

Intelligent Asset Management



Intelligent Asset Management

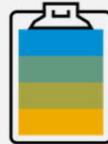
Trends

Digital readiness surveys show that companies clearly see the need to leverage the digital capabilities to optimize their asset management:



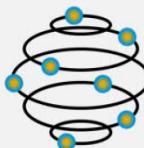
76%

of organizations consider it important to **predict potential failures** by leveraging data models



21%

Only 21% of organizations employ **predictive and preventive maintenance** effectively



83%

of organizations consider it important to have asset management processes and related metrics standardized across facilities and regularly tracked



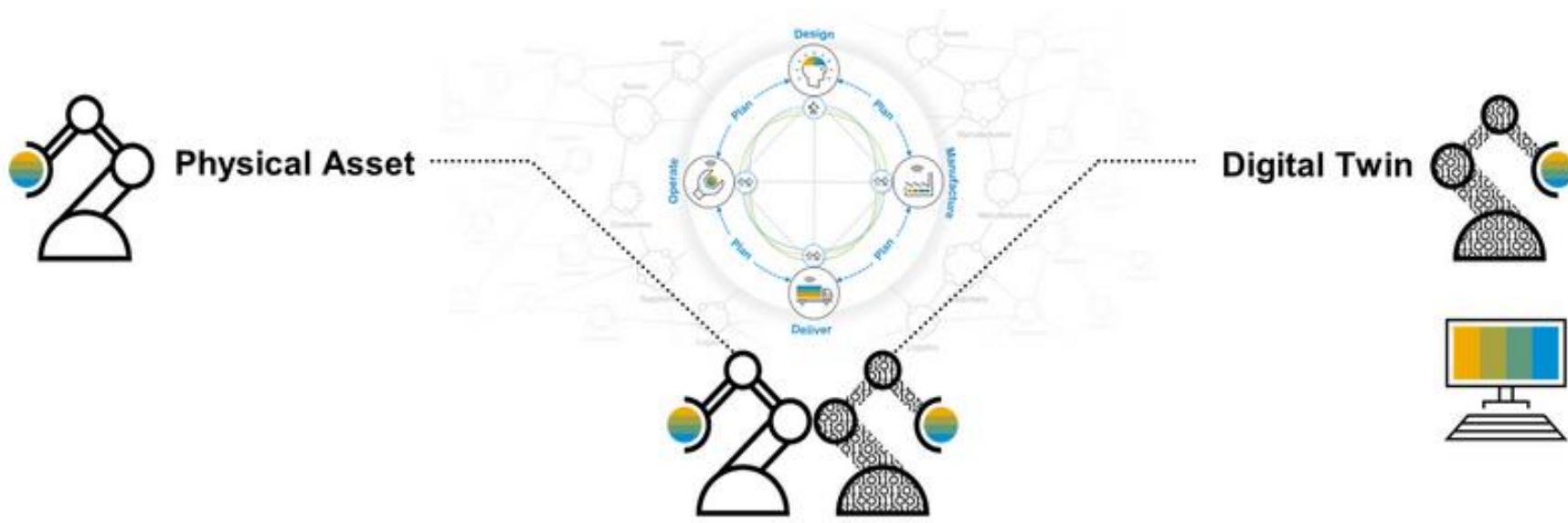
13%

Only 13% of organizations are able to drive asset performance based on analysis of real-time sensor data, along with historical maintenance data

Source: Business Performance Benchmarking by SAP 2017

Intelligent Asset Management

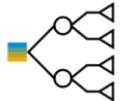
Digital Twin



Intelligent Asset Management

Capabilities

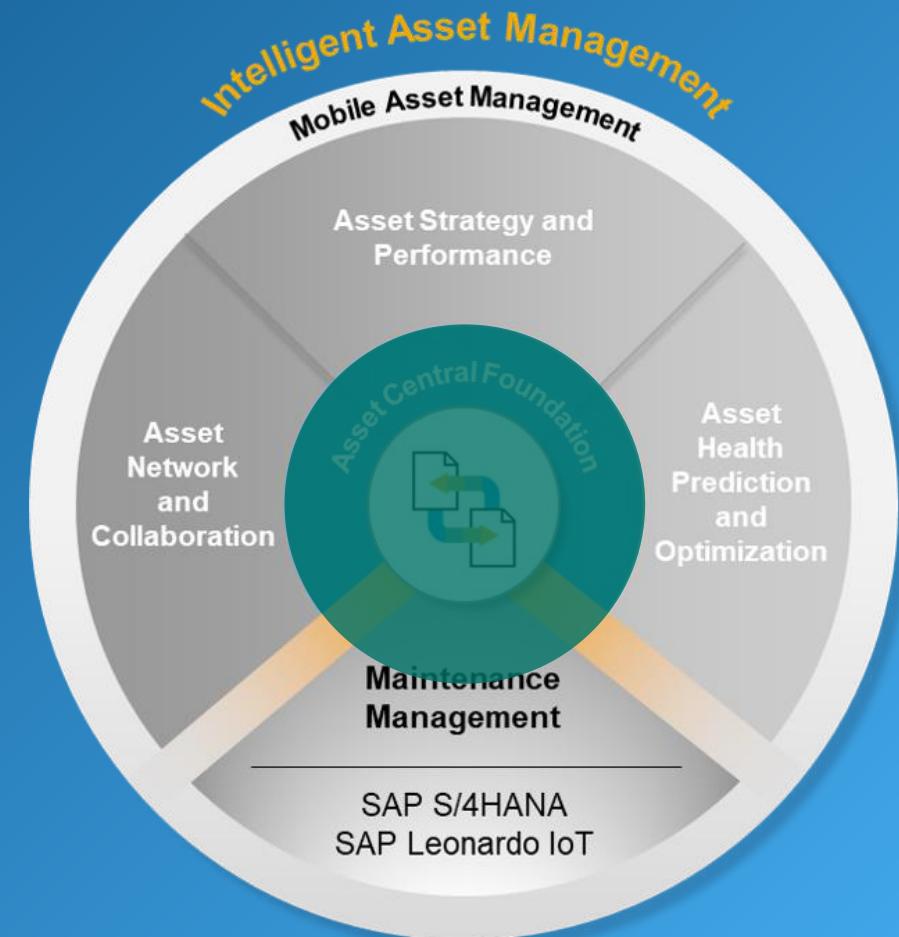
Cloud oplossing met nieuwe functionaliteiten:

-  Nieuw data model en centrale plek voor asset data, geïntegreerd met S/4HANA & ECC
-  Het delen van asset gegevens met partners. Eén actuele versie / digital twin.
-  Real-time informatie & IoT. Voorspellen van storingen
-  Bepalen van asset strategieën aan de hand van risico methodieken
-  Mobiele applicatie voor melding en werkorderafhandeling



2. Asset Central Foundation & integratie

Intelligent Asset Management



Asset Central Foundation

■ Centrale plek voor asset data

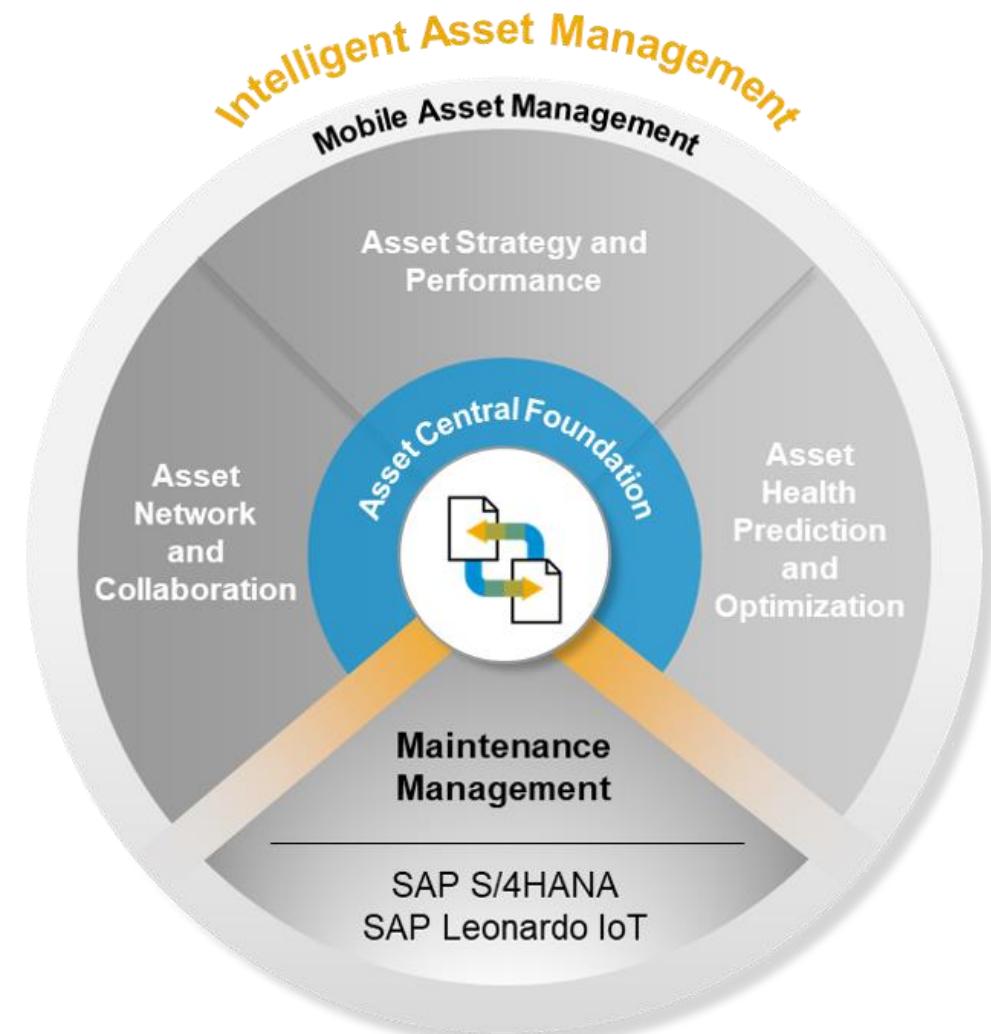
- Basis voor alle oplossingen in IAM suite
- Eenvoudig te delen met partners

■ Verbeterd en gestructureerd data model

- Classificatie a.d.h.v. industry standard ISO 14224
- Volledige asset informatie voor elk asset management scenario
- Verbeterde user experience

■ Integratie

- Met SAP ECC & S/4HANA
- Andere IoT oplossingen
- Synchronisatie met EAM objecten
 - Functieplaats
 - Equipment
 - Meldingen
 - ...

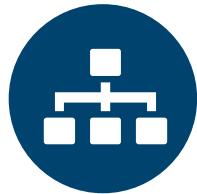


Asset Central Foundation

Taxonomie

ACF gebruikt een nieuw gestructureerd data model gebaseerd op biologische taxonomie.

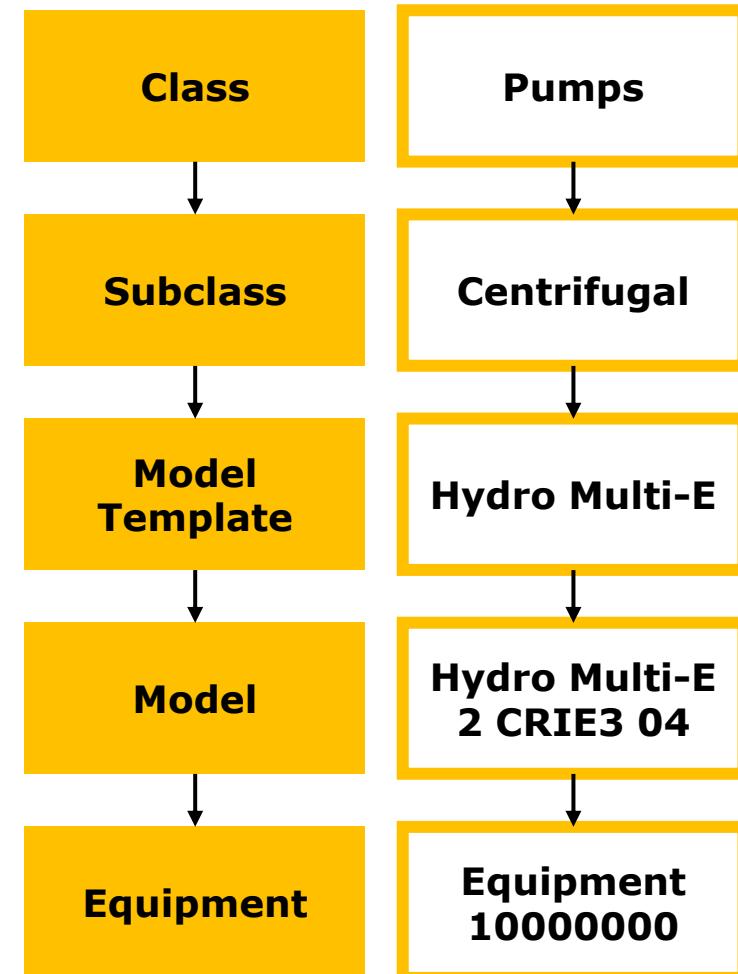
De bekendste taxonomie in de biologie is *Systema Naturae*. Elk niveau erft steeds alle kenmerken over van de niveaus erboven.



Elk niveau is volledig omvat in het niveau erboven.

