EUROPEAN TURBINE NETWORK

Annual General Meeting
TC4&5: Digitalisation

15 March 2018, Bucharest

Program TC4 / TC5

- ETN Best Practice Award: review and next steps
- Digitalisation:
  - Review work done & white paper
  - Additional content: **maturity model** with self-assessment / **implementation model**

Digitalisation: actions of October Meeting

- First draft of white paper (Pascal & Chris) (Nov)
- Distribute for comments (all) (Feb)
- Organize user call (ETN) (Feb)
- Publish first white paper (ETN) (Mar)
- Work out some of the gaps at AGM 2018 (e.g. details on maturity model, technical concepts, ….)

Review of previous work (White Paper)

Objectives of White Paper

- Information to the members:
  - What steps are needed to move onto the path of the digitalisation and unlock the value of the data (step by step procedure)
    - What are the difficulties we experienced in the past?
    - What does new technology have to offer?
    - How can we benefit from that? What are specific risks?
    - How to define the maturity level of organization?
      Where are you on digital journey towards industrial internet maturity?
- Inputs to developers on the requirements / gaps

White paper: Historic Roadblocks

- Data:
  Missing data, data islands (different systems so not a complete picture, different equipment), data continuity over time, data resolution, different formats (e.g. time series, FFT's, text, …), systems with no connectivity
- Hardware or software issues:
  Obsolescence, Back ups, interface issues
- Missing information to create the "complete picture":
  e.g. inspection data, chemistry, market / grid needs
- Security, data distribution, data access:
  Limited access
- Modeling capabilities, model maintenance
- IPR issues, data ownership
- Expertise to derive the right actions from the generated insights
- Organizational barriers
- Uncertainties on cost / benefit

White paper: What is new?

- Data and Connectivity:
  - Sensors: improved, lower cost, increased connectivity options, faster data acquisition processing techniques (e.g. for surge monitor allows to go closer to the limit)
  - Centralisation in the cloud, linking of data sources, ability to handle large amounts of data, improved storage, improved internet access (different channels to connect), SaaS
  - Centralised management improves data quality, resolution, reliability, scalability, cost
- Data security:
  - Central management incl. back up and version control, SSO, data diode,
  - DOWNSIDE: all data at one location, so if someone gets in, it is much worse, one of the main concerns with the users.
- Analytics:
  - Improved techniques and self learning systems, more experience leads to less maintenance, code sharing, digital twin with multiple use (e.g. factory testing, design, monitoring)
  - Processing power
  - Visualisation options

Opportunities / benefits?
How can we create value?

