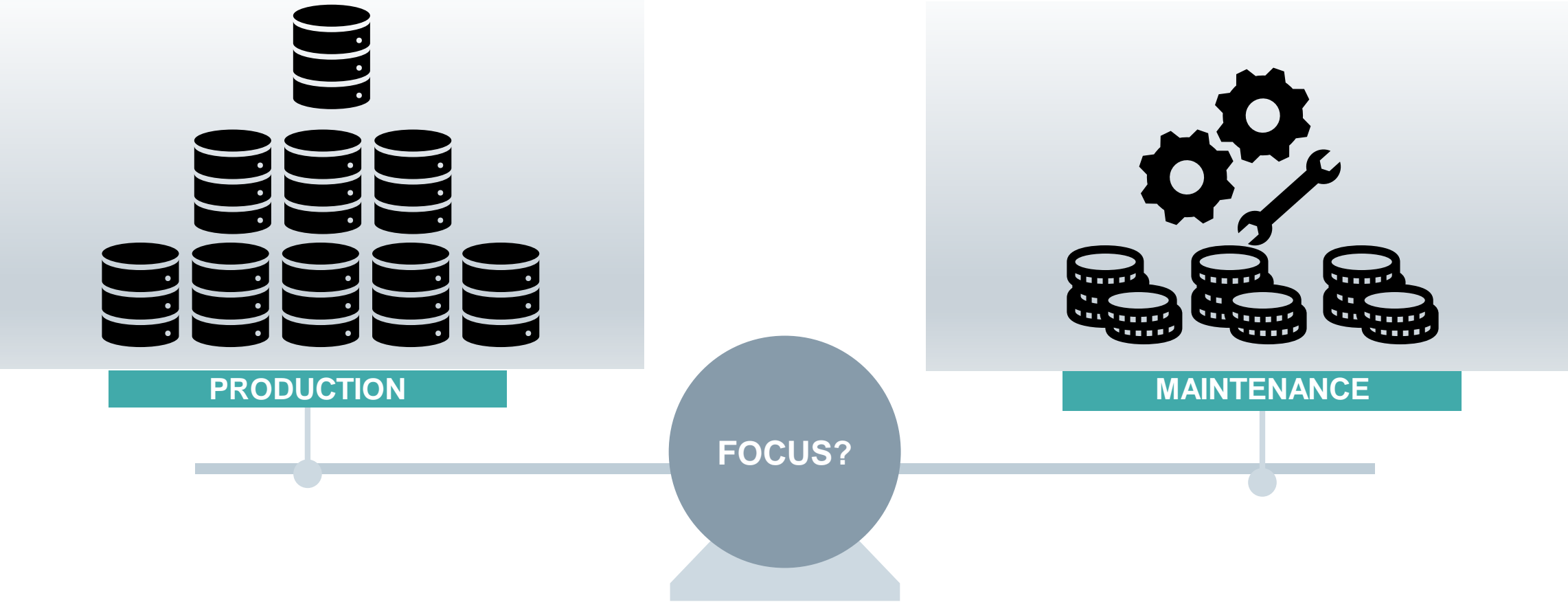


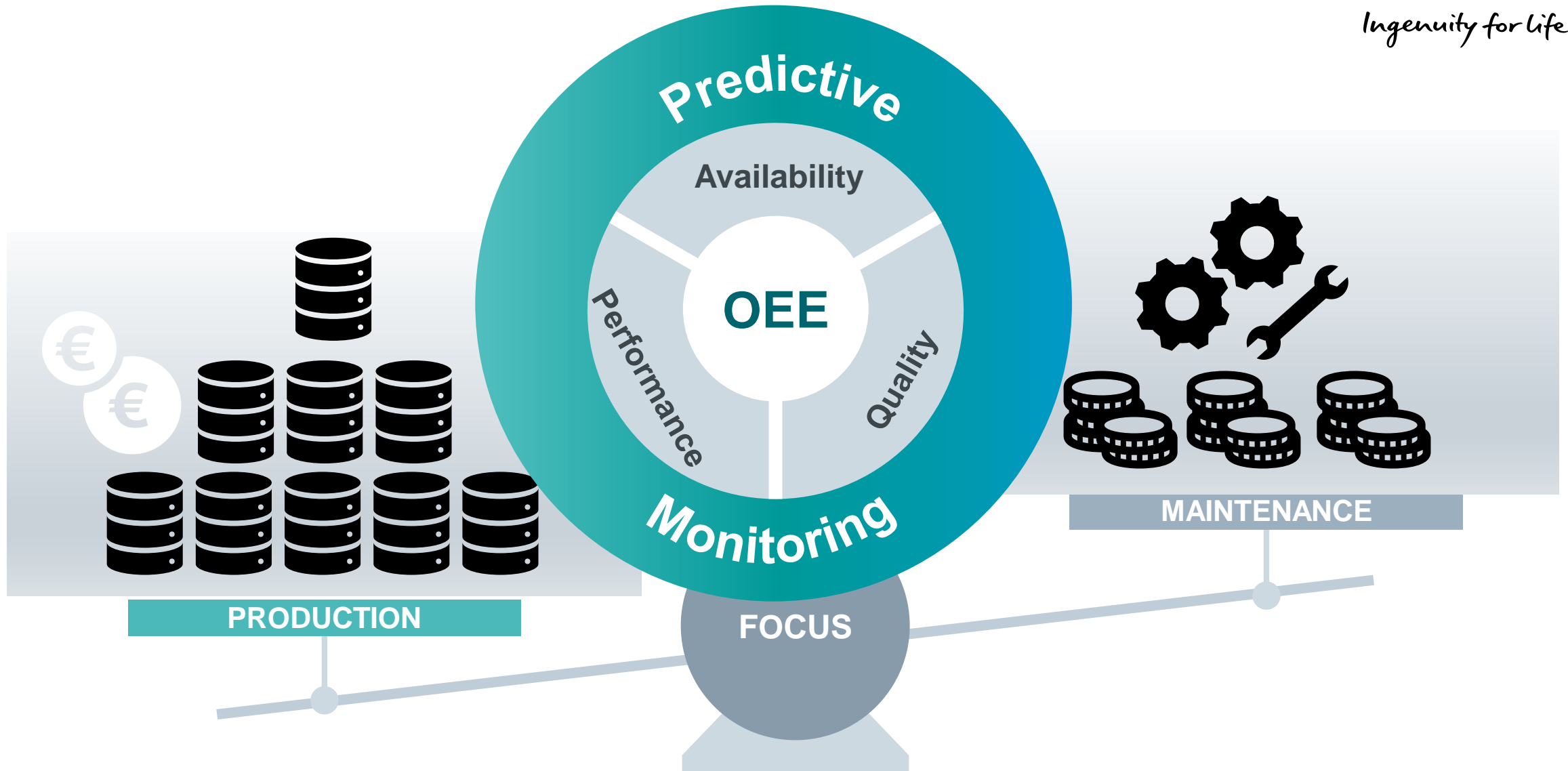


Equipment Predictive Analytics V1.0
Sales Material

Value of more production vs. value of maintenance saving



Value of more production vs. value of maintenance saving



Effectiveness is the key to **profitability** in the **process industry**. This means **maximize value add** by increasing **production output, quality and availability** while **minimizing the resources input** (e.g. energy and material)

But what are the hurdles why customers don't continuously optimize?



