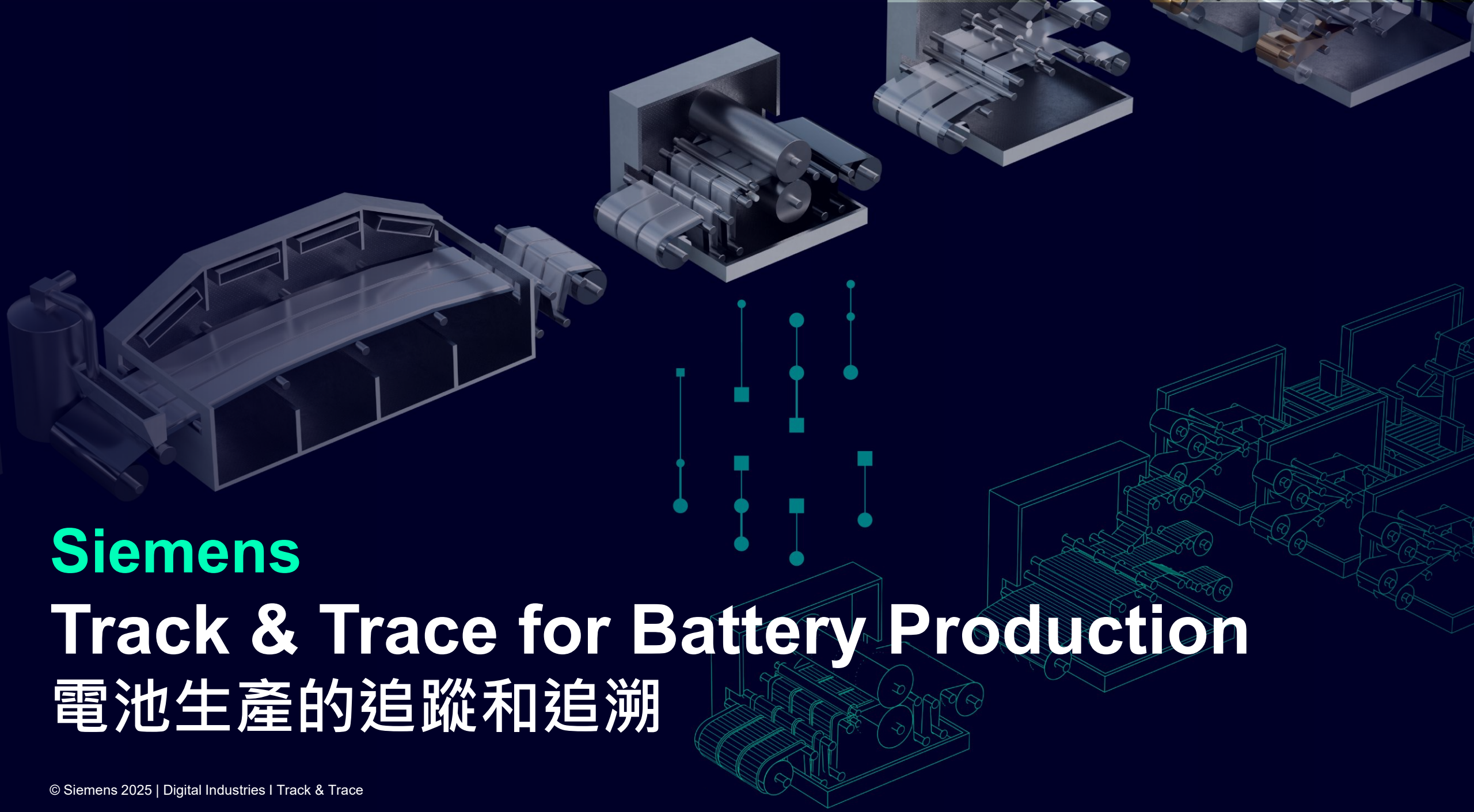


Siemens

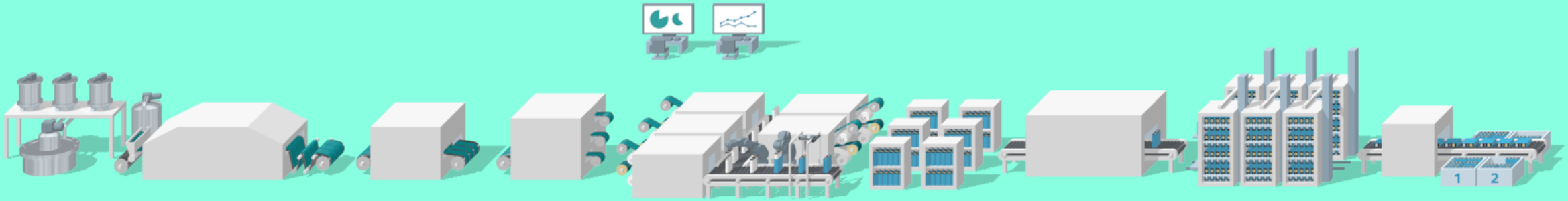
Track & Trace for Battery Production

電池生產的追蹤和追溯

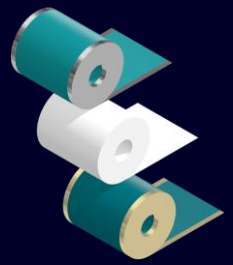
鋰離子電芯的生產流程生產

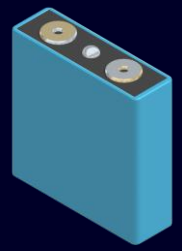
電極生產

電芯生產



1. **攪拌** Mixing
2. **塗布** Coating
3. **輥壓** Calendaring
4. **分條** Slitting
5. **電芯裝配** Cell assembly
6. **乾燥** Drying
7. **注液** Electrolyte filling
8. **化成和老化** Formation & aging
9. **測試和分容** Testing & grading





SIEMENS

Key challenges in cell production data management

電蕊生產的關鍵挑戰是資料管理

Insightful Data Management

How to efficiently process 1000+ data points generated per cell during production

Cross-Process Analytics

Connecting data patterns from EOL tests with production data to predict quality issues

Traceability & Recall Efficiency

Reducing recall investigation time from weeks to hours through precise cell tracing

Quality Issue Detection

Accelerating root cause analyses by automatically identifying patterns in production parameters

Unified Data Architecture 統一的資料解構
Seamless integration of data across all production stages through standardized interfaces and real-time synchronization

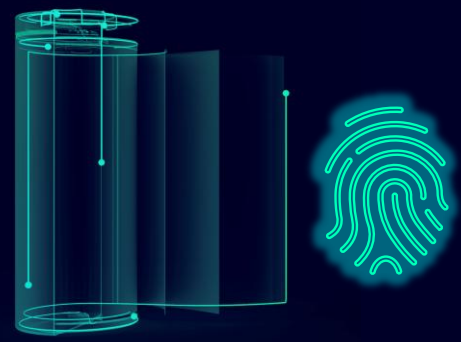
Precision Quality Mapping 精準品質對應
Systematic parameter checking against product specifications at every production step with centimeter-precise localization

Smart Data Visualization 智能資料視覺化
Product-centric dashboard displaying critical KPIs across the entire production lifecycle

Intelligent Pattern Discovery 智慧模式自動發現
Automated detection and notification of significant data patterns without manual configuration

