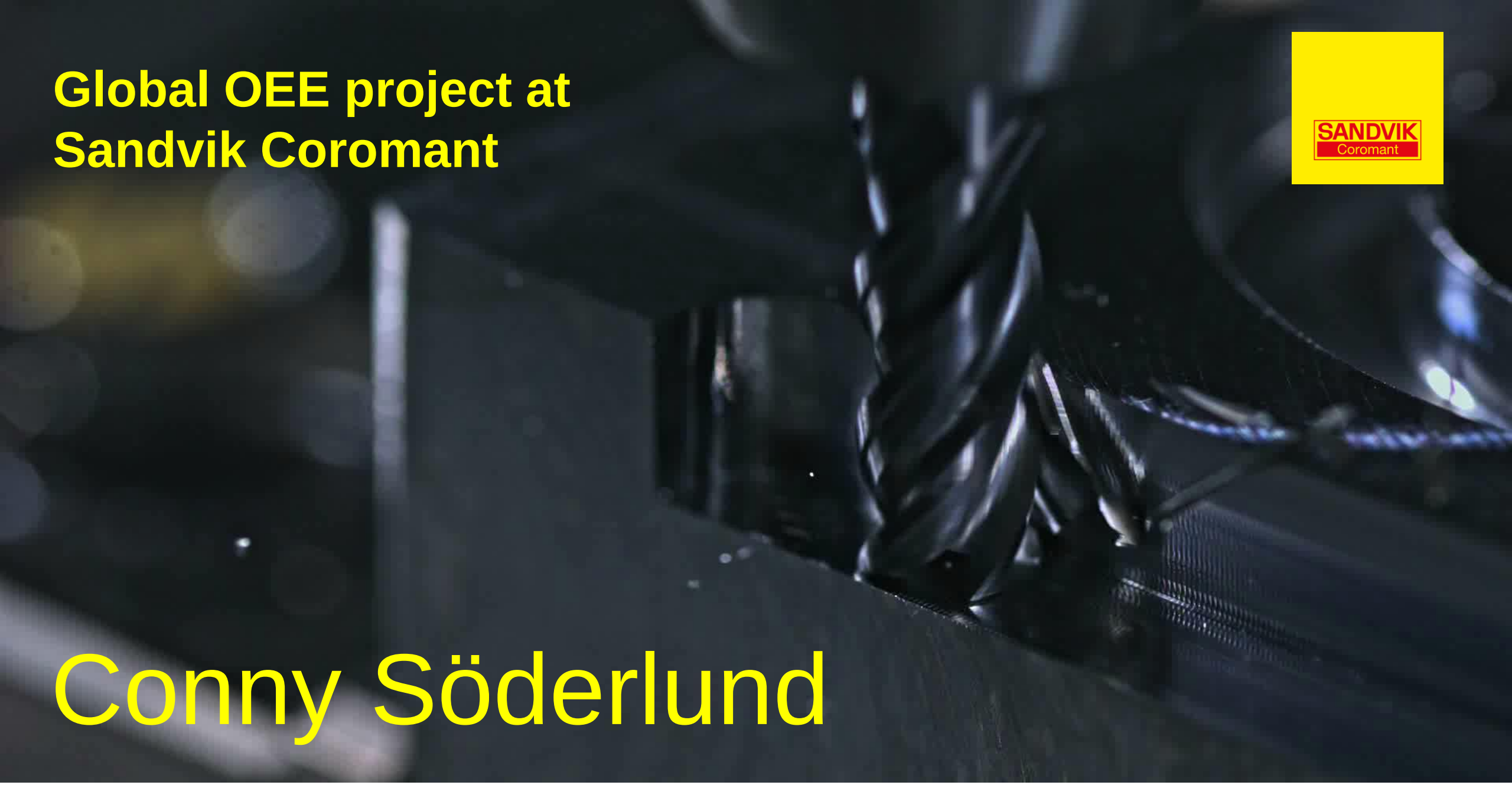
Global OEE project at Sandvik Coromant



Conny Söderlund

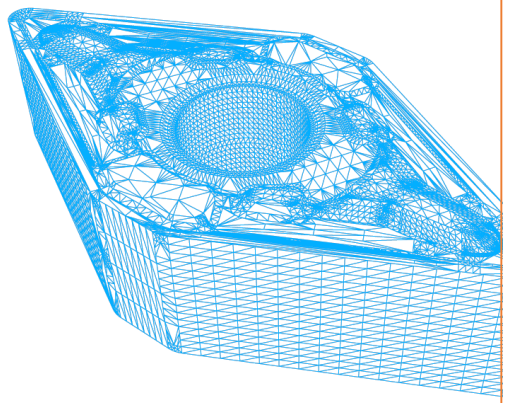
TO AIR-DRIVEN ENERGY

FROM NANOTECHNOLOGY

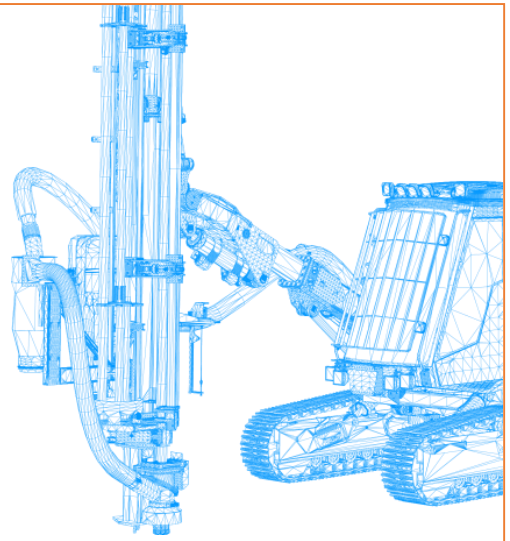
SANDVIK

World-LEADING POSITIONS

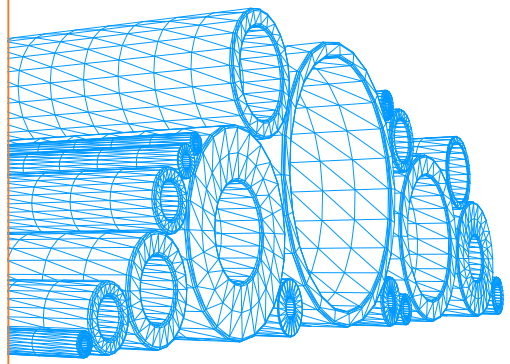
IN THE FOLLOWING AREAS



METAL CUTTING



MINING AND ROCK TECHNOLOGY



ADVANCED MATERIAL KNOWLEDGE

43,000
EMPLOYEES

82
BILLION SEK
INVOICED SALES

60
R&D CENTERS GLOBALLY

SALES IN OVER
150
COUNTRIES
AROUND THE GLOBE

3.5
BILLION SEK
ANNUAL R&D INVESTMENT

7,900
ACTIVE PATENTS AND OTHER IP* RIGHTS

SANDVIKEN_

PASSION FOR EXCELLENCE

8,000 employees and is represented in 130 countries

SANDVIK Coromant

FAGERSTA_

MAKING IT EASIER

has 5,600 employees with local offices in 60 countries

SECO

TÜBINGEN_

ENGINEERING KOMPETENZ

3,800 employees and around 50 subsidiaries and distribution partners worldwide

WALTER

MILAN_

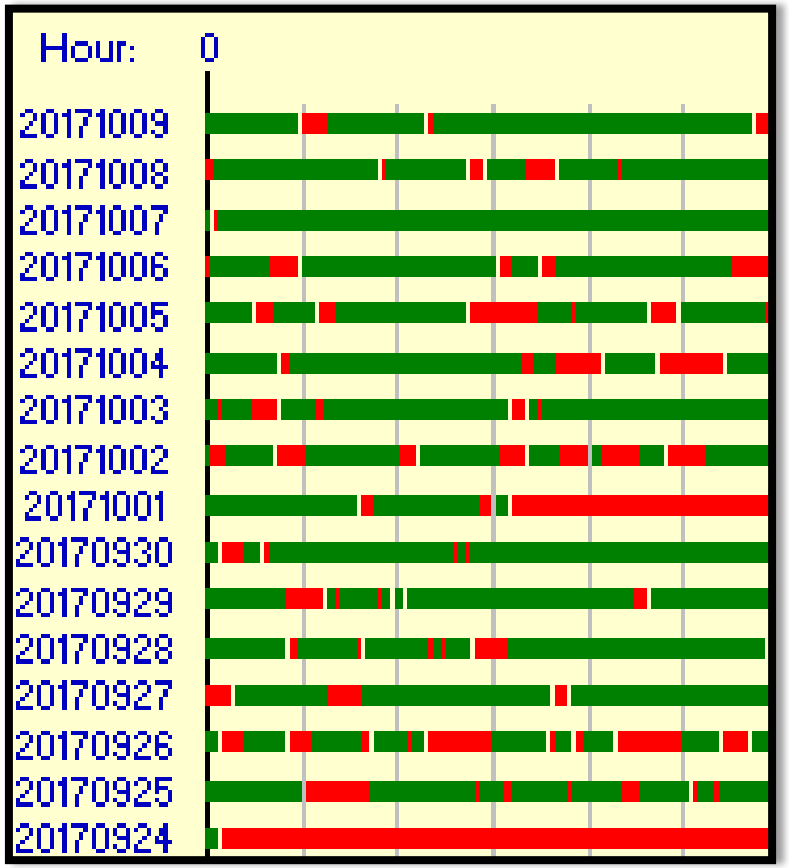
SIMPLY RELIABLE

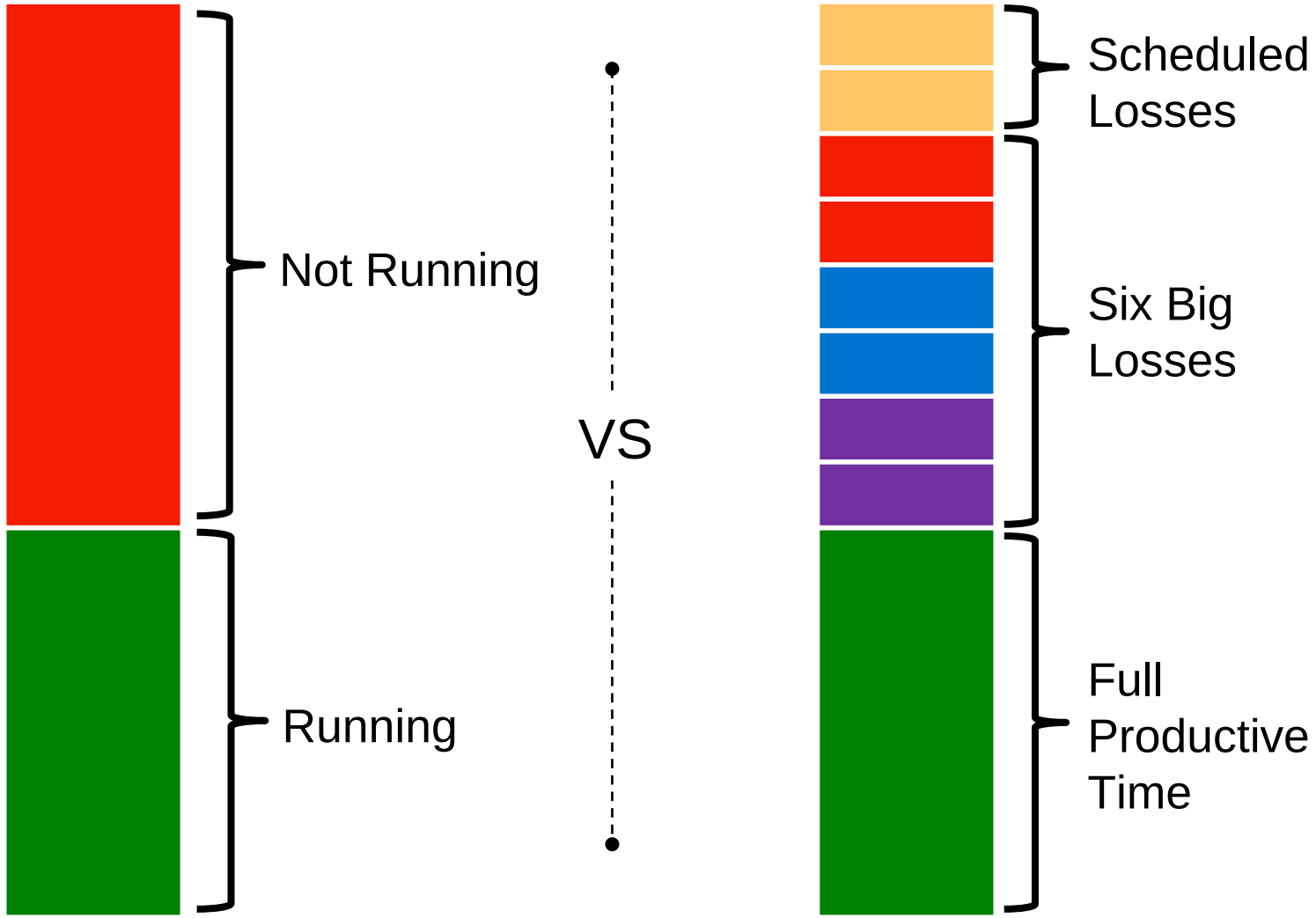
1,700 employees and are represented in 100 countries