Resources – most customers don't have the needed resources to continuously monitor and analyze their processes and assets



Competence - some customers don't have the necessary knowledge on site and the transparency to know where and what to optimize

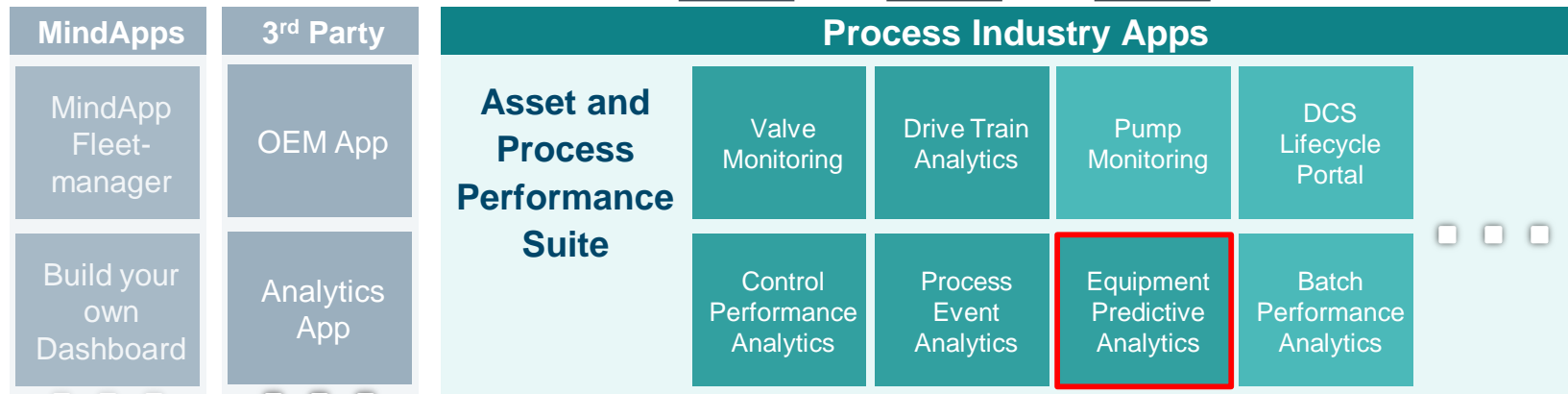
Vision – A cloud based, vendor independent Asset and Process Performance Suite



User level



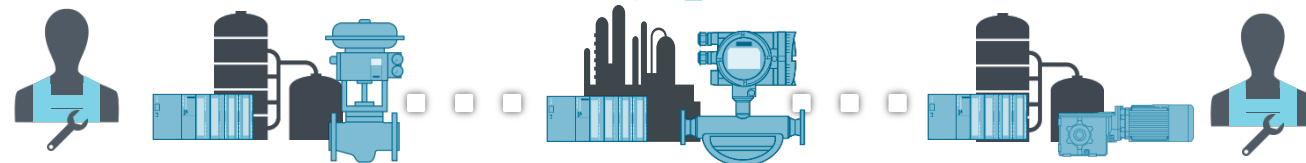
Services and Applications



IIoT platform (cloud)



Plant level (worldwide)



- Data analysis asset diagnosis
- Health monitoring
- Predictive maintenance

- Specific applications for certain asset groups
- Harmonized Look and Feel
- Covers assets from multiple manufacturers

- Secure data storage
- Worldwide access to all plants and locations

- Data acquisition via field sensors and plant network

Equipment Predictive Analytics Benefits / Value Proposition



Increased Plant Uptime



- **Avoid** unplanned **shut-down** of your plant by **predicting failures** of critical equipment (based on historical data)
- **Analyze behavior of equipment** within process environment and **find anomalies**

Cost reduction



Increased reliability and effectiveness (OEE)

Higher Operation Efficiency



- Get an **intuitive picture** of the health of your equipment in a timely and efficient manner
- Achieve a **predictive maintenance** instead of time-based / reactive maintenance
- Enable **remote monitoring** and issue identification

Asset integrity



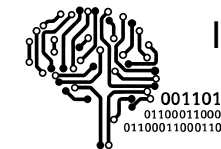
All assets fully operational and optimally utilized

Better Decision Accuracy



- **Identified correlations** hidden in data for smart decisions on operation
- **Consolidate knowledge**, experience and data for 24/7 stable monitoring performance
- **Reduce workload** for limited resources on experienced engineers

Smart Data



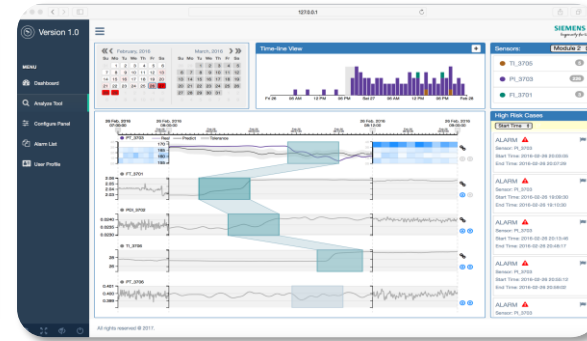
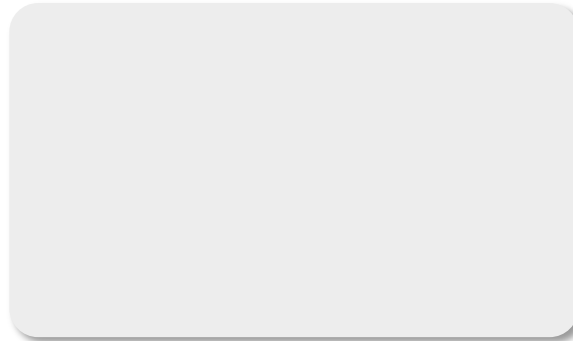
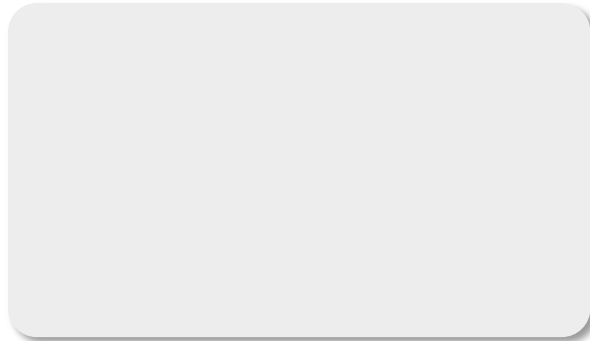
Intelligent **linking of knowledge and data**