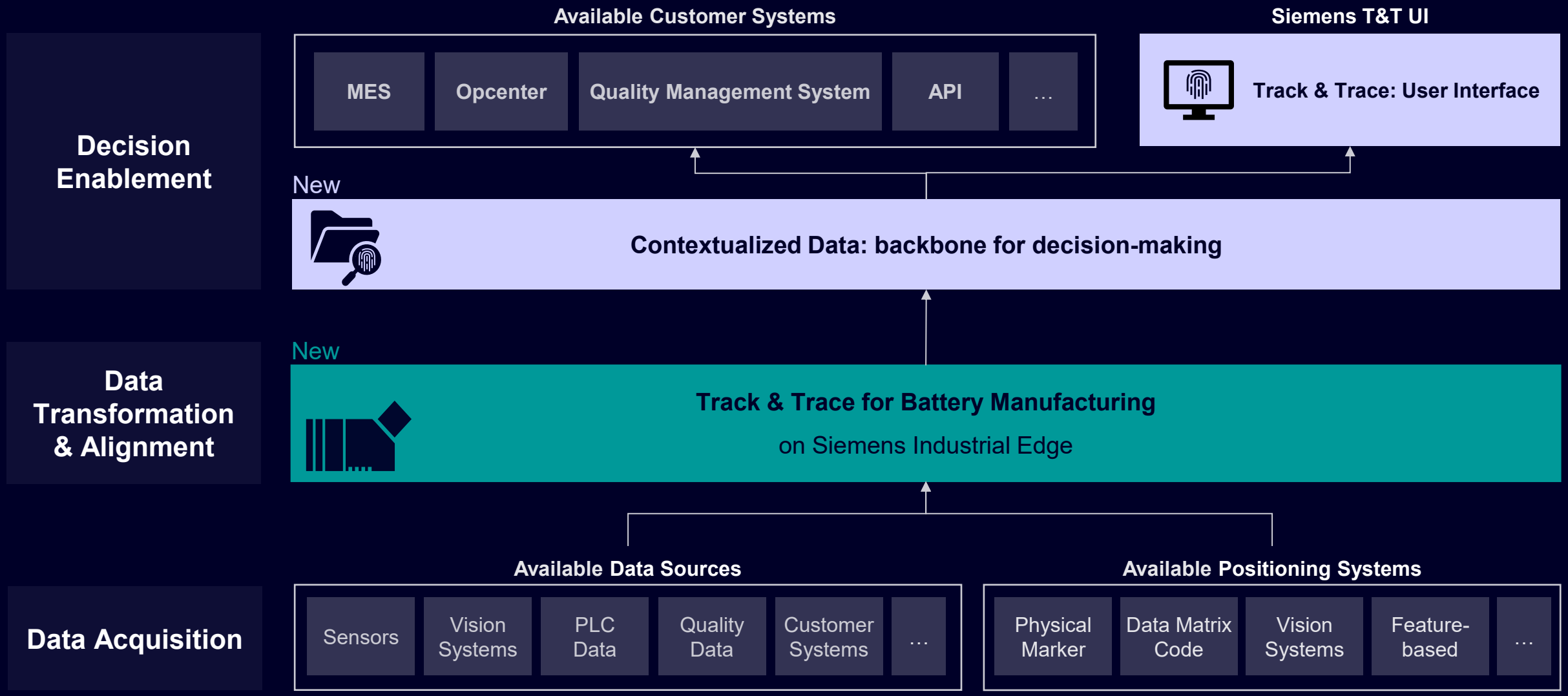
AI-Ready Data Foundation 人工智慧就緒資料基礎
Premium-quality data stream enabling seamless integration with customer-specific AI solutions

We deliver a unique DNA per cell



SIEMENS

How Tracking and Tracing for Battery Manufacturing works
電池製造的追蹤和追溯如何運作



SIEMENS

Exemplary brownfield approach based on Industrial Edge Virtual Device
工業邊緣虛擬設備在既有的設備的示範

Siemens Industrial Edge Use Case

Long-term Storage Manager

Track & Trace Analytics

Siemens Industrial Edge + **Track & Trace for Battery Manufacturing Application**

Machine Cell

Siemens IPC
BX39-A
(Industrial Edge Device)