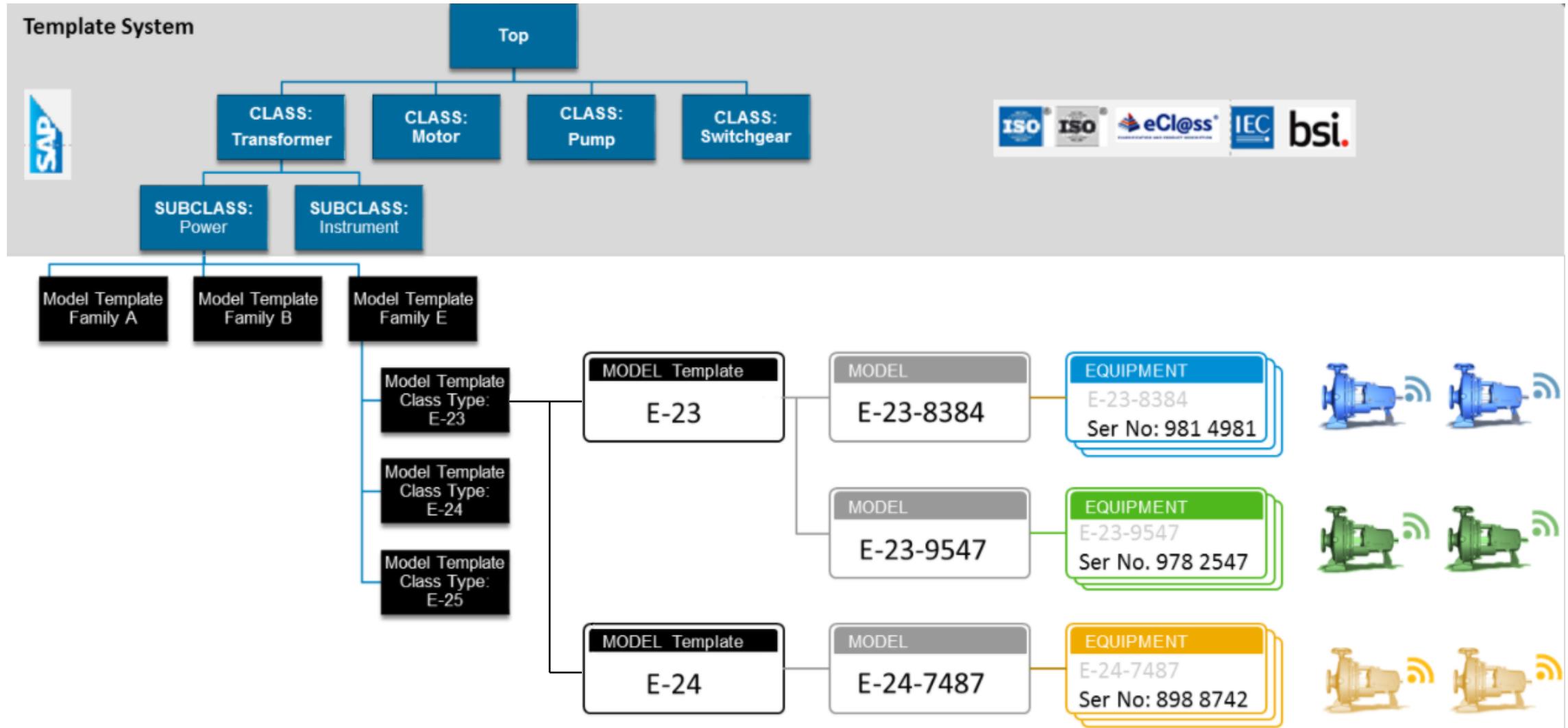


Niveaus worden steeds specifieker van boven naar beneden.



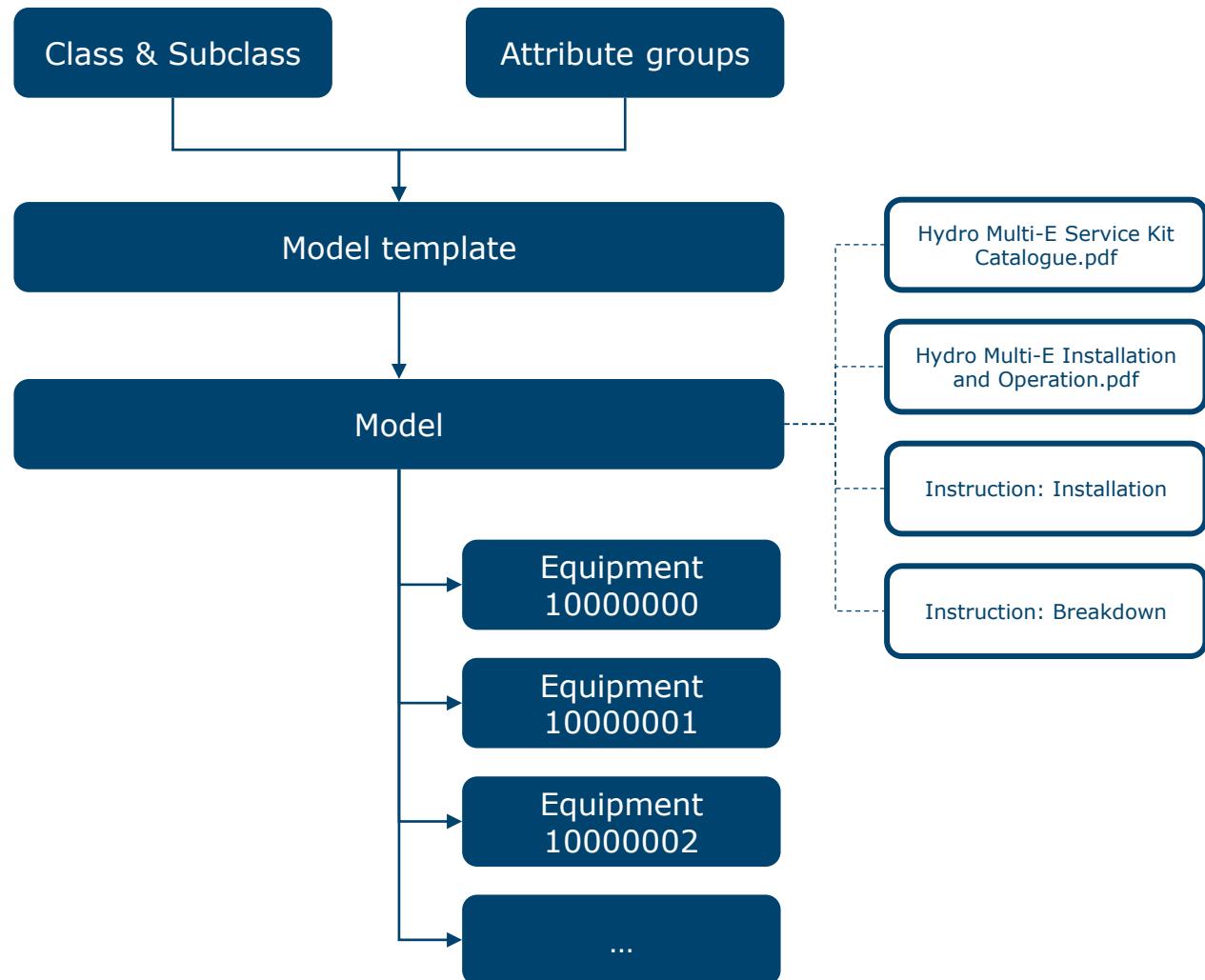
Asset Central Foundation

Taxonomie



Case – nieuw type pomp

Equipment



Hydro Multi-E 2 CRIE3 04



Kenmerken

- Manufacturer
- Power = 50 KW
- Speed = 1400 RMP
- Impeller type = open
- ...

Documenten

- Installation
- Service Kit
- ...

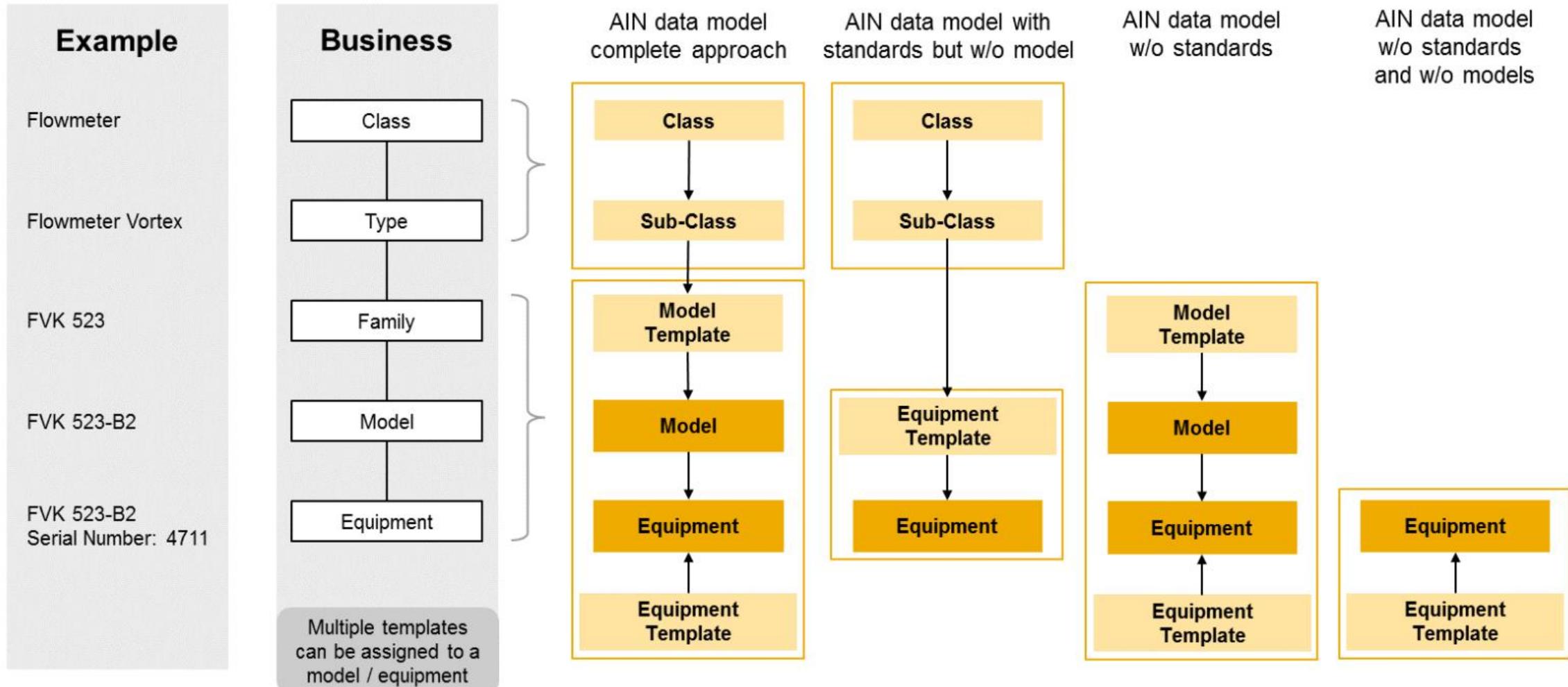
Instructies

- Installatie
- Breakdown
- ...



Data Model

Mogelijkheden

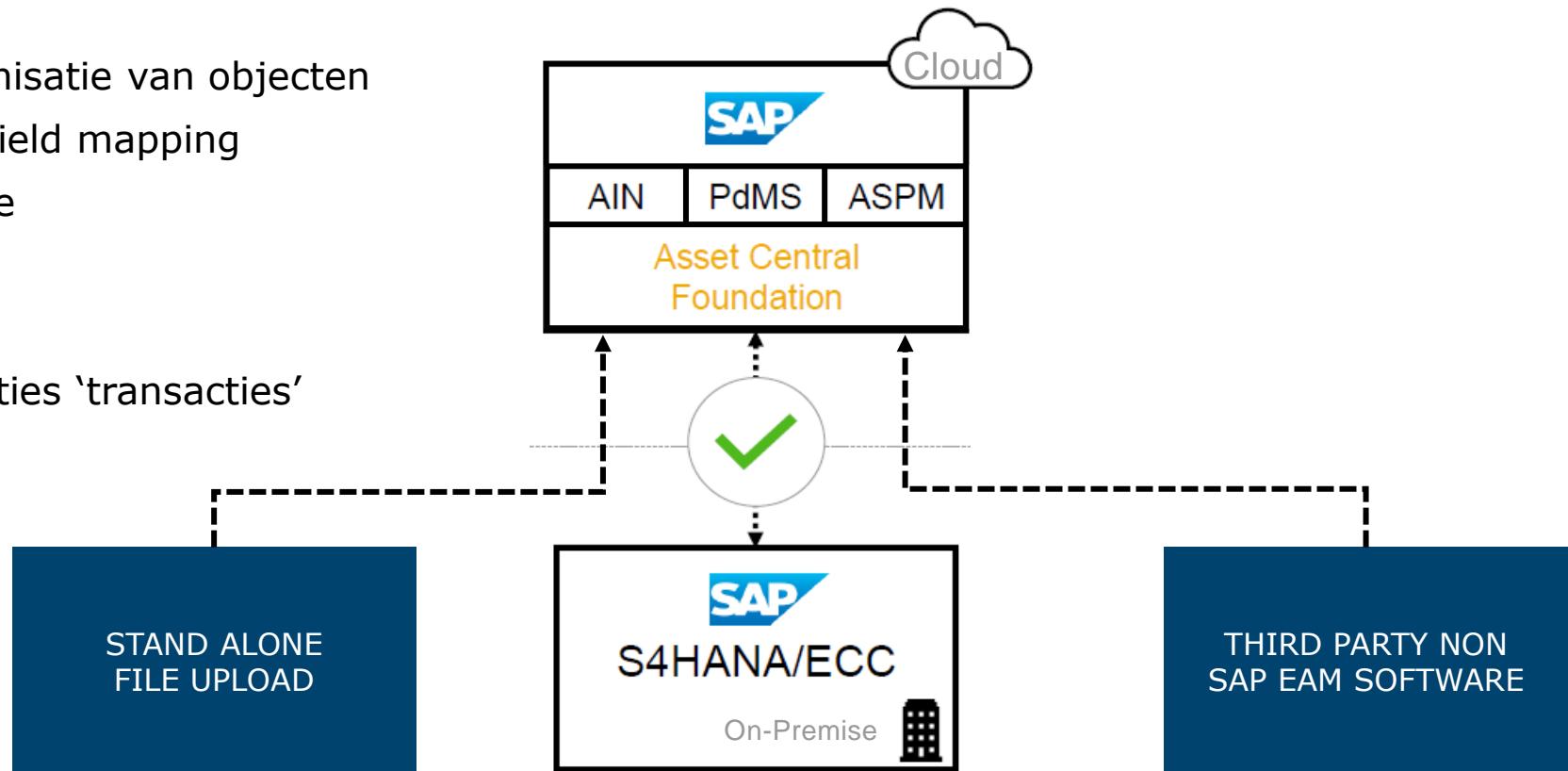


Integratie ACF – S/4HANA & ECC

Integratie architectuur

Functionaliteiten:

- Real time, bi-directionele synchronisatie van objecten
- Synchronisatie obv data filters & field mapping
- Configuratie en monitoring console
 - Configuratie van integratie
 - Bekijk de gelinkte objecten
 - Opvolging van alle synchronisaties 'transacties'
- Verschillende integratie methodes

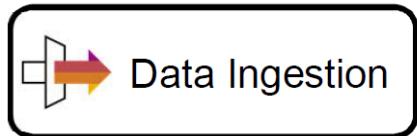


Supported Releases – **S/4 HANA On Premise 1709 & above, ERP Enhancement package 6 & above.**