**Practical & robust tool for predictive monitoring
integrating human experience/know-how and machine analysis capability**

Equipment Predictive Analytics Goals

Configuration and Training

Predictive Monitoring



Ensure Overall Equipment Effectiveness

↑ **Plant uptime**

Increased plant uptime through avoidance of shut-downs by pre-alerting on failures

↑ **Operation efficiency**

Higher operation efficiency through predictive monitoring

↑ **Decision accuracy**

Better decision accuracy through identification of correlations hidden in data



Data analysis



Artificial intelligence



Correlation



Cloud-ready

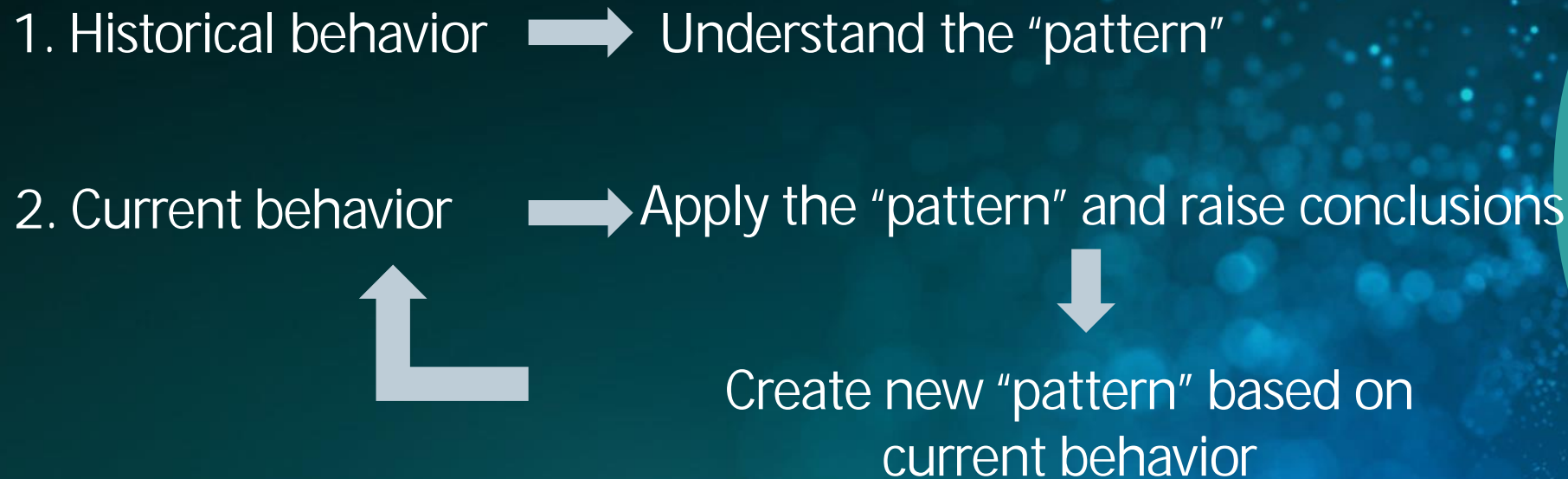


Reporting



IT Security

What is Artificial Intelligence?