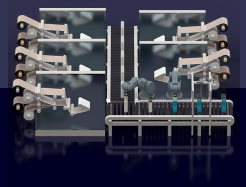
Machine Cell

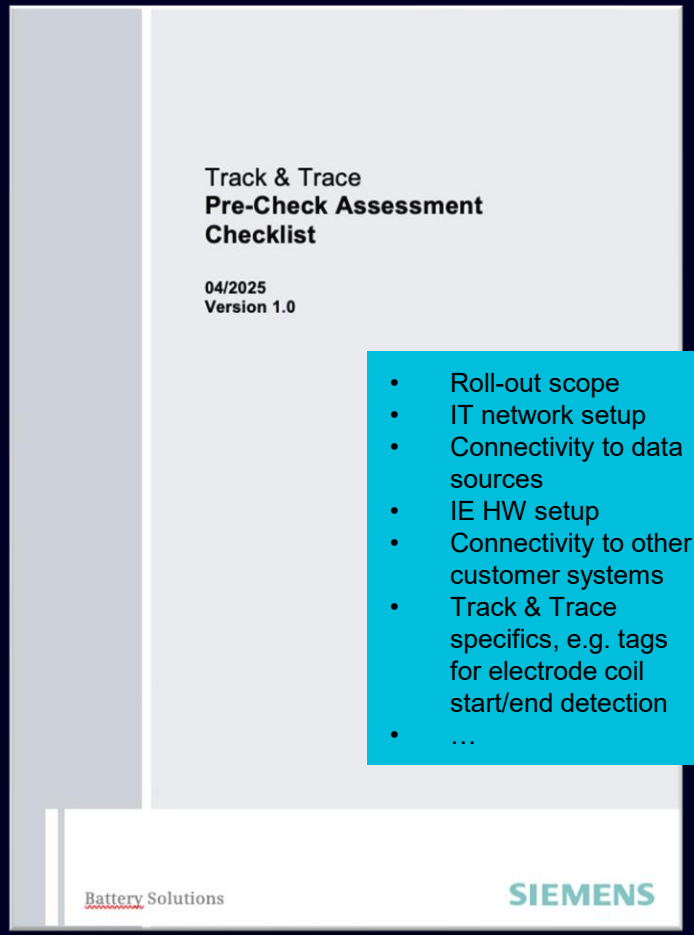
Siemens IPC
BX39-A
(Industrial Edge Device)

+ **Siemens IEVD***

Machine Cell

3rd party vendor IPC





- Roll-out scope
- IT network setup
- Connectivity to data sources
- IE HW setup
- Connectivity to other customer systems
- Track & Trace specifics, e.g. tags for electrode coil start/end detection
- …