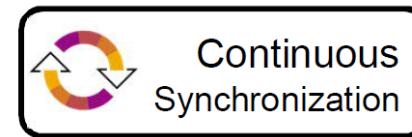
Integratie ACF – S/4HANA & ECC

Methodes



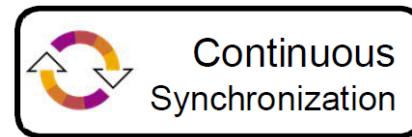
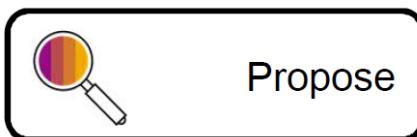
Initial Load:

- Opladen van SAP ERP data in ACF via het schedulen van initial loads
- One-time actie



Real time sync:

- Automatische synchronisatie van nieuw aangemaakte objecten en wijzigingen
- Continue proces

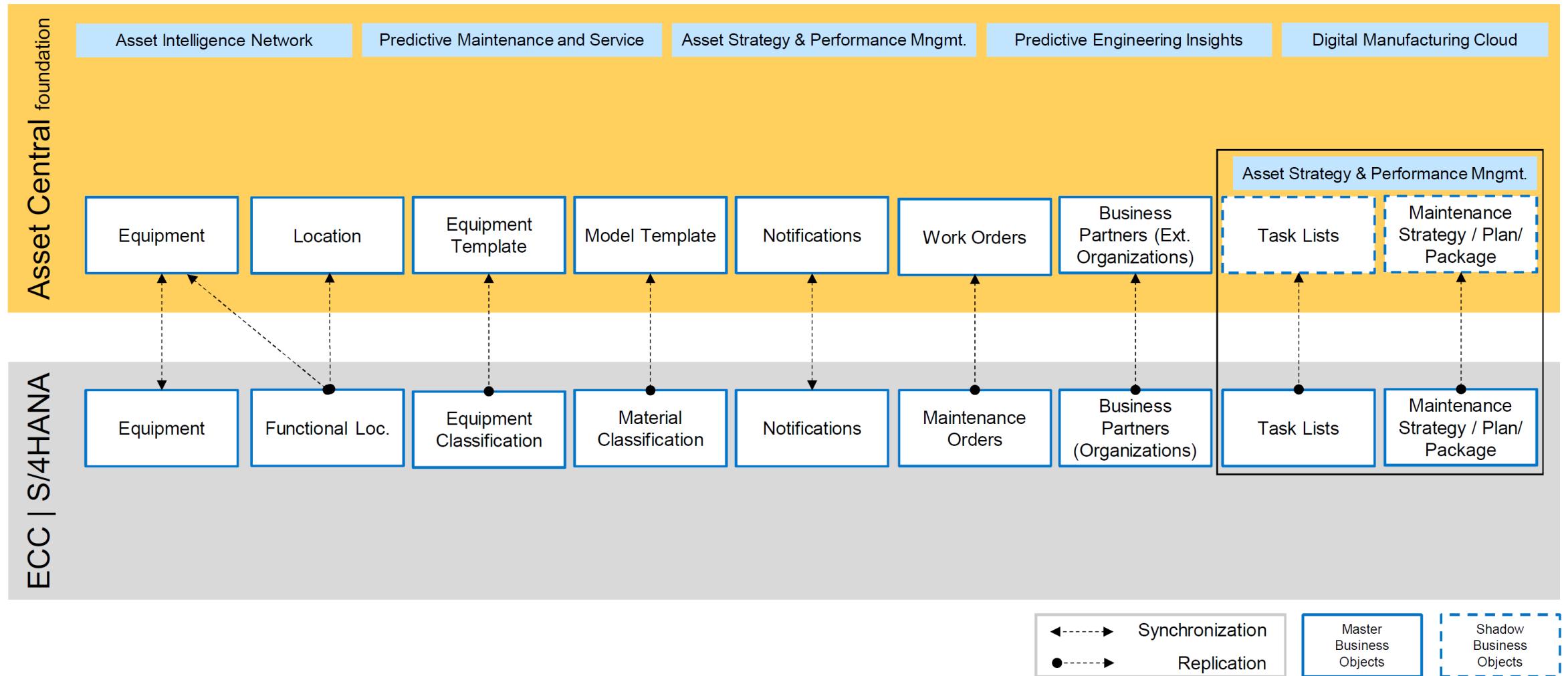


Propose & link:

- Manueel linken tussen 2 bestaande ACF/ERP objecten
- Via standaard programma's

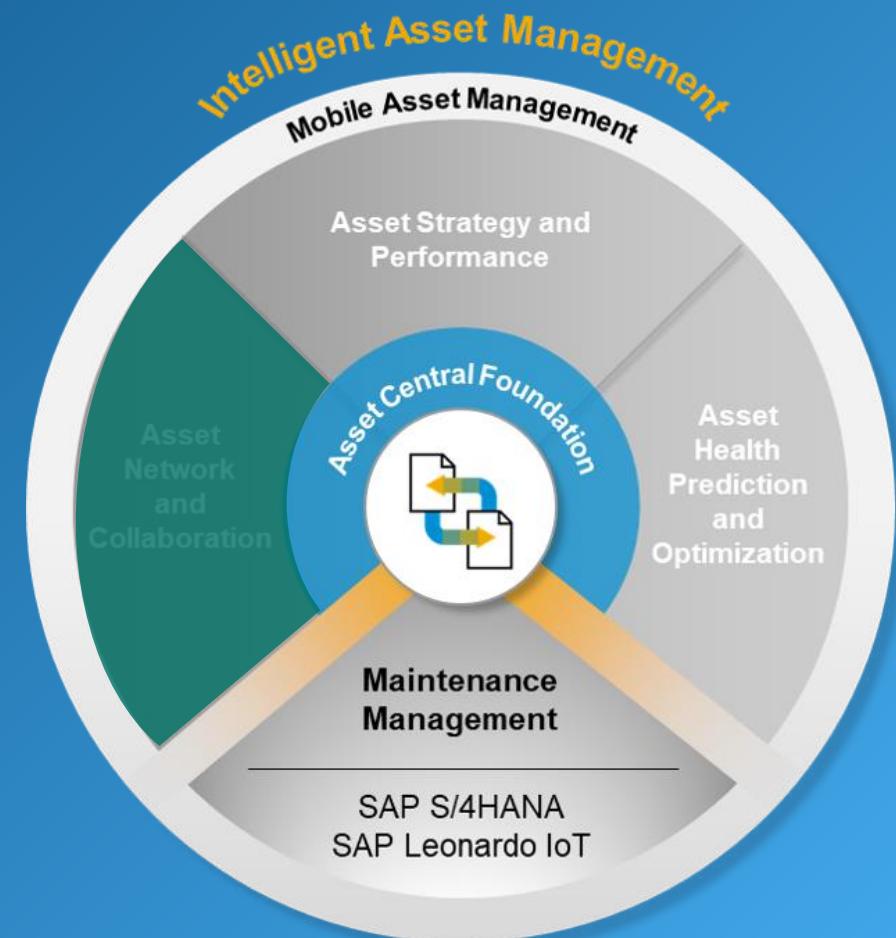
Integratie ACF – S/4HANA & ECC

Mapping PM objecten naar ACF



3. Asset Network & Collaboration

Intelligent Asset Management



Asset Intelligence Network

Netwerk voor samenwerking met business partners



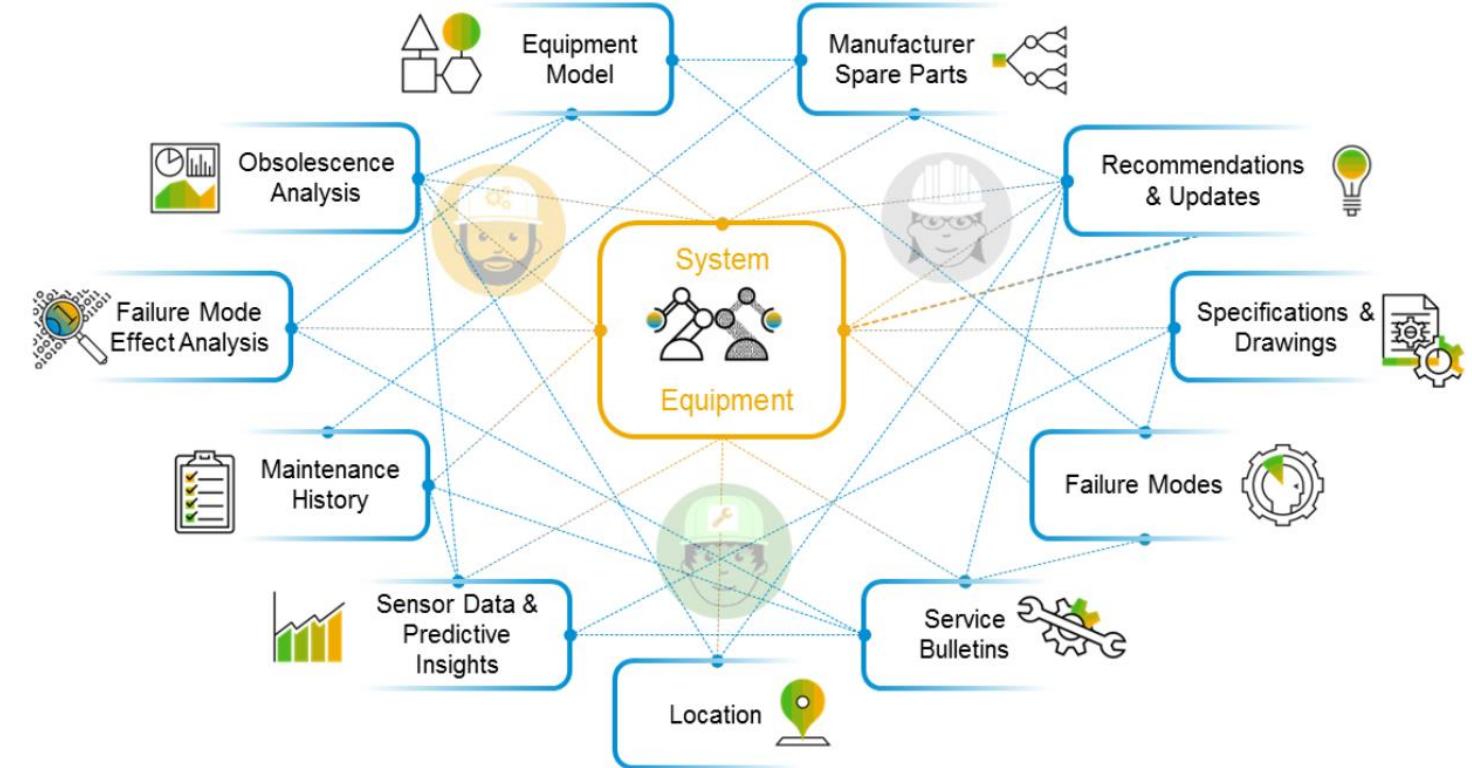
Manufacturer, Service Provider, Operator,...