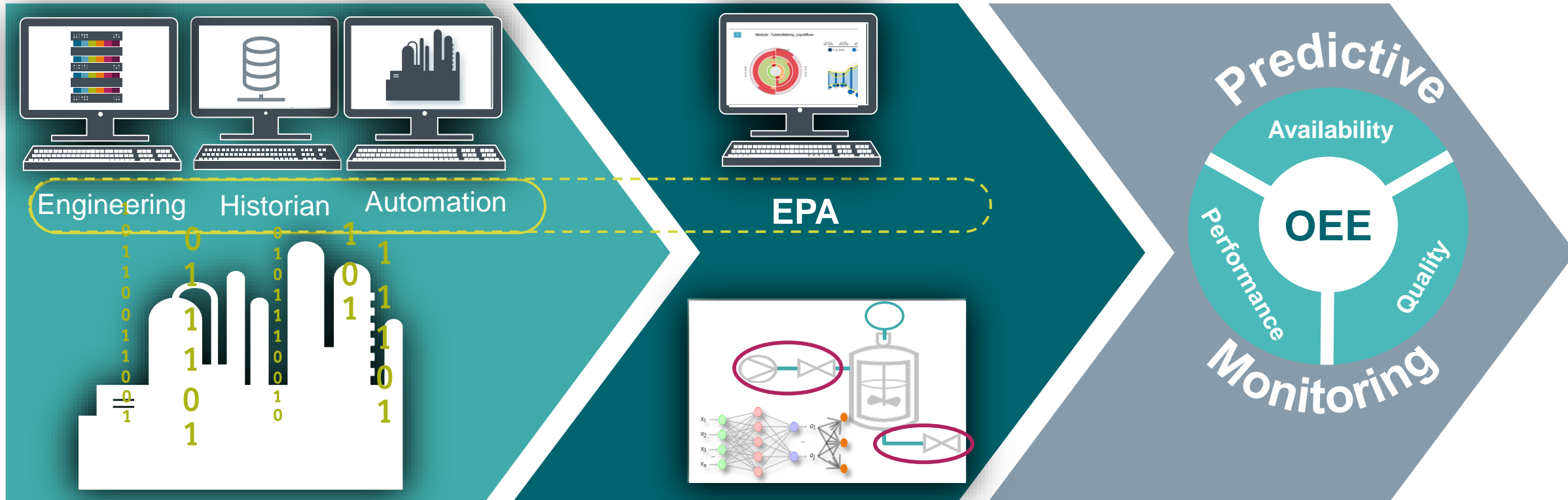


Artificial Intelligence
Program that can sense,
reason, act, adapt

Machine Learning
Program that improves as soon
as it is exposed to more data

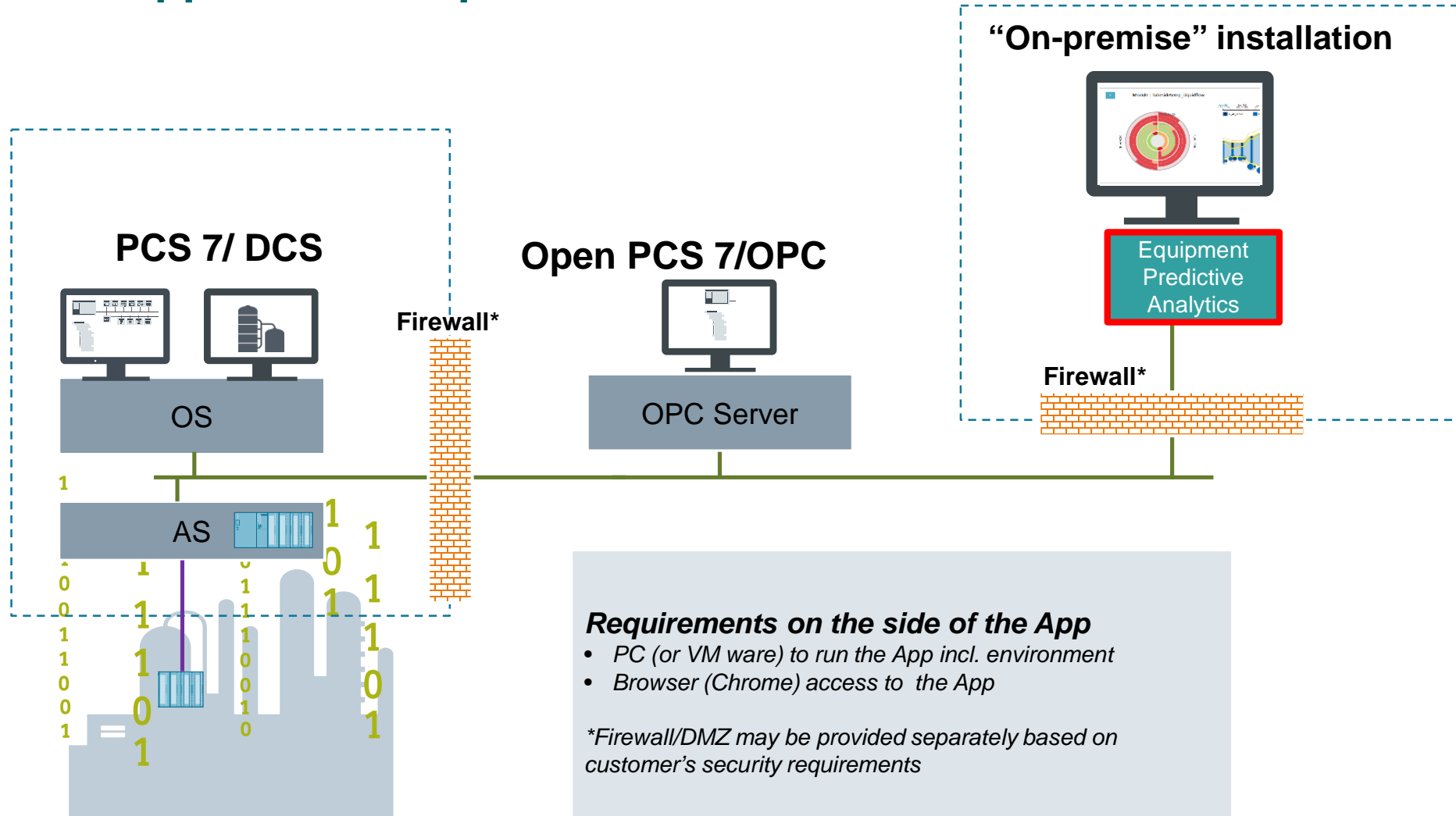
Deep Learning
Program that learns
based on multilayer
neural networks

Data Availability and Analysis



EPA - System Integration with PCS 7 or third party DCS

V1 of App as an “On-premise”



Requirements on the side of the App

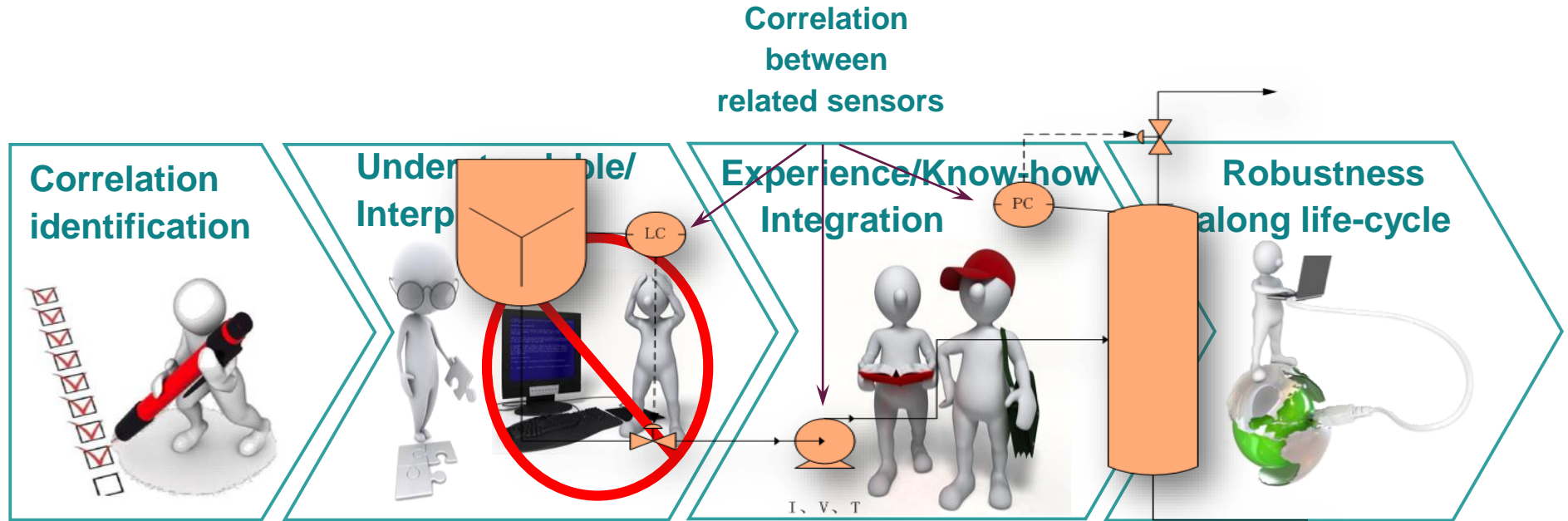
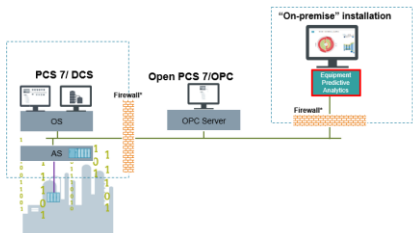
- PC (or VM ware) to run the App incl. environment
- Browser (Chrome) access to the App

*Firewall/DMZ may be provided separately based on customer's security requirements

