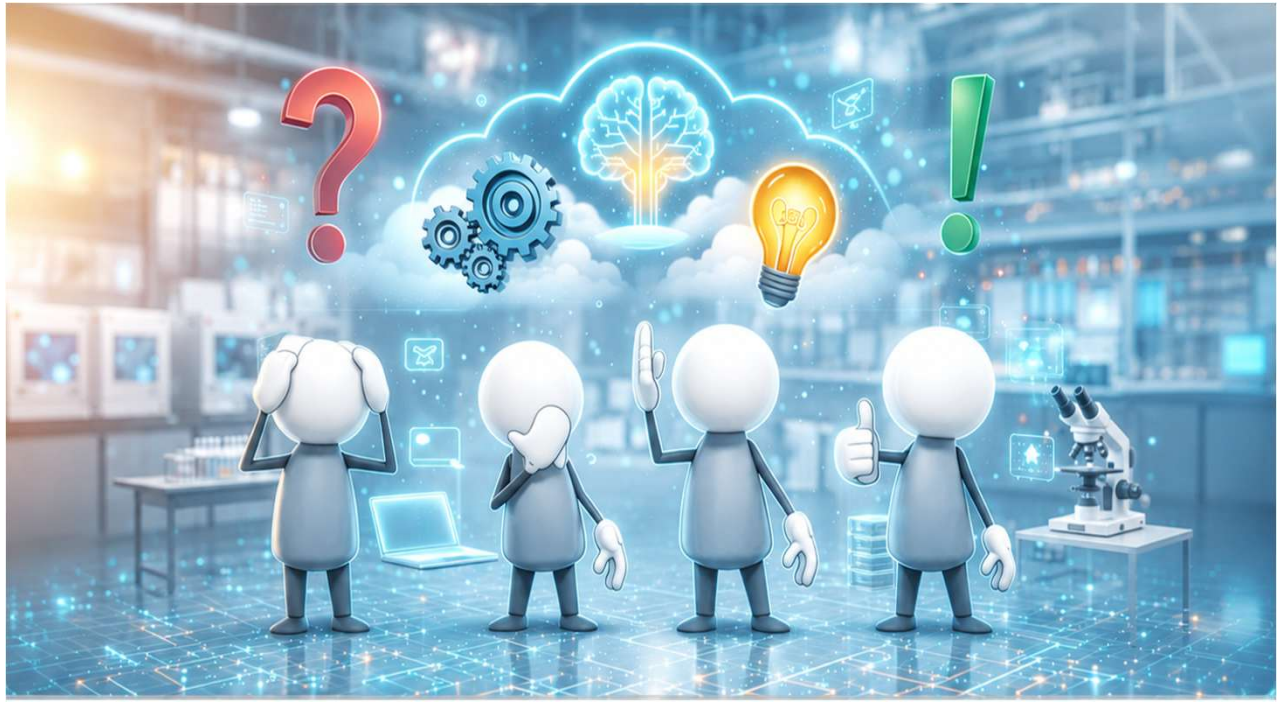

QMULUS.AI
FOR SURFACE TREATMENT®

FROM PROTHERM 9800 TO QMULUS



FROM PROTHERM 9800 TO QMULUS

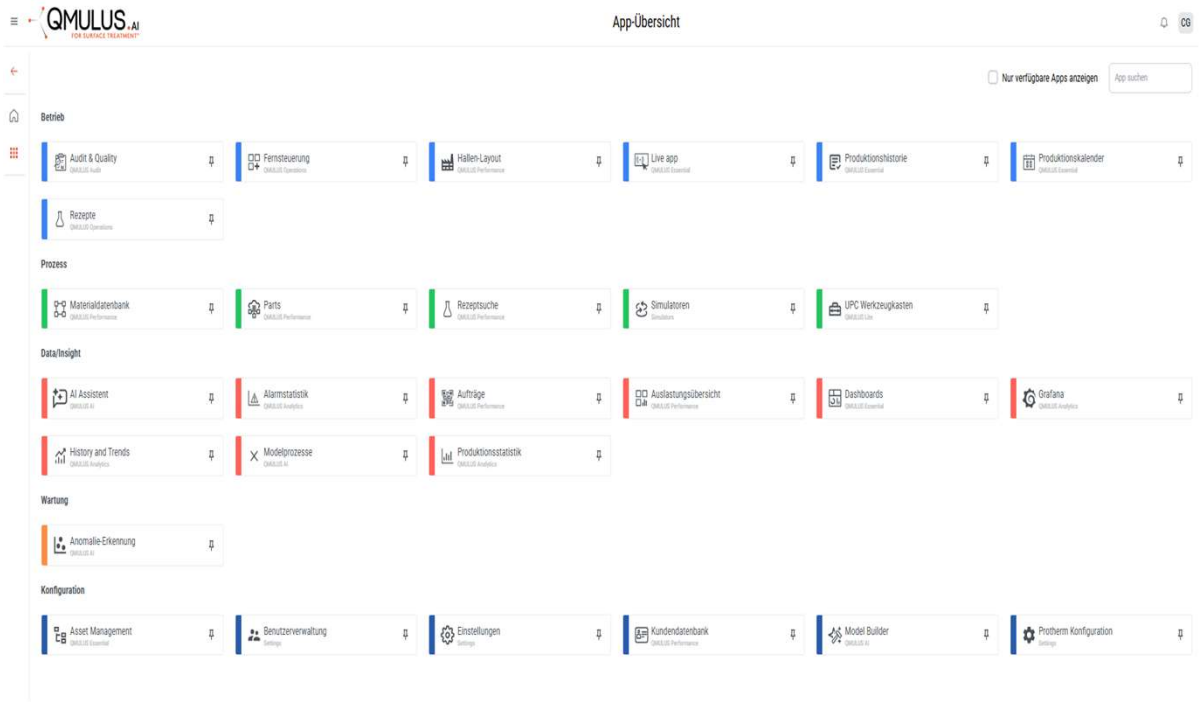
QMULUS is the next evolution of UPC's successful production control systems

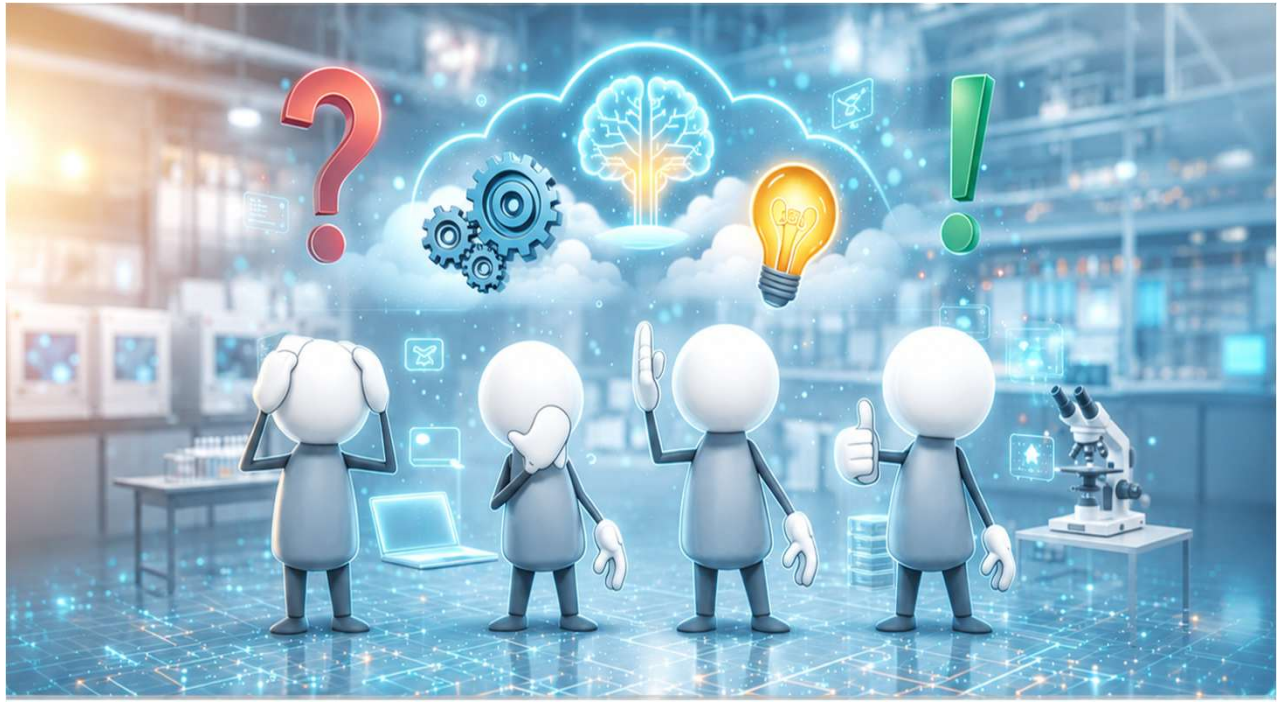
- PROTHERM 9000 and
- PROTHERM 9800

with about 450 installations worldwide.

It incorporates all SCADA and MES functionality of its predecessors and enhances their functionality by adding state-of-art data-driven insights.

Being a native web application, QMULUS can be used from
everywhere at any time;
as easy as using a standard browser entering the URL.
Authentication supports Single-Sign-On and can be seamlessly integrated in local IT environment (e.g. MS Active Directory).





MOTIVATION

FROM PROTHERM 9800 TO QMULUS

Tackle current pain points

Politically driven

- ✓ reduce your CO_2 footprint
- ✓ avoid waste

Economically driven

- absorb rising costs
  - ✓ optimize processes
  - ✓ optimize equipment
  - ✓ reduce non-productive times
- full documentation (genealogy)
- shortage of skilled workers

IT driven

- data consolidation, connected systems,
- transparency and availability of information

Reduce cost per unit, remain competitive

Capacity utilization indicates what proportion of your potential capacity you are using and provides information about the profitability of your company.
The higher the capacity utilization, the lower the production costs and the higher the profit.

Achieve additional profits by increasing capacity:

- ✓ optimize workflows
- ✓ automate processes
- ✓ invest in new technologies

FROM PROTHERM 9800 TO QMULUS

Keep the ball rolling

„Predictive quality describes the continuous optimization of process and product-related quality using data-supported forecasts.“

SCADA / MES & DATA WAREHOUSING

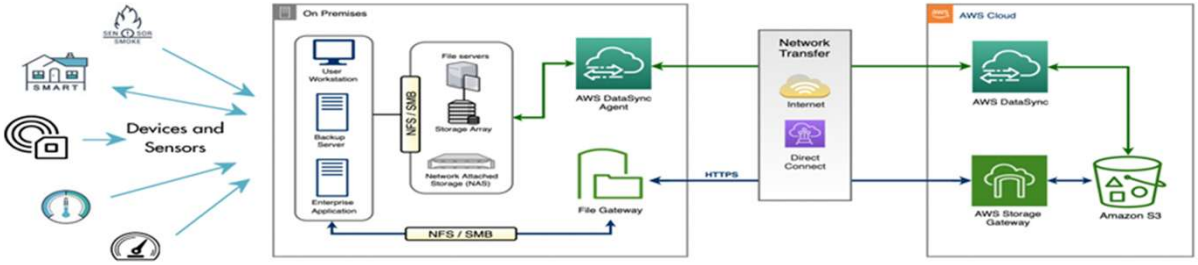
FROM PROTHERM 9800 TO QMULUS

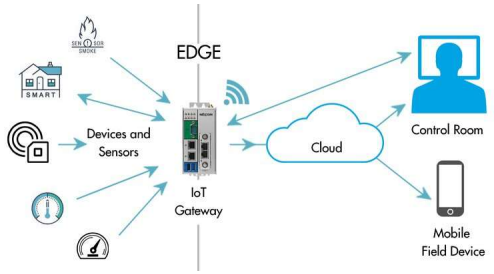
Data acquisition

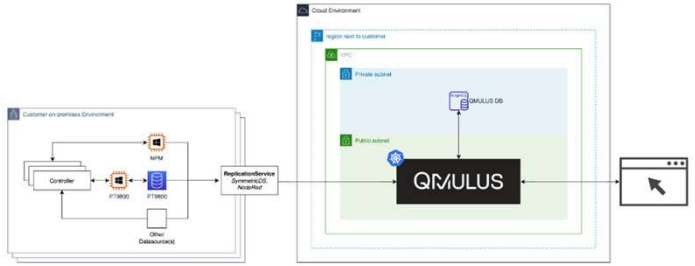
QMULUS can collect data from many sources

- machines / PLCs / controllers
- ERP, PPS/MES
- laboratory equipment
- energy management systems
- QA systems, if not implemented in QMULUS
- documents
- all 3rd party applications offering a data interface

All this data will be either picked up directly, accessed in shared or mirrored database tables or simply uploaded by the user.