Data betrouwbaarheid

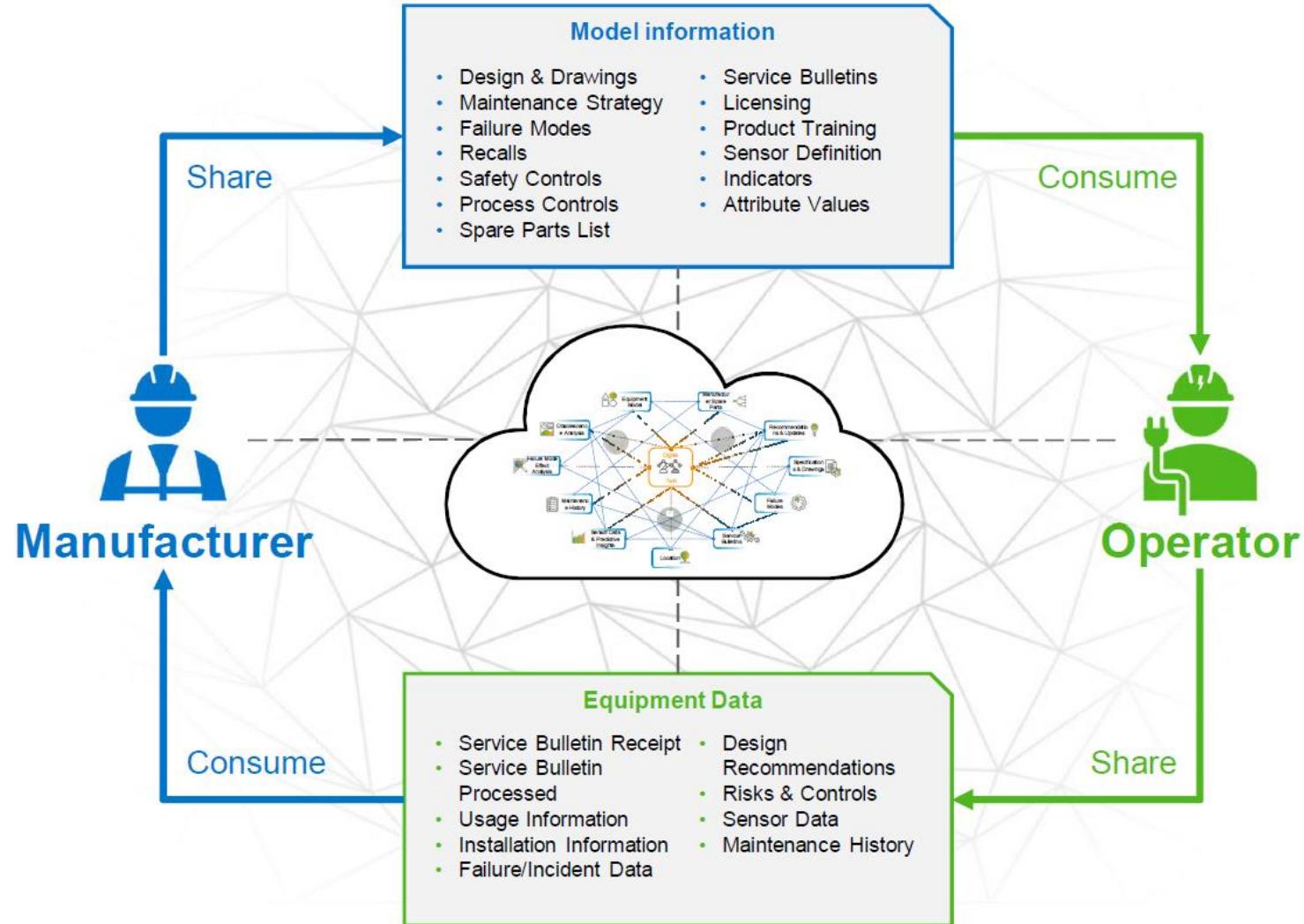


Single version of the truth



Asset Intelligence Network

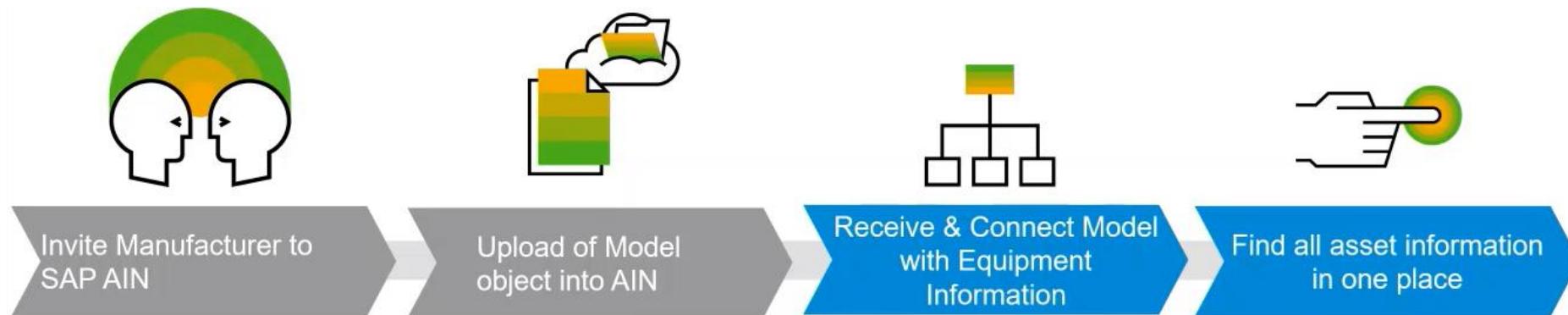
Wie levert wat?



Scenario's

Brownfield

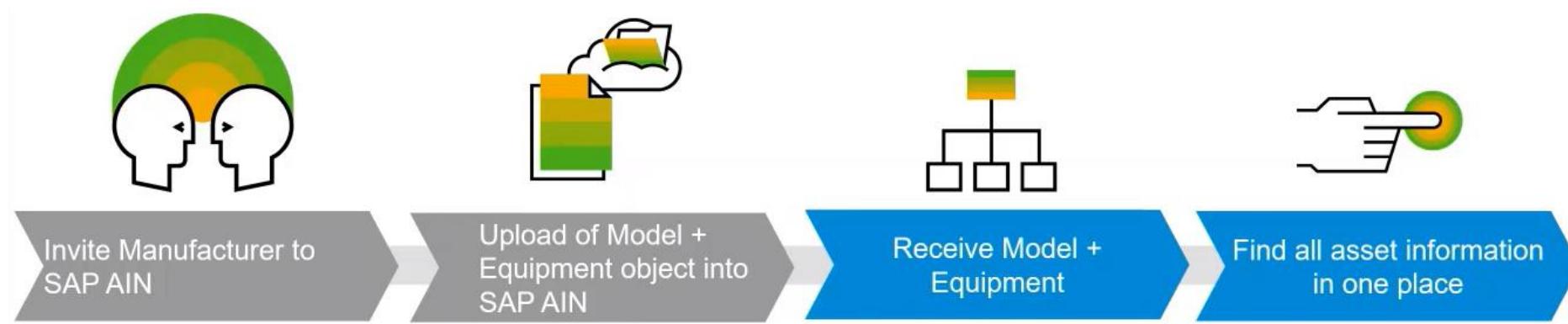
- Aanvullen van bestaande Master Data
- 2 opties
 1. Model sharing vanuit manufacturer
 2. Model request vanuit Operator



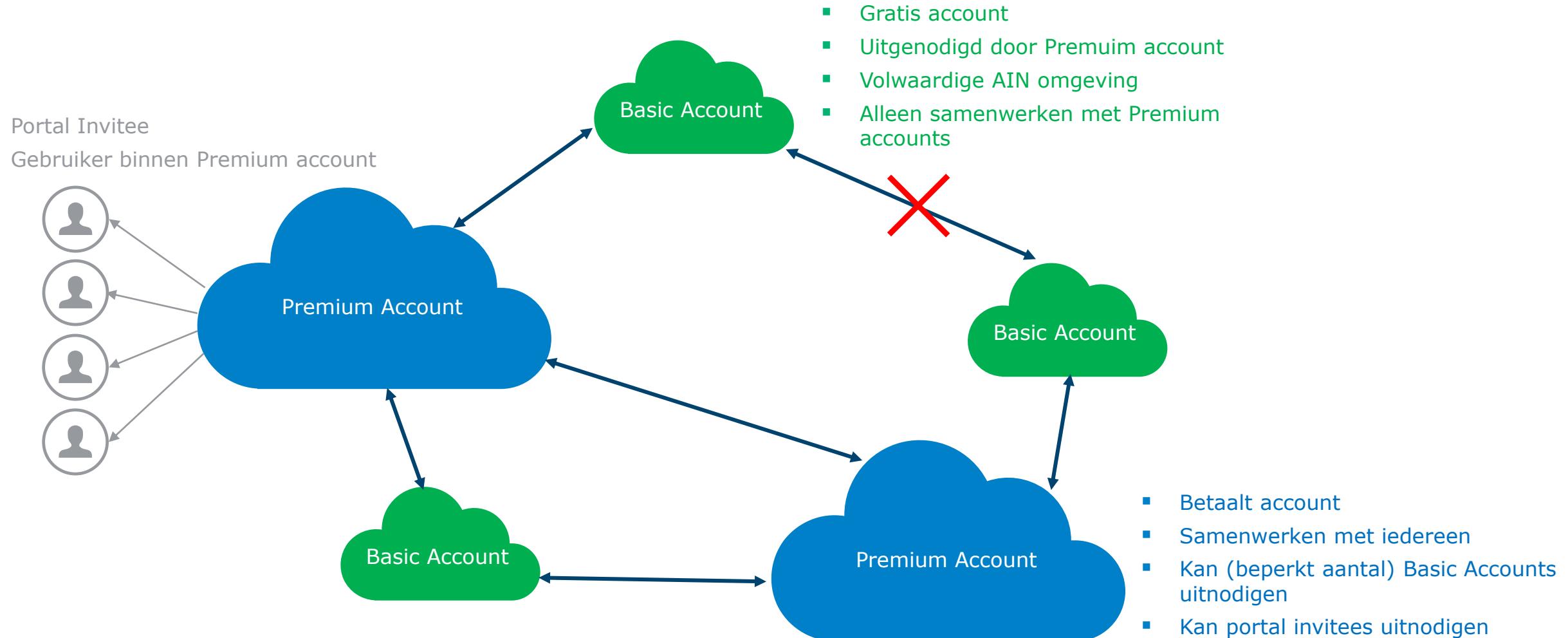
Scenario's

Greenfield

- Creëren van nieuwe Master Data
- 2 opties
 1. Equipment Sharing
 2. Equipment Request

