop further processing if necessary

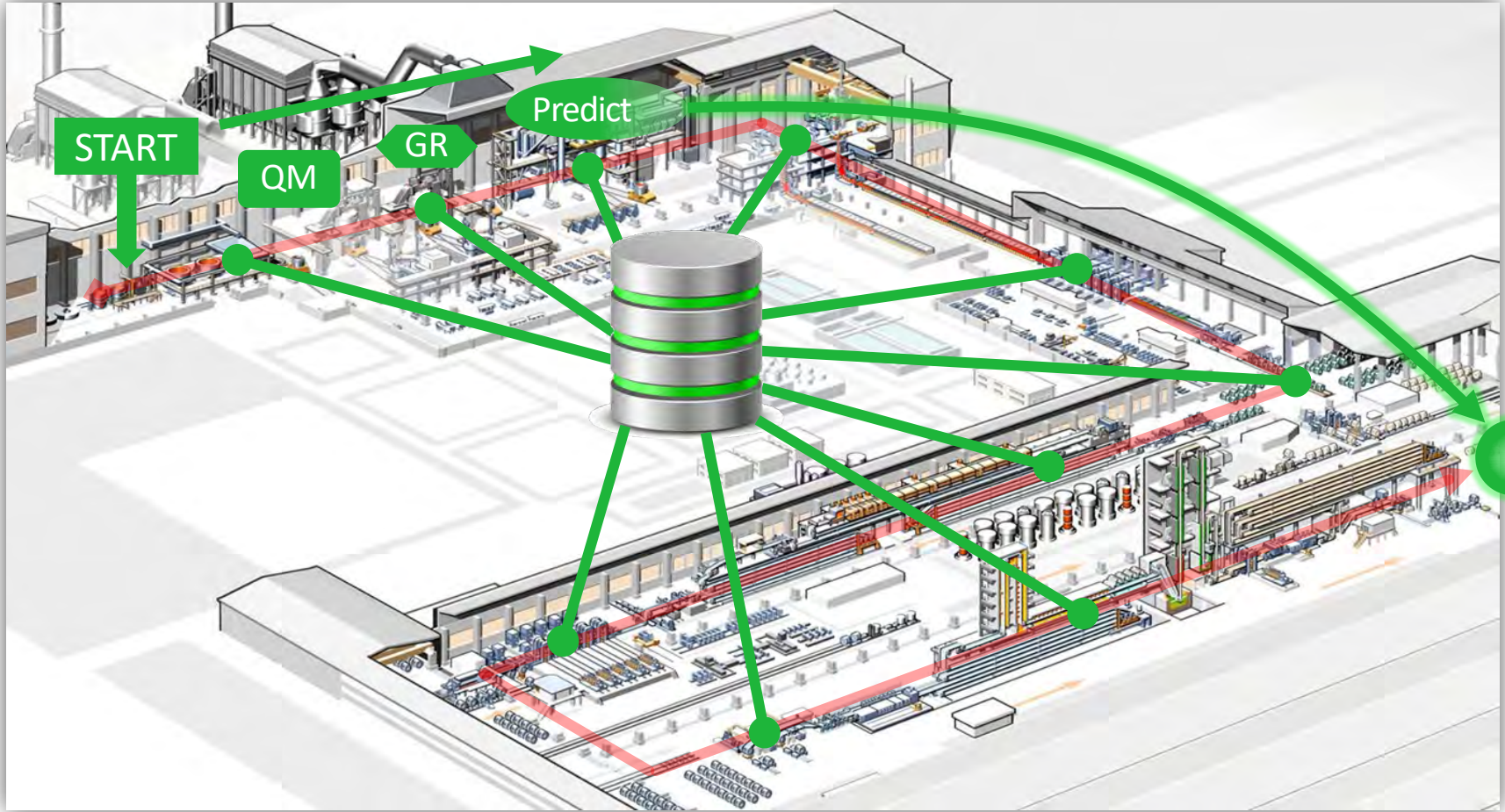
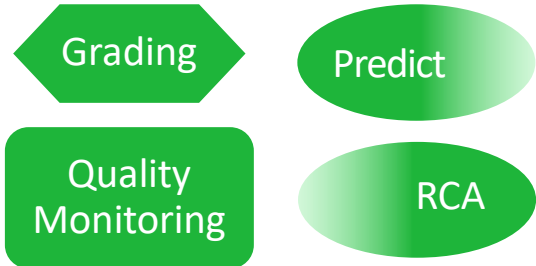


How can quality execution management be implemented?