DORMER PRAMET

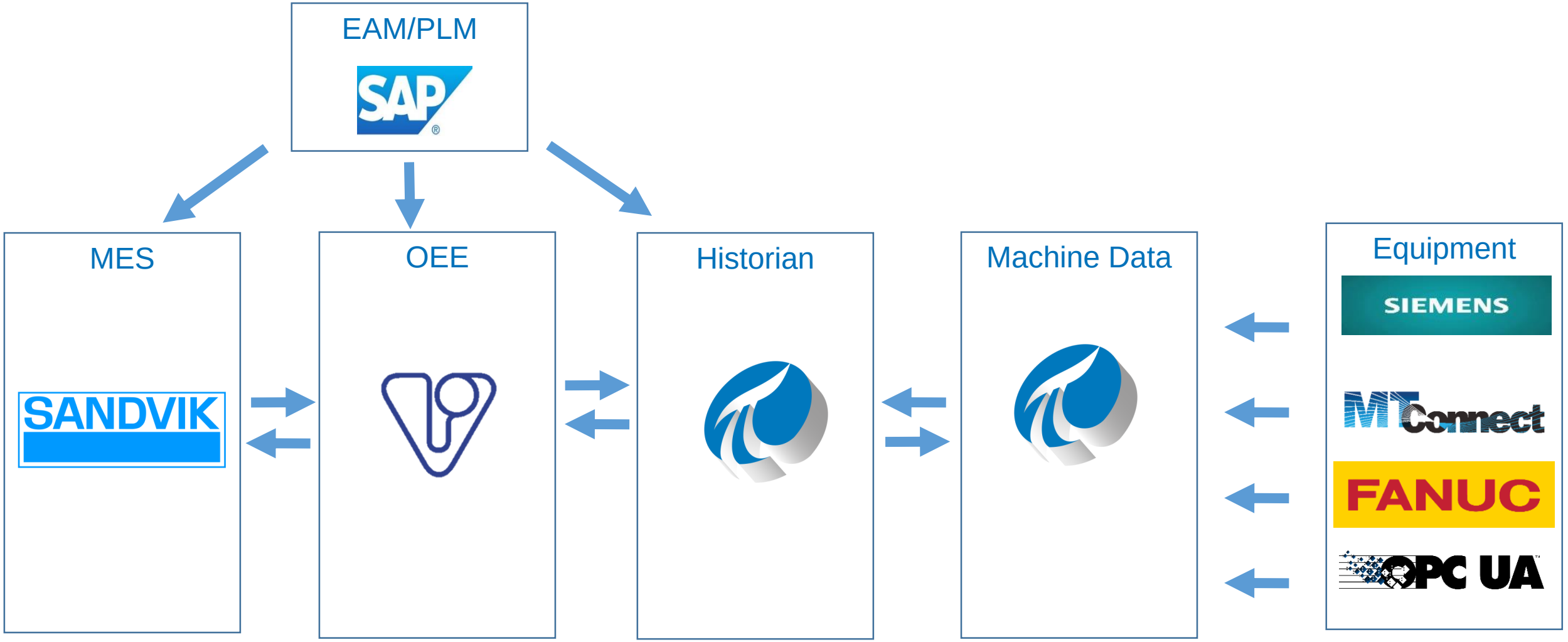
PRODUCTS

Our Objective – Standardize OEE



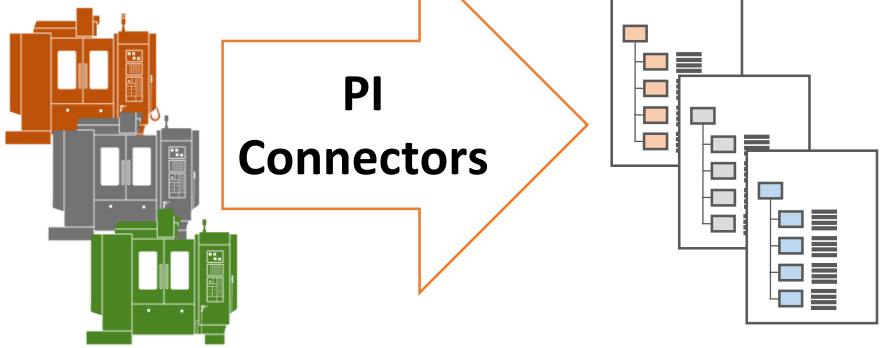


Solution – Our System Architecture

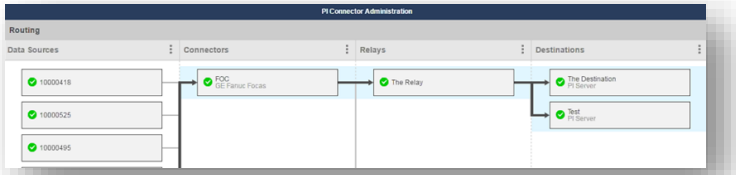


The Role of the PI System

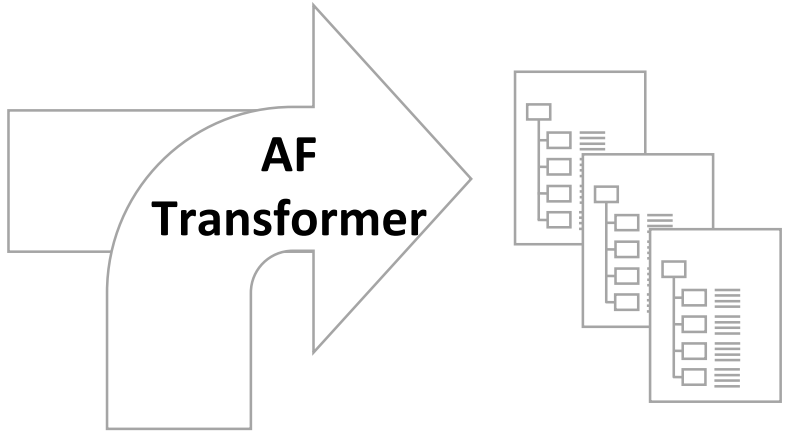
Connect



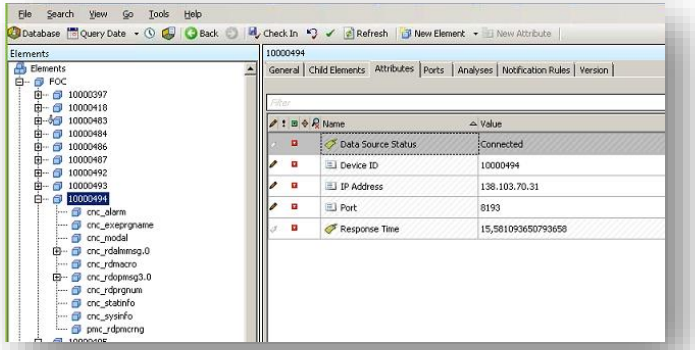
Data Collection Manager



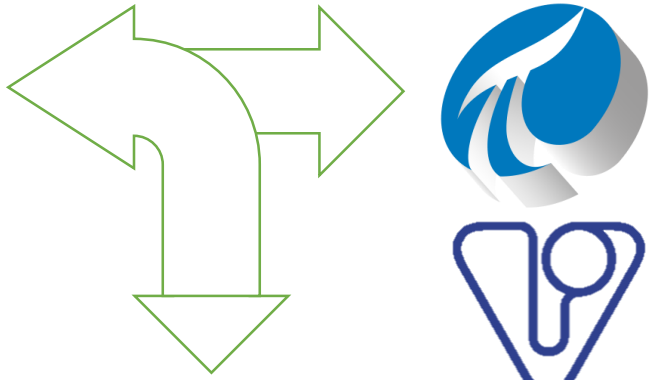
Standardize



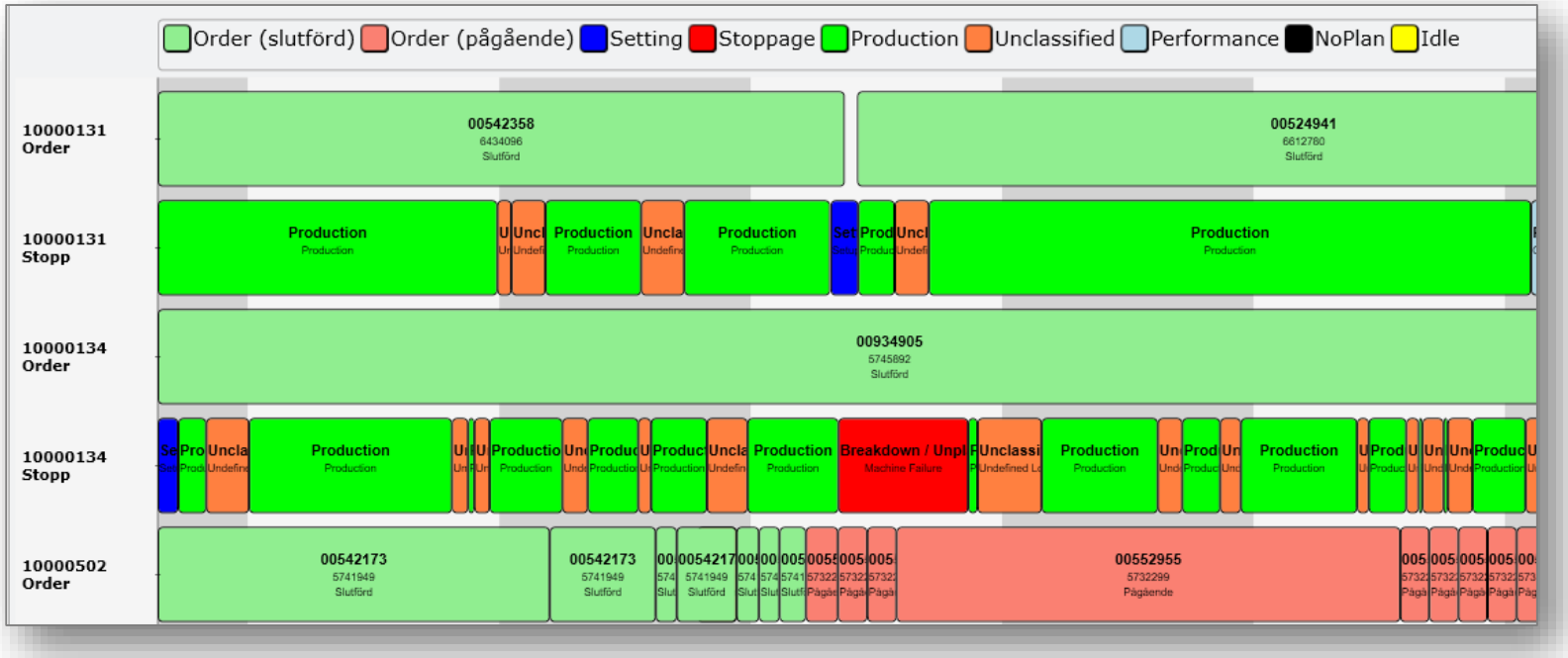
Standardized Templates