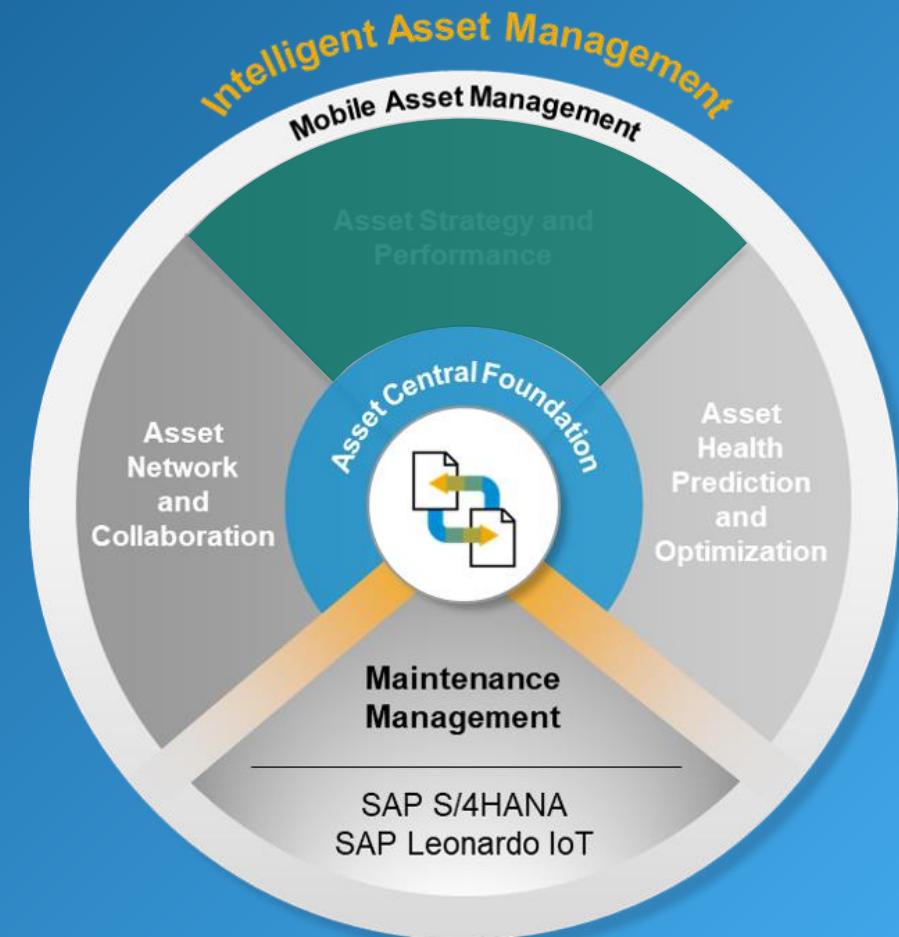


Account Types



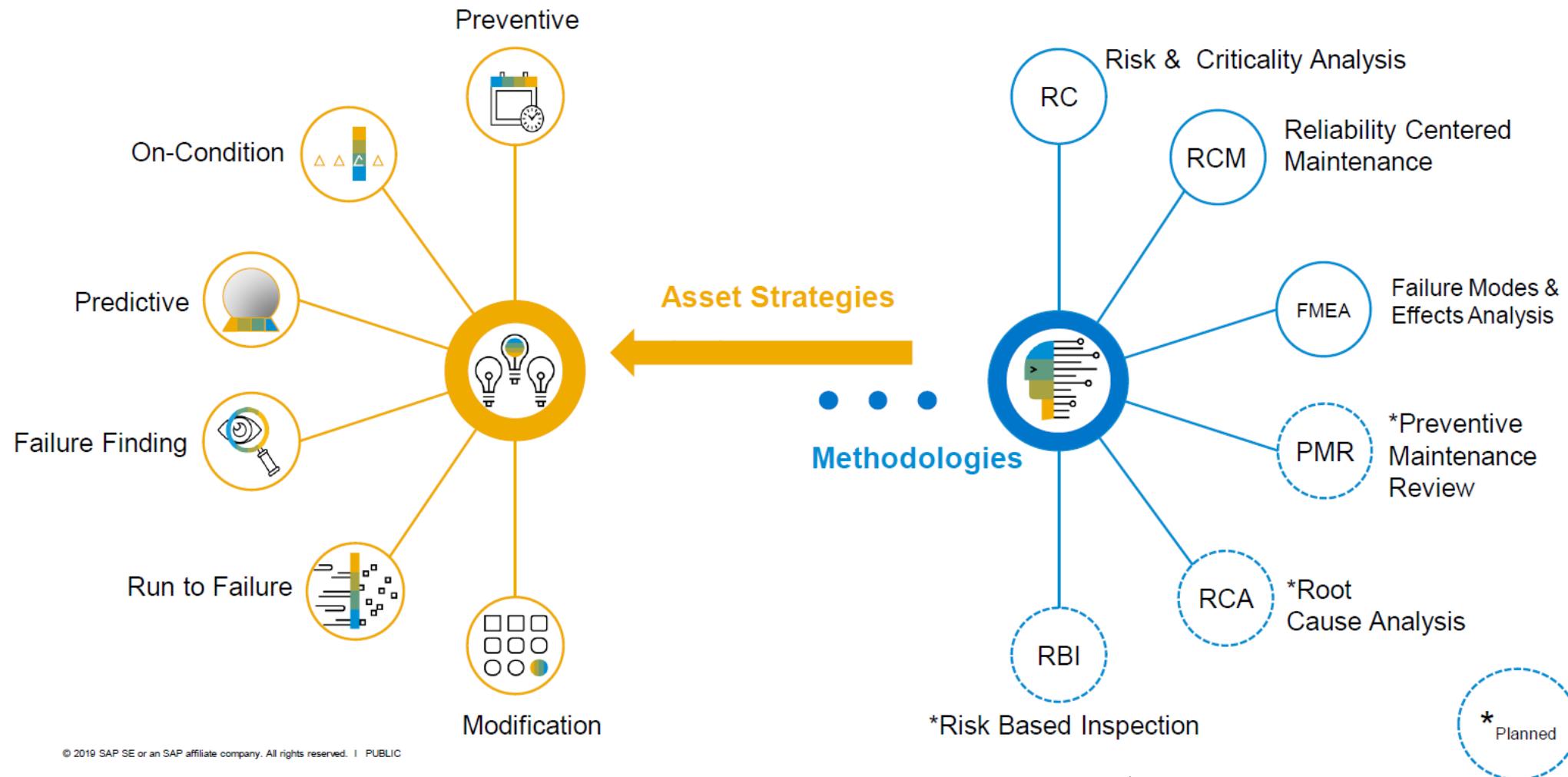
4. Asset Strategy & Performance

Intelligent Asset Management



Asset Strategy and Performance

Bepalen onderhoudsstrategie



Juiste onderhoudsstrategie = Reliability ↑

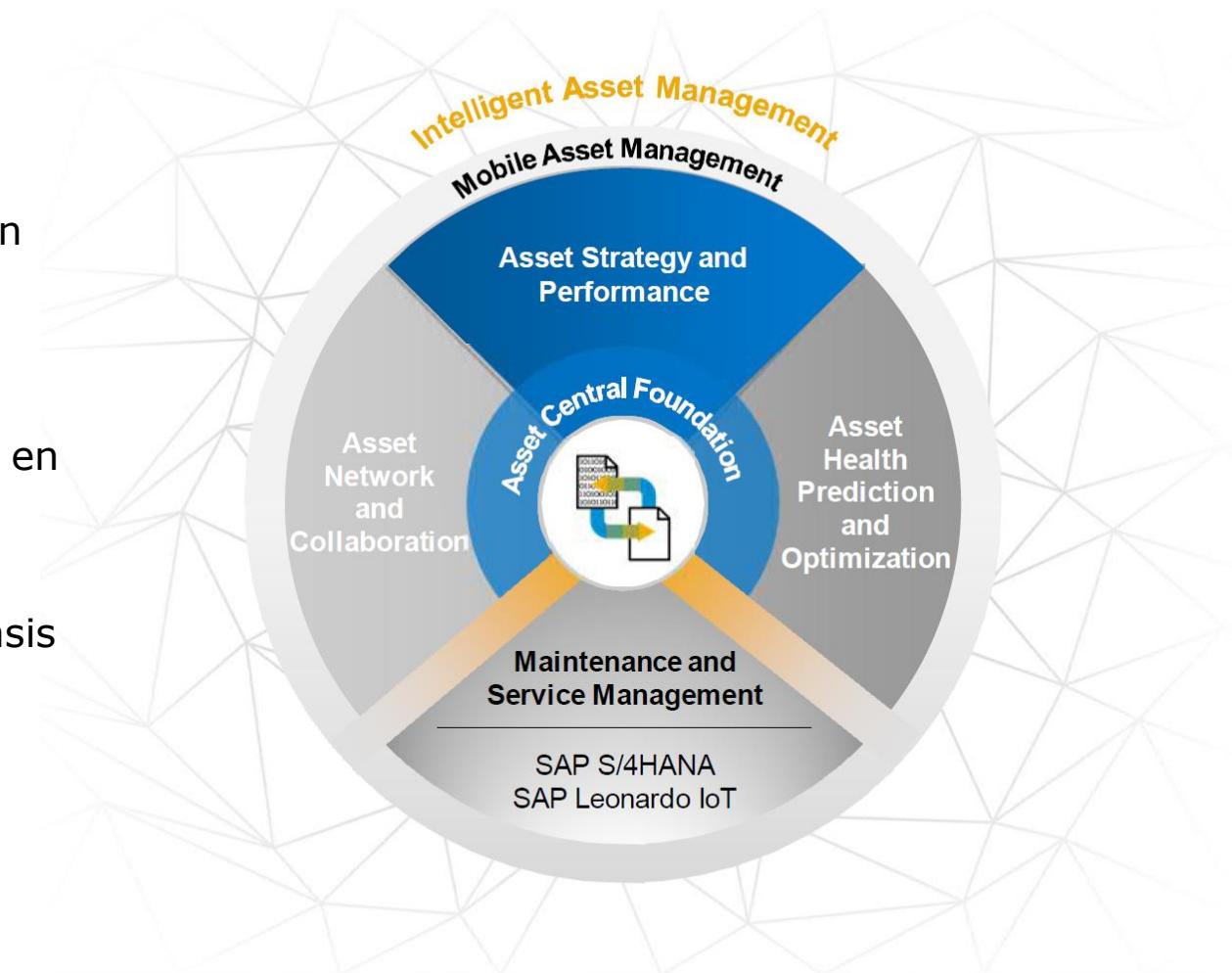


Asset Strategy and Performance

Bepalen onderhoudsstrategie

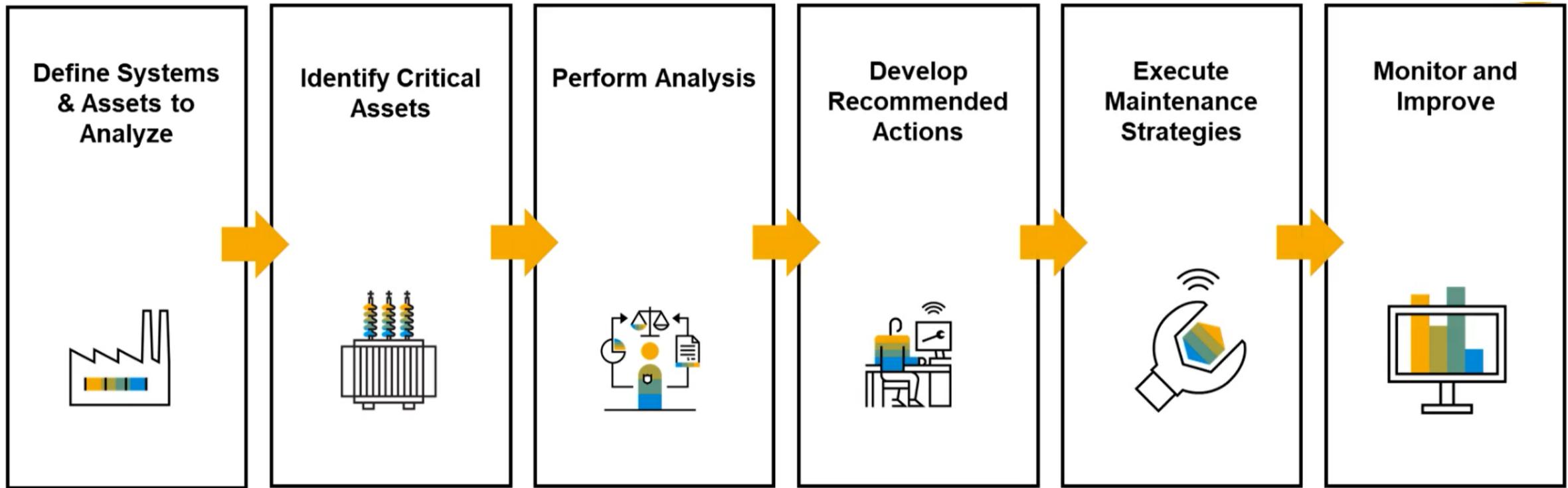
SAP Asset Strategy and Peformance Management biedt de mogelijkheid om structureel kritische assets te identificeren en RCM/FMEA analyses uit te voeren waaruit de juiste onderhoudsstrategie bepaald kan worden.

1. Bepaal de kriticiteit van elke asset obv een risico score en Risk & Criticality Analysis
2. Voer FMEA/RCM analyses uit obv de risico score
3. Maak aanbevelingen voor onderhoudsactiviteiten op basis van RCM/FMEA analyses



Asset Strategy and Performance

ASPM proces - 1



Adopt a risk based approach to determine critical assets driving optimal asset strategies

1

2

3

4

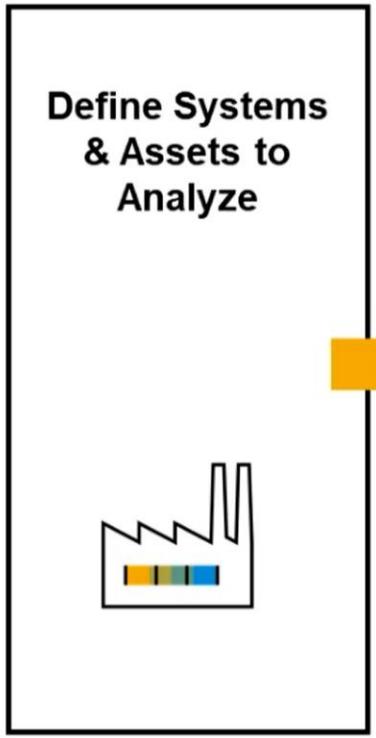
5

6



Asset Strategy and Performance

ASPM proces



Define Systems & Assets to Analyze

Vastleggen systemen en assets mbv Asset Central Foundation

- Models
- Equipments
- Functional locations
- ...

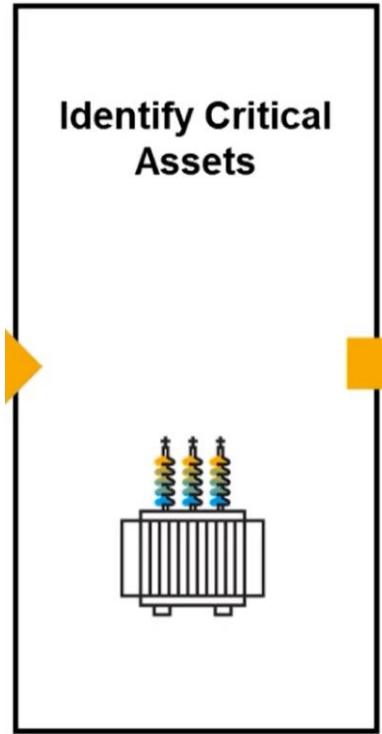
The screenshot shows a SAP interface titled 'Equipment'. The top navigation bar includes 'SAP', 'Equipment', 'Standard', 'Search', 'Show Filter Bar', and 'Filters (1)'. Below the header, there are tabs for 'Equipment (599)' and 'Standard'. A table lists four equipment entries:

| | Equipment | Subclass | Model ID | Manufacturer | Operator | Phase |
|--------------------------|------------------------------|-------------|--------------------------|--------------|----------|-------------------|
| <input type="checkbox"/> | 12001 Slurry Pump | | | | Dimensys | Planned |
| <input type="checkbox"/> | 11000001 Centrifugal pump | CENTRIFUGAL | Hydro_Multi-E_2_CRIE3_04 | Grundfos | Dimensys | Fully Operational |
| <input type="checkbox"/> | 11000000 Clean waterpump | CENTRIFUGAL | Hydro_Multi-E_2_CRIE3_04 | Grundfos | Dimensys | Fully Operational |



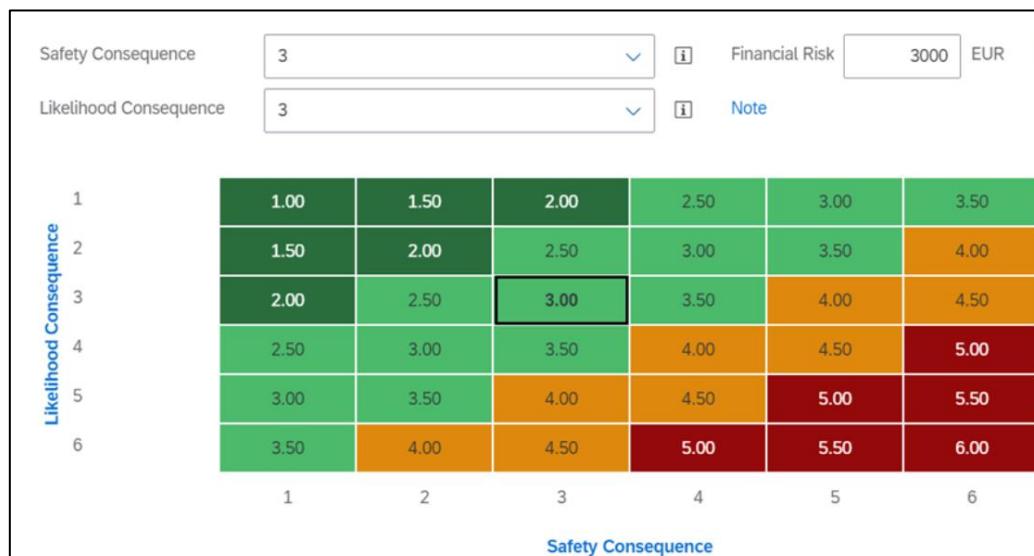
Asset Strategy and Performance

ASPM proces



Identificeer kritieke assets a.h.v. risicomatrix met impact-categorieën

- Zelf te ontwerpen
- Resulteert in een risico score en geschikte analyse methode
- Uitvoeren op individuele of groepen van assets



SAP Equipment ▾

PUMPS / CENTRIFUGAL / Hydro_Multi-E_2_CRIE3

Clean waterpump B ✓

11000000 Manufacturer: Criticality B "Medium"

Normalized Risk 51.5 %

INFORMATION Score 3.06

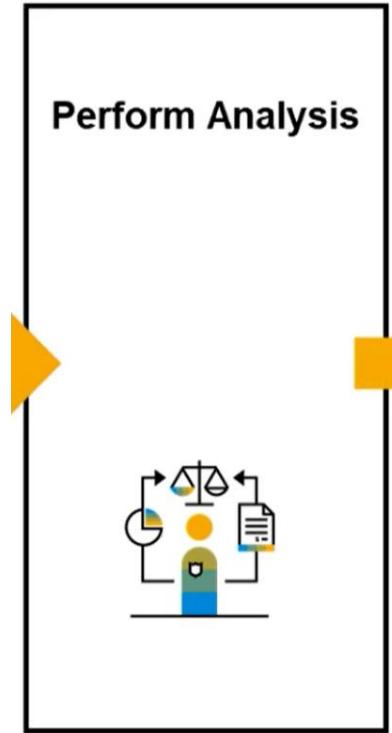
Highlights Color

Action FMEA



Asset Strategy and Performance

ASPM proces



3

- Uitvoeren van **FMEA analyse** in ASPM
- Ontwerpen FMEA templates (detectability, occurrence, severity)
- Bepaling van RPN score per cause van elke Failure Mode

| Dimensions | Type |
|---|---------------|
| <input type="checkbox"/> How detectable is the failure mode? DM.DMC.15 | Detectability |
| <input type="checkbox"/> How frequently does the failure mode occur? DM.DMC.16 | Occurrence |
| <input type="checkbox"/> What is the severity of the failure mode? DM.DMC.14 | Severity |

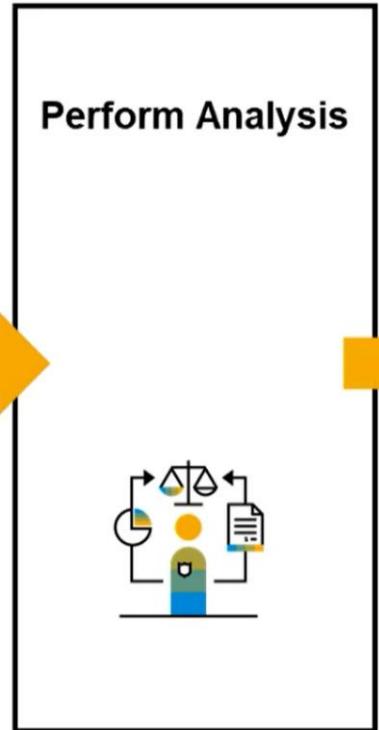
Bearing Failure ▾
FM.DMC.4

INFORMATION ▾ EFFECTS CAUSES

| Causes | RPN | Effect | Detectability | Occurrence | Recommendations |
|---|-----|------------------|---------------|------------|-----------------|
| <input type="checkbox"/> Cause Incorrect type of lubricant CS.DMC.6 | 60 | Overload bearing | 3 | 4 | 0 > |
| <input type="checkbox"/> Cause Insufficient lubricant CS.DMC.7 | 160 | Overload bearing | 4 | 8 | 0 > |
| <input type="checkbox"/> Cause Contaminated lubricant CS.DMC.8 | 225 | Overload bearing | 5 | 9 | 0 > |
| <input type="checkbox"/> Cause Improper mounting CS.DMC.9 | 160 | Shaft damage | 4 | 5 | 0 > |
| <input type="checkbox"/> Cause Shaft misalignment CS.DMC.10 | 192 | Shaft damage | 3 | 8 | 0 > |
| <input type="checkbox"/> Cause Corrosion CS.DMC.11 | 360 | Overload bearing | 8 | 9 | 0 > |

Asset Strategy and Performance

ASPM proces



3

- Uitvoeren van **RCM analyse** in ASPM
- Ontwerpen RCM templates (consequentie beslissingsschema) + aanbevolen maatregel
- Bepaling van maatregel per function/failure/effect

EF.DMC.9 - Low output effect

Information Consequence Evaluation Risk Assessment Recommendations Notes

Simulate Save

Will the loss of function caused by this failure mode on its own become evident to the operating crew under normal circumstances?

