AFRY’s engineering and data analytics services for operational excellence & predictive maintenance

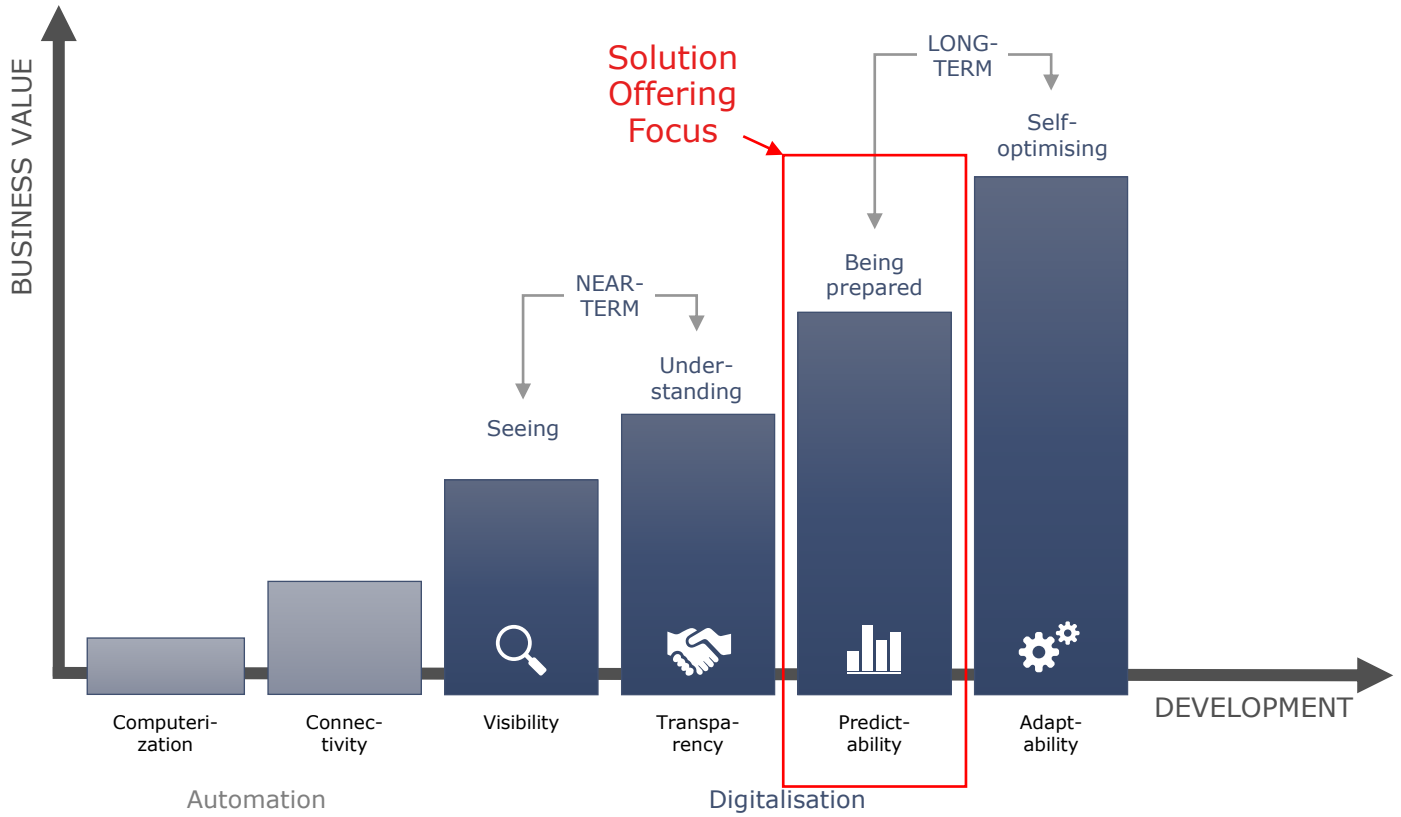
HV Transformers Case Study – AI driven

28.09.2022

ASSET DIGITALISATION JOURNEY

The digital transformation of assets is a journey requiring a clear long-term vision in order to maximise business value