* Industrial Edge Virtual Device

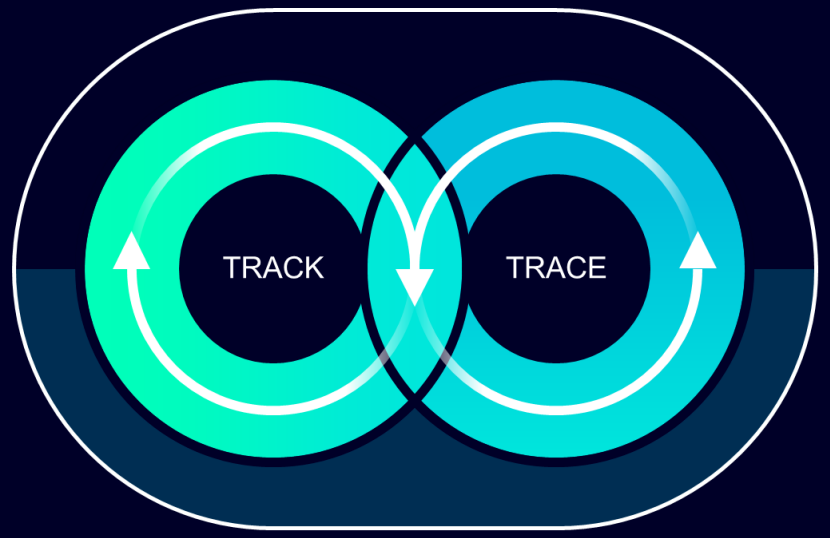
SIEMENS

Track & Trace for Battery Manufacturing Offering
電池製造的追蹤和追溯可提供

1 Tracking: Inline

- Full transparency of defects and quality issues using a product HealthMap
- Seamless tracking and analysis from raw materials to end of line testing
- Correlation of data across production steps
- Enrichment of data points along the process chain, enhanced by virtual sensors

Contextualized



sensor, process & quality data

2 Tracing: Historical

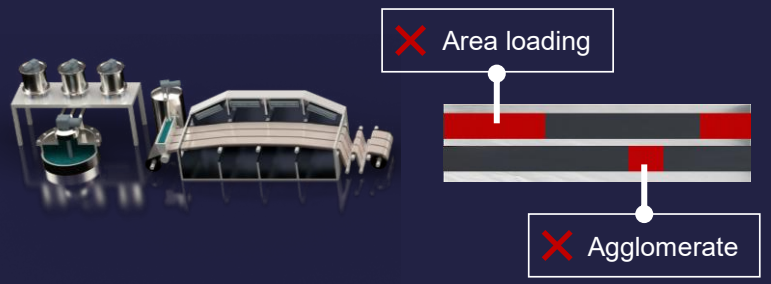
- Root-cause analysis for products and single production runs
- Pattern and error detection across several production runs
- Easy and comprehensive access to production and quality data in recall or audit scenarios
- Customer-centric, demand-oriented data storage ensuring full data sovereignty

SIEMENS

Transparency gained with Tracking drastically improves yield
透過追蹤獲得的透明度可大幅改善良率

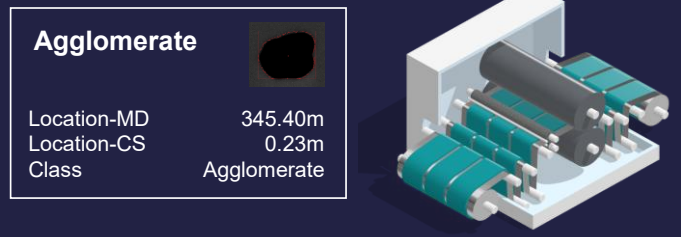
Example: Tracking use-case

Identification & localization of NG material



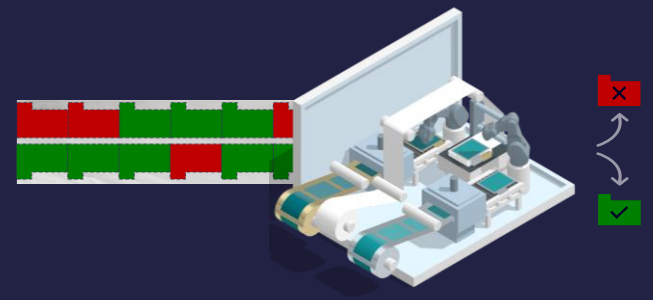
Exemplary visualization of ‘not good’ sections

Inline tracking of NG sections



e.g. adjusting calender roller gap

Precise ejection of NG material



Scrap removal at different process steps

Actionable ‘Track & Trace’ data can be used for inline cross-process adjustments and quality assurance

SIEMENS

Product-centric overview enables efficient, accelerated and targeted Root-Cause Analysis
以產品為中心的概覽可實現高效、快速且有針對性的根本原因分析
Example: Tracing use-case

- **Easy selection of relevant data sources**
- **Faster analysis due to product-centric view**
- **Flexible customization**
- **Further analyses using APIs**

SIEMENS

The benefits of Track & Trace - 追蹤與追溯如何節省成本並提高質量

Accelerated root-cause analysis

Minimize revenue loss by retrieving long-term storage data in hours

Increased sustainability

Optimized laser drying and reduced formation, aging costs cuts energy use and boosts efficiency