Hidden Failure Consequences Yes

Does the failure mode cause a loss of function or other damage which could injure or kill someone?

Safety and Environmental Consequences No

Does the failure mode cause a loss of function or other damage which could breach any known environmental standard or regulation?

Safety and Environmental Consequences No

Does the failure mode have a direct adverse affect on operational capability (output, product quality, customer service or operating costs in addition to the direct cost of repair)?

Operational Consequences Yes

Is a task to detect whether the failure is occurring or about to occur technically feasible and worth doing?

Operational Consequences Yes

Impacts / Sections: Operation Safety

Recommended Mitigation Step: Perform Condition-Based Maintenance (CBM)

Observations:



Asset Strategy and Performance

ASPM proces - 1



4

| SAP Preventive Maintenance Review ▾ | | | | | | | |
|-------------------------------------|---|---|-----------------|----------------|--|----------------|------------------------|
| Recommendations (5) Standard ▾ | | Transform ▾ Schedule for Maintenance Reject | | | | | |
| <input type="checkbox"/> | Recommendation Object | Failure Mode | Effect | Estimated Cost | Current Risk | Remaining Risk | Current Financial Risk |
| <input type="checkbox"/> | Pump bearing lubrication RCMD.DMC.2 PREVENTI... | 11000000 | Bearing Failure | 300.00 EUR | | | |
| | From: Instruction | | | | Status: INSTRUCTION HAS BEEN ASSIGNED. | | |
| <input type="checkbox"/> | Pump Maintenance RCMD.DMC.1 CORRECTI... | 12000 | Low output | | | | |
| | From: Instruction | | | | Status: IMPLEMENTATION IN-PROGRESS | | |

Insufficient lubricant
CS.DMC.7

RECOMMENDATIONS

Recommendations

PREVENTIVE

Pump bearing lubrication
RCMD.DMC.2

Estimated Cost: 300 Euro
Status: Draft
Priority: 1

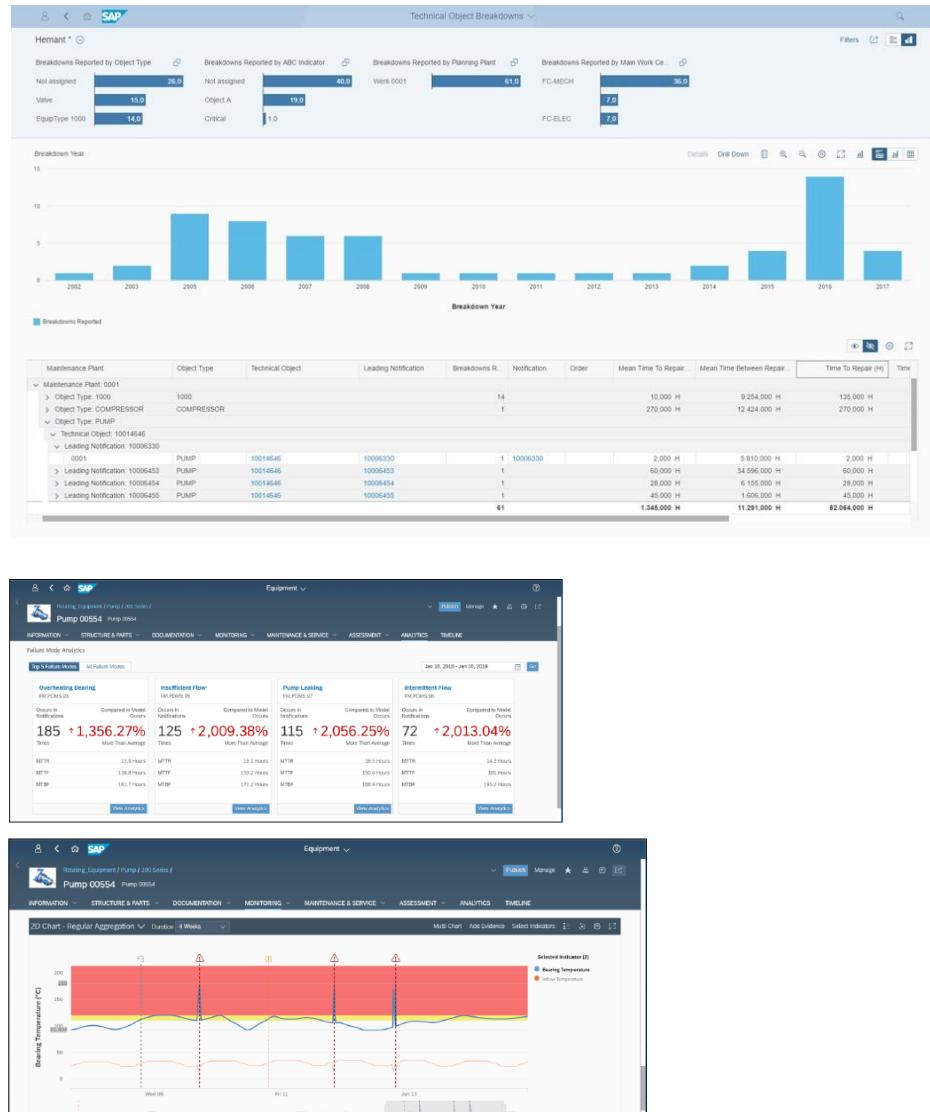


Asset Strategy and Performance

ASPM processes



- Implementeren onderhouds-strategie & acties
- Monitor je assets via S/HANA apps/dashboards & Asset Health Prediction and Optimization



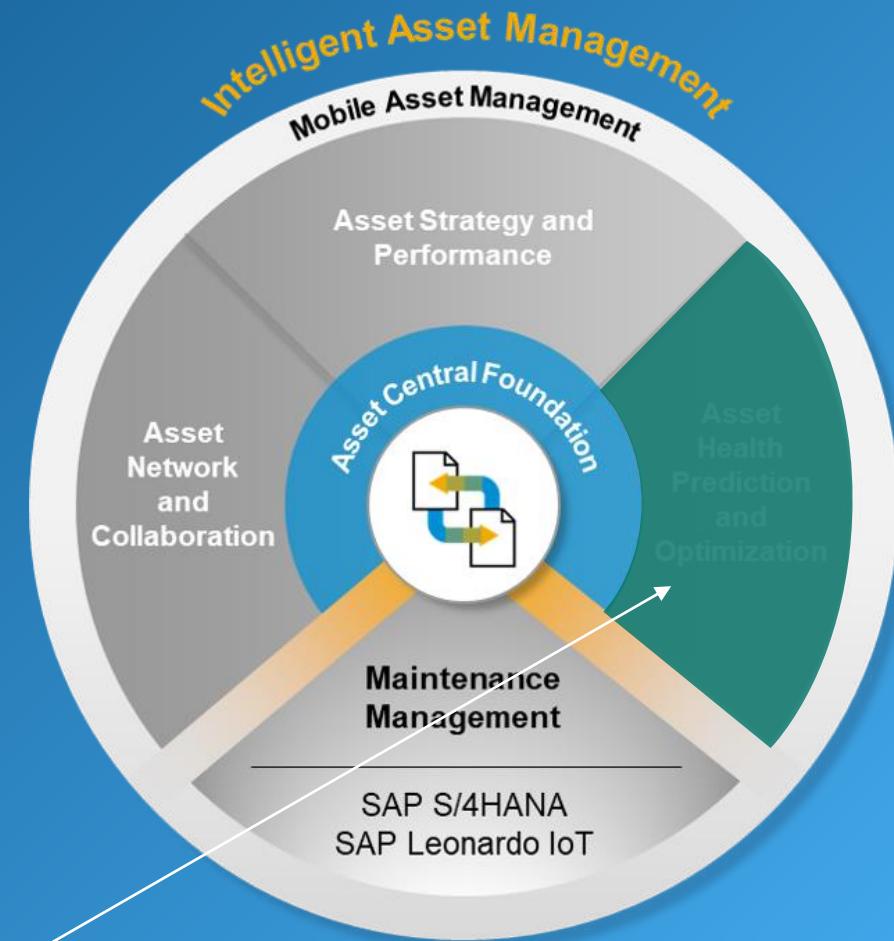
5. Asset Health Prediction & optimization

Intelligent Asset Management

Predictive Maintenance & Service
Predictive Engineering Insights

Rebranding

Predictive Asset Insights (PAI)



Predictive Asset Insights

SAP PAI is een Internet of Things application welke gebruik maakt van real-time data van sensoren om defecten te identificeren en de toekomstige prestaties te voorspellen.



Optimize the availability of your assets by using predictive maintenance and service capabilities and the Internet of Things to take corrective actions early



Collect and analyze sensor data from physical assets to predict operational failure



Initiate preventive countermeasures that trigger service or maintenance orders



Optimize asset performance with a closed-loop maintenance and service process



Create physics-based digital twins of industrial assets based on a real-time and predictive engineering analysis



Predictive Asset Insights

Functionaliteiten



Decision Support for Asset Management & Reliability Professionals

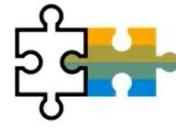
A 360 Degree View of Assets

Advanced Analytics for Decision Support

Intuitive and Scalable Machine Learning

Simulation-based Digital Twins

Business Process Integration



A comprehensive view across asset model, master, transactional and performance data in a single solution

Advanced analytics to support maintenance execution and strategy decisions

Machine learning for maintenance professionals... “machine learning for the masses”

Feed IoT data into system level engineering models to simulate and predict operational performance

Part of a comprehensive asset management portfolio

Asset Central Foundation!

ACF + AIN + S/4HANA ...



Advanced Analytics for Decision Support

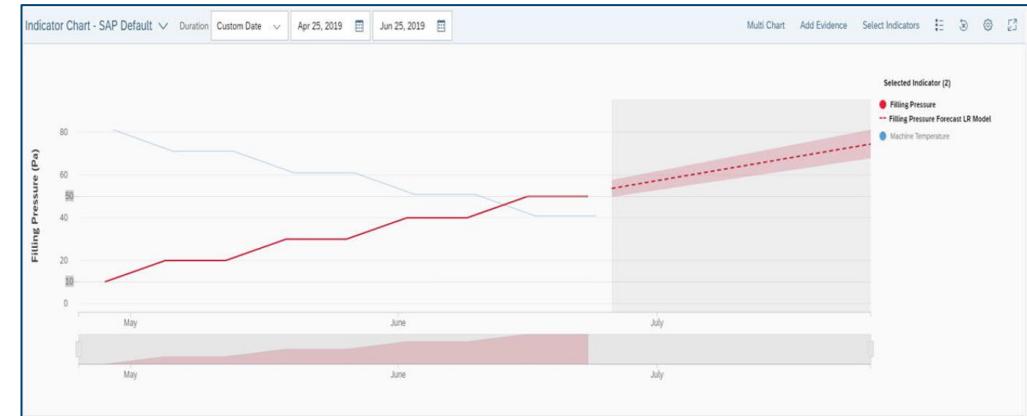
Ondersteun operations en onderhoud met real-time sensor data, alerts, forecast & analyse mogelijkheden.

Functionaliteiten:



Indicator Forecasting

Visualiseer en bereken trends voor sensor data, neem de juiste beslissing obv forecasting



Advanced Rule-based Alert Creation

Definieer regels om geautomatiseerde alerts te genereren.



Fingerprint Management

Vastleggen van 'referentie toestanden' waaruit faalvormen snel herkenbaar zijn. Een visueel inzicht in de operationele status van assets.