Solution and Key Techniques

Data Integration

- Process control sensor data
- Equipment real-time monitoring data
- Others



Solution and Key Techniques

Correlation
identification

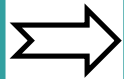
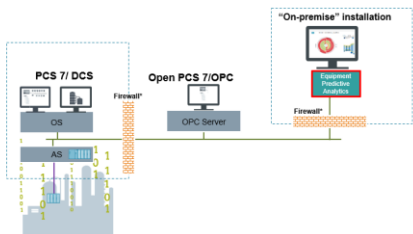
Understandable/
Interpretable

Experience/
Know-how Integration

Robustness
along life-cycle

Data Integration

- Process control sensor data
- Equipment real-time monitoring data
- Others



Correlation Identification

- Identify target key monitoring sensors and correlated sensors
- Define integrated “**Equipment DNA**”

✦ Input:

Historical data of certain time period (suggest ≥ 1 year) consisting of time series generated by sensors

- on the equipment
- within the related manufacturing context/process

✦ Output:

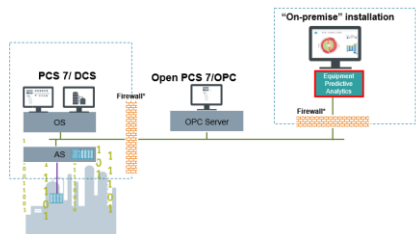
- Target monitoring sensors
- Correlated sensors for each target monitoring sensors which are identified based on integration of data-driven results and domain knowledge.

Solution and Key Techniques



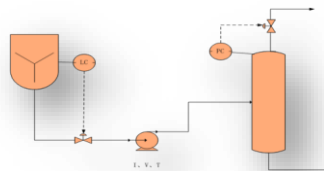
Data Integration

- Process control sensor data
- Equipment real-time monitoring data
- Others



Correlation Identification

- Identify correlated points for key alarm
- Define integrated **Equipment DNA**



Risk Analysis

Anomaly Pre-alert

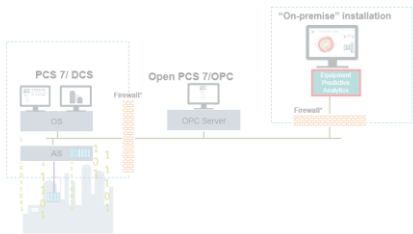
- Based on "Equipment DNA", build **Status Reference Library** to alert on anomalies
 - ▣ **Training/modeling:**
Characterizing reference "normal" conditions in the past
 - ✦ **Input:** - Equipment DNA
 - A set of time periods for good conditions of equipment
 - Historical data for those time period
 - ✦ **Output:** Model of Status Reference Library
 - ▣ **Monitoring:** Evaluate risks with real-time status
 - ✦ **Input:** - Model of Status Reference Library
 - Real-time data stream (suggested with certain freq.)
 - ✦ **Output:** Estimated risks by deviations from normal conditions and pre-alerts for high risk cases

Solution and Key Techniques



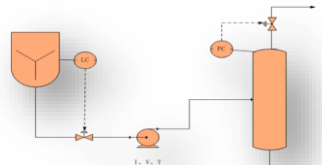
Data Integration

- Process control sensor data
- Equipment real-time monitoring data
- Others



Correlation Identification

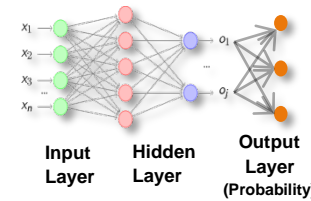
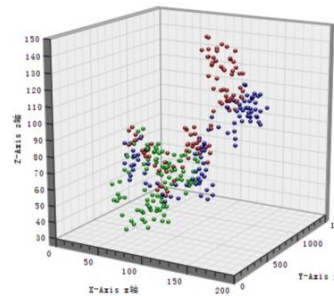
- Identify correlated points for key alarm
- Define integrated **Equipment DNA**



Risk Analysis

Anomaly Detection

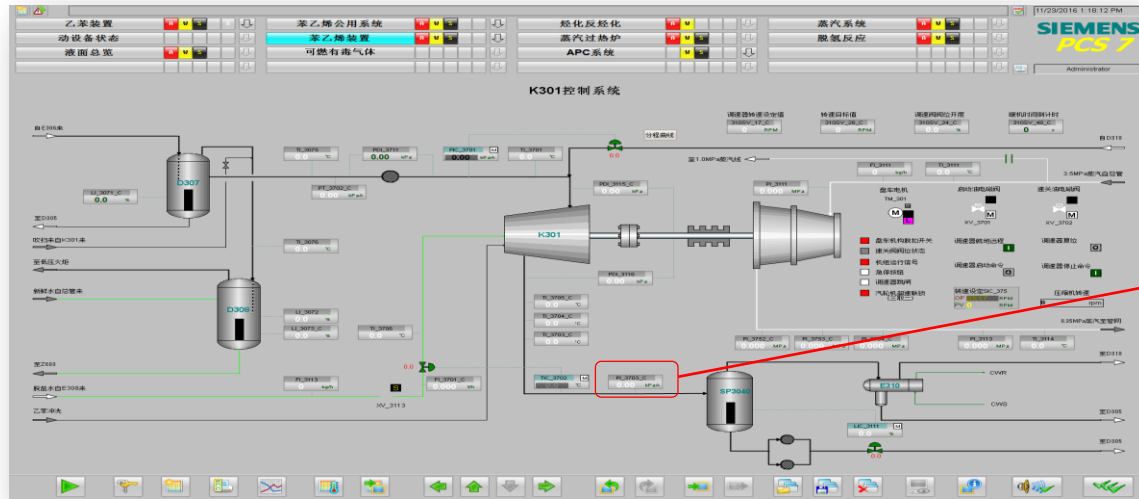
- Based on “Equipment DNA”, build **Status Reference Library** to alert on anomalies



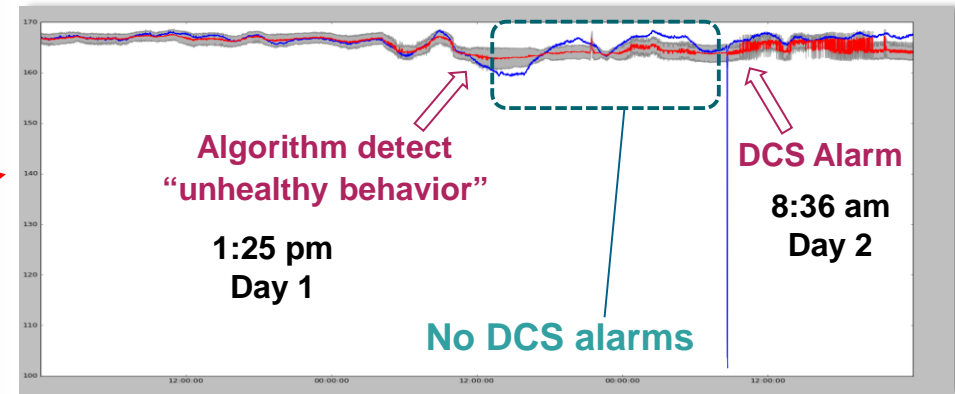
Interactive Machine Learning

- Inspection for root cause analysis
- Feedback to **improve model iteratively**
- Adaptive for whole equipment **life-cycle**