FROM PROTHERM 9800 TO QMULUS

Data management

Data of different data sources and data types is stored according to

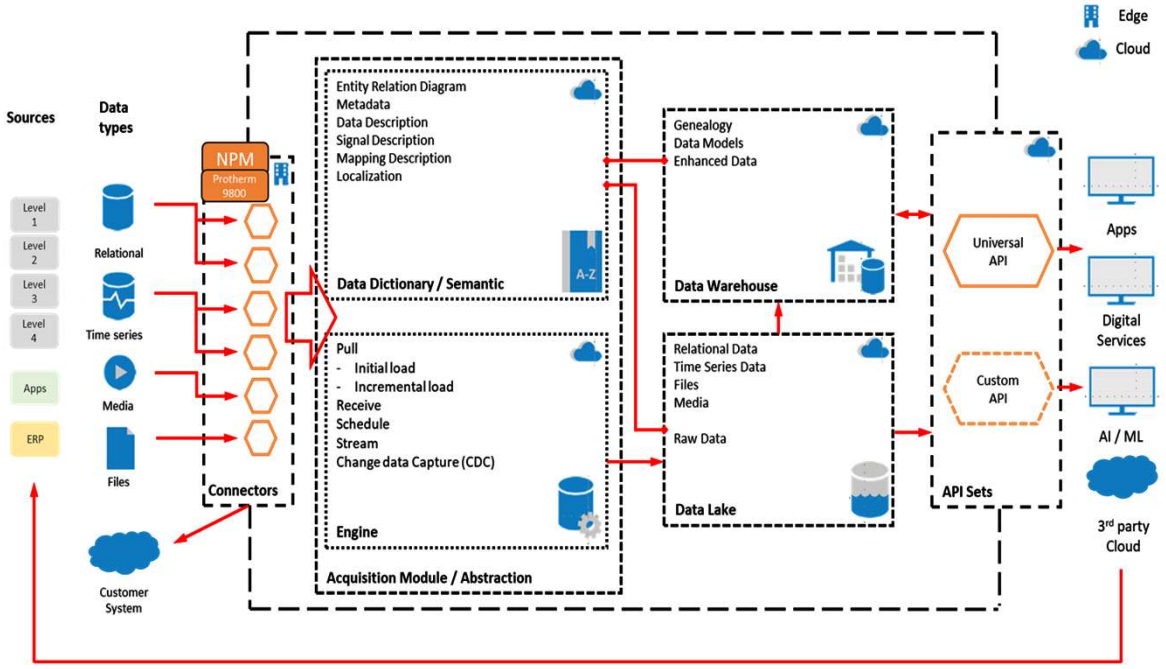
- type of source and
- requirements for further processing in the QMULUS data space.

The data is cataloged upon receipt, enhanced with metadata and stored.

A universal API can be used in both ways

- Entering data into QMULUS
- Accessing QMULUS data

A data lake is a huge repository for structured and unstructured data whose purpose is not defined. A data warehouse is a repository for highly structured historical data that has been processed for a specific purpose.

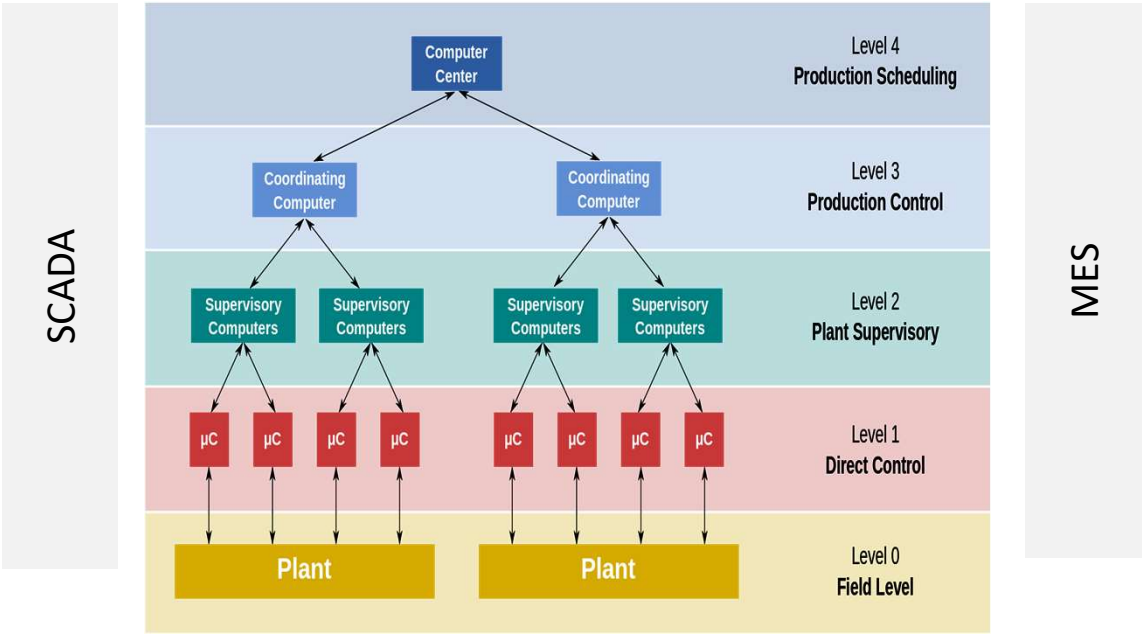


FROM PROTHERM 9800 TO QMULUS

SCADA and MES by definition

Supervisory Control And Data Acquisition
is a control system for high-level
supervision of machines and processes.

Manufacturing Execution System
is an intermediate step between
an enterprise resource planning (ERP) system,
and the SCADA or process control system.



FROM PROTHERM 9800 TO QMULUS

UPC – SCADA history

UPC is developing SCADA systems since the mid 1980s.

Thus, NITREX/UPC is experienced in using and managing
various operating systems and connecting
to different data base engines and sources.

Some of your experienced employees
might still remember our former systems ☺

- OCD, OCL, OCSM
- PROCESS MASTER, PROFIL 9000, PROTHERM 9800
- SelfControl, NPM …

The following slides give some impressions.