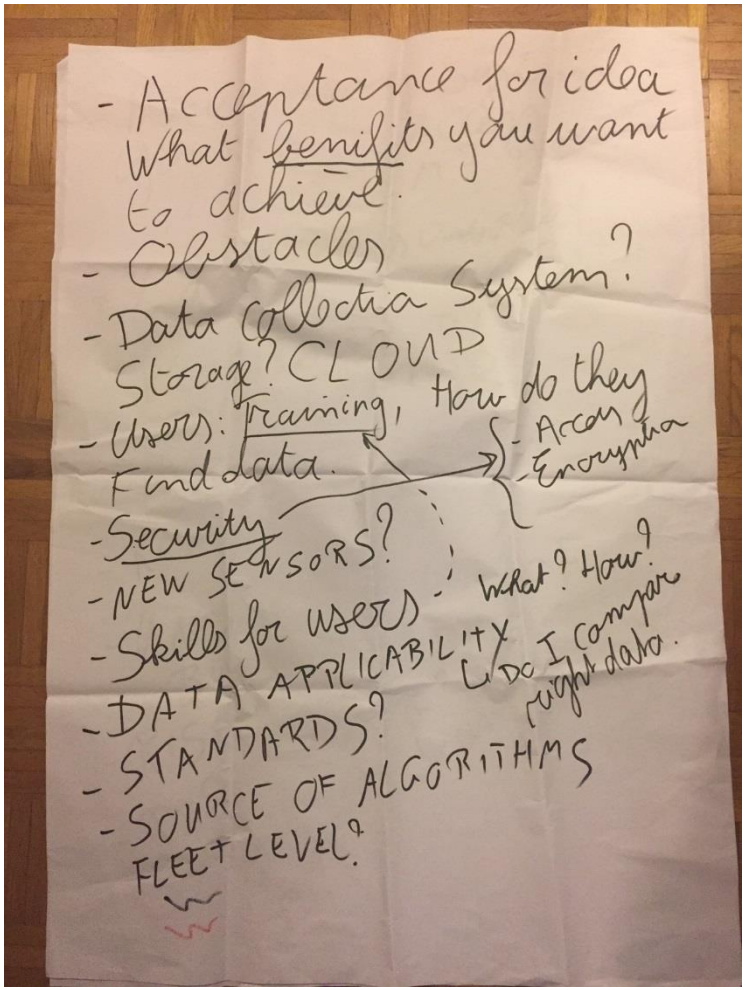
- Accelerate productivity (increase income):
  - Smart grid: better short and medium term demand forecasting based on many factors (weather, time of the day, …) to better anticipate load / operation management
  - Go closer to the limits of the equipment (e.g. surge, combustion) through better sensors and models to increase performance, become faster, …
  - Trade offs between income and cost
- Reduce inefficiency and waste (reduce spending):
  - “Off design” tuning (part load, ambient) for optimum efficiency
  - Predicting failures, calculating lifetime -> trade off life consumption for profit, maintenance planning and cost reduction / reliability improvement
  - Reduce life cycle cost (investment, maintenance, consumables, …) and/or improve reliability, through risk and condition based maintenance, based on better insights from the available data on condition and business impact (risk)
  - Fleet level comparison to optimize operations, benchmarking between plants (fuel consumptions, maintenance tasks, ….)
  - Better alignment between internal organizations through better visibility of priorities
- Enhance the human work experience:
  - Mobile worker becomes more efficient
  - Robotic inspection technologies

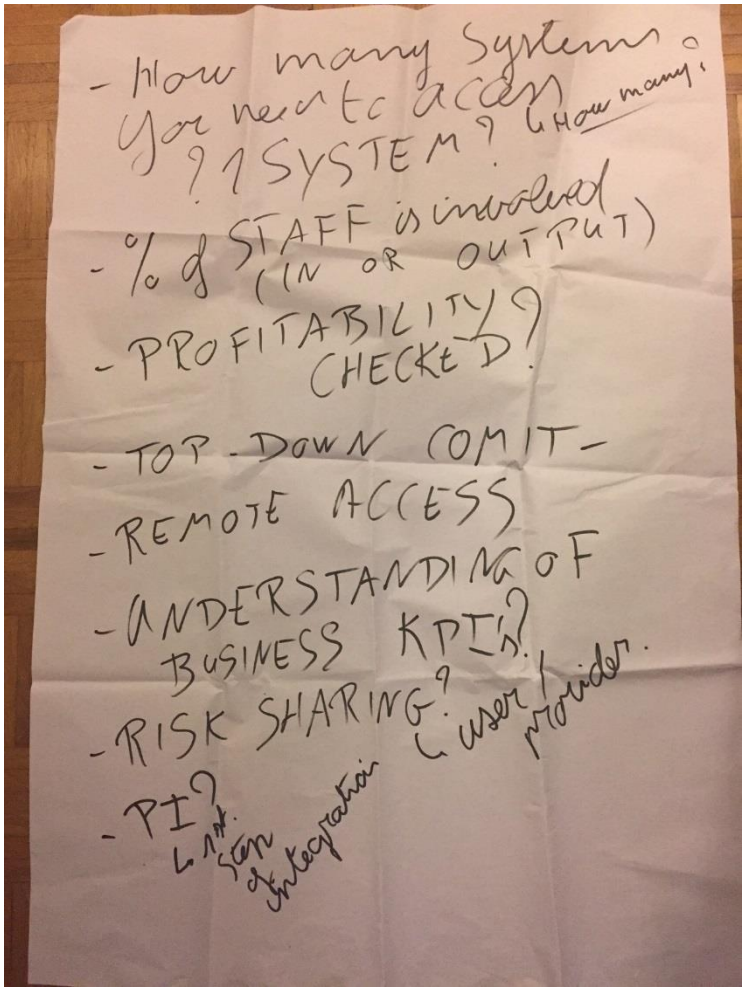
Specific (new) risks / pitfalls related to new technology?