THE DIGITAL TRANSFORMATION JOURNEY



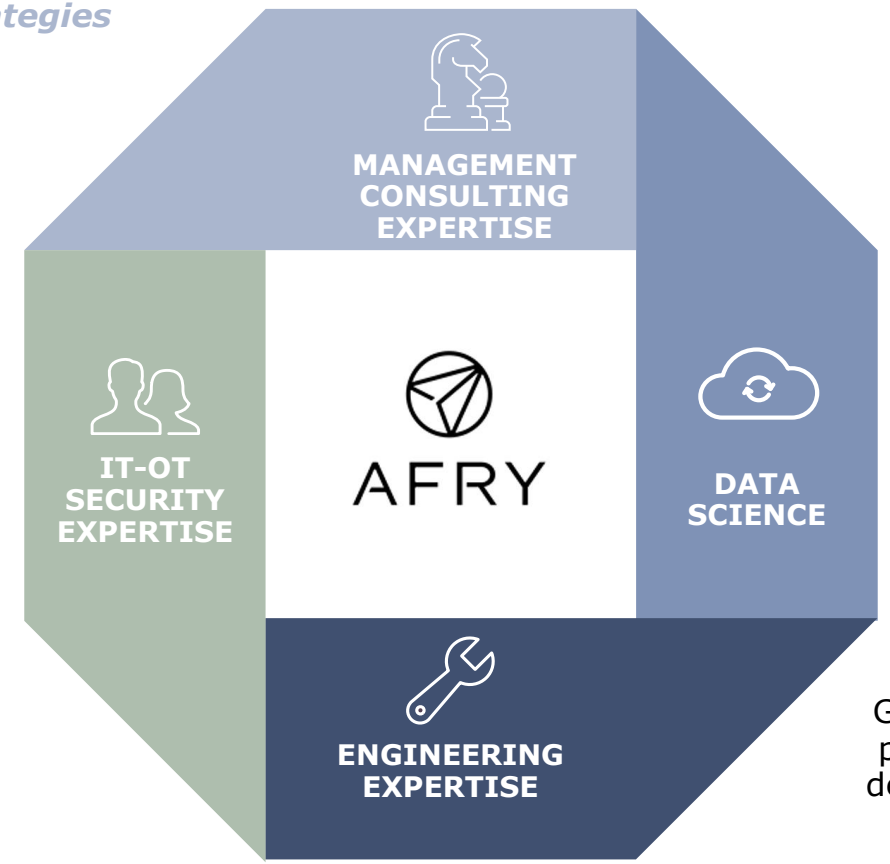
- A fully integrated, remote controlled and self-optimising system **is not a single product**
- It is a **vision** that defines the **digital transformation journey** and includes several stages of development along the way
- Having an understanding of the **business value** as well as vendor independent **technical capabilities,** AFRY supports clients to **plan and execute complex digital roadmaps**

WHY AFRY

Our clients benefit from our combined expertise in one-house in management consulting, data science, engineering and IT-OT

We develop & implement digital strategies

Market-leading trusted advisor for transmission and distribution system operators, supporting them in reorganising their processes, evaluating business use cases, scouting for innovation or assessing impact of regulatory changes



We digitalise assets & processes

Proprietary digital solutions developed and managed by highly experienced data science professionals who master the art of extracting insights from big data analytics

We speak IT-OT security

Highly experienced technology consultants with leading corporate functions in IT and OT security departments of digital companies

We plan and build power grids

Global network of engineering experts for power lines, substations and transformer design, large EPC projects as well as asset operation and maintenance services

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E-DAP UNIQUE SELLING PROPOSITION