DOWNSTREAM

- ◆ PDW
- ◆ Monitor start of process
- ◆ Automatic grading
- ◆ Predict final product quality

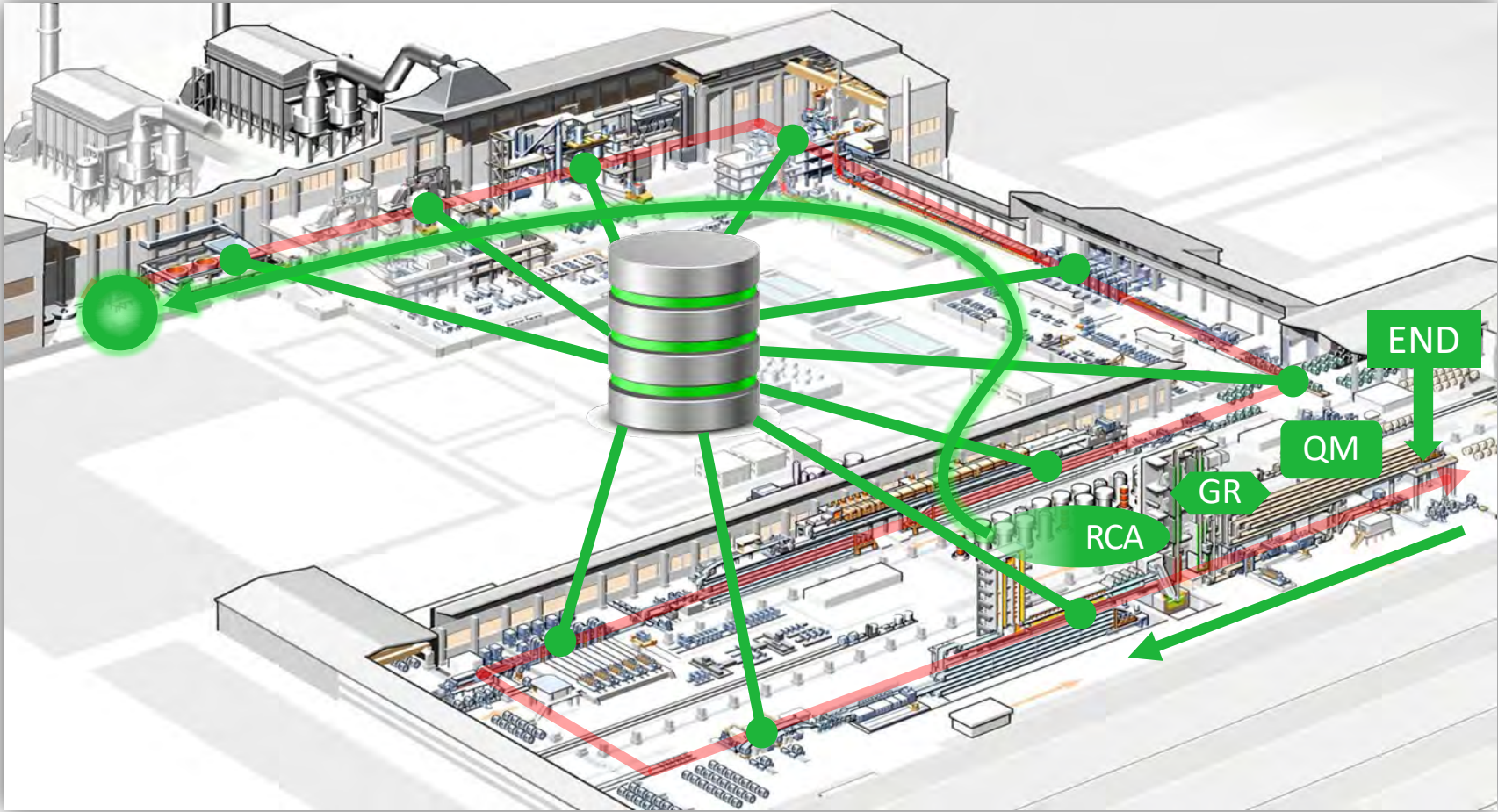
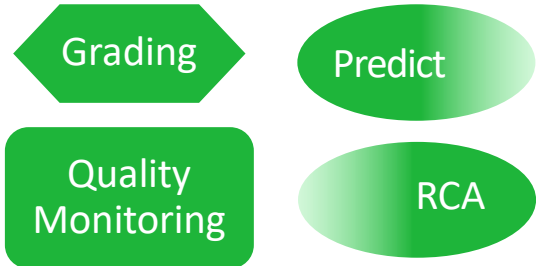