- Cyber Security:
  - Hackers who want to harm your IT system, or even your plant
  - Competitors who get insight in your business to get competitive advantage (note: link to something can be better secured compared to report that is e-mailed around)
  - Privacy concerns
- Skills
  - Acquiring the needed skills to leverage IoT data
- Abundant data by itself solves nothing
- Who owns the data? Who owns the system?

Maturity Model / Self-assessment

Brainstorming: Questions to Ask in maturity model / KPIs / how to measure them?





Brainstorming results of October meeting. How to measure maturity?

- Acceptance, clear on potential benefits. Clear on KPI's to address?
- Has profitability been checked
- Top-down commitment?
- ~~Obstacles~~
- Type of data storage? Cloud?
- How many users are using / familiar with the system? Training? Do they find what they need? User skills? % of staff involved?
- Security measures (access, encryption)
- Use of new sensors
- Fleet level, plant level, system level?
- How many different systems do I need to access?
- Remote access
- How much data is collected
- Clear risk sharing defined between end users and providers?

Fundamental elements / dimensions (Ref: “Digitalization and Energy”, by IEA)

- Digital capabilities
  1. Data:
     How much, how good, advanced sensors
  2. Connectivity:
     Infrastructure to connect devices, humans
  3. Analytics:
     How is data turned into information, insight and action, how is it used to create value (modelling, machine learning, optimisation, …)
- Leadership / organizational:
  1. Management support, vision, clear plan, KPI’s linked to business outcomes
  2. Adoption, training for everyone, relationship to “IT” dept
- Develop questions for **self-assessment** and score from 1 to 5 (1 strongly disagree / not at all, 3: neutral / partly, 5: strongly agree / fully in place)

Brainstorming results of October meeting. How to measure maturity?

DATA

- How much data is collected
- Use of new sensors

CONNECTIVITY / INFRASTRUCTURE

- Type of data storage? Cloud?
- Security measures (access, encryption)
- Fleet level, plant level, system level?
- How many different systems do I need to access?

ANALYTICS

- Remote access

LEADERSHIP

- Acceptance, clear on potential benefits. Clear on KPI's to address?
- Has profitability been checked
- Top-down commitment?
- How many users are using / familiar with the system? Training? Do they find what they need? User skills? % of staff involved?
- Clear risk sharing defined between end users and providers?

Data, sensors

- We systematically collect and store operational data on all equipment of the plant.
- We systematically collect and store results from inspection and measurements on all equipment of the plant.
- O&M manual
- We have more sensors than what is strictly required for controls
- We use advanced additional instrumentation and/or measurements

Connectivity / infrastructure

- Type of data storage? Cloud?
- Security measures (access, encryption)
- Fleet level, plant level, system level?
- How many different systems do I need to access?
- Knowledge mgmt

Analytics

- Remote access, remote monitoring center
- Machine learning

Leadership

- Acceptance, clear on potential benefits. Clear on KPI's to address?
- Has profitability been checked
- Top-down commitment?
- Clear risk sharing defined between end users and providers?

Organization

- How many users are using / familiar with the system? Training? Do they find what they need? User skills? % of staff involved?

Implementation Model

Implementation

- Merge new technology and new organisational methods with existing technology and methods
- Requirements:
  - Develop digital capabilities
  - Leadership to set a vision and execute on it, organizational development, sustainability

Implementation scenarios (options, identified during previous meetings)

- Start with simple things, low hanging fruits that show some tangible results, start with existing data and sensor
- Start from the result you try to achieve, not from the solutions or data that are available (outcome based), move from a discussion on “digital” to “value”
- Big Bang

Implementation scenarios: both in parallel

- Reference: “Leading Digital, turning tevhnology into business transformation” (George Westerman, Didier Bonner, Andrew McAfee):

– Whereas traditional IT projects depended on clear design and well-structured plans, more recent IT projects often engage in test-and-learn strategies, based on experiments. However doing major implementations of new technology in a learning-by-doing approach could be dangerous. It may increase rework, waste money and introduce security risks

– USE TWO SPEEDS and don’t try to work around addressing the “IT issue”:

1. Build up a digital backbone (in parallel continue supporting old IT processes) that has access to legacy systems. Do this in a careful and systematic manner.