Proof of concept Advanced compressor monitoring

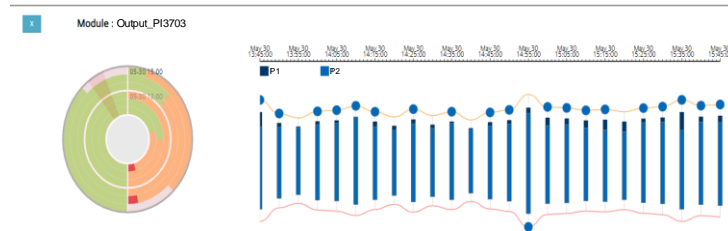


PI 3703 – Compressor output pressure

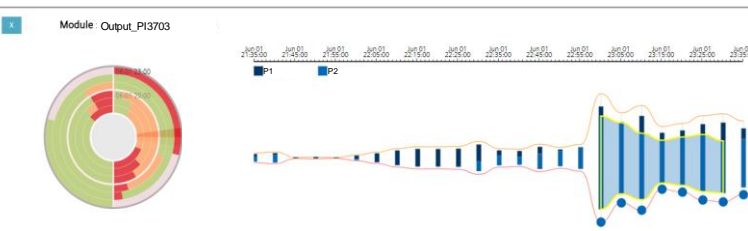


Risk detected ~18 hours earlier!

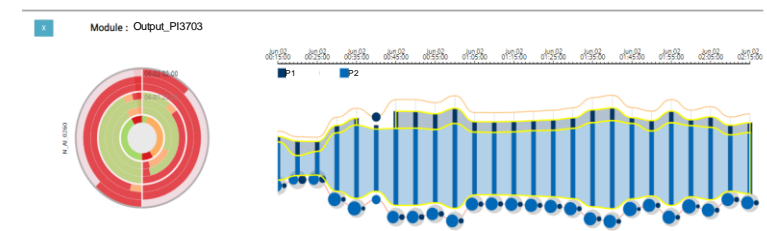
1. Almost no high risk alerts



2. Series of high risk alerts

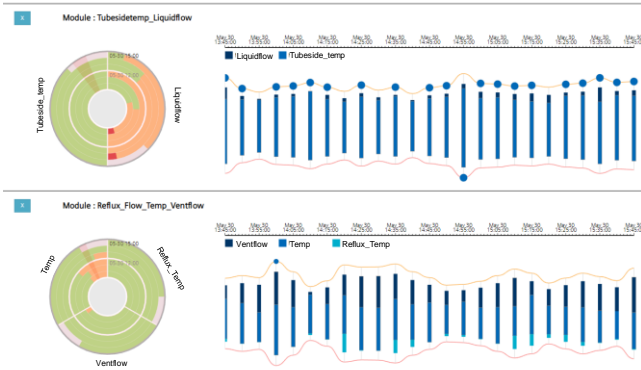


3. Only high risk alerts

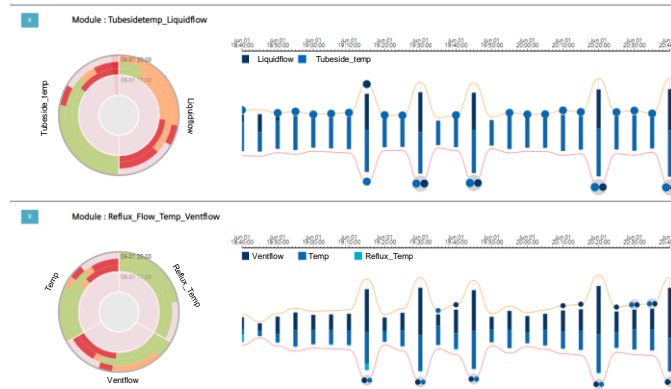


Proof of concept Advanced pump monitoring

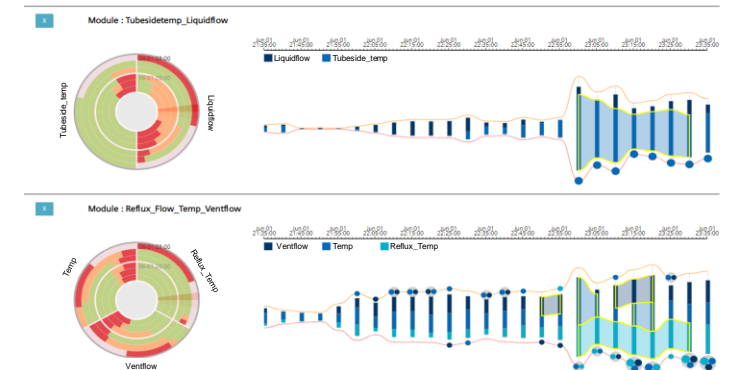
1. 30th May 3pm: almost no high risk alerts



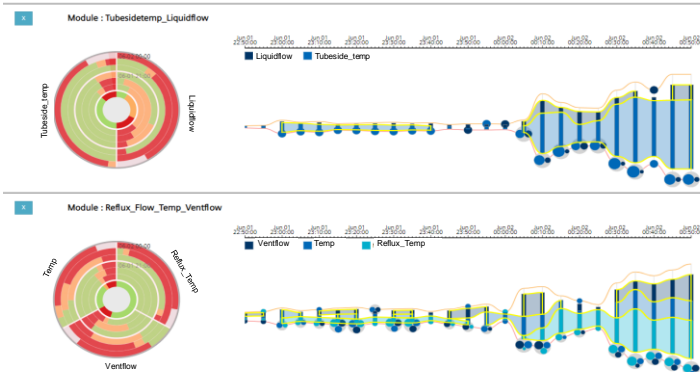
2. 1st June 6:40 pm: sporadic high risk alerts



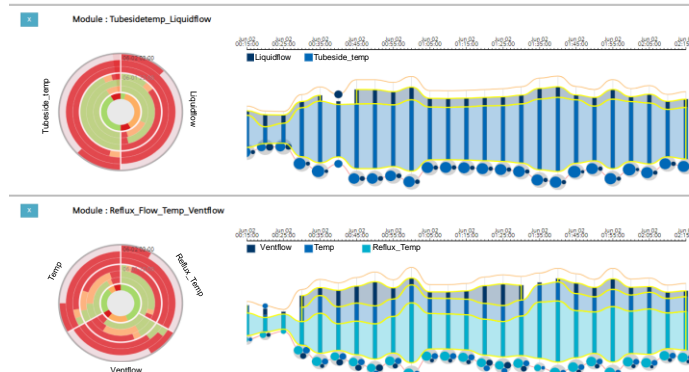
3. 1st June 11pm: series of high risk alerts