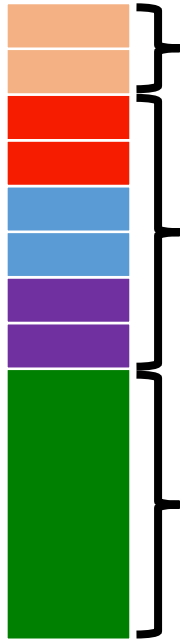


Deliver & Store



Standardized OEE Dashboard





Scheduled Losses

Six Big Losses

Full Productive Time

Improve Asset Utilization

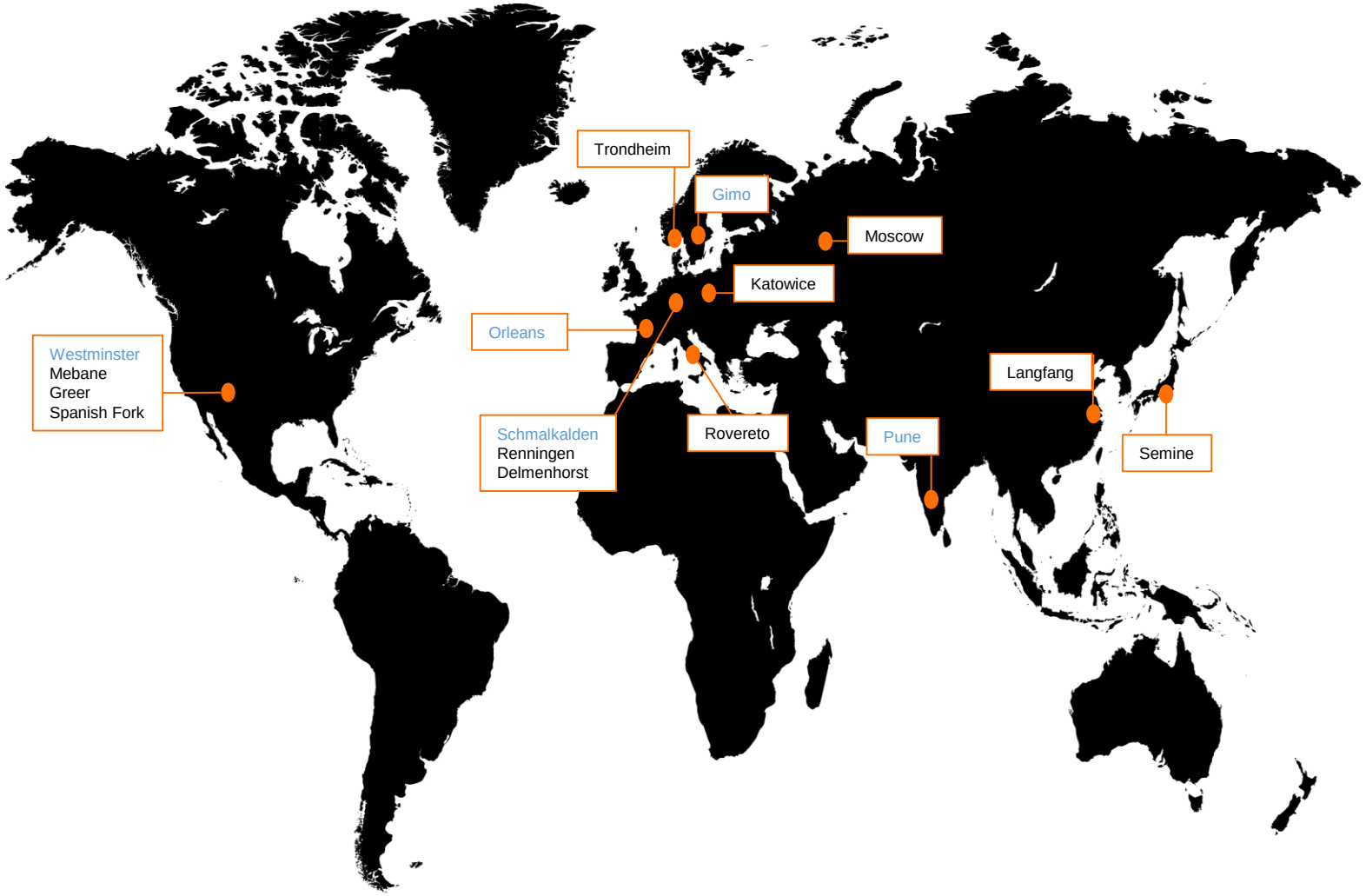
Global and Local Improvements

Real Time Feedback

PRODUCTION

8 PU’s are running system with more than 200 machines connected. Remaining machines will now be connected according to plan.

Furthermore, new business opportunities is added to original business case.