FROM PROTHERM 9800 TO QMULUS

UPC – SCADA history

Protherm 9000

Self-Control

PT9800

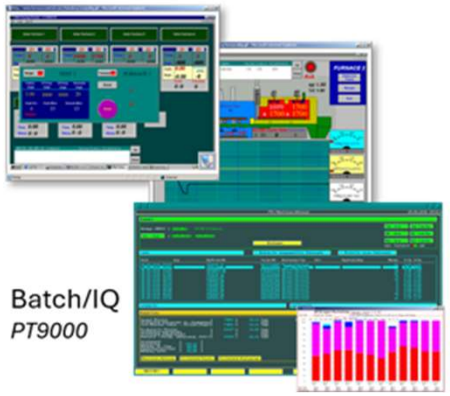
NPM – Nitrex Plant Manager

PT9800 China

QMULUS

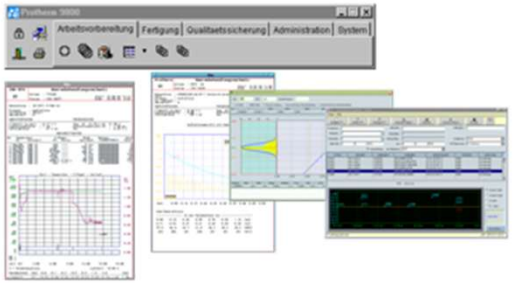
1980 1990 2000 2010 2020

Automated
Bell-Line



Batch/IQ
PT9000

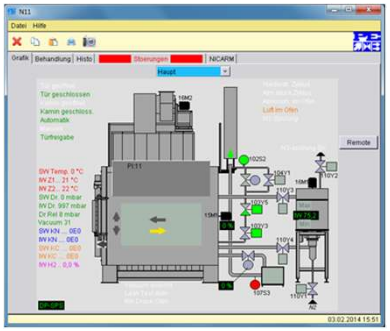
Pit furnace
Self-Control



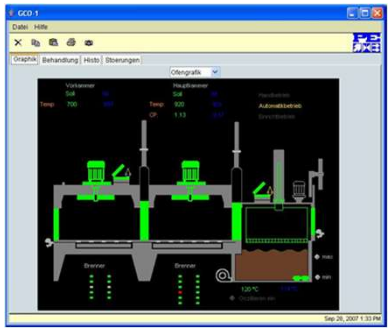
Documentation und SPC+
PT9800

FROM PROTHERM 9800 TO QMULUS

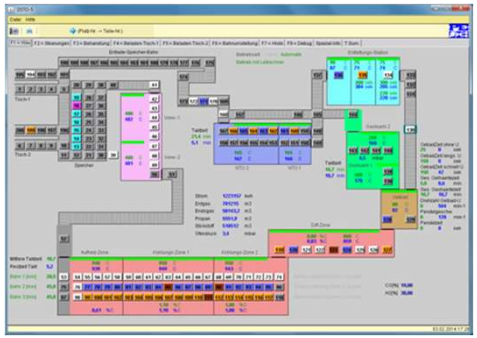
UPC – SCADA connected equipment



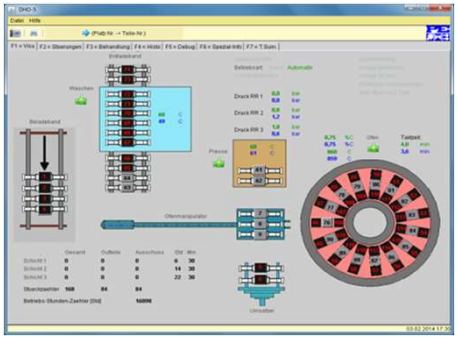
Chamber furnace



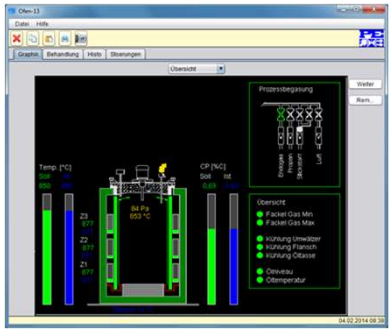
Multi-chamber / IQ



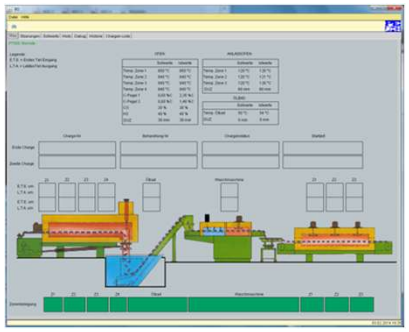
Pusher



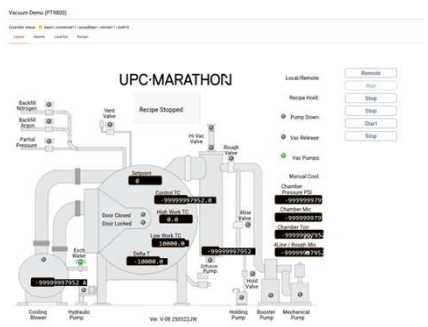
Ring Hearth



Pit



Belt furnace



Vacuum furnace

Automated Lines

WAS HAT SICH GEÄNDERT AUF DEM WEG VON PROTHERM9800 ZU QMULUS

FROM PROTHERM 9800 TO QMULUS

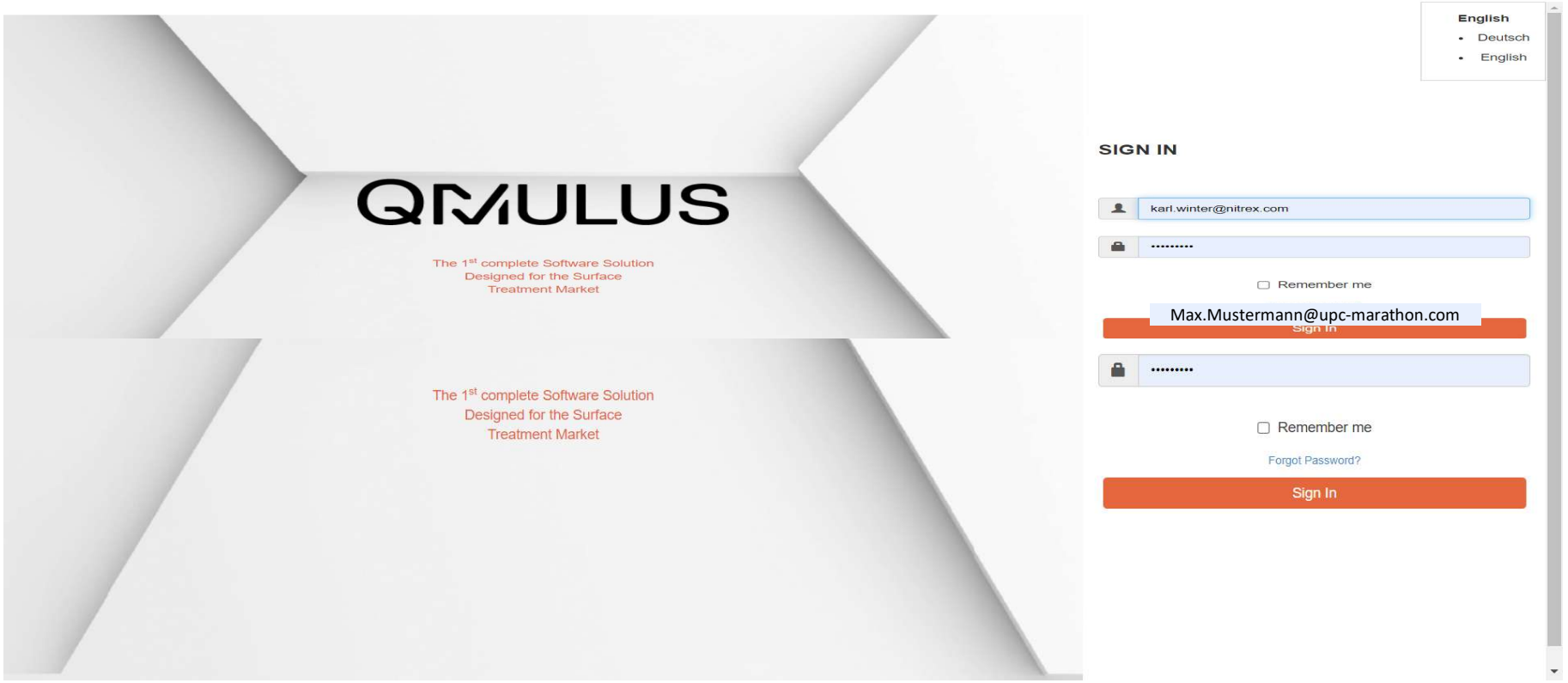
UPC – SCADA/MES features

- shop view
- furnace view
- recipes
- materials
- parts
- process simulation
- shop orders
- production flows (on heat-treat level)
- process documentation
- statistics
- maintenance calendar
- planned and unplanned outages

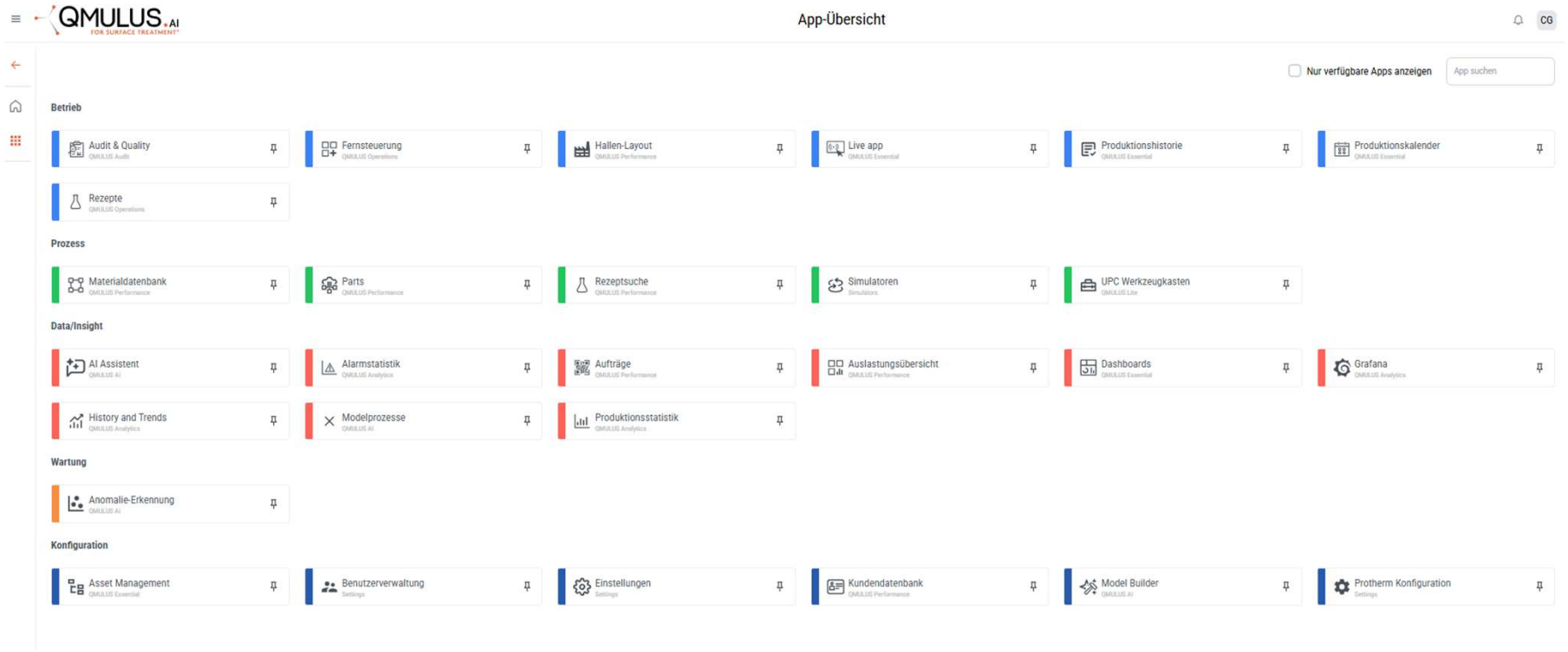
- QA test equipment
- QA lab reports
- QA test plans
- QA sample evaluation
- QA SPC control charts

- production planning
- load tracking
- serial number tracking
- ERP interface (TTC, SAP, Navision, Bluestreak ...)