How can quality execution management be implemented?



UPSTREAM

- ◆ PDW
- ◆ Monitor final product quality
- ◆ Automatic grading
- ◆ Root cause analysis

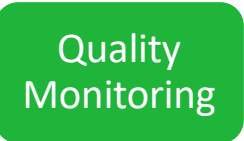
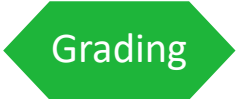
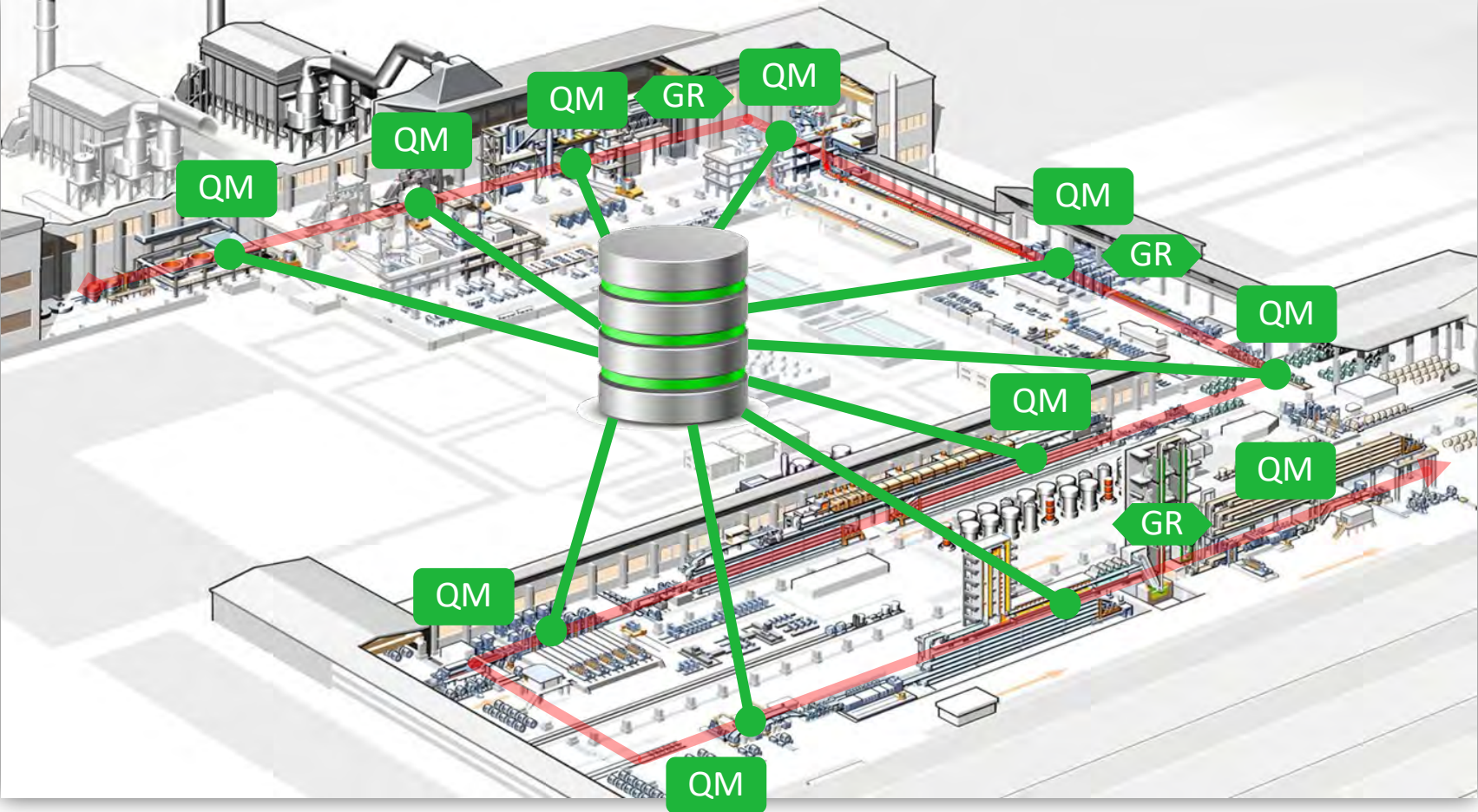