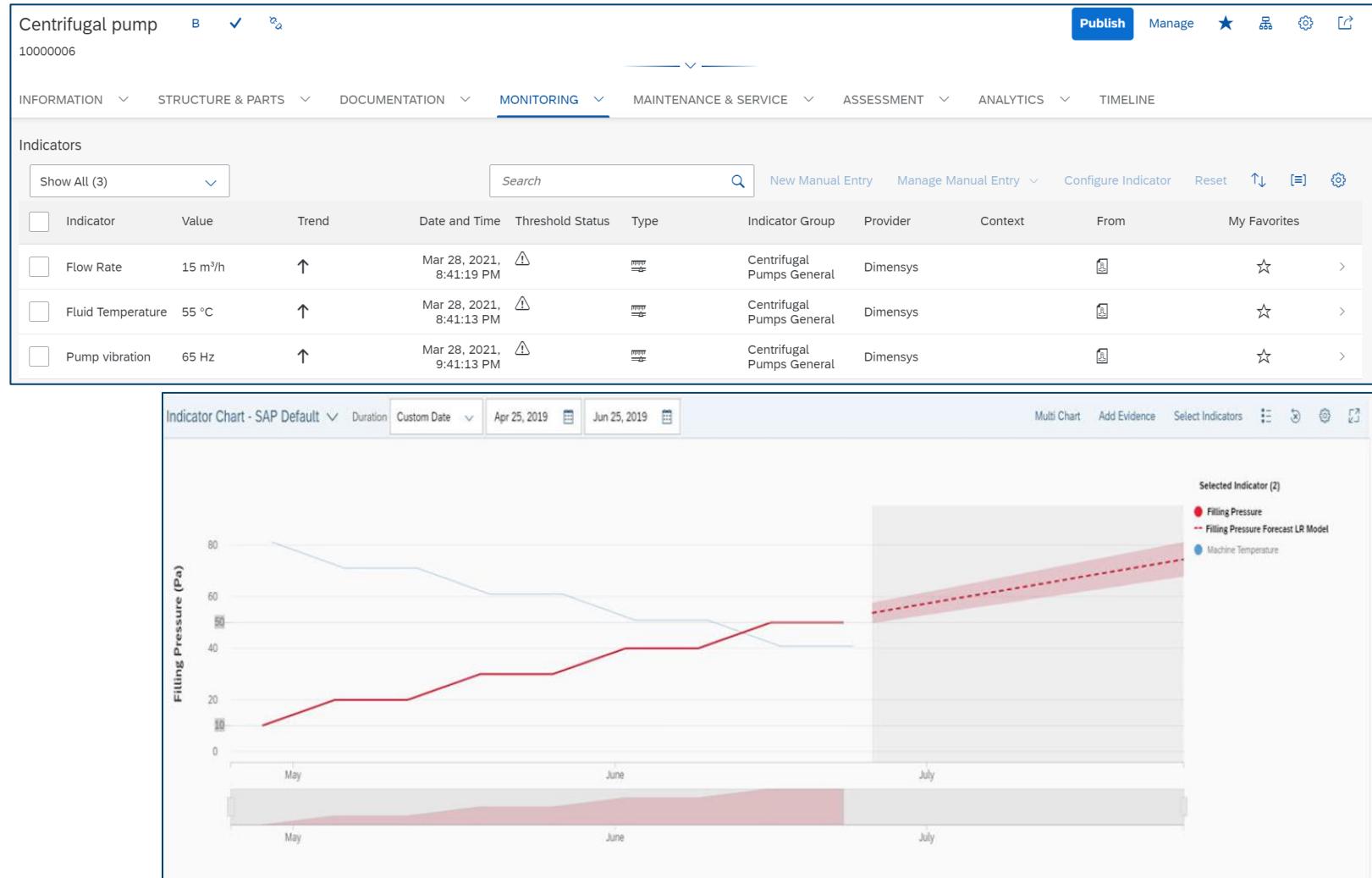




Indicators

Visualisatie + Indicator Forecasting

- Zichtbaar in de monitoring tab
- Manuele ingave mogelijk
- Equipment Indicator Chart
 - Trend & visualisatie
 - Forecasting





Alerts

Alert: Waarschuwing voor een anomalie, potentieel defect of een indicator die een grens overschrijdt.

Gecreëerd door:

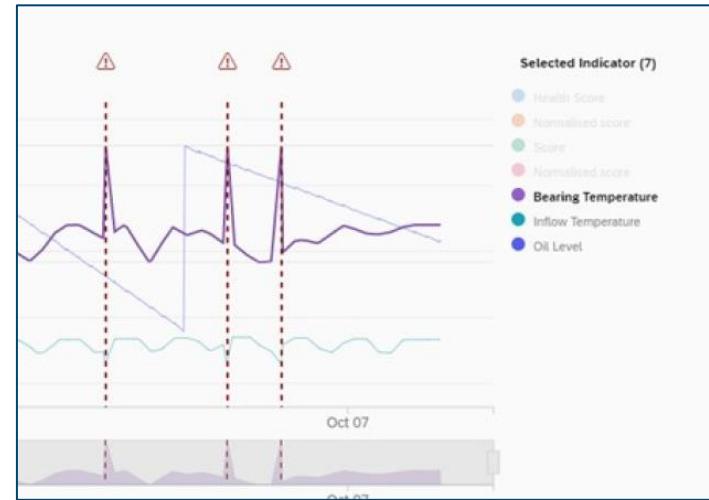
- Rules (zie later)
- Machine

Alert Type: soort waarschuwingen afkomstig van equipments

Bevat:

- Indicator
- Failure modes (eenvoudig instructions identificeren)
- Deduplication (1x aanmaken per x periode)
- Severity: warning, information error

Alert Type Groups: Groeperen van Alert types, verbonden met models



Pump vibration
PU.VIBR
Languages: EN

ALERT TYPE DETAILS FAILURE MODES (2)

Information

| | |
|----------------|----------------|
| Alert Type ID: | PU.VIBR |
| Description: | Pump vibration |
| Category: | Machine |
| Severity: | Warning |
| Indicator: | Pump vibration |
| Origin: | Rule |

Settings

| | |
|-----------------------------|--------------------------|
| Deduplication: | ON |
| Allow Updates: | <input type="checkbox"/> |
| Maximum deduplication days: | 30 |
| Auto Close: | OFF |





Rules

Opbouw

Rules creëren Alerts op basis van de conditie van assets.

Verbonden met een Equipment of model.

When:

- Scheduled: controle op een vast tijdstip
- Triggered: Equipment alarm (Alert)

If: eigen logica definiëren voor alert

- Attribute (van het object)
- Indicator (constant of threshold)
- Aggregator (min, max, som, ...)

Then:

- Alert van type ...
- Notification
- Email

Rule Details

When

Event Type: Scheduled Recurrence Pattern: Minute Every 10 Minutes

If

IG.002 VIBRATION(in Hz) > 100

Hydro_Multi-E_2_CRIE3.IG.002.VIBRATION > 100

Then

Alert Type: PUMP_MALF.PU.VIBR

Notification

Email

Rule Status: ON



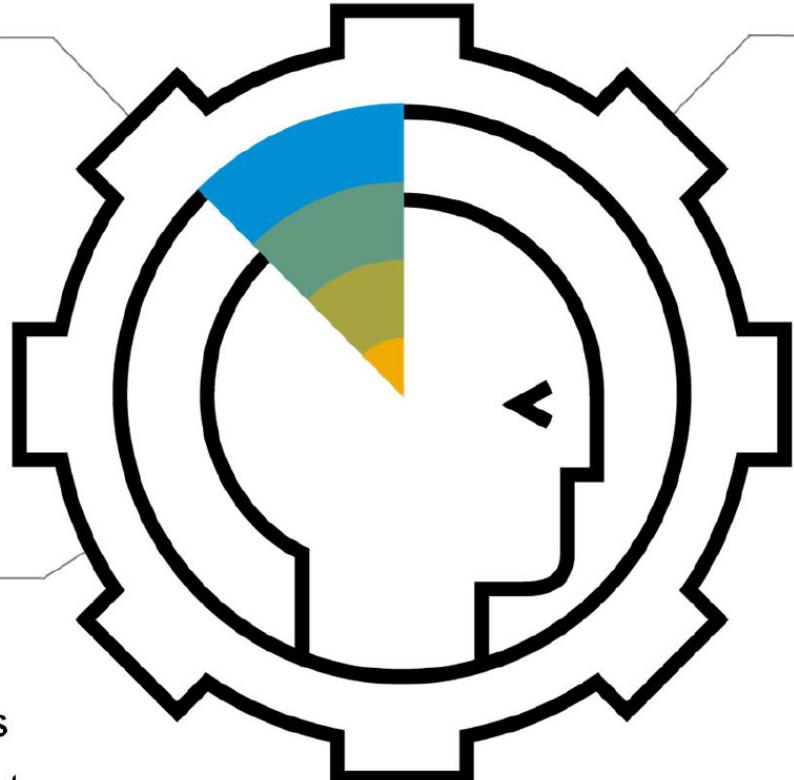
Machine Learning

What is Machine Learning?

- Computers **learn patterns in historic data** without being explicitly programmed
- Trained models are then applied to new data in order to make predictions or detect anomalies

Why now?

- IoT/device connectivity
- Big data available for training models
- Declining hardware and software costs
- Massive computing power (in-memory & distributed computing)



What are the use cases?

- **Data security...**
malware & fraud detection
- **Financial trading...**
stock market predictions
- **Healthcare...**
cancer research
- **Marketing...**
customer profiles & recommendations
- **On-line searches...**
Google
- **Predictive maintenance**



Machine Learning

(oude PDMS)

Machine learning for maintenance professionals... “machine learning for the masses”

Capability Highlights



Prediction & Anomaly Detection Algorithms

Out-of-the-box machine learning algorithms tailor made for predictive maintenance use cases



Flexible Extension Concepts

Deploy custom algorithms into solution or perform machine learning outside of solution in tool/language of choice



Dataset Configuration and Model Management

Intuitive dataset preparation capabilities to prepare data for machine learning. Tools to configure, train, and score models.



Automated Machine Learning

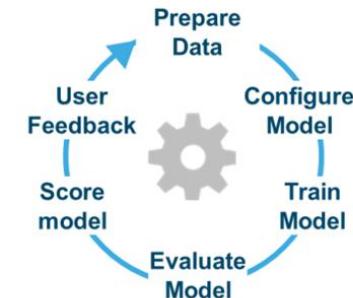
Run automated anomaly detection & failure prediction algorithms without the need to choose algorithm or hyper-parameter settings



Leading Indicator Analysis

A machine learning capability used to identify the most impactful indicators leading to failure events or specific failure modes

Scalable Machine Learning Engine



Prediction Algorithms

| Type | Technique | Input Data Type | Output |
|---|---|------------------------------|--|
| Failure Prediction based on Failure and Sensor Data | Tree Ensemble Learning | Sensor and Failure Data (IT) | Probability of Failure |
| Failure Prediction based on Failure and Sensor Data | Logistic Regression | Sensor and Failure Data (IT) | Probability of Failure |
| Automated Failure Prediction based on Failure and Sensor Data | Automated Machine Learning for Failure Prediction (AMP) | Sensor and Failure Data (IT) | Probability of Failure |
| Failure Prediction based on Failure Data | Weibull Lifetime Analysis **On-premise only** | Failure Data (IT) | Remaining Useful Life and Probability of Failure |

Anomaly Detection Algorithms

| Type | Technique | Input Data Type | Output |
|---|--|-----------------|---------------|
| High-dimensional Anomaly Detection | Principal Component Analysis (PCA) | Sensor | Anomaly score |
| High-dimensional Anomaly Detection | One-Class Support Vector Machine (One-Class SVM) | Sensor | Anomaly score |
| Distance-based Anomaly Detection | Earth-Movers Distance (EMD) | Sensor | Anomaly score |
| Time-based Anomaly Detection | Multivariate Auto Regression (MAR) | Sensor | Anomaly score |
| Parameter-free univariate time series anomaly detection | Interquartile Range Test (IQR) | Sensor | Anomaly Score |
| | | Sensor | Anomaly Score |



Machine Learning

Applications

| | |
|---|-----------------------------------|
| Health Indicator Data Set Configuration | Health Indicator Model Management |
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Dataset configurator

Intuitive dataset preparation capabilities to prepare data for machine learning (i.e., aggregation periods, new features, null values). Enables creation of new data sets or the copying of existing data sets.

Manage models to calculate health indicators

The Health Indicator Model Management application brings scale to the machine learning processes. Intuitive tools to support model configuration, training, and scoring.

The screenshot shows the SAP Health Indicator Model Management interface. On the left, a list of models is displayed:

- 200Series2M_AAD: Unsupervised, TRAINED
- 200Series2M_RAM: Unsupervised, NOT TRAINED
- A_DEMO_Model: Unsupervised, NOT TRAINED
- AFModel: Unsupervised, NOT TRAINED
- AFModel2: Unsupervised, TRAINED
- ANOMALY: Unsupervised, TRAINED

In the center, a "Training Run 1" section shows a green checkmark and the message "COMPLETED — 2 log entries available". It includes fields for "New Training From" and "To" (both set to "M/dyy, h:mm:ss a") and buttons for "Set Schedule" and "Start Training". Below it, a "Scoring for Training Run 1" section also shows a green checkmark and "COMPLETED — 3 log entries available".

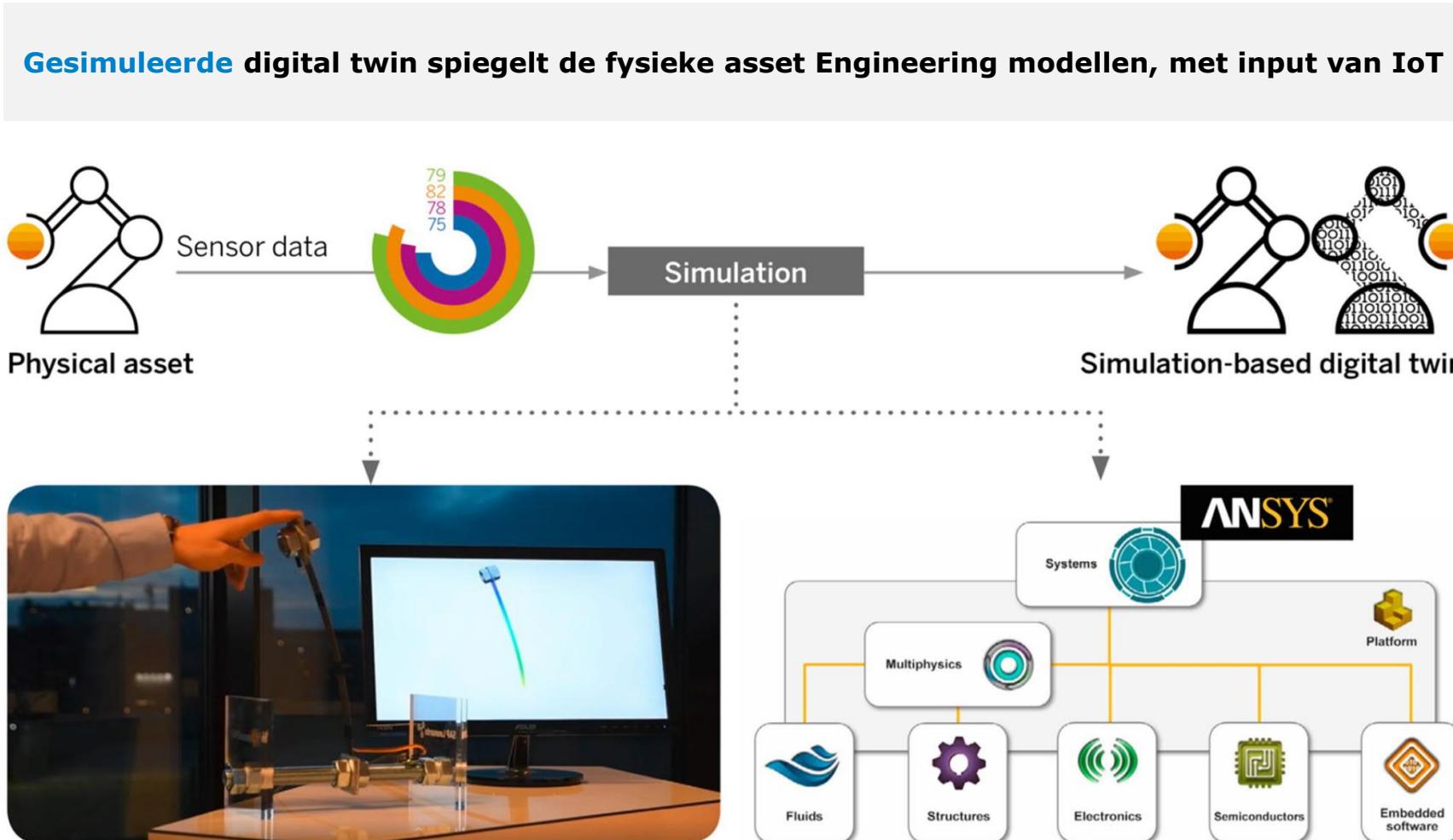
A modal dialog box is open in the foreground, titled "Score Data Points". It lists "Indicator Group" and "Indicator" pairs for the "ANOMALY" model. The "Indicator Group" column has checkboxes for "rotor_98" and "rotorTemp_98", while the "Indicator" column lists "axialDisp_98", "rotorSpeed_98", "rotorTemp_98", "windingTemp1_98", "windingTemp3_98", "windingTemp2_98", "bearingDE_98", "bearingNDE_98", and "bearingTemp_98".