QMULUS – accessible via browser

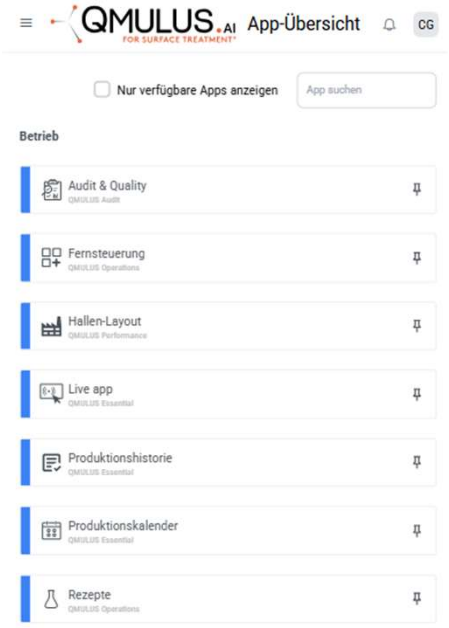


QMULUS – application overview

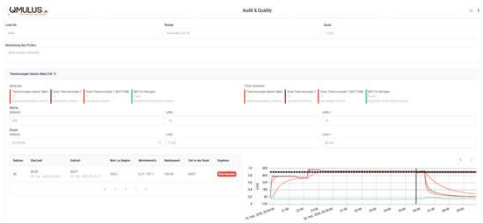


FROM PROTHERM 9800 TO QMULUS

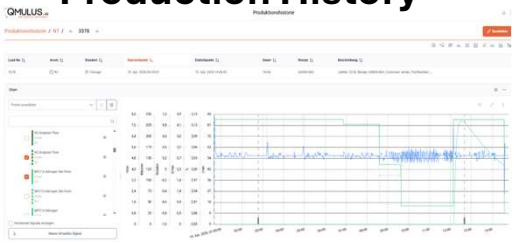
QMULUS – operational apps



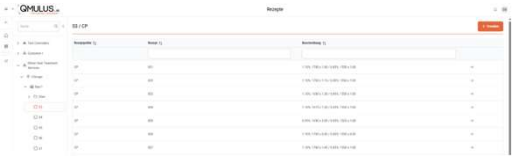
Audit&Quality



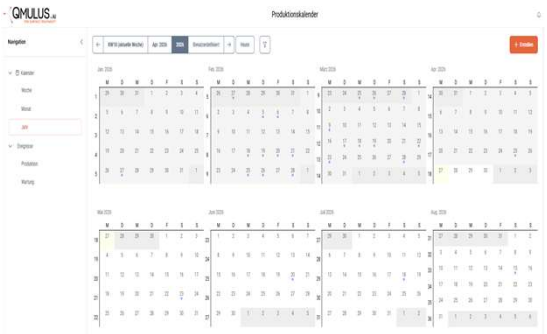
Production History



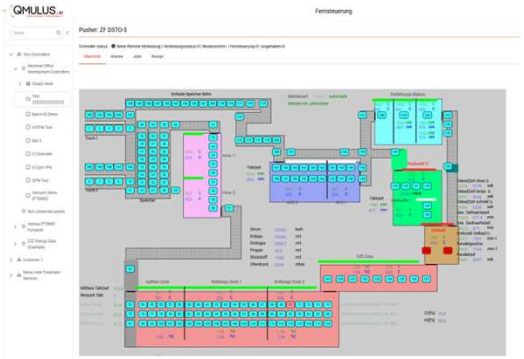
Recipes



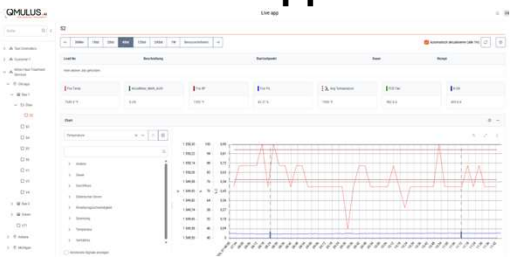
Production Logs



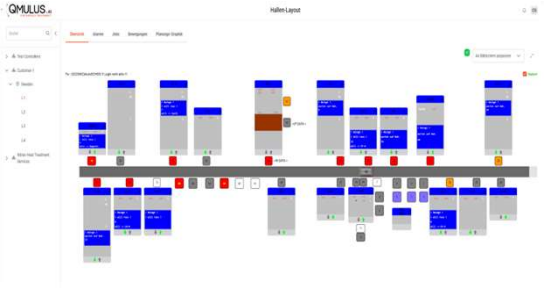
Remote Control



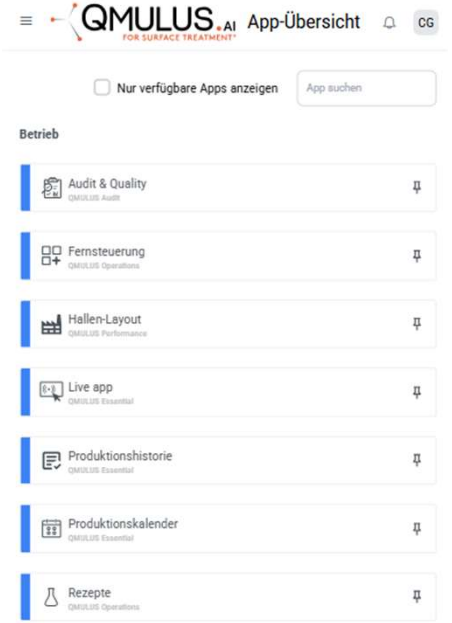
Live App

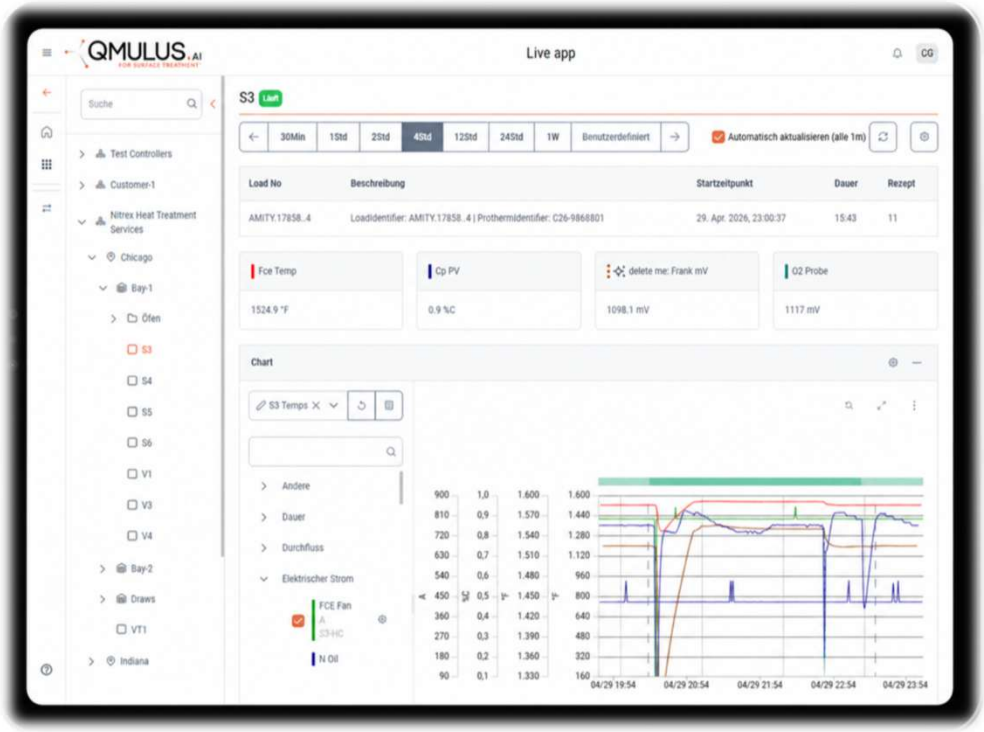


Shop Layout



QMULUS – operational apps

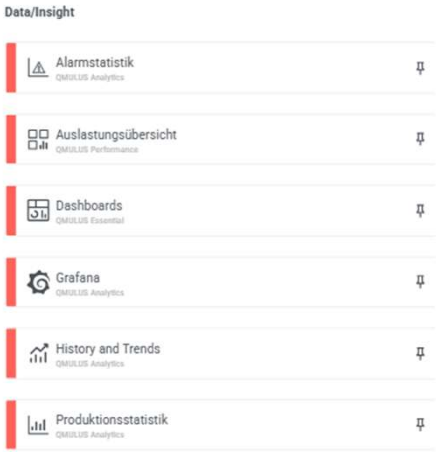




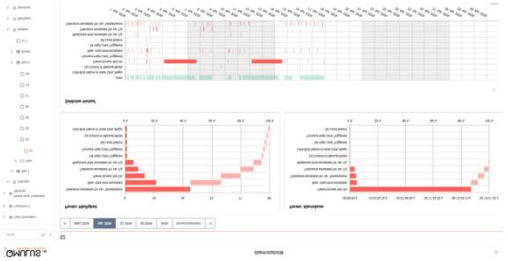
Live App View On I Pad Pro

FROM PROTHERM 9800 TO QMULUS

QMULUS – data insight apps



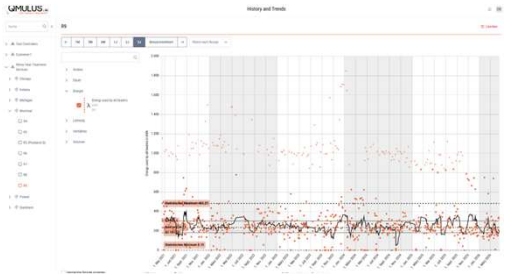
Alarm statistics



Grafana Dashboarding

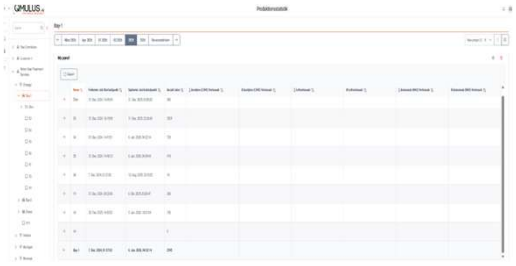
Dashboards

History and Trends



Productivity

Production statistics

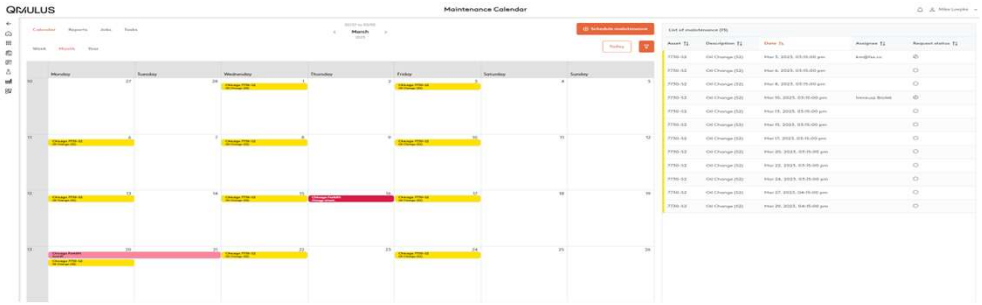


QMULUS – maintenance apps

Wartung

Anomalie-Erkennung
QMULUS AI

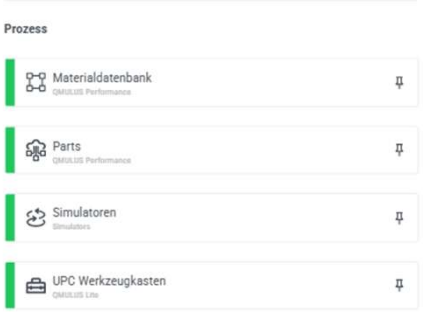
Maintenance calender



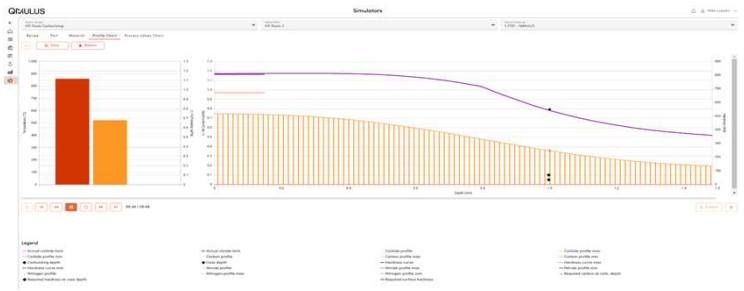
Anomaly detection

FROM PROTHERM 9800 TO QMULUS

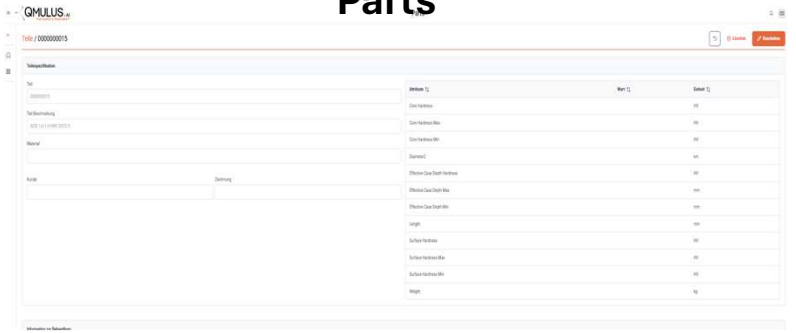
QMULUS – process apps



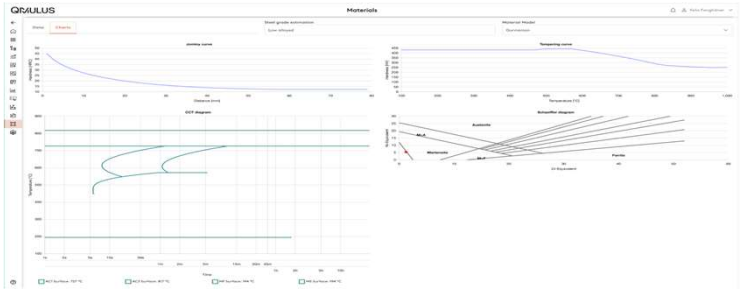
Simulator



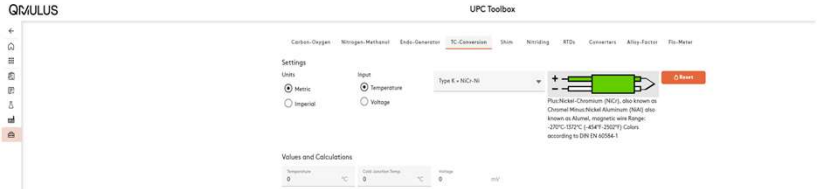
Parts



Materials



UPC App Toolbox



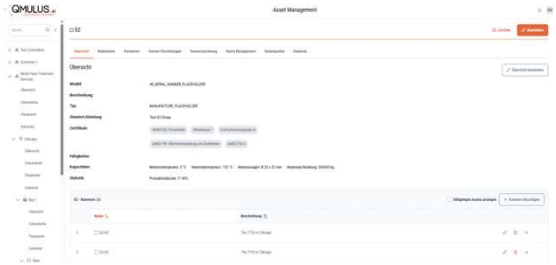
FROM PROTHERM 9800 TO QMULUS

QMULUS – configuration apps

Konfiguration

- Asset Management
  QMULUS Essential
- Benutzerverwaltung
  Settings
- Einstellungen
  Settings
- Kundendatenbank
  QMULUS Performance
- Model Builder
  QMULUS AI
- Protherm Konfiguration
  Settings