4. 2nd June 12am: start of long series of high risk alerts

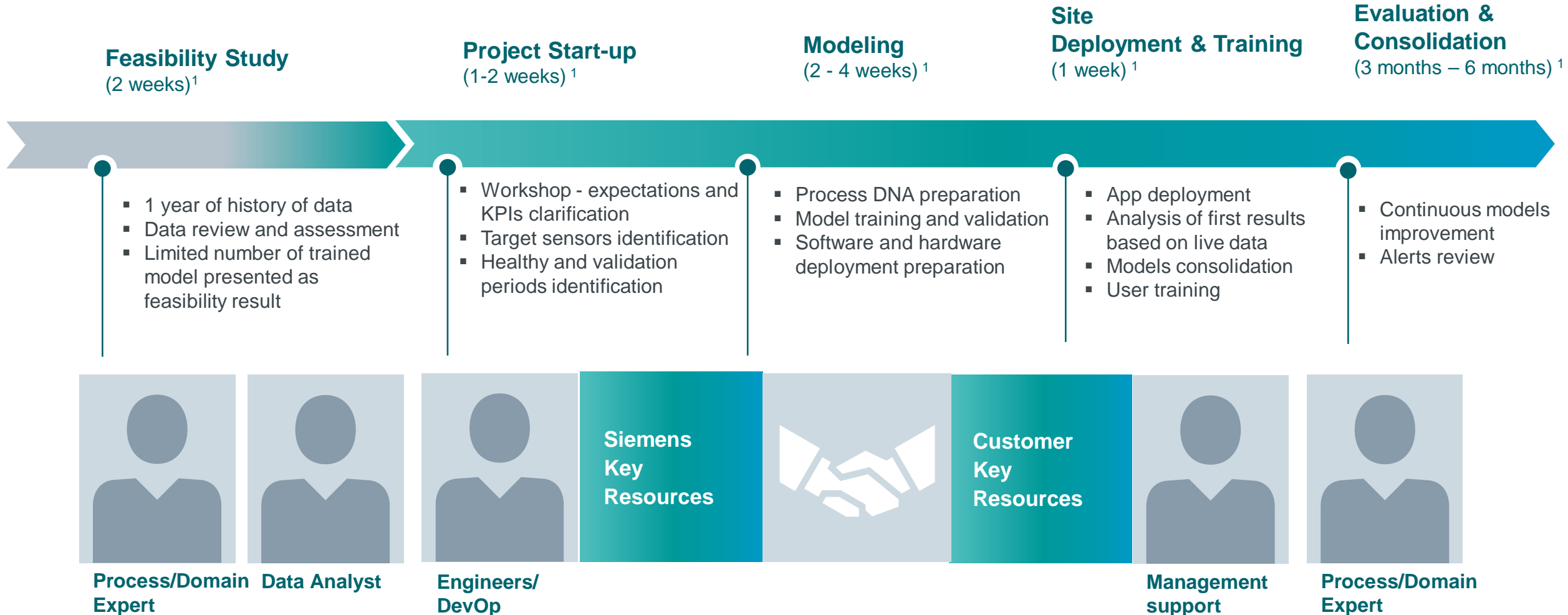


5. 2nd June after 12pm: only high risk alerts

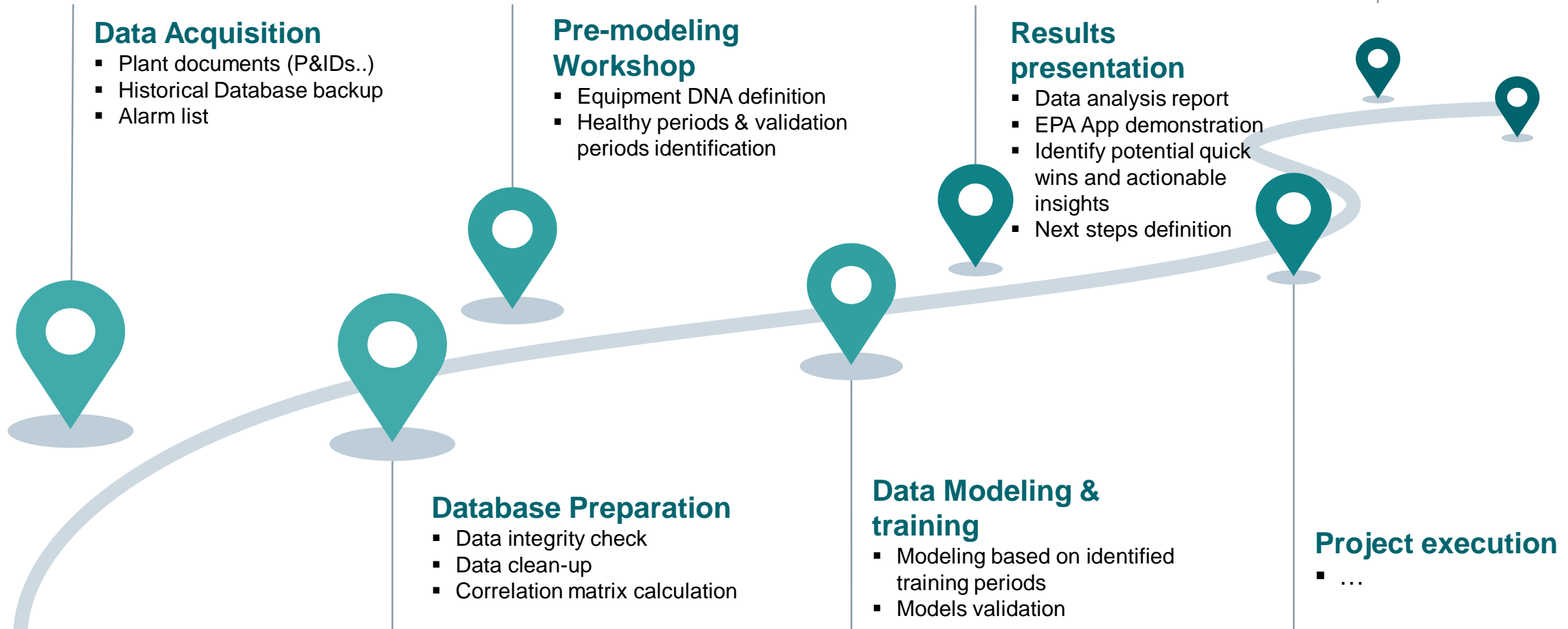


- EPA starts alerting in the evening of 1st of June!
- Actual failure of the pump on 13th of June!