Best in-class cell quality

Avoiding and extracting NG-coated sections lowers waste and cuts costs

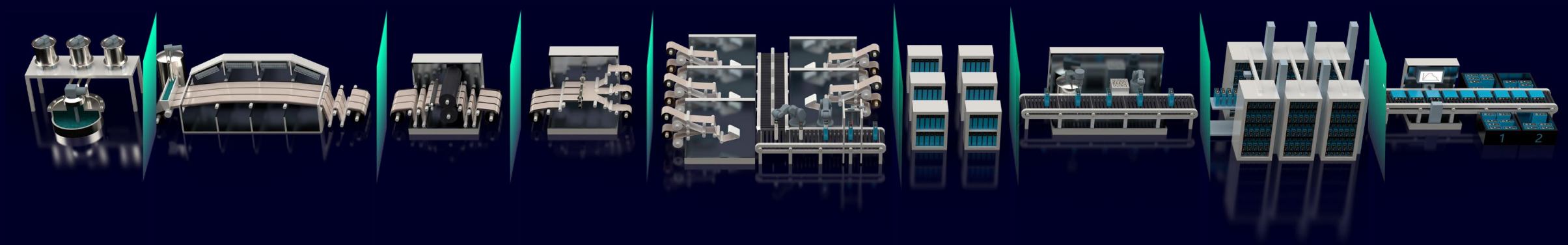
Cost Savings

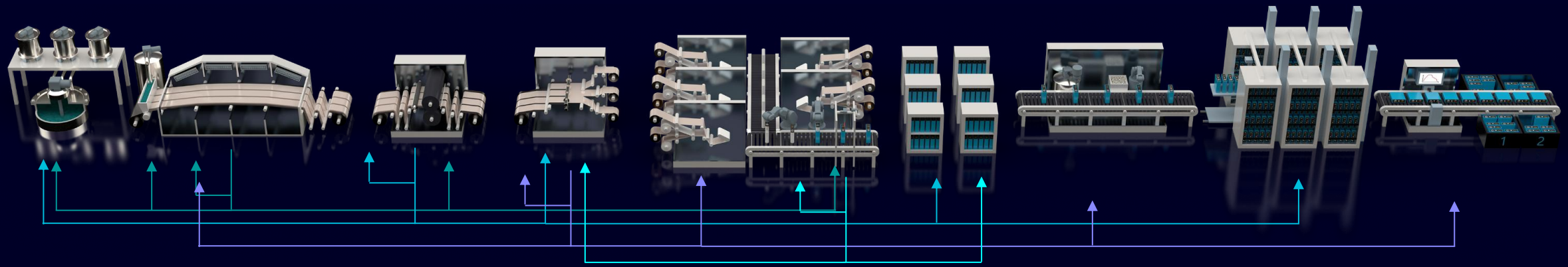
Identifying and removing NG sections before aging cuts expenses