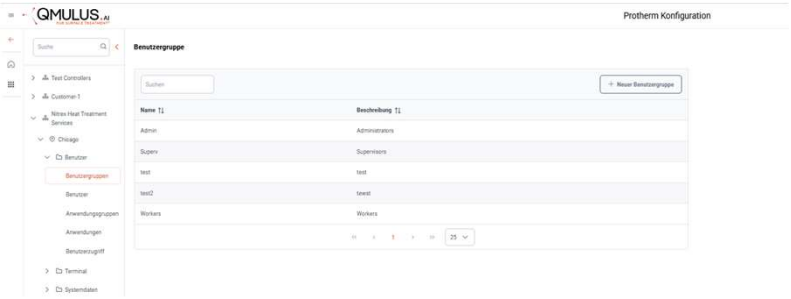
Asset managment



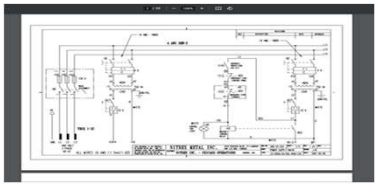
Model Builder

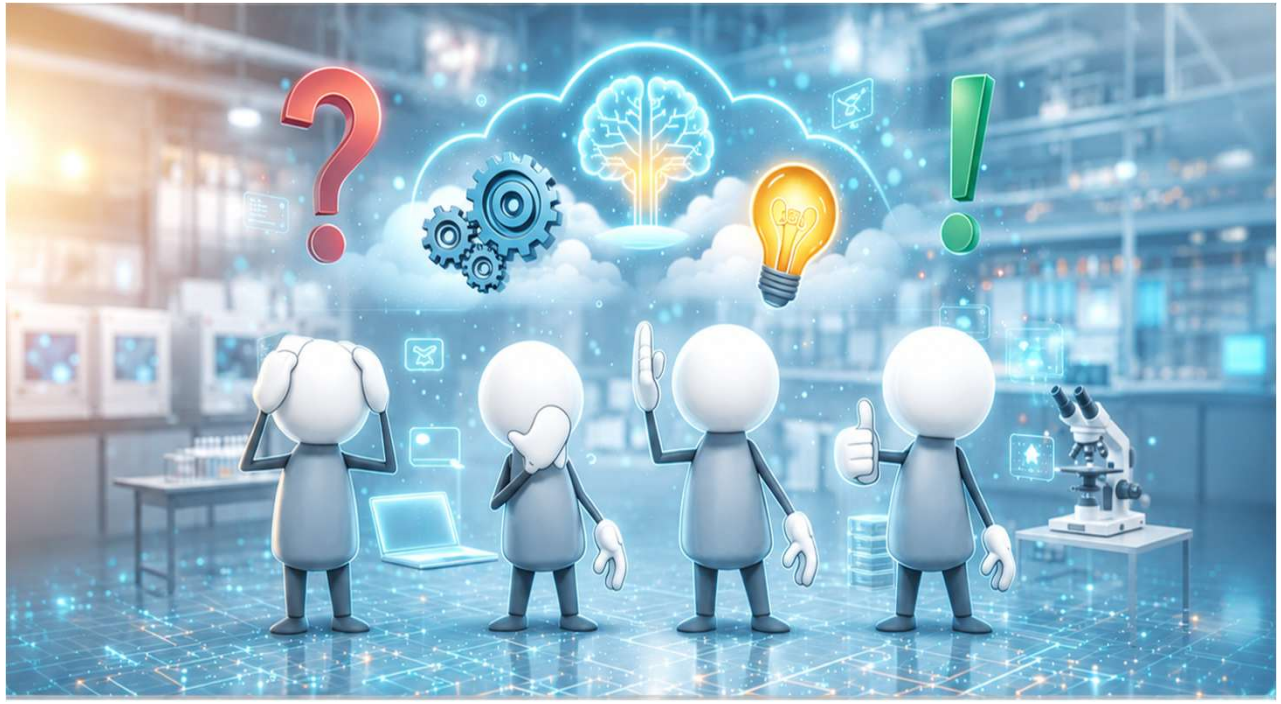
Settings

Protherm configuration



Asset Documentation





STATISTICS & DATA ANALYTICS

FROM PROTHERM 9800 TO QMULUS

QMULUS – more than a SCADA

Providing:

- IIoT data space
- Asset management
- KPI monitoring using enhanced statistics of e.g.
  - Production data (# of produced goods, # of scrap, rework)
  - Process data (time, temperature, gas flows, potentials, consumption)
  - Machinery data (alarms, maintenance activities, outages)

- Anomaly detection with root-cause-analysis
  - Predictive maintenance
  - Predictive quality

Data analytics – definition

„Data analysis allows you to gain insights from data.
You can extract, transform and centralize them to
discover and analyze patterns, relationships, trends,
correlations and anomalies or to validate a theory or
hypothesis.

In the past, data was analyzed to make future decisions; today you can analyze data to make decisions in real time. You can also identify new trends and gain insights that would not have been possible with traditional data processes.“

FROM PROTHERM 9800 TO QMULUS

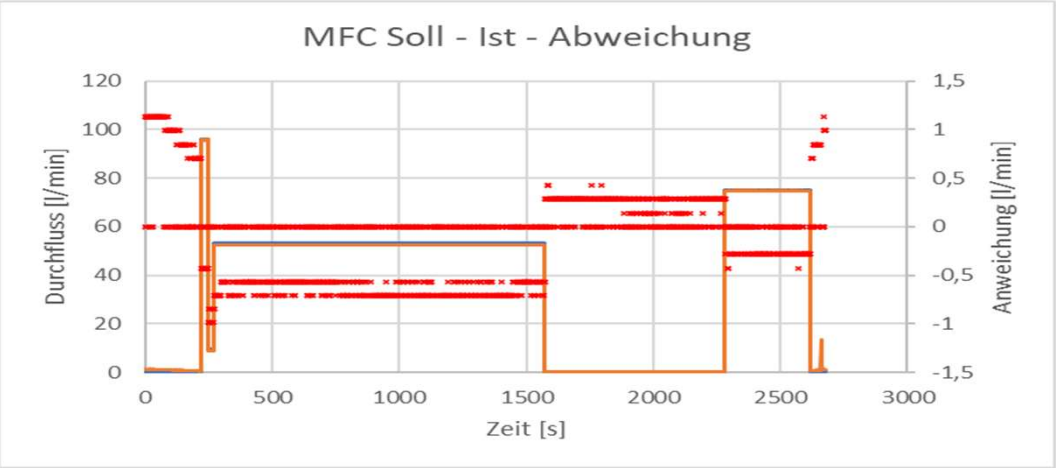
Data analytics – descriptive

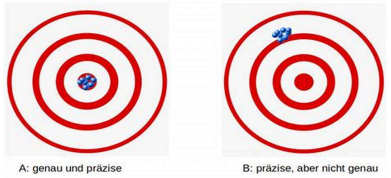
Data mining using statistical methods to summarize data volumes. Quantile and mean value tables, variance and standard deviation are used.

Example:

Deviation of an MFC in steady state

mean error = 0.102 l/min
std. deviation = 0.456 l/min





Data analytics – descriptive

Data mining using statistical methods to summarize data volumes. Quantile
and mean value tables, variance and standard deviation are used.

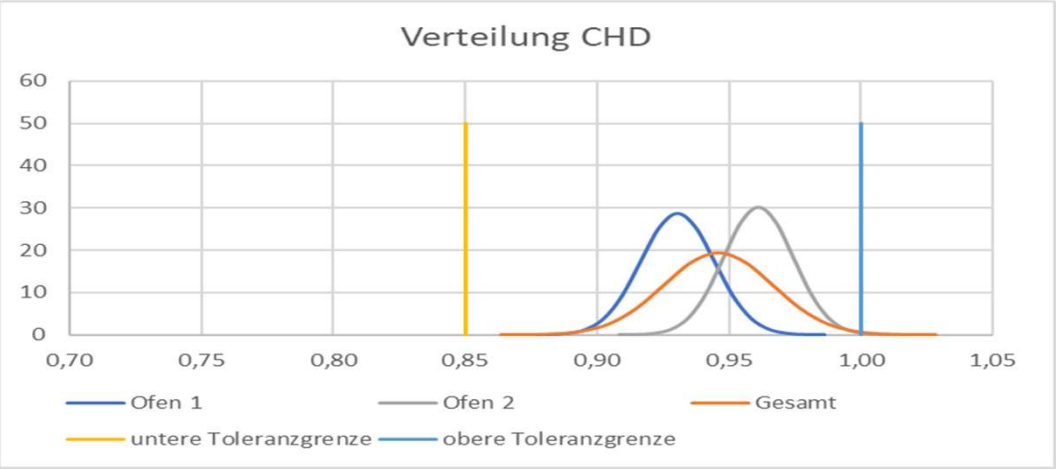
Example:

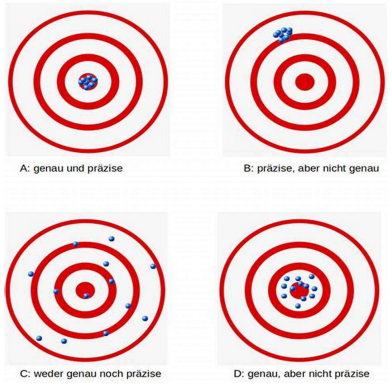
CHD achieved by two ovens O_1/O_2
for a batch of identical parts.

O_1: $\bar{x} = 0.933$ / $\sigma = 0.0125$
O_2: $\bar{x} = 0.965$ / $\sigma = 0.0112$

Total

O_1&O_2: $\bar{x} = 0.945$ / $\sigma = 0.02$

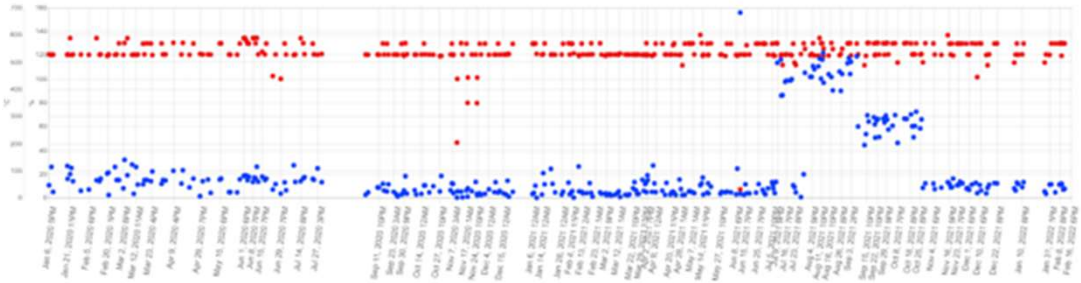




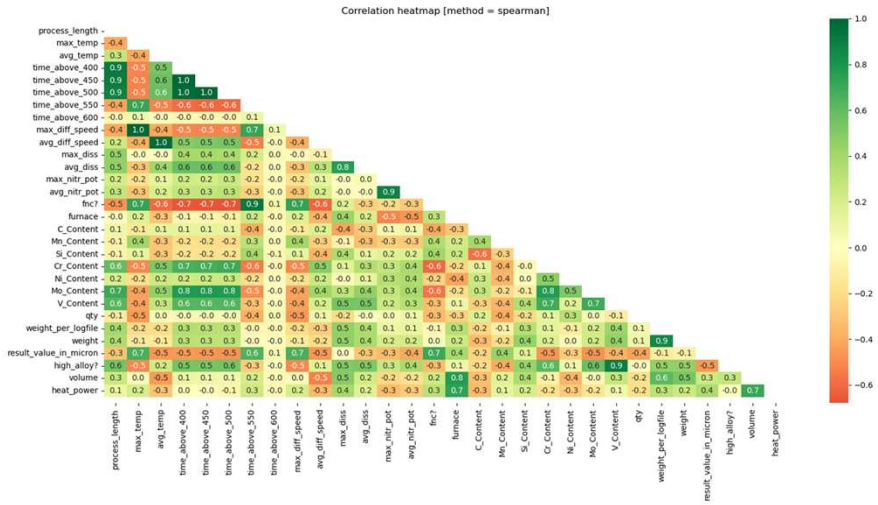
FROM PROTHERM 9800 TO QMULUS

Data analytics – explorative

Exploratory data analysis methods include scatter plots, box plots and heat maps. These methods help to identify relationships, distributions and patterns in the data.



Control Chart: Temperature (red), power loss (blue) of an oven system



Heatmap: Correlation of the metadata of a nitriding batch

Data analytics – predictive

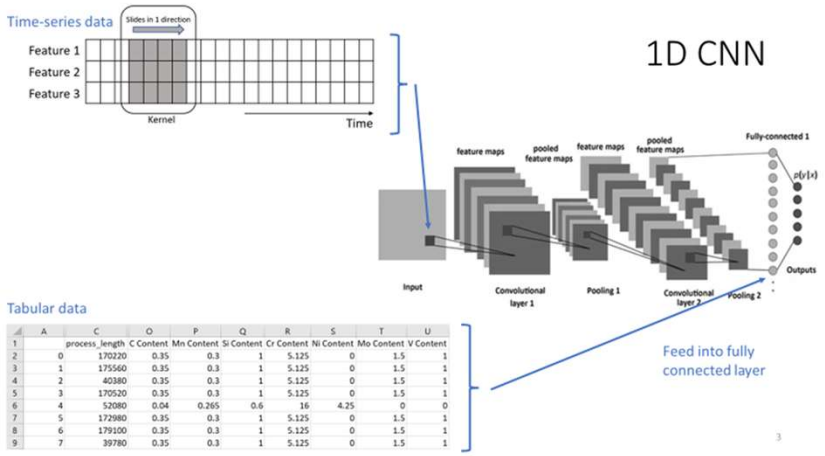
Predictive data analytics makes use of methods such as data modeling, machine learning and even artificial intelligence to identify patterns.