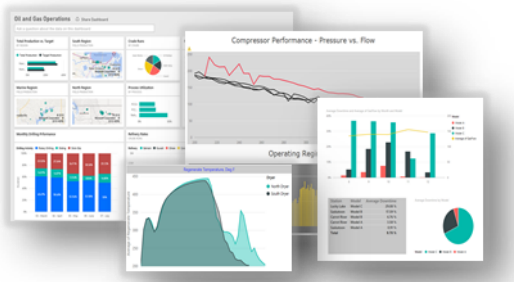
The digital journey

- Its not <only> about data collection for OEE Kpi´s.
  - Context and structure is ever so important to reach actionable insights
    - Insight requires much more structured data then OEE requires
  - Integrate into other processes; Design, planning, SCM, Order mgmt., quality, energy mgmt.
  - Keep data and logic on the appropriate ISA-95 level,
    - Edge2Cloud
- Peripheral data is becoming more and more important
- Trust the data, quality and trust in the data is very important
  - Collecting data is not the problem
  - Decisions can be more fact based
- New skillsets is needed in production to understand and draw RELEVANT conclusions

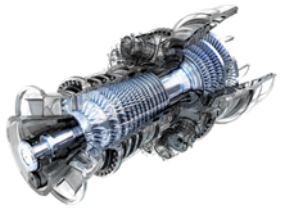
The digital journey

- Plan for a horizontal strategy and what OI data is relevant for YOUR processes
- Conclusion so far; Information drives the need for more information, and YES it should all be connected

The most likely scenario without a strategy or plan..

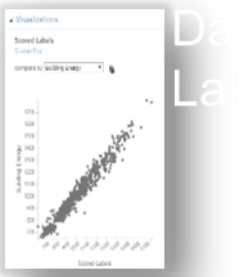


Applications

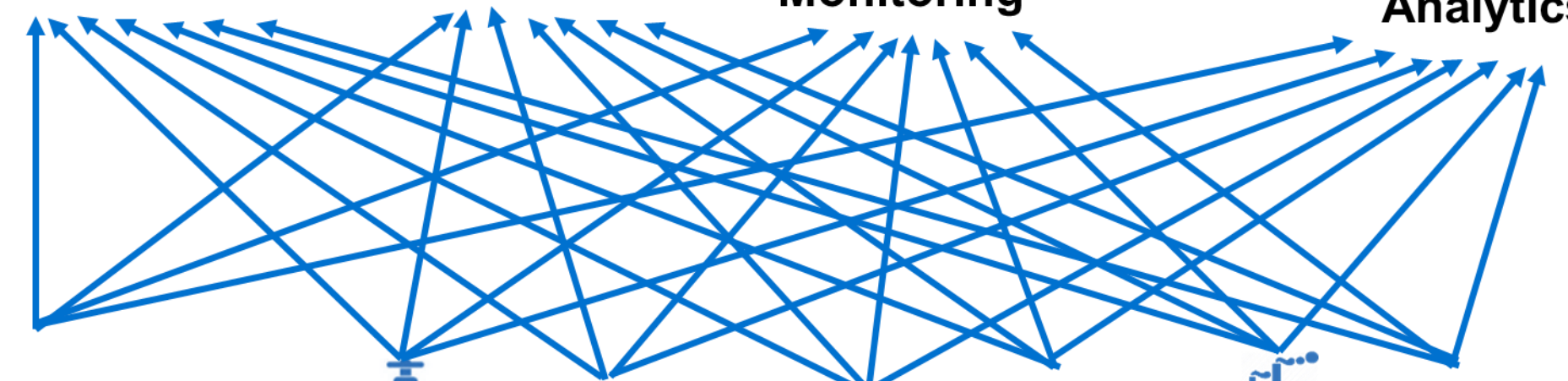


Services

Real-time Monitoring



Advanced Analytics



Devices

Assets

Site

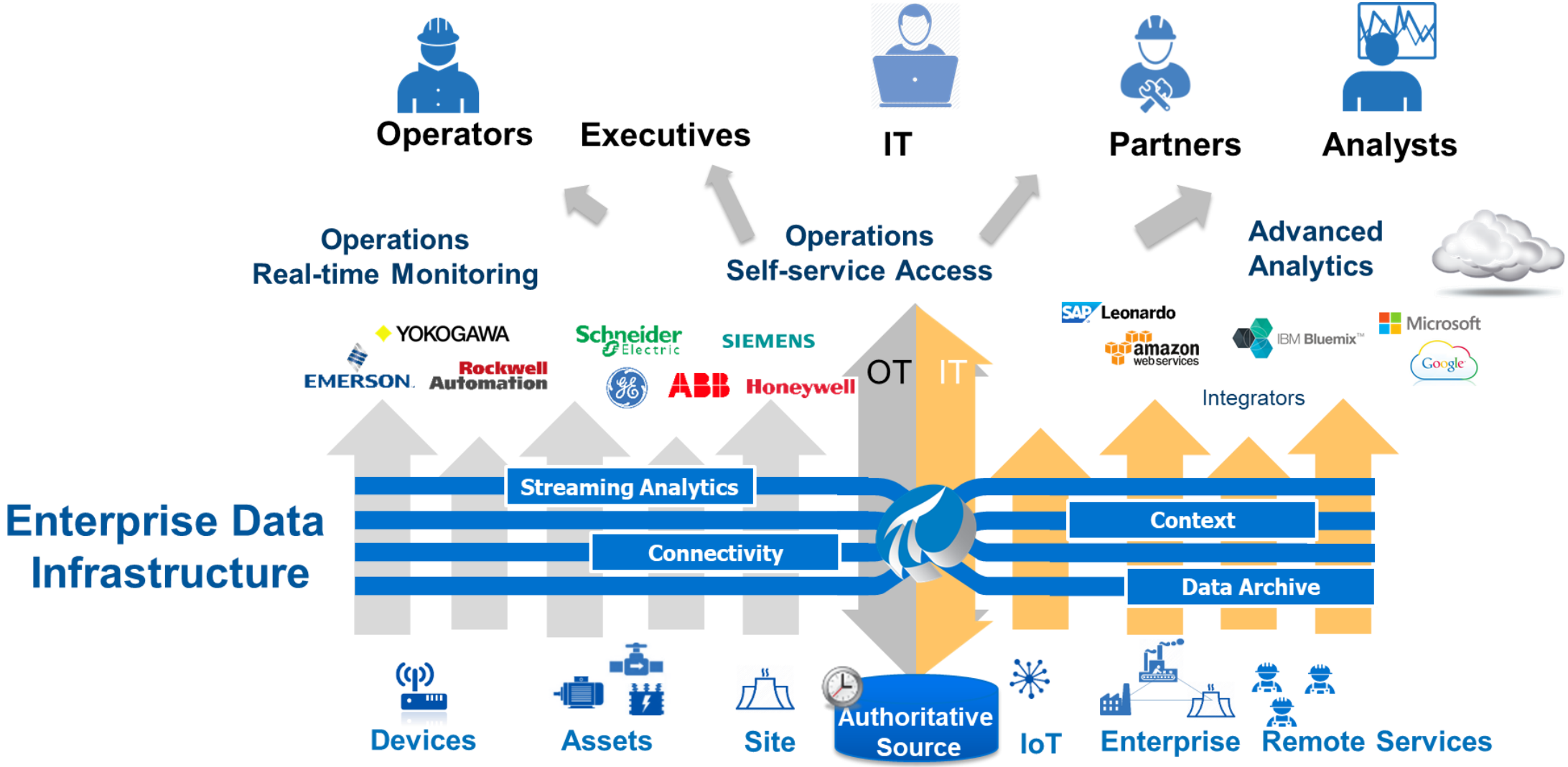
Authoritative Source

IoT

Enterprise

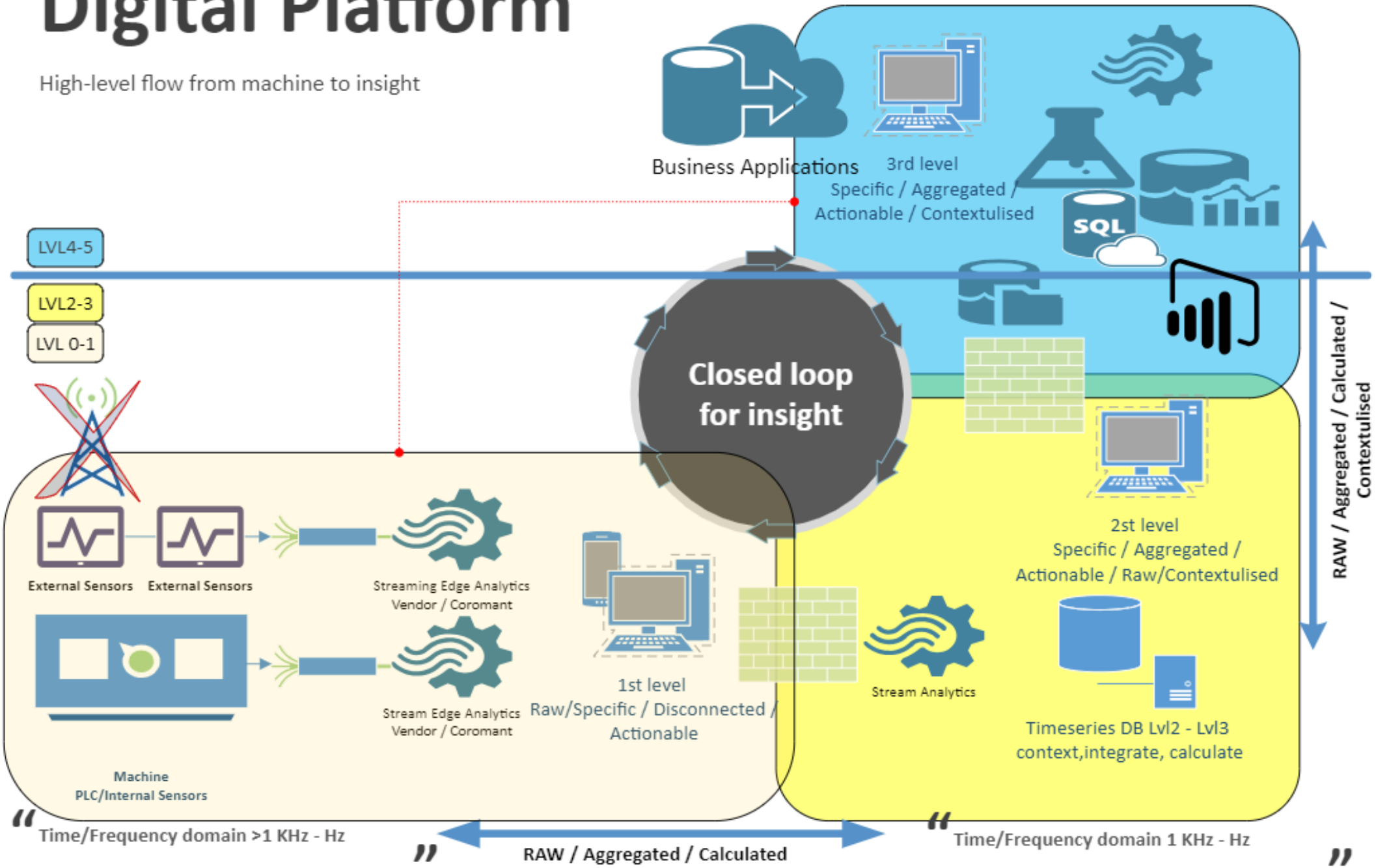
Remote Services

To a data infrastructure for digital agility



Digital Platform

High-level flow from machine to insight



Dataflow

METADATA

ERP,MES

Quality Control, ProductData..