How can quality execution management be implemented?



STEPWISE

- ◆ Extend PDW
- ◆ More grading decisions



SUMMARY

Quality management in the aluminum industry

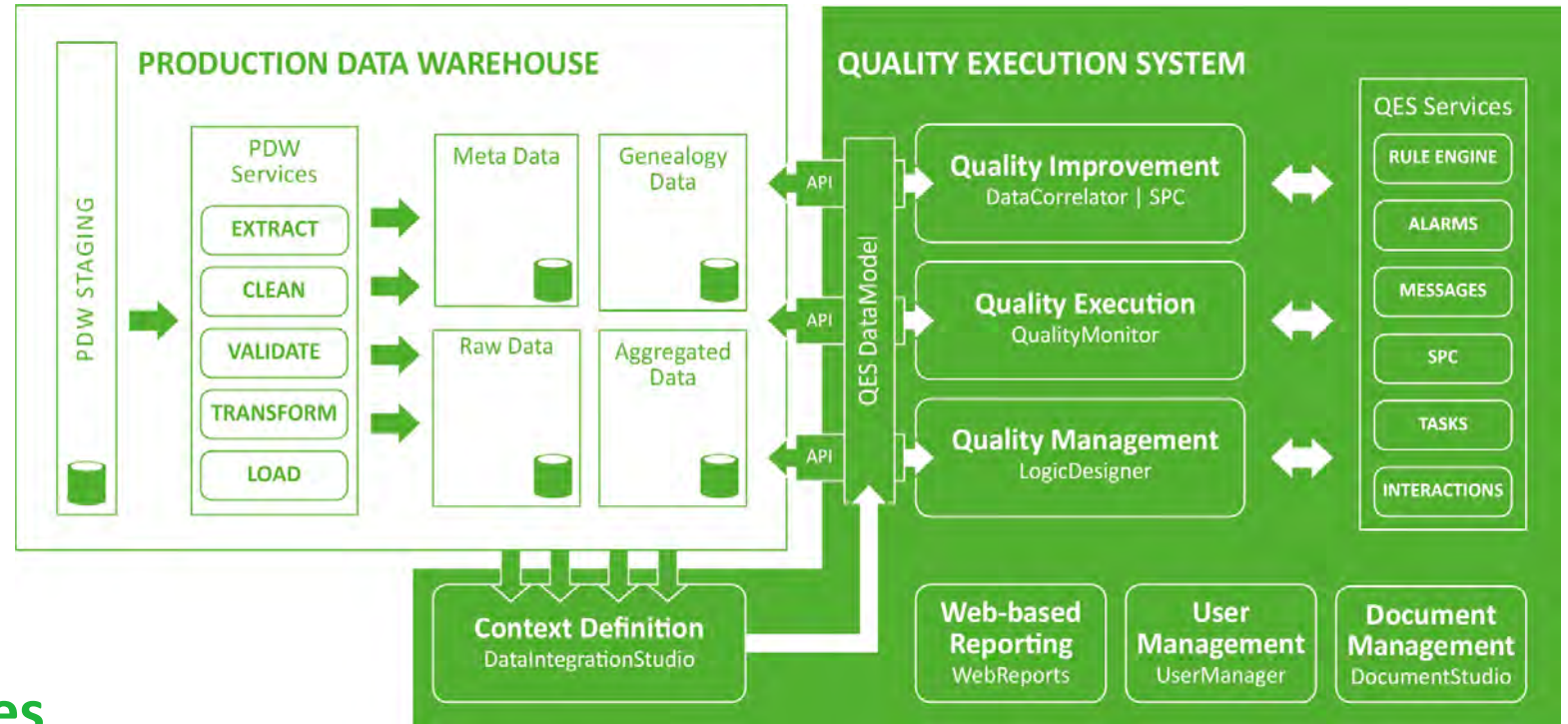
- There has always been the desire for a holistic view of the product quality along the processing path
- But there are many reasons why this is difficult to implement in practice:
 - inhomogeneous, historically grown data landscapes
 - “island thinking” mindset
 - no ready-made directions and no compass
 - a lack of software tools
 - ...