Tracing Tracking

SIEMENS

From data- and control-silos





to a fully digitalized gigafactory

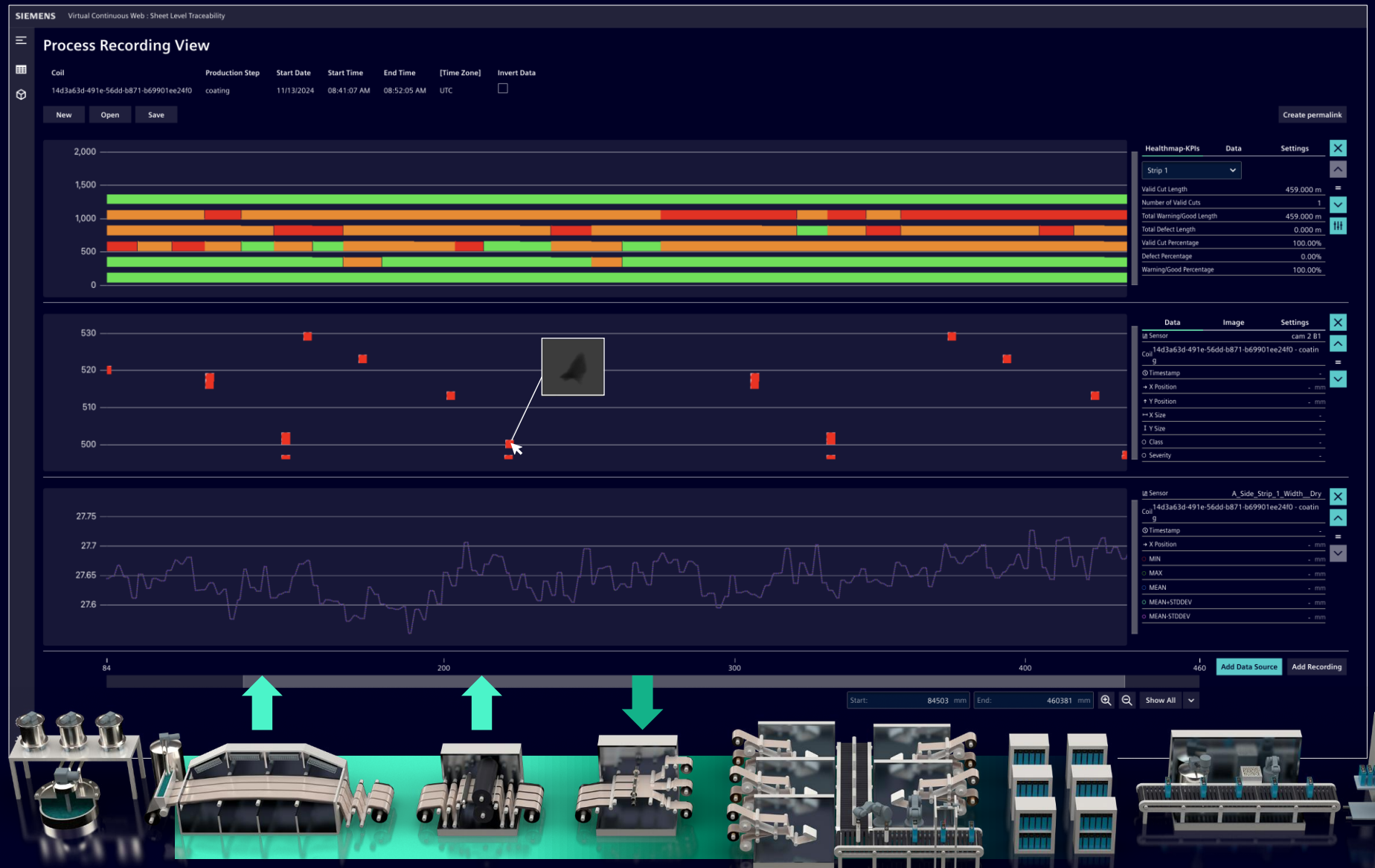
SIEMENS

One Coil – One Health Map.