Propagate

OEE

Visualization / Consumption

Analyze

Information with context for decision support And consumption by others

Contextualize

Raw signal data is converted into understandable information

Aggregate

Collect

Large quantities of Rawdata

SANDVIK Coromant

Transformation

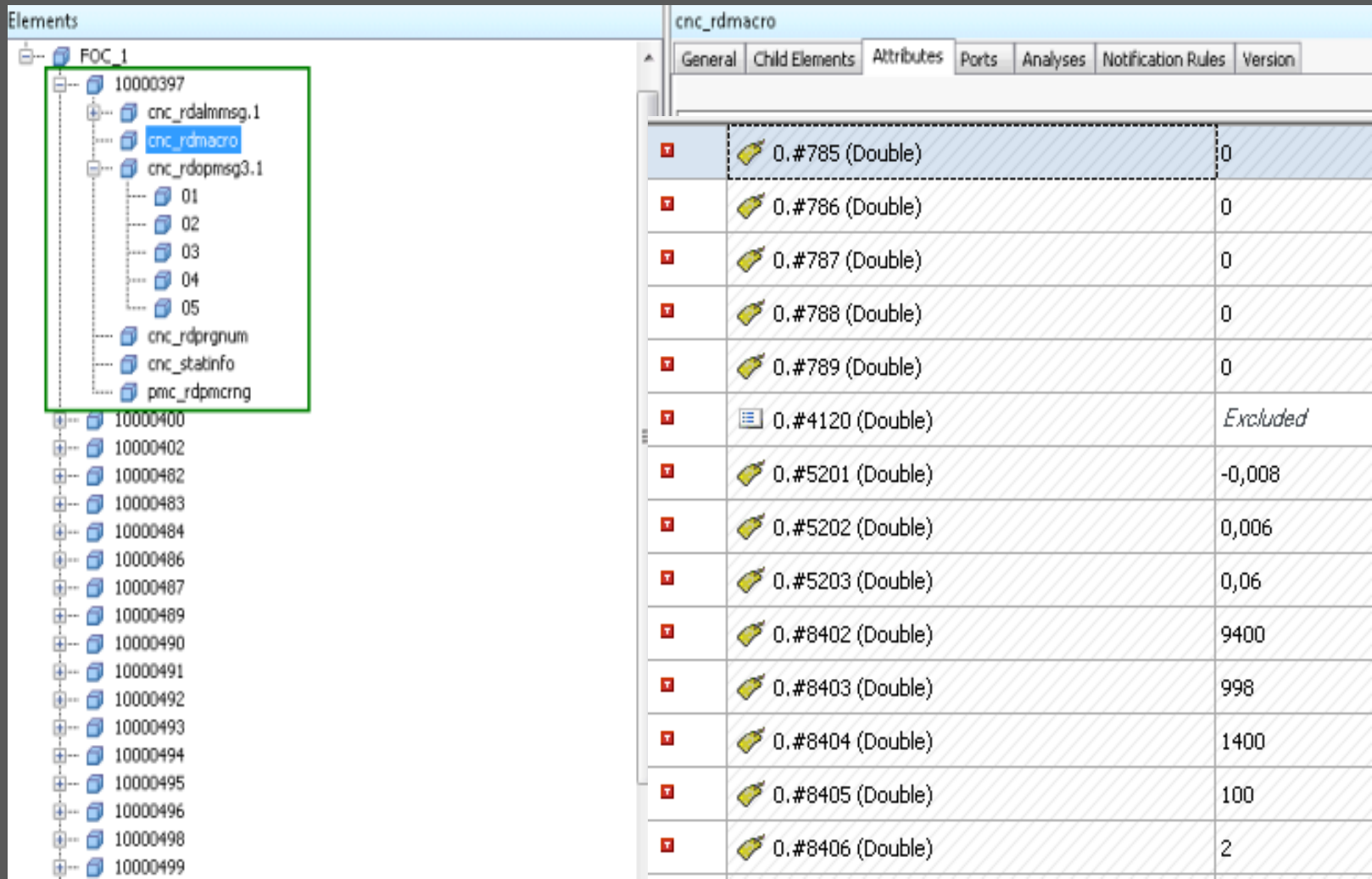
From signal to insight

Raw data

SANDVIK Coromant

Collect rawdata, used both for OEE and PDA

Only a subset is relevant for OEE, but we collect much more for CI, RCA, Analytics etc



Calculate / Transform / Contextualize

SANDVIK Coromant

10000397

General | Child Elements | Attributes | Ports | Analyses | Notification Rules | Version

Name: 10000397

Description: Stama:MC 734/M

Template: FOC_F31_1_Stama_1

Categories: Fanuc Focas;Machine Templates;Top Level

10000397

General | Child Elements | Attributes | Ports | Analyses | Notification Rules | Version

Name | Backfilling

AlarmTransfer
CycleTime
FRO
HeartBeat
MaterialID
Mode
OEECycleCo...
OEEScrapCo...
OEEStopLos...
OEEYieldCo...
OneSecTrig...
OperationID
PiecesPerCy...
ProcessStage
Production...

Name: AlarmTransfer
Description:
Categories:
Analysis Type: Expression

Evaluate

Name	Expression	Value at Evaluatio	Value at Last Trig	Output Attribute
ValueIsOKAla1	IF HasValueChanged('cnc_rdalmmsg.1|01|			Map
ValueIsOKAla2	IF HasValueChanged('cnc_rdalmmsg.1|02|			Map
ValueIsOKAla3	IF HasValueChanged('cnc_rdalmmsg.1|03|			Map

Elements

Elements
- Gimo Tools-Assembly Mark.Pack
- Gimo Tools-Capto
- Gimo Tools-Drilling tools
- Gimo Tools-Hardening Surf.Tre.
- Gimo Tools-Milling tools
  - 10000397
  - 10000402
  - 10000439
  - 10000440
  - 10000450
  - 10000455
  - 10000462
  - 10000464
- Gimo Tools-Regrind
- Gimo Tools-Turning tools

Element Searches
- Element Quick Search Results 1
- Element Quick Search Results 2
  - 10000397

10000397

General | Child Elements | Attributes | Ports | Analyses | Notification Rules | Version

Filter

Name	Value
Configuration MDC Template	FOC_F31_1_Stama_1
Description	Stama:MC 734/M:M1
EAM	Enterprise Asset Information
GMI	General Machine Interface
CONF	Configuration Attributes
ERP	Enterprise Resource Planning
MDC	Machine Data Collection
MES	Manufacturing Execution System
MII	SAP MII Integration Platform
OEE	Overall Equipment Effectiveness