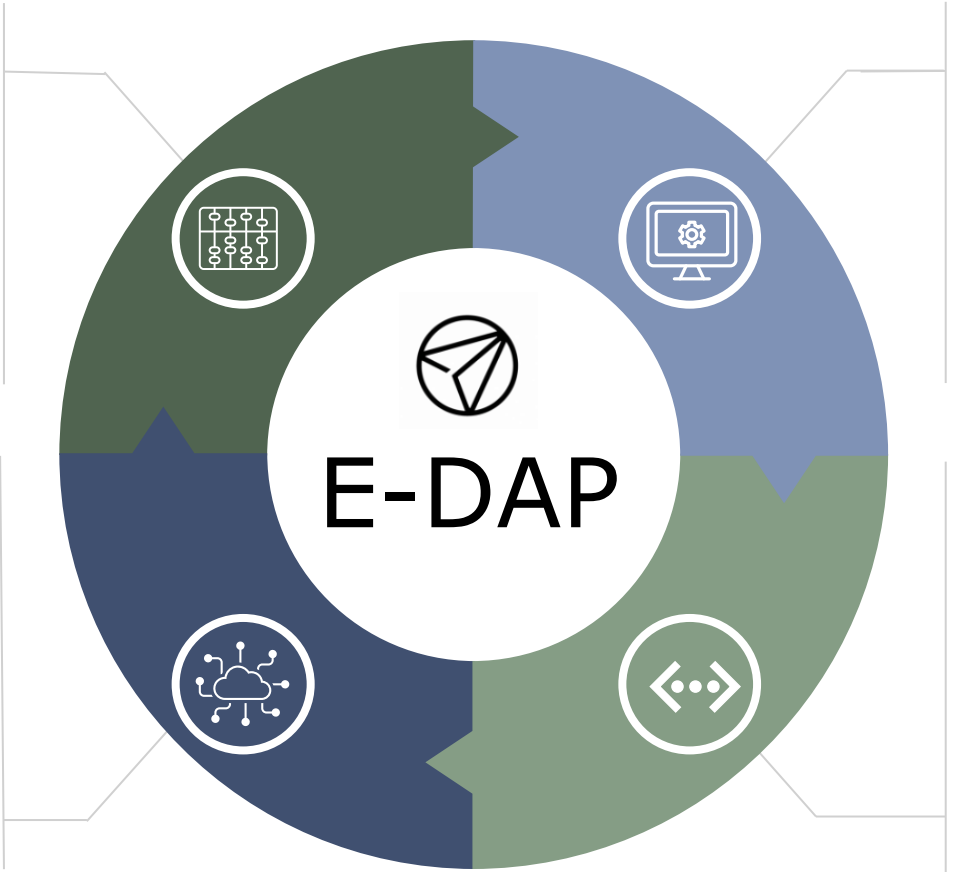
E-DAP is AFRY's end-to-end cloud-based data analytics platform designed for grid companies seeking to optimise their O&M costs

1 End-to-End architecture

- Encompassing all the data analytics ingredients, without being distracted by other tools (Open BI, Azure AI resources, Jupiter notebooks, etc.):
- IoT (Kepware, MQTT, Scada); data engineering & management, ML/AI, Digital twin, Insight page.

4 IoT Ingestion and Live Dashboarding

- IoT data are not always sufficient
- Can add simulation data to enrich the ML-training
- Create artificial faults and extrapolate the application range
- Create digital twins using simulation data (SDT)



2 Tailored Insight Hub

- A dedicated page for model and digital twin (DT) reporting, defined in concert with the client
- The page reports KPI's specific to:
  a. *Operational Excellence*
  b. *Predictive Maintenance and anomaly/fault Detection*
- KPI's are either calculated on the IoT live data, or on the DT results.

3 Extended Connectivity

Can connect to external platforms via

- Import standard ML/AI models
- Import FMU models (e.g Modelica)
- Connect to 3rd party data brokers using REST APIs
- BIM configurations

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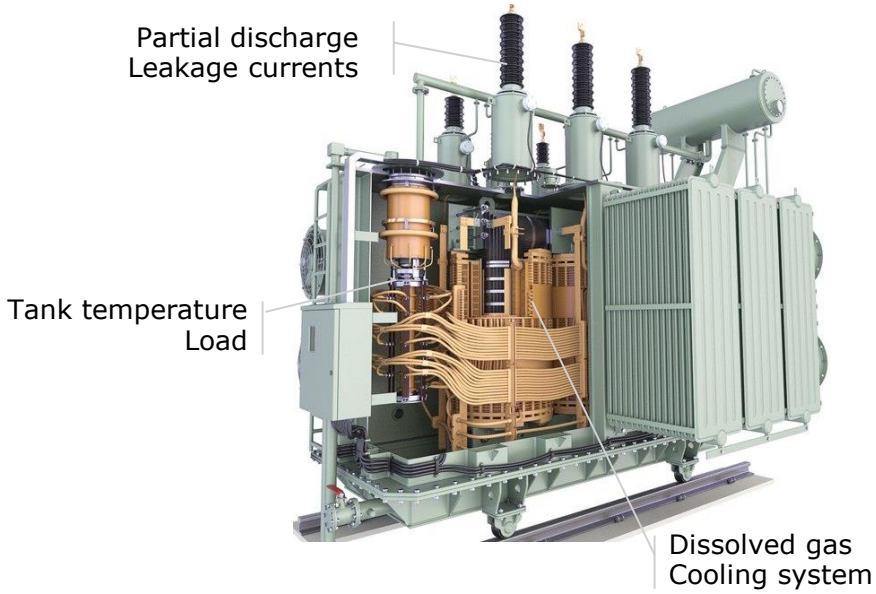
DIGITAL JOURNEY CHALLENGE

Grid operators are deploying more sensors to measure their transformer condition, yet most do not succeed in extracting the value add from big data