„Artificial intelligence is the ability of a machine to imitate human capabilities such as logical thinking, learning, planning and creativity. “

FROM PROTHERM 9800 TO QMULUS

Data analytics – prescriptive

Prescriptive data analytics is a dynamic approach that is data-driven and uses mathematical algorithms to suggest the right decision options. Prescriptive analytics methods use a combination of machine learning, business rules, artificial intelligence and algorithms.



Potential failure	Impact of the failure	Possible root cause	Counter action	**Failure Modes and Effects Analysis**
Impact of the failure	Potential failure	Possible root cause	Counter action	**„*reverse*“ FMEA**

FROM PROTHERM 9800 TO QMULUS

How can digitalization and data analysis contribute to success?

In contrast to simple cost-cutting measures, data-driven measures can aim at both:

- ✓ increasing capacity (higher throughput) and
- ✓ reducing cost (avoiding unnecessary expenses).

With a fictitious sales price of 1.3 x costs, a higher
throughput of 10 % results in a 10 % increase in sales revenue, by adding only 10% on the variable
costs.

This results in +27 % in profit.

FROM PROTHERM 9800 TO QMULUS

How can digitalization and data analysis contribute to success?

Added to this are the savings achieved by

- ✓ avoiding rejects and rework (process safeguarding)
- ✓ optimizing maintenance costs (repair, if necessary)
- ✓ avoiding power peaks (which is typically already installed)

FROM PROTHERM 9800 TO QMULUS

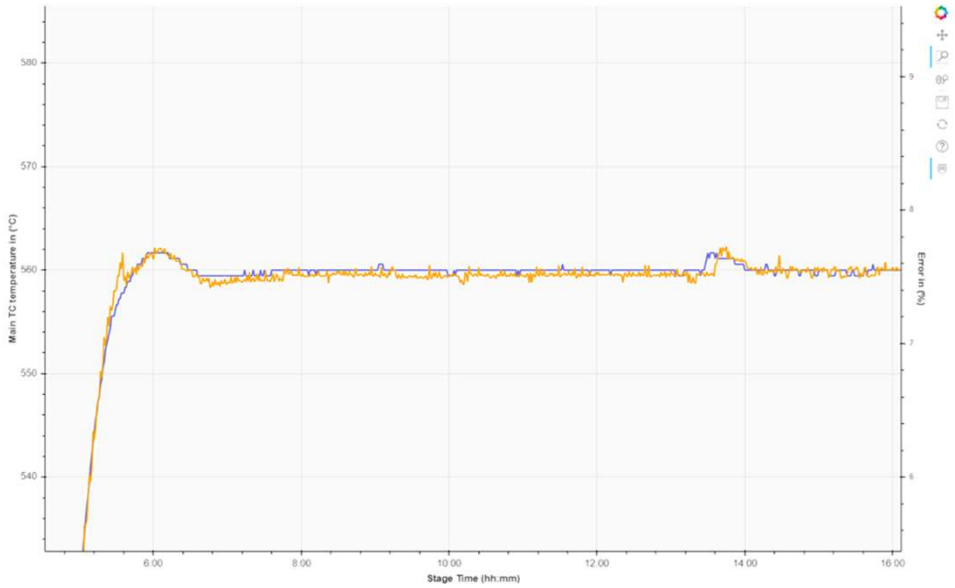
How to secure the process integrity?

By evaluating the data of each load treated, QMULUS models all decisive parameters for the process, by using other variables.

Examples:

$T_{Furnace}$ = f(all T_{Zones}, $Flow_{Gases}$, ...)
T_{Zone} = f(other T_{Zones}, $Power_{Zone}$, ...)

Hybrid models use regressions and neural networks partially coupled with thermo-chemical algorithms.



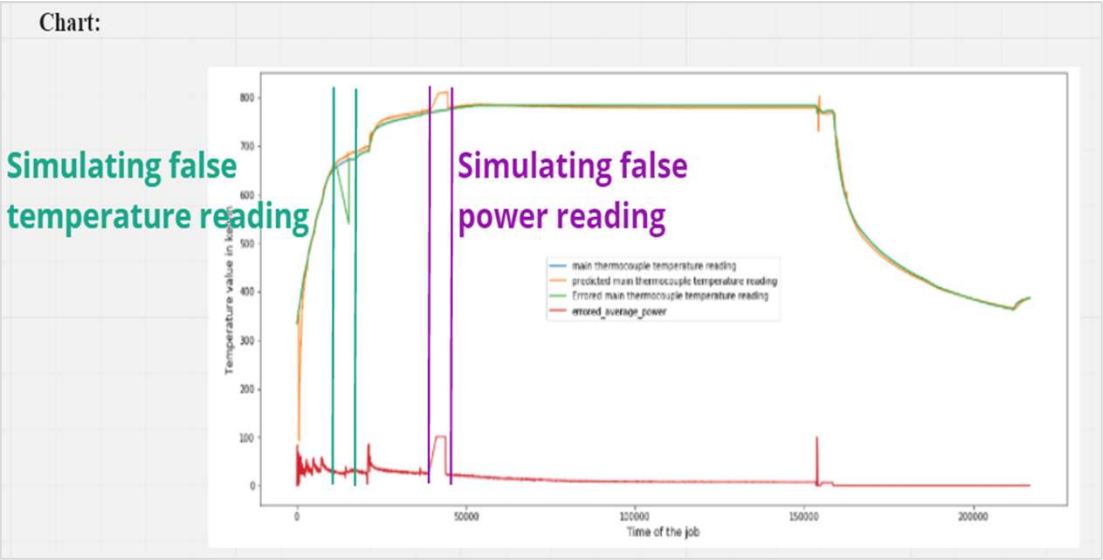
Comparing modeled inner thermocouple with actual thermocouple reading

FROM PROTHERM 9800 TO QMULUS

How to secure the machinery integrity?

Once the behavior of the parameters in relation to each other is known, QMULUS can calculate the future course of a modeled value for several minutes in advance.
This allows to react to errors that have not yet occurred.

Draw conclusions about the presumed error depending on the deviation.



Comparing modeled zone temperature with actual thermocouple reading

FROM PROTHERM 9800 TO QMULUS

How to shorten process time?

Having a look on the example presented a few slides before. The specification for the parts calls for a CHD of 0.85+0.15 mm. As the two furnaces show different results, total $\bar{x}$ and σ forces us to aim for 0.96 mm.

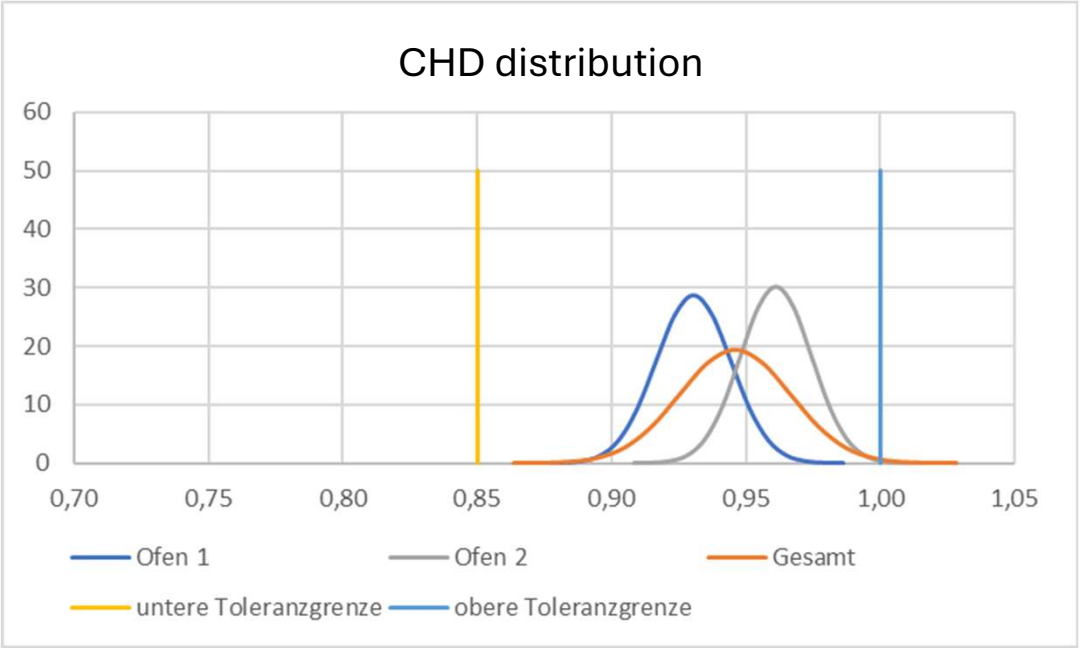
Example:

CHD achieved by two ovens O_1/O_2
for a batch of identical parts.

O_1: $\bar{x} = 0.933$ / $\sigma = 0.0125$
O_2: $\bar{x} = 0.965$ / $\sigma = 0.0112$

Total

O_1&O_2: $\bar{x} = 0.945$ / $\sigma = 0.02$



FROM PROTHERM 9800 TO QMULUS

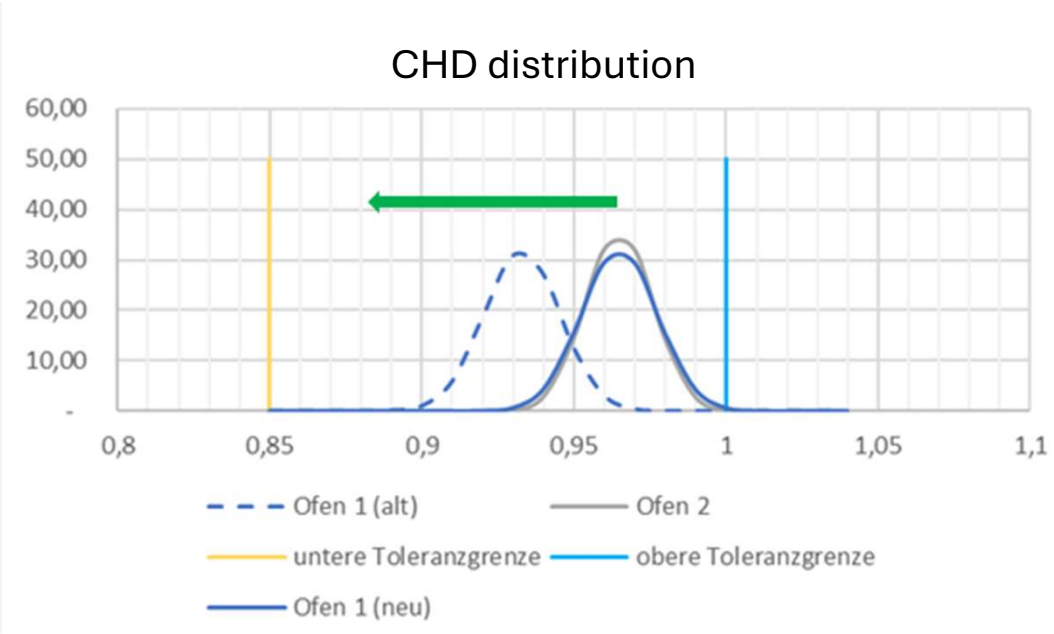
Reduce the dispersion of furnace systems

If we now adjust the diffusion model in the controller of oven 1 so that the result shows an $\bar{x}$ of 0.965 ($\bar{x}$ of the second furnace), the distributions shift as shown in the picture. This allows for a reduction of the targeted carburization depth from 0.96 mm to 0.87 mm.

Assumption:
Carburization temperature = 930 °C
Hardening temperature = 860 °C.

- ✓ The process time 38 minutes shorter
- ✓ An increase of ~10 % in capacity.

- ✓ Equivalent to ~25 % in profit.