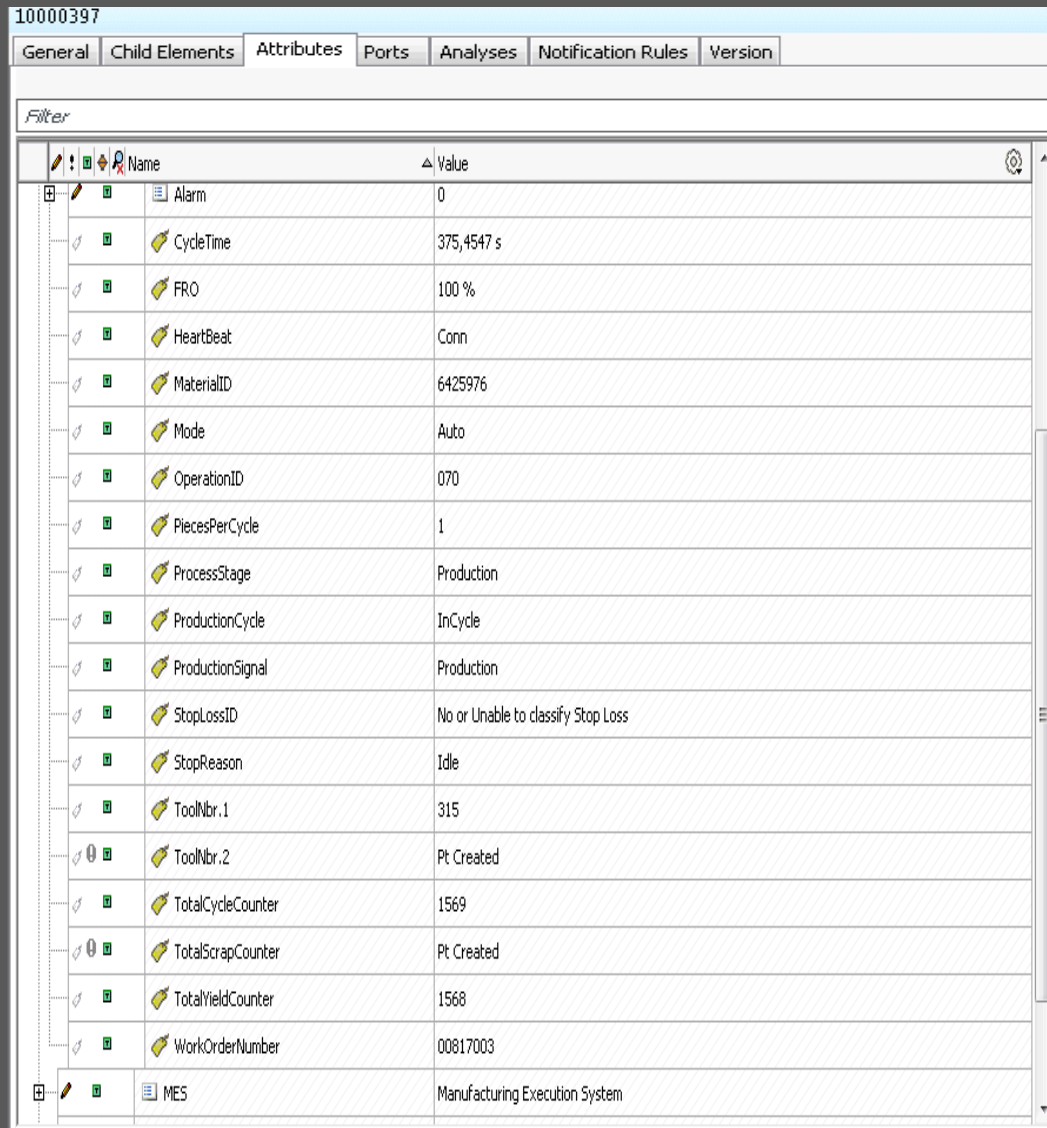
Voila! Human readable

SANDVIK Coromant

Logic implemented

With a big effort to make this reliable and trustworthy

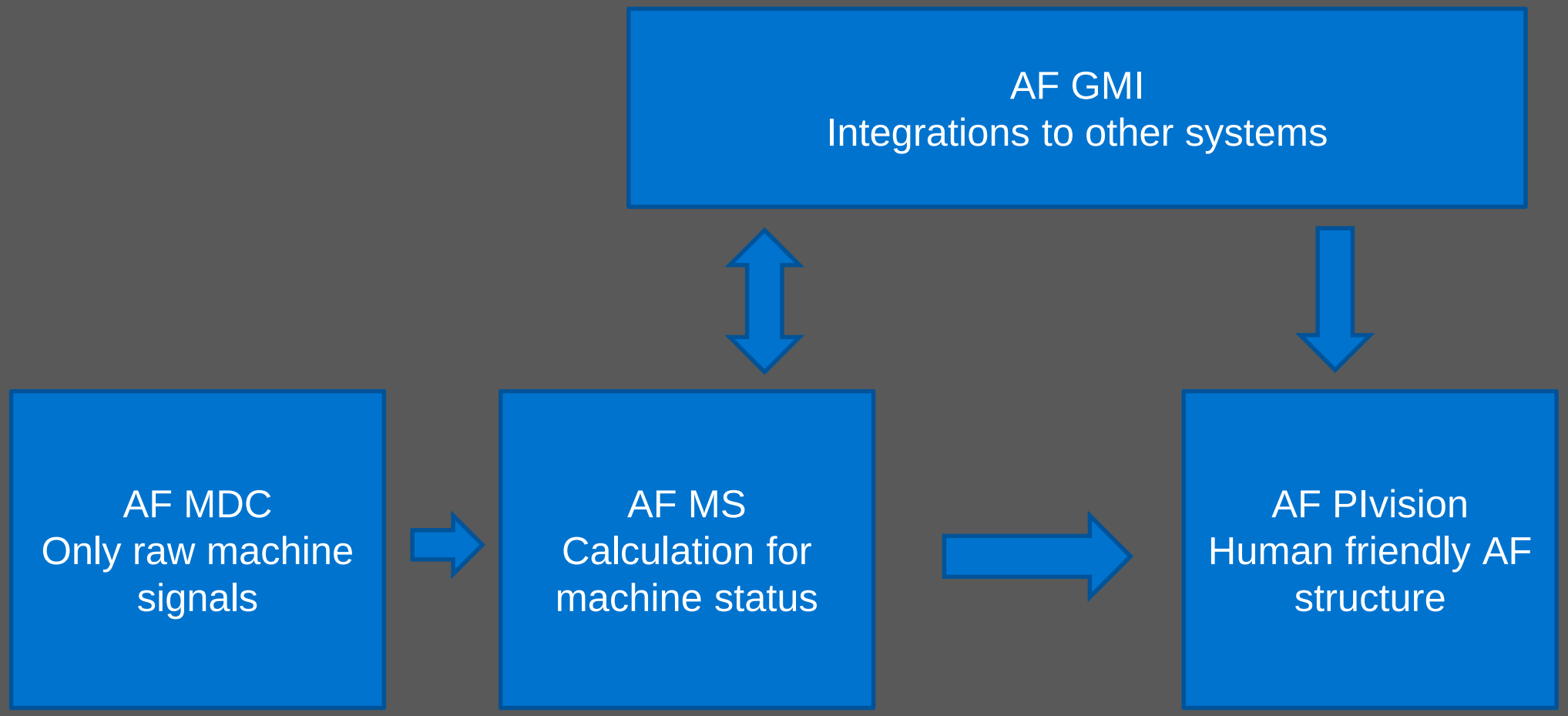
Everything from raw signal, process analytics, contextualize is done within same platform



Structure

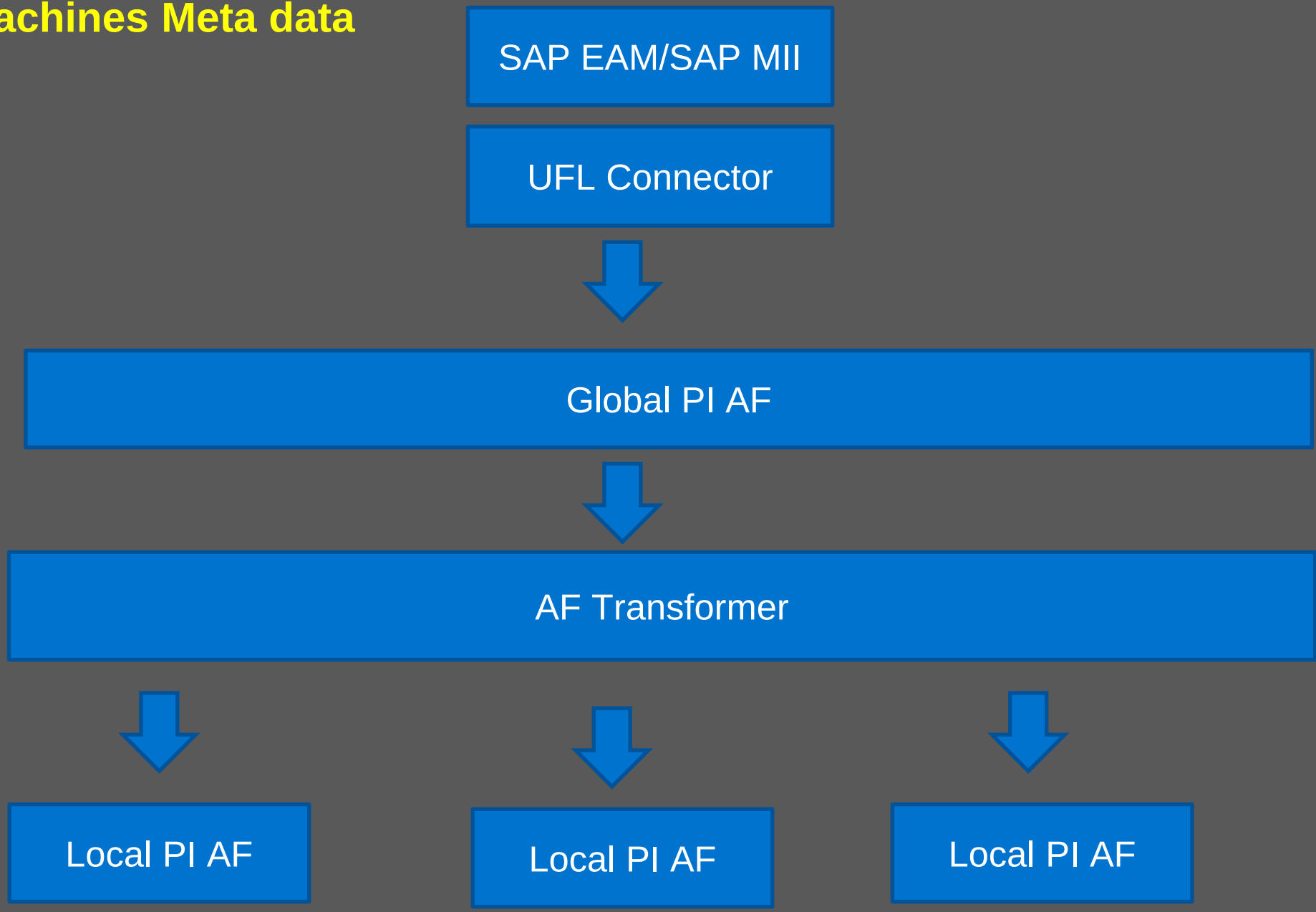
- Stabile AF/DA structure that covers both current demands but also can be expending to cover future demands.
- No islands of information is allowed to exist within PI