2. Build up various capabilities in a fast, agile and flexible manner. We also call this the “continuous deployment” approach.

Implementation scenarios: both in parallel

- Reference: “Leading Digital, turning technology into business transformation” (George Westerman, Didier Bonner, Andrew McAfee):

1. Management awareness of the importance , know your starting point (digital maturity) and define the company transformative (as opposed to incremental) vision around strategic assets with a clear business outcome
2. Define goals, develop plan, budget
3. Implement IT backbone and first applications (pilot projects, quick wins)
4. Expand, learn, train, measure, correct and sustain

Actions / next steps

Next steps

- …
- Updated white paper

ETN

Quotes

On a very basic level, what is the Internet of Things?

On the business and society level, the Internet of Things creates new business and service models that integrate and reinvent the way business, services, and capabilities are delivered. It embodies the opportunity to transition from a transactional-based approach to a service- and outcomes-based guarantee.

From a technology standpoint, IoT is the combination of capabilities and technologies that improve cost, performance, suitability, and standards. Those components are sensory and connectivity technology, cloud capabilities, and analytics and machine learning. From a solutions standpoint, IoT is the combination and integration of those capabilities. On the use-case basis, IoT is about creating integrated experiences, digital heartbeats, and digital connections for everyday devices and capabilities that aren't yet connected.

"Cloud has removed all the constraints that we used to have," said Vogels. "Everything that used to be hardware is now software."

IEA Report

- Digitalization within the **power** sector has the potential to save around USD 80 billion per year, or about 5% of total annual power generation costs, based on the current system design and enhanced global deployment of available digital technologies to all power plants and network infrastructure. This can be achieved by reducing operation and maintenance costs, improving power plant and network efficiency, reducing unplanned outages and downtime, and extending the operational lifetime of assets.

Reduced O&M costs

Digital data and analytics can reduce O&M costs, enabling predictive maintenance,[6] which can lower costs for the owner of plants and networks and ultimately the price of electricity for end users. This type of maintenance is only possible with detailed component-level information delivered in real time, a prohibitively difficult and expensive task without digital sensors.

Globally, the IEA estimates that O&M costs in power generation and electricity networks were just over USD 300 billion in 2016. Over the period to 2040, a 5% reduction in O&M costs achieved through digitalization could save companies, and ultimately consumers, an average of close to USD 20 billion per year. For renewable energy technologies, improved maintenance also supports better performance throughout the life of the project.