Customer Implementation Procedure



Feasibility Study - Details



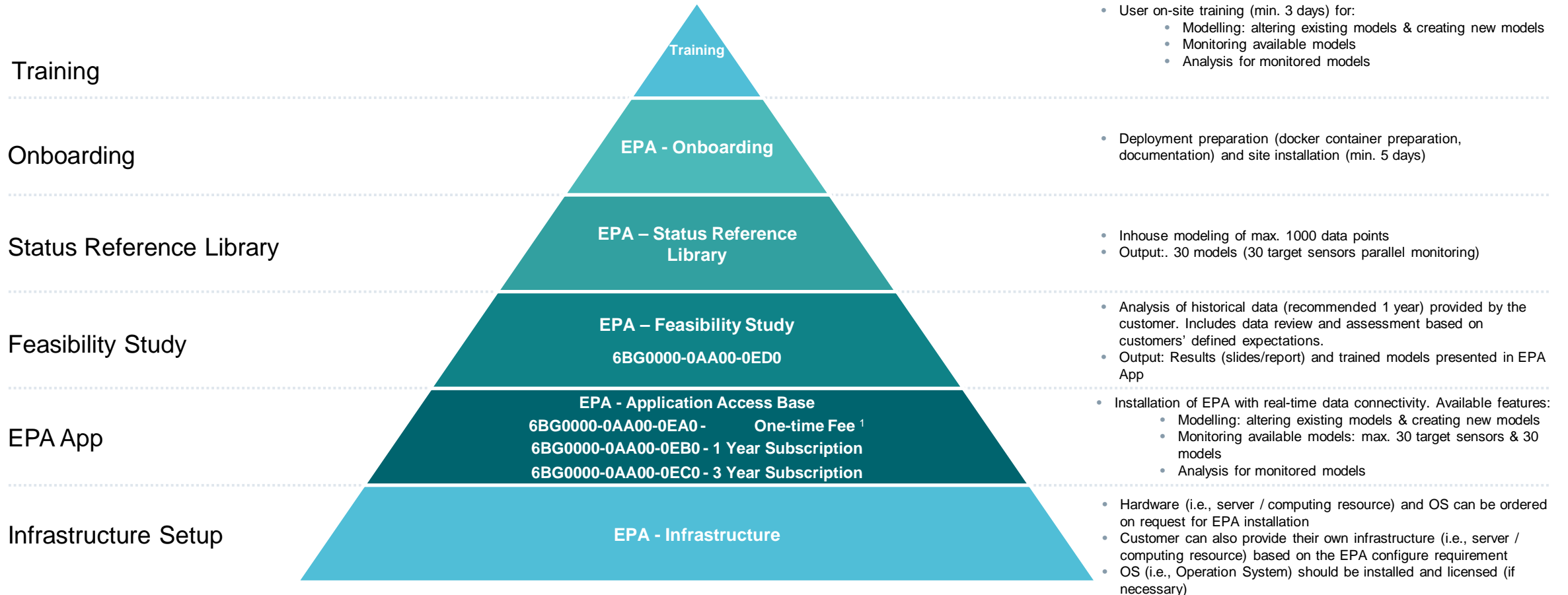
Scalable Value and EPA (on-premise) portfolio overview



Value scale

Offering structure

Short description



¹ One-time fee for current released version. Annual Maintenance Fee (6BG0000-0AA00-0EE0) not included. Maintenance fee covers all available updates/versions which are available for download.

Equipment Predictive Analytics Key Takeaways

SIEMENS
Ingenuity for life

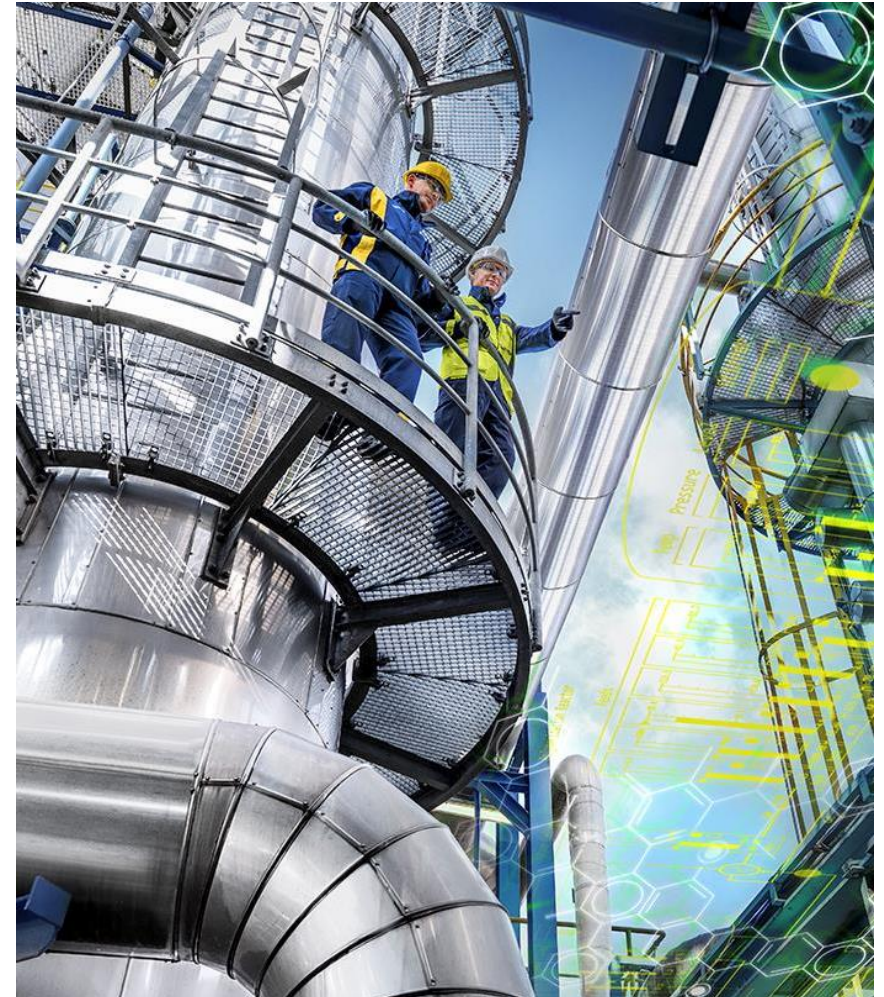
EPA improves your Overall Equipment Effectiveness (OEE).

Artificial intelligence needs data and domain experts to become smart.

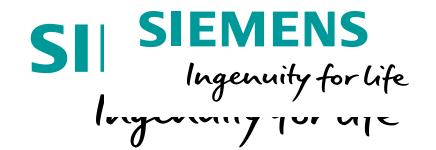
Rethink the process – let's work agile.

History is already now.

We have **answers** and **solutions**.
We are here to **support YOU**.



Thank you for your Attention!



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