1 Unique feature of UPC controllers

FROM PROTHERM 9800 TO QMULUS

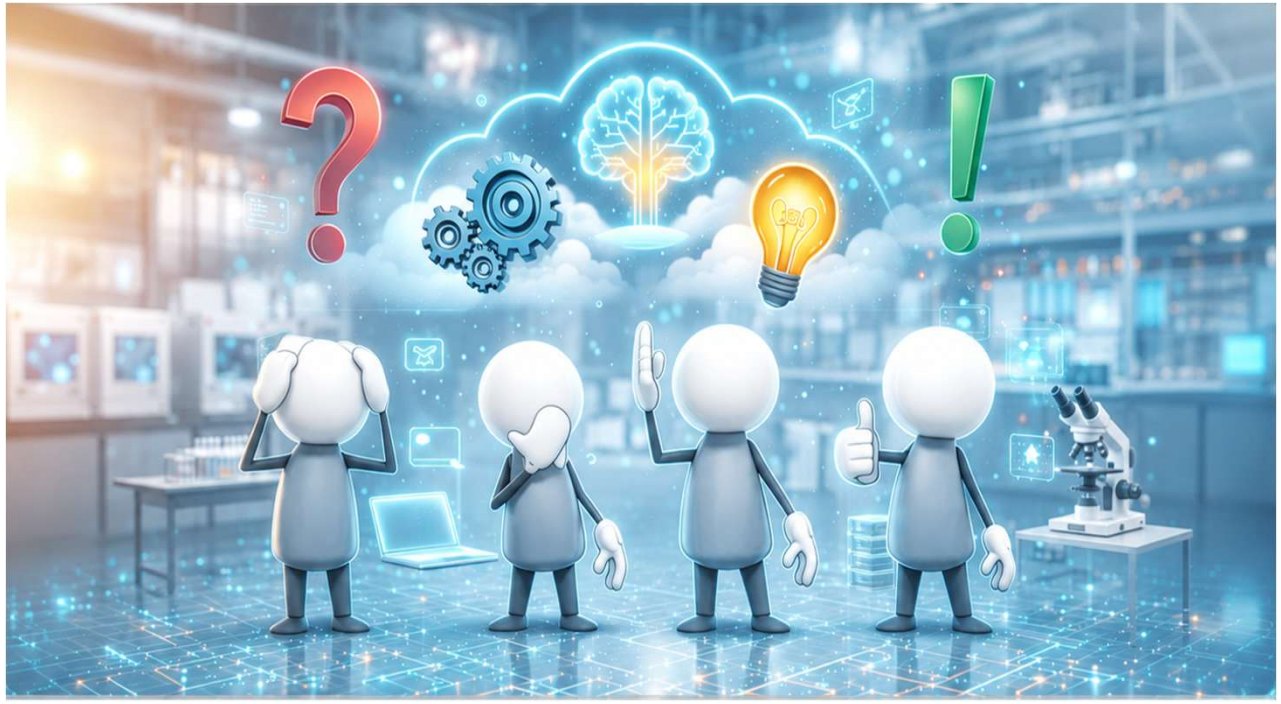
Data is the most valuable resource

According to an article in the Economist in 2017

"*The world's most valuable resource is no longer oil, but data*".

Evaluating and modeling on existing data can already lead to significant savings.

Additional data should then be included and analyzed as required to refine the models and enable additional savings.



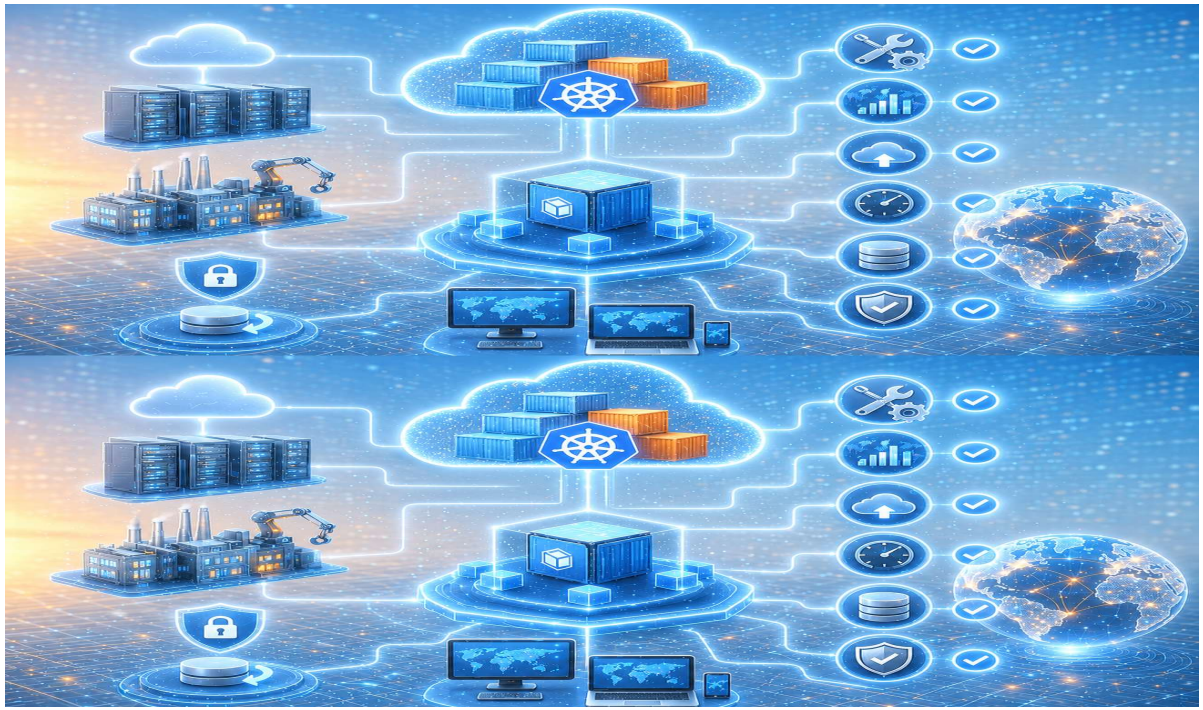
IMPLEMENTING QMULUS

How to integrate QMULUS – setup

QMULUS is a containerized application capable to operate on any Kubernetes cluster. The cluster can be hosted either in the cloud (recommended) or on-premises (data security, setup in responsibility of local IT).

Advantages of a cloud setup:

- ✓ Infrastructure and databases are monitored and serviced by NITREX.
- ✓ Insights into production across locations.
- ✓ Updates and improvements are automatically released.
- ✓ Cloud computing offers suitable computing power, whenever required.
- ✓ Database backups and data archiving are automated.
- ✓ Data security is managed by the cloud provider.
- ✓ Software maintenance included.



FROM PROTHERM 9800 TO QMULUS

How to integrate QMULUS – data exchange

QMULUS is a hybrid system whereby the production control remains on-premises, untouched. QMULUS acts as an additional layer on-top of a PROTHERM 9800 data environment.

Integrating data to QMULUS data space

- ✓ 9800 Process data is directly mirrored.
- ✓ Other data sources (ERP, QA, Energy Management …) are continuously synchronized
- ✓ Both cases allow for a bidirectional data exchange

Installation of QMULUS and configuration of data exchange takes usually less than one day. Setting up interfaces to 3rd-party applications require an analysis of source and format of the data and a planned installation.

FROM PROTHERM 9800 TO QMULUS

How to integrate QMULUS – application access

Installation requires no production downtime:

- ✓ No training required for operators to continue production
- ✓ No shutdown of 9800 server required
- ✓ Java clients remain fully operational
- ✓ Immediate additional access to web interface

FROM PROTHERM 9800 TO QMULUS

How to integrate QMULUS – available packages

QMULUS Essential

is the core package featuring a powerful SCADA solution. It enables you to keep all equipment documentation in a single place, to access all production logs and to document and investigate proper chart recordings. Dashboards provide condensed views onto the floor.

Comprehensive statistics and KPIs can be monitored for a specific frame, an entire division, a location, a selected asset, or a single recipe. Investigating alarms in depth to eliminate failures.

QMULUS Operations

allows to interact with your shop regardless where you are – acknowledge alarms and modify a running recipe. Furnace views provide all relevant information of interest. Create and manage recipes in a comfortable and easy way. Benefit from a database with your parts and materials. With load planning you can assign loads with recipes to certain equipment.

QMULUS Audit & Quality

allows to apply customized audits on your treatments. Connecting your laboratory and documenting the lab results for the treatments improves and the internal process.

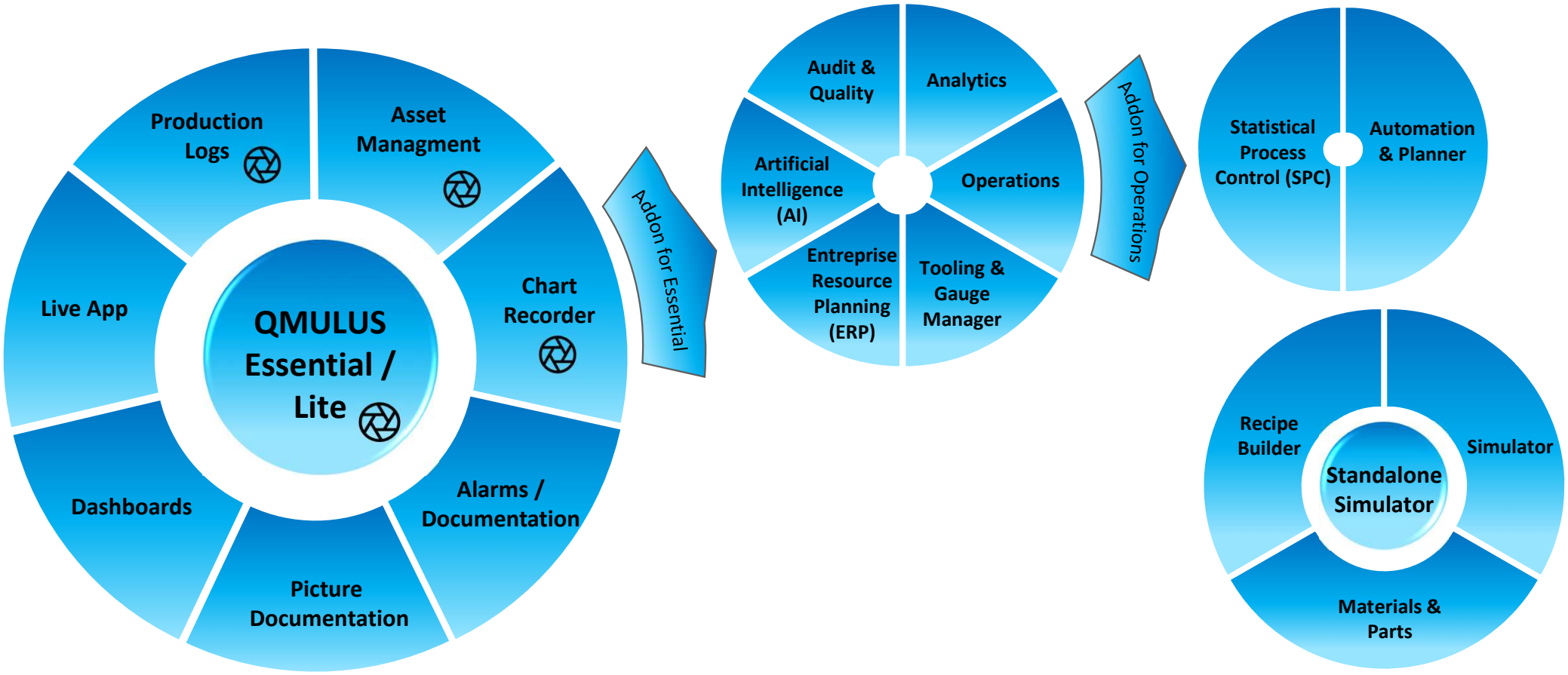
QMULUS AI

Brings “magic” to your site. Create Model Processes as benchmarks for your processes. Benefit from documented root cause analysis and ultimately take advantage by detecting both equipment and process anomalies.
Derived values you never realized, i.e. heat loss, show you hidden faults.

QMULUS Simulators

To design your recipes to the point. Featuring all processes from carburizing to nitriding including low pressure and vacuum.