SITUATION

- Grid operators are heavily investing in the modernization of their networks to cope with the integration of variable renewable energy and electrification of heating and transport
- Grid operators are incentivized to optimise and better plan their mid term and long-term investments for revision and replacement of transformer by minimising their TOTEX
- Today experience has shown that 80% of failures in transformers can be detected by measuring the parameters of the on-load tap changer, the bushings and the windings
- Grid operators are measuring condition data points of the major components most of their transformers and storing the results, yet are not capable to derive insights from the data to predict the remaining useful life of their transformer



COMPLICATION

- It is unclear if and how a grid operator can correlate the condition measurement data of its transformer with its physical aging to move to a reliable and holistic condition-based maintenance strategy across all subcomponents of the transformer

QUESTION

- How can a grid operator design a reliable predictive maintenance model for its transformers that is based on the existing database and modular to take in future data ingestion?

REFERENCE: PREDICTIVE MAINTENANCE

AFRY designed for an innovative TSO a modular and reliable predictive maintenance model to optimise the maintenance plan of its HV transformers

Project Metrics

- 2022, 2.5 months
- AFRY Management Consulting Berlin & AFRY AMS Zurich

Client

- European Transmission System Operator

Service and Approach

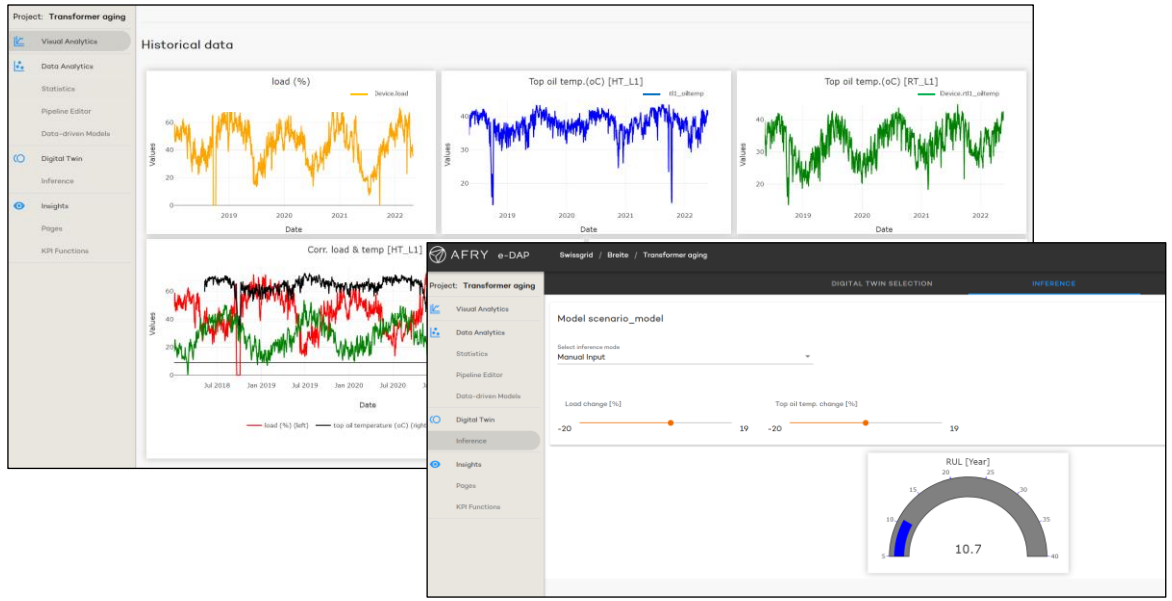
- AFRY used its end-to-end Engineering Data Analytics Platform (E-DAP) to build a predictive maintenance model for the aging of the transformer
- AFRY used existing data (both frequent and seldom) to understand how the maintenance has been conducted over the last 40 years.
- AFRY analyzed any indication of oil degradation from the inspection analysis conducted by the client to feedback patterns in e-DAP
- AFRY identified the paper polymerization as the main cause of degradation for the transformer useful life
- AFRY used analytical modelling relating the collected data to the health index and resorted to machine learning to reconstruct the missing data and predict future trends

Client Impact and Value Added

- The client holds a license for a modular and reliable predictive maintenance model that can predict the remaining useful life of its HV transformers and optimise as such its maintenance plan
- The client is capable to conduct scenario analysis changing temperature, load, and oil cleaning periodicity and assessing their sensitivity to the asset health index update

Situation and Challenge

- The client has measured and stored the temperature condition of the oil windings and the load of the transformer every 5 minutes for the past five years
- It is unclear if and how the client can correlate the condition measurement data of its transformer with its physical aging to move to a reliable and holistic condition-based maintenance strategy across all subcomponents of the transformer



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