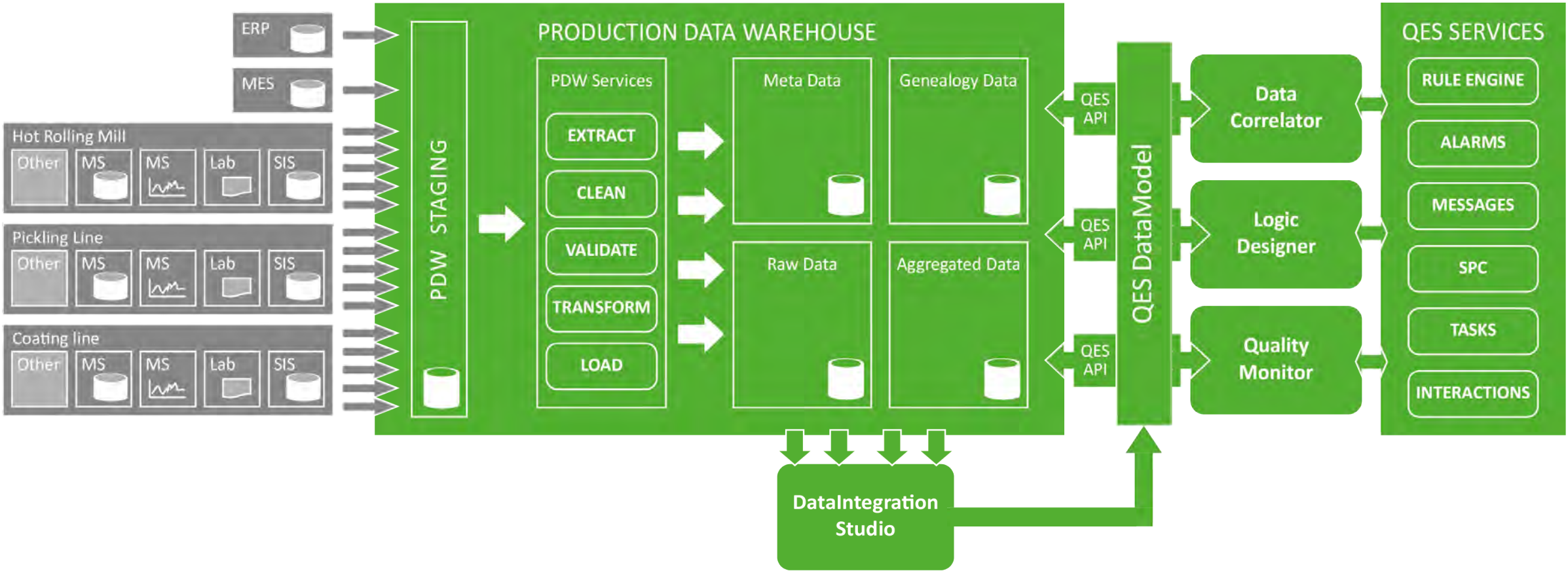
Solution: Quality execution with complete efficient data access



- ◆ Data integration
- ◆ Genealogy
- ◆ Quality monitoring
- ◆ Automatic product grading
- ◆ Translation, modification and definition of quality rules
- ◆ Correlating data and feedback



Solution: Quality execution with complete efficient data access





Thank you for your attention! Your questions please ...