Health map

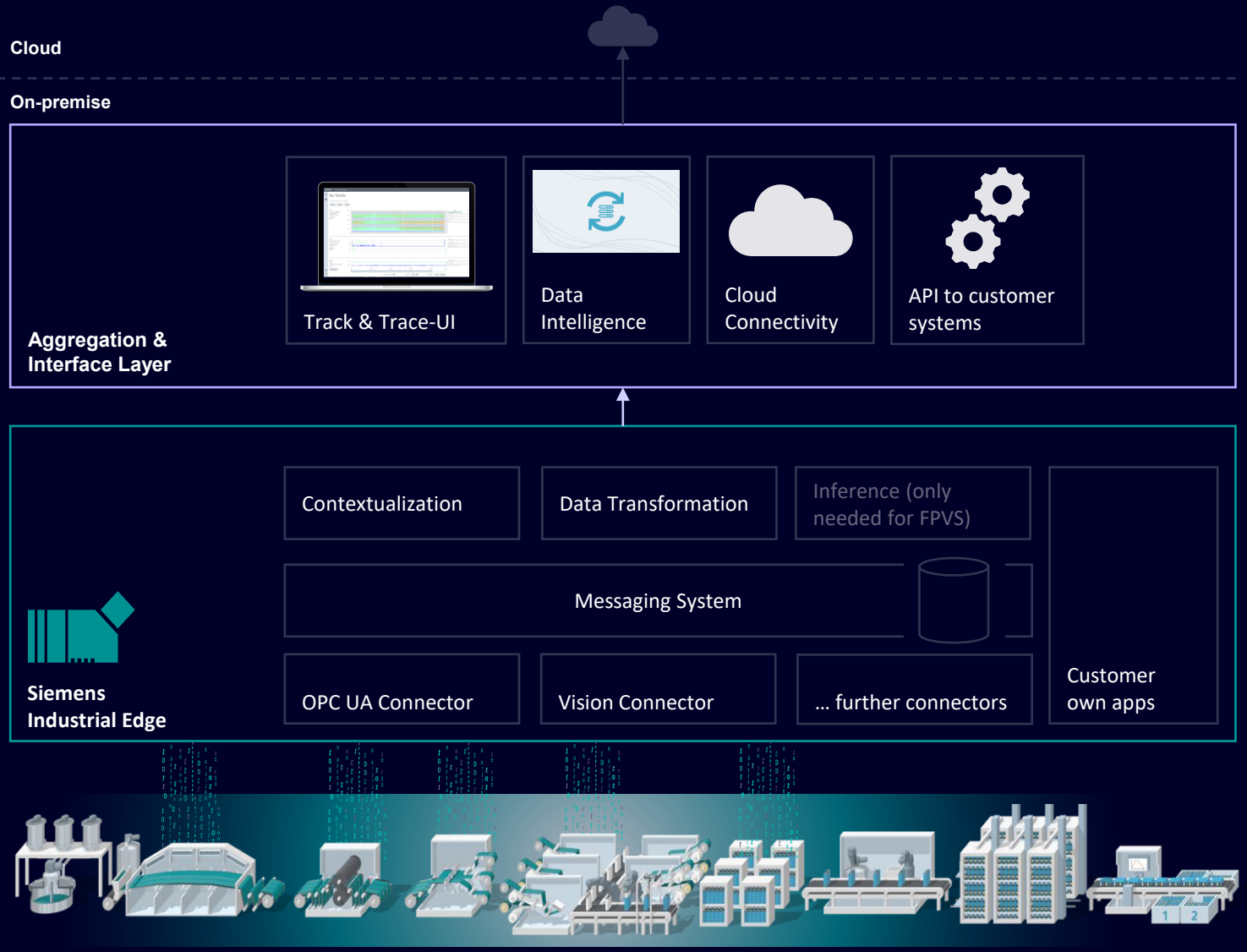
Defect map

Dryer temperature



SIEMENS

Track & Trace for Battery Manufacturing
On-Premise Architecture 本地架構



Cloud

- Long-term storage (owned & operated by customer)

Aggregation & Interface Layer

- Integration into 3rd party MES system utilizing REST API
- Outbound messages are buffered in messaging system to handle downtime & backpressure scenarios (e.g. raw vision data-campaign)
- AI Model Management to deploy AI model based on customer product

Industrial Edge Devices

- **Data collection based on industrial standard protocols**, incl. OPC UA, SMB/FTP (100ms – 1s acquisition cycle)
- Contextualization: meta-data enrichment (e.g. sensor position)
- Spatial Transformation: Convert from time-series towards spatial position on the material
- Inference: Model execution & feature extraction for data matching

SIEMENS