On the right side of the dialog, there are sections for "Select Functions" (COUNT, FIRST, LAST, MIN, MAX, SUM, AVG, STDDEV) and "Specify Aggregation Period Values" (Aggregation Period: 1 Day, Period Offset: 0, Use Default Values). There are also sections for "Specify Range" (Minimum: -999, Maximum: +999, No Limits) and "Preview" (4 New Features).

At the bottom of the dialog, there are "OK", "Apply", and "Cancel" buttons.



Simulation-Based Digital Twin



SAP® Predictive Engineering Insights enabled by ANSYS offers a true simulation platform with best-of-breed simulation across all major physics.



Simulation-Based Digital Twin

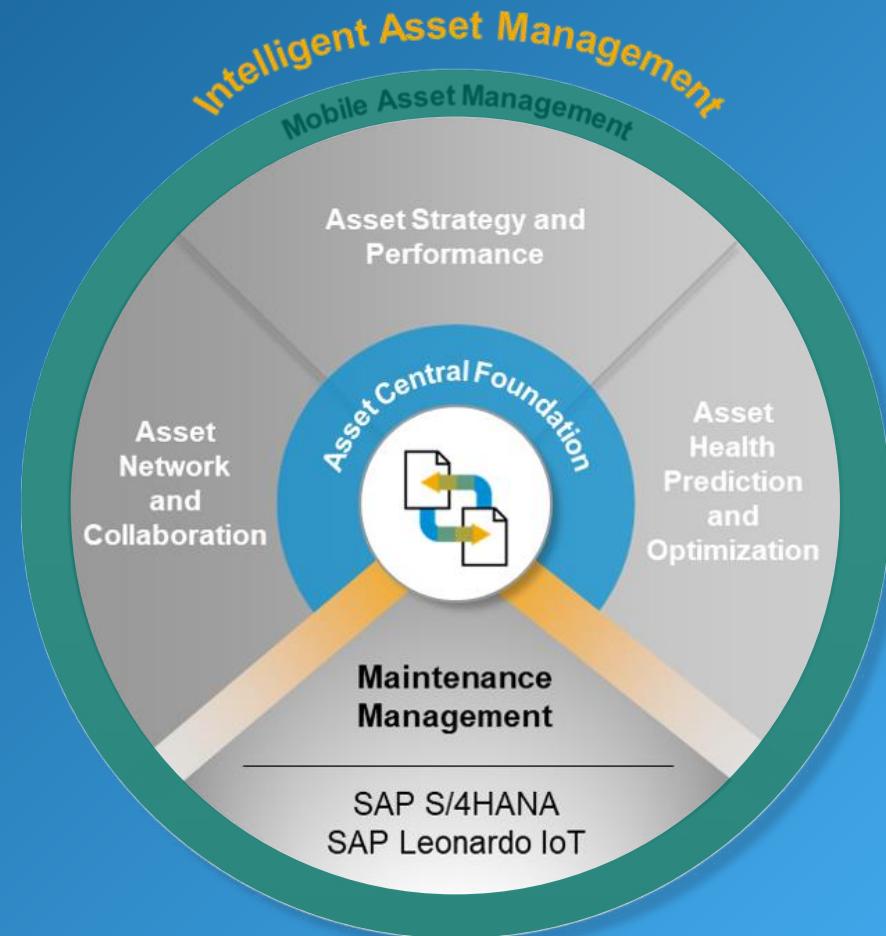
Bridge Monitoring



SAP is monitoring the Stavå bridge in real time using SAP Predictive Engineering Insights. Vehicles passing over the bridge create vibrations that are picked up by accelerometers and sent to the cloud-based solution where the bridge model resides as a digital twin (Photo: Morgan Frelsøy/OPP).

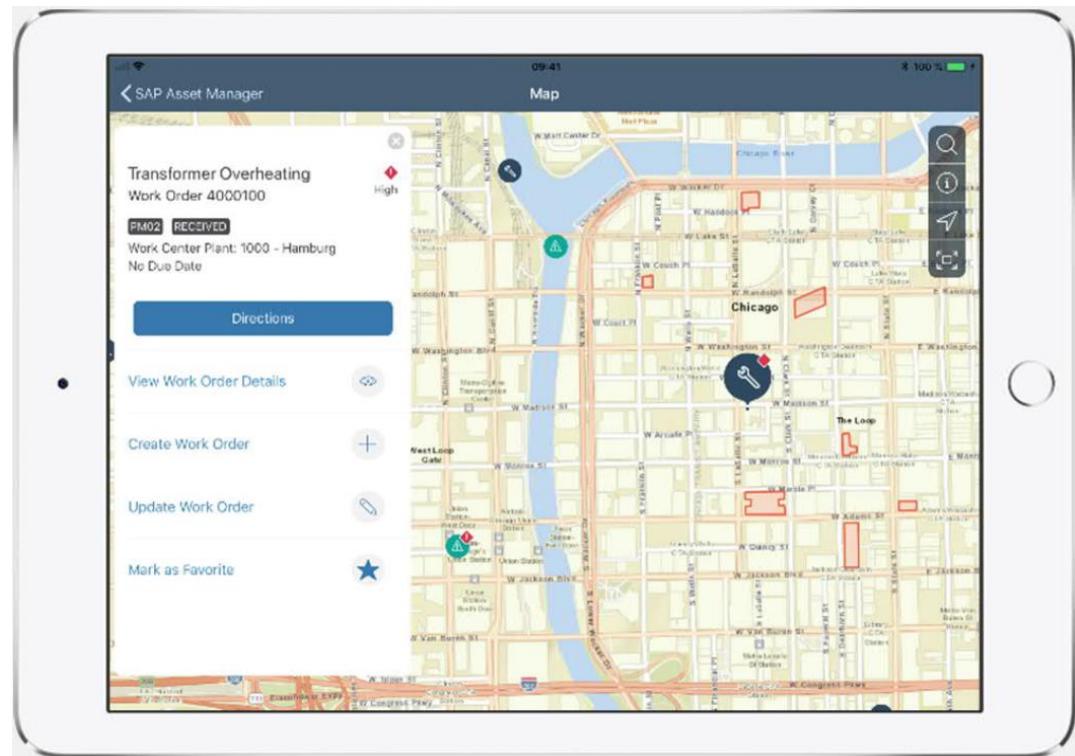
6. Asset Manager

Intelligent Asset Management



Asset Manager

- Standaard SAP **mobiele applicatie** voor onderhoudstechniekers
- Focus op **user experience**
 - Snelle en eenvoudige afhandeling van werk
 - Beheer van asset gegevens
 - Minder papier & administratie
- **Geïntegreerd** met S/4HANA Asset Management & IAM
- **Online & offline** werking
- **Easy customization**



Asset Manager

Functionaliteiten

Systeem:

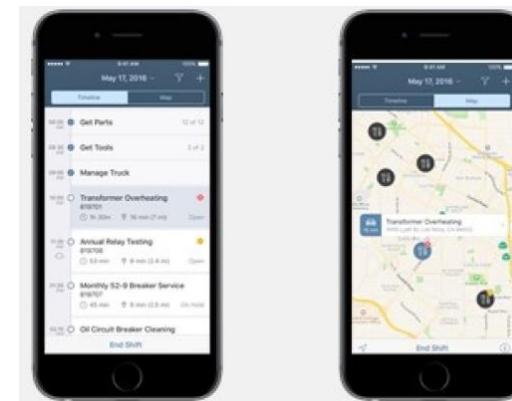
- Android & iOS User Interface (Apple – SAP Partnership)
- S/4HANA & ERP6.0 Ehp7 Support
- Online & Offline
- Map integratie (Esri ArcGIS)

Assets:

- Asset data + install/dismantle
- Bijlagen & documenten
- Meetdocumenten
- Garanties
- Kenmerken
- PRT's

Maintenance Management:

- Notification/order management
- Toewijzing techniekers aan orders & taken
- PM terugmeldingen
- Start/stop functie – CATS Timesheets
- Artikels toevoegen & goederen afgifte
- ASPM Checklists uitvoeren

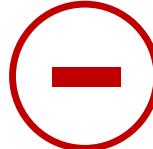
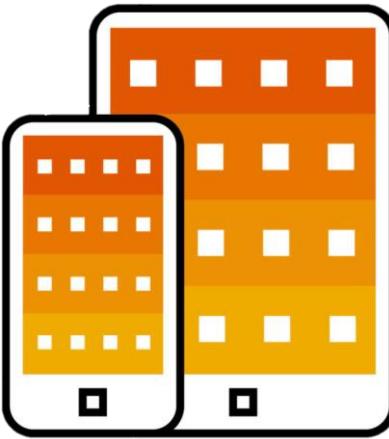


Asset manager

Pro & Con



- Brede functionaliteit
- SAP Roadmap: Future proof
- Standaard SAP & integratie
- Uitbreidbaarheid
- Offline



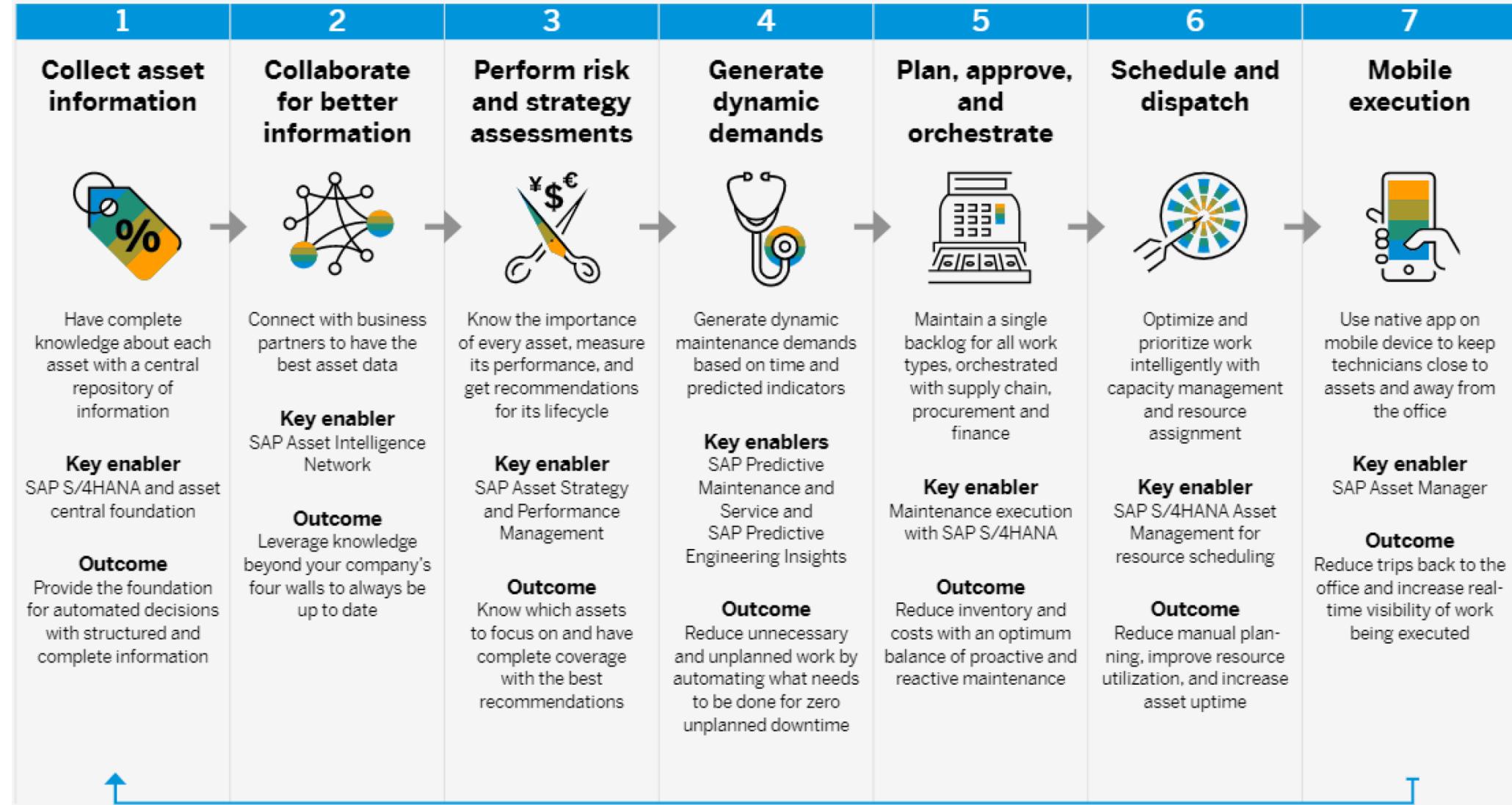
- Niet Windows compliant
- Licentie kosten

Andere mogelijkheden:

- Eigen Mobile (Fiori) app bouwen (Dimensys accelerator)
- SAP Screen Personas

Intelligent Asset Management

Proces & benefits



Vragen?



Contact



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