FROM PROTHERM 9800 TO QMULUS



FROM PROTHERM 9800 TO QMULUS

	LITE	Simulator	ESSENTIAL	Analytics	Audit & Quality	Tooling & Gauge Manager	Enterprise Resource Planning (ERP)	Artificial Intelligence (AI)	Operations	Automation + Planner	Statistical Process Control (SPC)
Requires				Addon for Essential						Addon for Operations	
Asset Management	x		x								
Production Logs	x		x								
Chart Recorder	x		x								
Picture Documentation			x								
Live App			x								
Dashboards			x								
Alarms/Notifications			x								
Furnace views (Remote Control light)?	x										
Performance Board				x							
Alarm Statistics				x							
History & Trends				x							
Production Statistics				x							
Lab Reports					x						x
Quality Audit Tool					x						
Automated Audits					x						
Tooling & Fixtures						x					
Measurement Equipment						x					
Connection to ERP systems							x				
Model Process								x			
Model Builder								x			
Anomaly Detection & Root Cause Analysis								x			
Recipe Builder		x							x		
Remote Control & Shop Layout									x		
Materials & Parts		x							x		
Orders & Customers & Load Planning									x		
Operations Calendar									x		
Serial Number Tracking									x		
Automated Lines & Scheduler										x	
Statistical Process Control											x

FROM PROTHERM 9800 TO QMULUS

How to integrate QMULUS – pricing schema (as of July 01, 2026)

Monthly fee
per Site 180 €
per Asset* 25-120€

Monthly fee
per Site 200 €
per Asset* 15-80€

Monthly fee
per Site 500 €
per Asset* 30-100€

Monthly fee
per Site 120 €

Monthly fee
per Site und Simulator 150 €

WAS HAT SICH GEÄNDERT AUF DEM WEG VON PROTHERM9800 ZU QMULUS

Integration von QMULUS – Preisschema (ab dem 1. Juli 2026)

QMULUS Essential

QMULUS Essential ist das Basismodul von QMULUS und stellt zentrale Geschäftslogik sowie Funktionen zur Datenintegration bereit.
Es umfasst die wichtigsten Anwendungen zur Exploration und Analyse historischer Prozess- und Produktionsdaten sowie Werkzeuge zur Unterstützung des täglichen Betriebs und des Anlagenmanagements.
QMULUS bietet einen zentralen Zugriff auf Zeichnungen, Handbücher und weitere technische Informationen.
Es ermöglicht die Konfiguration realer und virtueller Signale für jedes Asset und stellt leistungsstarke Produktionslog-Funktionen zur schnellen Abfrage vergangener und aktueller Arbeitsaufträge bereit.
Darüber hinaus können Benachrich
Anomalien
abonniert

monatlich
pro Site 500 €
pro Asset* 30-100€

QMULUS Operations

Operations bietet eine übersichtliche Darstellung von Controllern, Hallen -Layout und allen relevanten Produktionsdaten.
Es ermöglicht die einfache Erstellung und Bearbeitung von Teilen, Materialien, Arbeitsaufträgen und Rezepten sowie die Nutzung integrierter Planungs- und Kalenderfunktionen zur effizienten Koordination.

QMULUS vereint
unter einer geme

monatlich
pro Site 180 €
pro Asset* 25-120€

QMULUS Audit & Quality

QMULUS ermöglicht eine einfache und schnelle Datenerfassung bzw. Integration durch vollständig anpassbare Vorlagen sowie die statistische Auswertung vorhandener Qualitätsdaten.

monatlich
pro Site 120 €

QMULUS AI

Bietet ein einheitliches Framework für Prozesseinblicke. Prozdatengetriebeneesse werden statistisch miteinander verknüpft, um die Realität bestmöglich abzubilden. Verschiedene Prozessvariablen werden überlagert, um die Auswirkungen neuer Prozessparameter vorherzusagen. Ergänzt wird dies durch eine Anomalien Erkennung, die mittels sta
automatisch u
identifiziert ur
auch möglich

monatlich
pro Site 200 €
pro Asset* 15-80€

QMULUS Simulators

Um Ihre Rezepte auf den Punkt zu bringen. Mit allen Verfahren vom Aufkohlen bis zum Nitrieren, einschließlich Niederdruck und Vakuum.

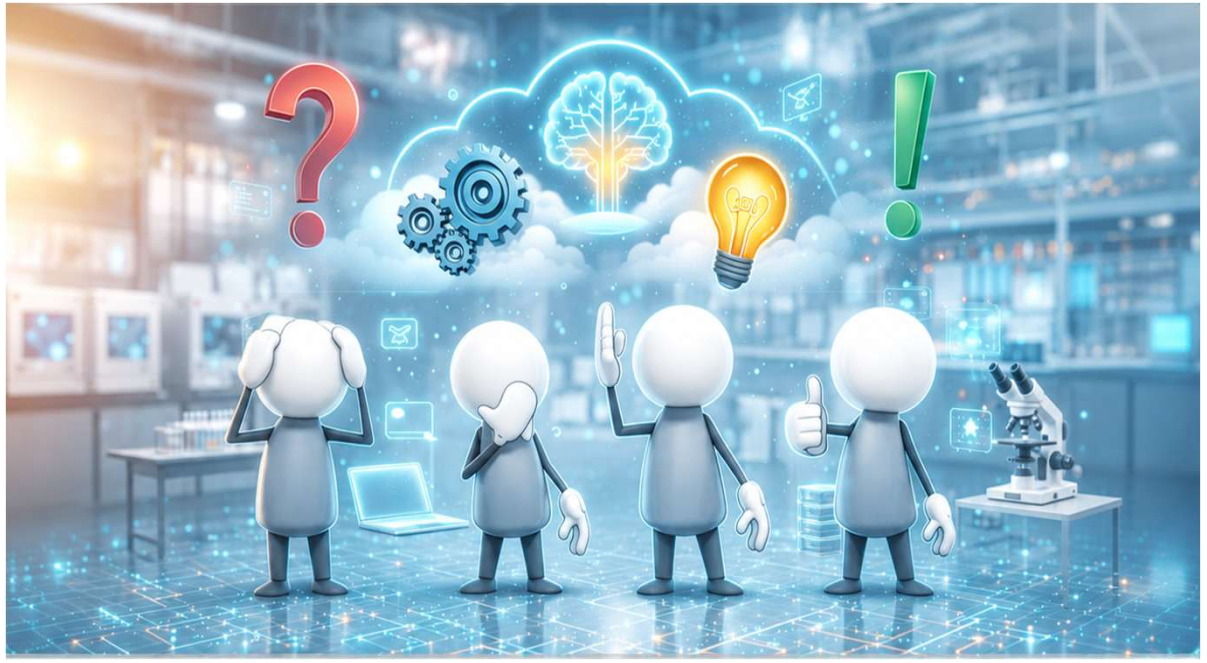
monatlich
pro Site und Simulator 150 €

QMULUS Analytics

Dieses Modul stellt die erforderliche Geschäftslogik bereit, um erfasste Daten automatisch zu verarbeiten und die daraus gewonnenen Statistiken und Erkenntnisse in einzelnen Anwendungen darzustellen.
Jede Anwendung bietet eine spezifische Perspektive und bereitet die Informationen für Reporting und weiterführende Analysen auf.
Das Modul schafft ein neues Maß an Transparenz und unterstützt dabei, relevante Zusammenhänge zu identifizieren, die üblicherweise verborgen bleiben.

QMULUS stellt einheitliche Ansichten bereit, die für alle Bereiche des Unternehmens von Nutzen

monatlich
pro Site 250 €



EXEMPLARY BUDGET QUOTATION

FROM PROTHERM 9800 TO QMULUS

based on the PROTHERM 9800 with the following setup

Connected assets		Asset per complexity	
13	pit type carburizing furnaces	low complex	= 14
4	preheat furnaces	standard	= 19
1	batch/IQ	complex	= 0
1	double chamber batch/IQ		
4	endogas generators		
2	temper furnaces		
2	pit type nitriding furnaces		
2	plasma nitriding furnaces		
3	washers		
1	sand blasting machine		

FROM PROTHERM 9800 TO QMULUS

QMULUS monthly cloud fee (SW maintenance included)

#1:QMULUS Essential & AI

➢ Site fee	= 700,- €
19 standard assets	= 1900,- €
14 small assets	= 1050,- €
Total	= 3650,- €
Discounted	= 0000,- €

#2:QMULUS Essential & Operations, without AI

➢ Site fee	= 680,- €
19 standard assets	= 1520,- €
14 small assets	= 770,- €
Total	= 2970,- €
Discounted	= 0000,- €

#3:QMULUS alle Module (Simulators – carburizing, nitriding)

➢ Site fee	= 1665,- €
19 standard assets	= 2660,- €
14 small assets	= 1400,- €
Total	= 5725,- €
Discounted	= ,- €

FROM PROTHERM 9800 TO QMULUS

based on the PROTHERM 9800 with seven pit furnaces

Connected assets

pit type carburizing furnaces = 7

Asset per complexity

standard = 7

FROM PROTHERM 9800 TO QMULUS

QMULUS monthly cloud fee
(SW maintenance included)

#1: QMULUS AI

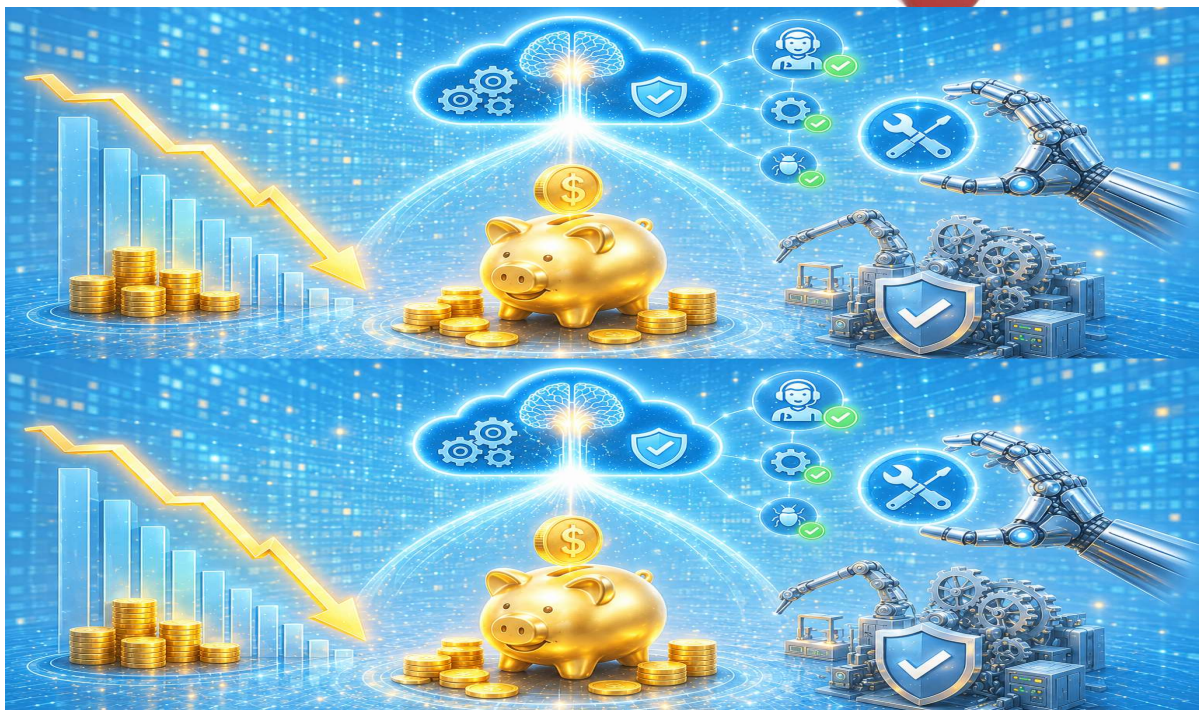
➢ site fee	= 150,- €
standard assets	= 827,- €
total	**= 977,- €**

#2: QMULUS Essential & Operations, without AI

➢ site fee	= 773,- €
standard assets	= 477,- €
total	**= 1.250,- €**

#3: QMULUS all modules (simulators – carburizing, nitriding)

➢ site fee	= 1.114,- €
standard assets	= 1.305,- €
total	**= 2.418,- €**



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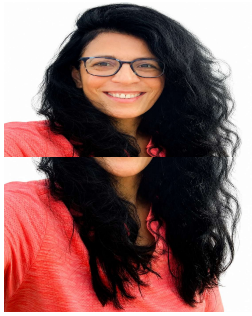

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