PI Local AF structure



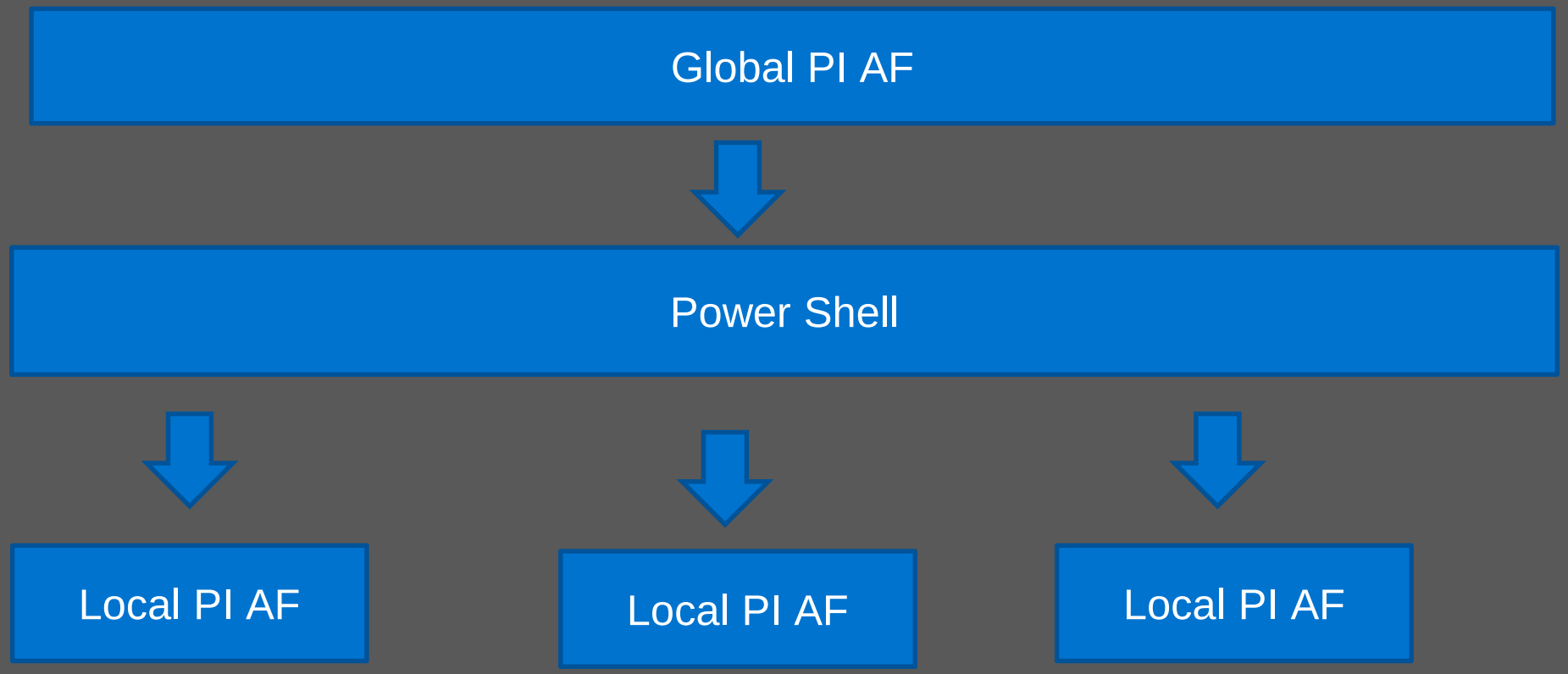
PI Global

Machines Meta data



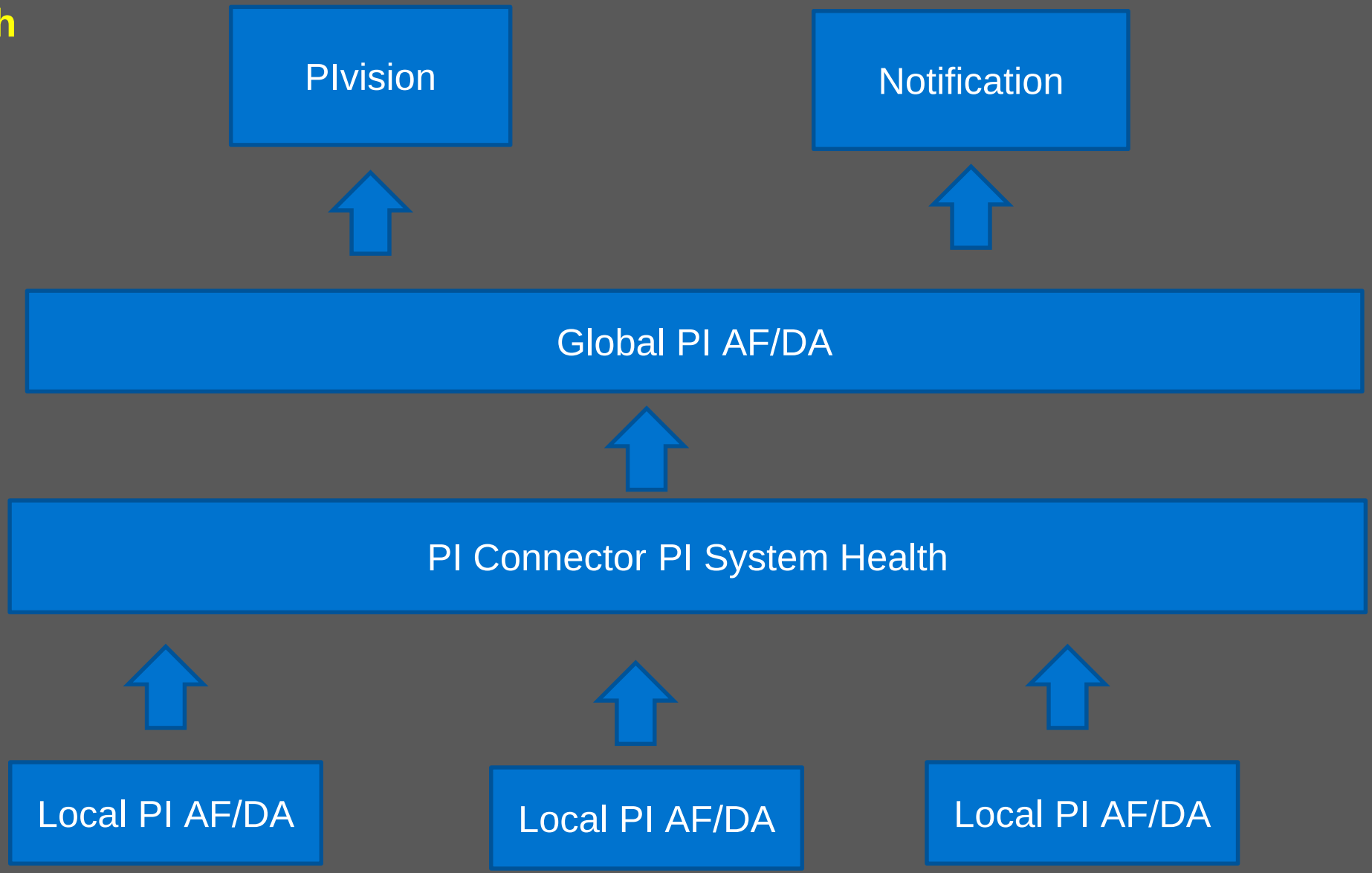
PI Global

Templates replicating



PI Global

Health



PI Vision

- AF transformer changes the AF structure to make it human friendly.
- Creates event frames based on machine stops and connect order.
- Production have started to created their own graphs / analyses with PI vision and data link. Not only OEE
- AD groups are used for security

- Datalink and PI system explorer are scripted and pushed out to end-user
- Processbook is not promoted within in Sandvik

PI Vision : Fette presses, live update

SANDVIK Coromant

OSIsoft PI Vision

New Display

Fette overview *(read-only)*

Ad Hoc D

Fette:MP 120 G1:NR 540 Line 4 Conn Cleaning No or Unable to classify Stop Loss	Fette:MP 120 G1:NR 541 Line 4 Conn Idle Setup	Fette:MP 120 G1:NR 542 Line 4 Conn Unloading No or Unable to classify Stop Loss	Fette:MP 120 G1:NR 543 Line 4 Conn Production No or Unable to classify Stop Loss
Fette:MP 120 G1:NR 544 Line 4 Conn Unloading No or Unable to classify Stop Loss	Fette:MP 120 G1:NR 545 Line 4 Conn Production No or Unable to classify Stop Loss	Fette:MP 120 G1:NR 546 Line 4 Conn Idle Setup	Fette:MP 120 G1:NR 547 Line 4 Conn Production No or Unable to classify Stop Loss
Fette:MP 120 G1:NR 551 Line 5 Conn Idle No or Unable to classify Stop Loss	Fette:MP 120 G1:NR 553 Line 5 Conn Idle Setup	Fette:MP 120 G1:NR 556 Line 5 Conn Idle No or Unable to classify Stop Loss	Fette:MP 120 G1:NR 560 Line 6 Conn Idle Setup
Fette:MP 120 G1:NR 561 Line 6 Conn Idle No or Unable to classify Stop Loss	Fette:MP 120 G1:NR 562 Line 6 Conn Idle Setup	Fette:MP 120 G1:NR 563 Line 6 Conn Production No or Unable to classify Stop Loss	Fette:MP 120 G1:NR 564 Line 6 Conn Idle Setup
Fette:MP 120 G1:NR 565 Line 6 Conn Cleaning No or Unable to classify Stop Loss	Fette:MP 120 G1:NR 566 Line 6 NoConn Idle Setup	Fette:MP 120 G1:NR 567 Line 6 Conn Idle Setup	Fette:MP 120 G1:NR 590 Line 9 Conn Production No or Unable to classify Stop Loss
Fette:MP 120 G1:NR 591 Line 9 Conn Inspection No or Unable to classify Stop Loss	Fette:MP 120 G1:NR 594 Line 9 Conn Inspection No or Unable to classify Stop Loss	Fette:MP 120 G1:NR 595 Line 9 Conn Inspection No or Unable to classify Stop Loss	Fette:MP 120 G2:NR 550 Line 5 NoConn Idle Setup
Fette:MP 120 G2:NR 552 Line 5	Fette:MP 120 G2:NR 554 Line 5	Fette:MP 120 G2:NR 555 Line 5	Fette:MP 120 G2:NR 557 Line 5