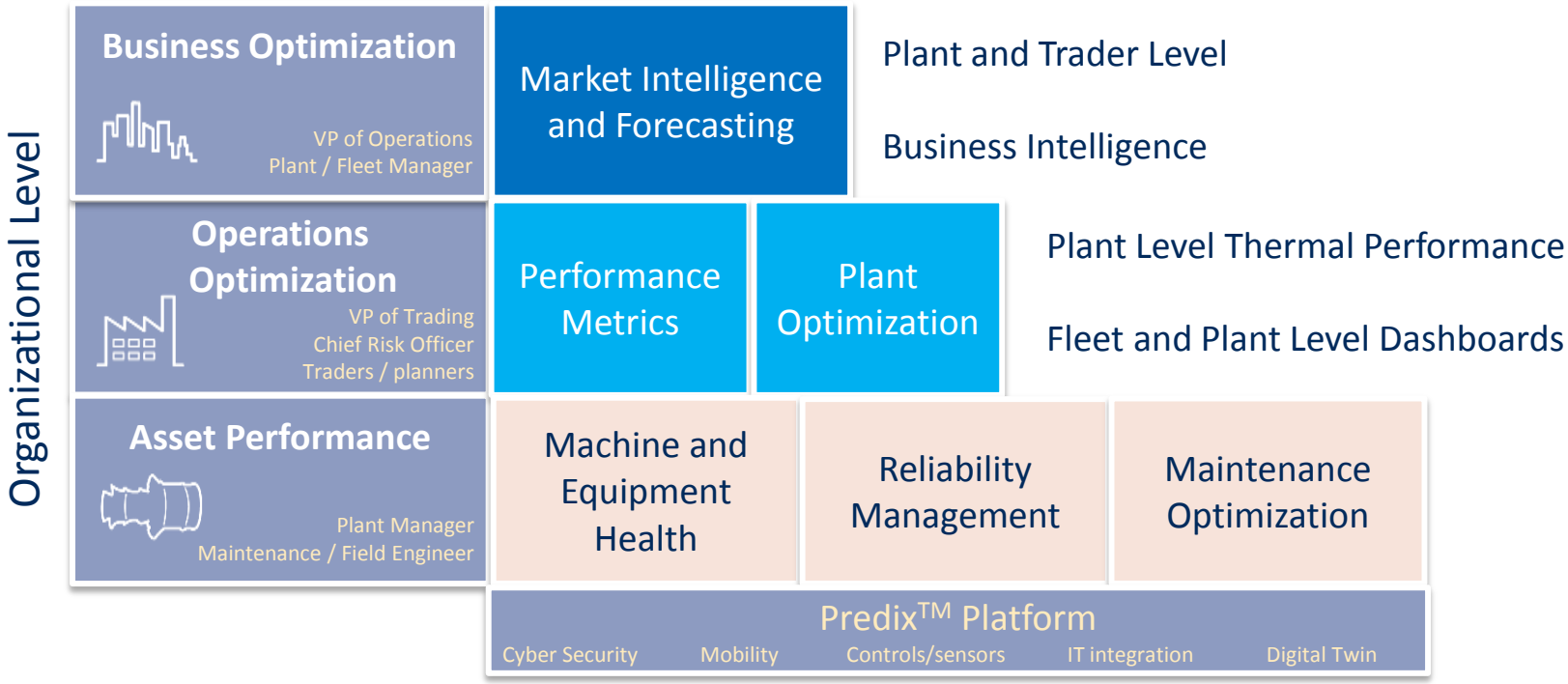
What are the different steps on the path to digitalisation? How does “digitalisation” “mature”

- **Step 1**: Connect
  All critical assets across the enterprise
- **Step 2**: Monitor
- **Step 3**: Analyze
- **Step 4**: Predict
- **Step 5**: optimize

DNV GL digitalisation aspects

Digital Twins, cyber-physical systems	Digital Platforms	Cloud-based infrastructure	Data management and analytics	Mobility
• Data about real-world objects, models • IoT, asset instrumentation and control • Simulations • Asset life cycle management • Asset data sharing • Asset knowledge management	• Reusable services and components • Open and expandable by customers, partners and others • Standardised customer/user facing • Provider and consumer interactions	• Scalable and industry standard infrastructure • “XaaS”: SaaS, IaaS, PaaS, DaaS and other “as-a-Service” • Cost and flexibility • Deployment cost and time • Proven architectures	• Data ingestion, management, curation, quality assurance. • Data analytics, learning algorithms and other value creation from structured and unstructured data	• Availability 24/7, everywhere, on all devices • Offline and online
Intelligent automation	**Digital trust**	**Digital processes**	**Business models and ecosystems**	**Digital competence**
• Value adding application of AI • Autonomous vehicles, vessels, etc. • Intelligent digital co-worker • Work process automation • Industrie 4.0	• Cyber security • Information privacy and security • IPR protection • Data and information quality • Digital asset traceability, veracity, and authenticity • Blockchain • Social trust models	• Work process support and improvement • Digital customer and partner interaction • Human-2-human, human-2-system, system-2-system • Process and data standardisation • Collaboration • Self-service	• Support different types of business models • Support bilateral and multilateral business interactions. • Support existing and new ecosystems • Platform businesses	• Build internal expertise in selected areas • Join in Open Innovation collaborations • Adapt innovation and value creating work processes to increased rate of change

Digital Solutions to Improve Plant Performance



Courtesy of General Electric Company

Brainstorming: Questions to Ask in maturity model / KPIs / how to measure them?

- Level of instrumentation? Any additional instrumentation to improve diagnostics?
- Cloud based / central data management?
- How is data accessibility inside the company? Are data sources consolidated? Inspection results?
- Analytics? Fleet level analytics
- Maintenance scoping?
- Is there a central M&D centre? If yes, what type of data is reviewed there?
- Level of automation? How much staff needed?
- How much equipment specialists? How are they used?
- Remote operation?
- Cyber security