PI Vision : Machine details

SANDVIK Coromant

OSIsoft PI Vision

Fette detail *(read-only)* Asset: Fette:MP 120 G1:NR 542 ▼

Machine: Fette:MP 120 G1:NR 542

Go back

Order information

BrandCode
COR

ProductCode
880-01 02 03H-C-GR

WorkOrderNumber
00805651

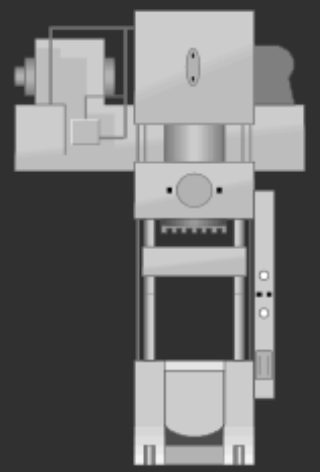
CAPP.Family

MaterialID
5765556

DesignCycleTime
381,02 s

Cycle time

Value ▲	Units	Trend ▲	Minimum	Maximum	Range
2,2608	s		0,076645	4,8315	4,7548



Machine Status

ProductionSignal
Idle

ProcessStage
Unloading

StopLossID
No or Unable to classify Stop Loss

CycleTime
2,2608 s

HeartBeat
Conn

Machine Information

Manufacturer Of Asset
Fette

Equipment Number
10000082

Inventory Number
11199100-00

Construction Year
2004

Machine Group
Line 4

Context
Integration to ERP / MES

- Machines information from SAP EAM
  - SAP MII sends information to PI UFL Connector REST

- Product/Order Information from SAP PLM / MES
  - Plantperformance write/read information to PI by AF SDK

Connectors

- Fanuc Focas
- Siemens RPC Sinumerik
- MTconnect
- OMF (OSIsoft Messaging Format)
- OPC UA
- UFL
- PI System Health

Interface

- Relational Database (RDBMS via ODBC)
- Modbus
- OPC DA

Connectivity in POC

- Connector IEC61850
  - Facility
- Connector BACnet
  - Facility
- Connector MQTT
  - Machine connectivity
- EtherNet/IP
  - Vibrations sensors
  - Issue! Connector doesn’t to support being master not only slave
- Foglamp
  - Edge/Sensors
  - Modbus

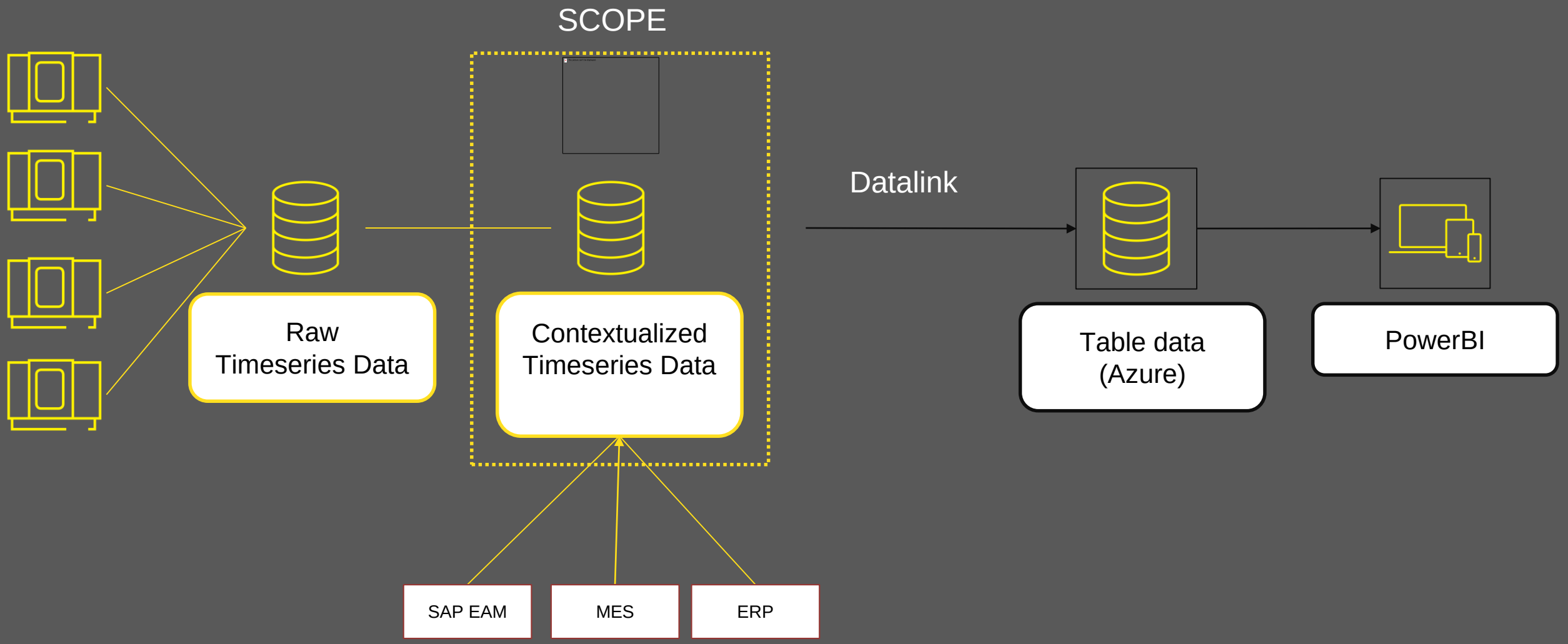
Roadmap (example)

- Sensors
  - Sensor with IO-link
  - Include the signals in existing AF structure
  - Vibrations
- Facility (Green Factory)
  - Facility meta data will be mastered in SAP EAM
  - The AF structure will combine facility signals with machine signals.
- Implement PI in powder manufacturing

Production Reports

BI Integration

Solution Overview



All reports is sliceable and possible to drilldown in most visuals

User cases examples

Be able to see on which product where the machine started to used a new cutting tool.

Spindle load compare with article and current NC row.

Verify that optimal model of trays are used during pressing.

Challenges

- Security
- Resources
- OEE rollout, timeline and resources
- Scope creep in project (PI)
- Connectivity (Allot of protocol to cover)
- Amount of Event frames in SQL database
- Several analytics server against on AF server

Roadmap PI

- Expand functionality to more than only OEE
- Tighter integration with SAP MII
- Implementing more types of connectors/Interface
- Connection to more production related systems
- Green Factory
- Machine learning and AI based on data from PI

Global OEE system at Sandvik Coromant

COMPANY and GOAL

Supporting tool for production units showing how expensive CNC machines are used and what losses we have in each area.

CHALLENGE

Collect and consolidate data from multiple systems, machines and sites and display result that gives operators and change leaders a visual view over how each machine is used in real time or in the past.

SOLUTION

Combining flexible interchangeable components that we can grow and move as the organization changes. Tracebility on machines and data is also vital.

RESULTS

Clear data that change leaders can act on.

- We expect to gain a minimum of 1% per machine and year in improved OEE on all machines.
- Future possibilities with PI that was not fully known as the project started.

QUESTIONS?

SANDVIK
Coromant

Contact Information

Conny Söderlund

Conny.soderlund@sandvik.com

IT Process Manager

Sandvik Coromant

Questions?

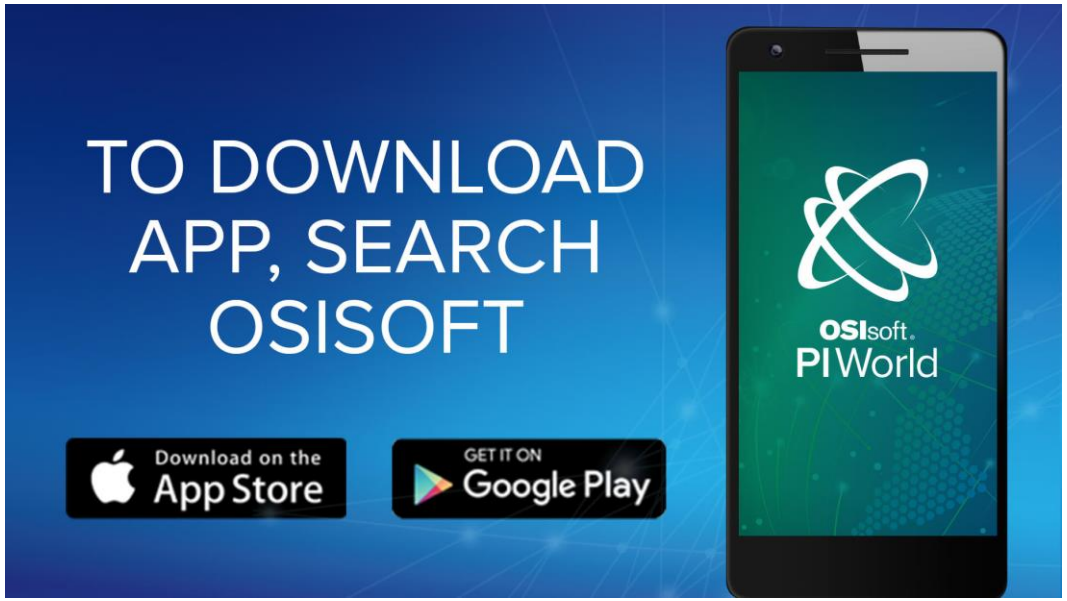
Please wait for the **microphone**

State your **name & company**

Please remember to…

Complete Survey!

Navigate to this session in mobile agenda for survey



Thank You