A SURVEY OF HEALTH MONITORING TECHNIQUES FOR THE DUTCH TRANSPORTATION INFRASTRUCTURE

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CONTENT PREVIEW

- Background and key drivers for the study
- Research Question & Research Methodology
- Findings from literature study
- Pilots
- Conclusions, Lessons-Learnt

BACKGROUND & KEY DRIVERS FOR THE STUDY (1)

- Ageing infrastructure assets may result in challenges to meet to meet pre-specified reliability, availability, maintainability and safety (RAMS) requirements.
  - Ageing due to technical, functional, economic reasons.
  - Electrical and mechanical components are critical elements with respect to the RAMS-criteria.
  - Unpredicted failure in them leads to societal impact, unsafe situations and (high) costs.

- Preferred situation:
  - Vitality of assets in control under the changing requirements and circumstances
  - Less down-time
  - Maintaining / increasing the reliability of assets
  - On-line monitoring of usage and availability.
  - Maintenance based on risk analyses in combination with data- and analytics driven predictive maintenance

BACKGROUND & KEY DRIVERS FOR THE STUDY (2)

- In various fields and industries, novel techniques are already used to monitor performance and predict behavior of electrical and (electro-) mechanical components.

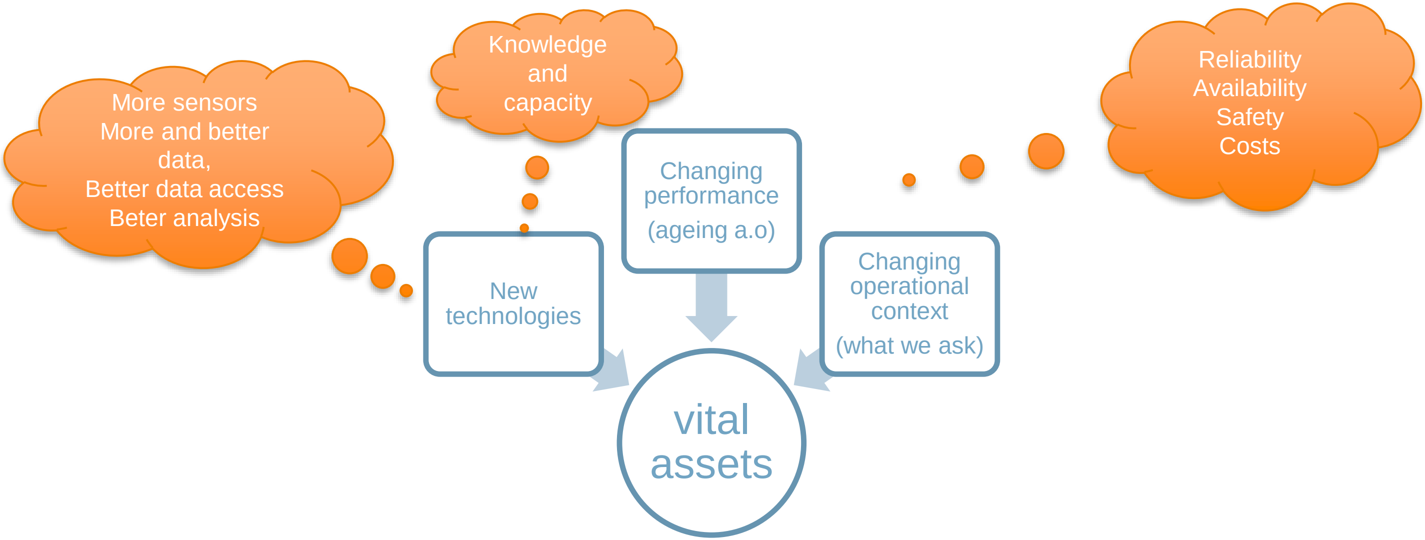
- These techniques combine insights and methods from different fields, such as computer and data science with knowledge about the assets, its usage, its subsystems and components.

Not new in Asset Management, but new in Infrastructure Asset Management !

RESEARCH QUESTIONS

- What are the drivers for predictive maintenance in other (industrial) areas?
- What can we learn from them, which technologies fit to the practice of Infrastructure Asset Management of Rijkswaterstaat?
- Which steps need to be taken to the maintenance, technical and organizational processes in order to move towards predictive maintenance practice?

LITERATURE SURVEY & FINDINGS



SIMILARITIES AND DIFFERENCES COMPARING TO THE ASSETS AND ASSET MANAGEMENT AT RWS

- Main drivers for monitoring and predictive maintenance are similar for all areas

- Technology enables but always custom tailored solutions required

- Context of Rijkswaterstaat is different:
  - Greater variety of objects and components (all different objects <> 200 identical Boeing 737s)
  - Greater distribution of age and lifespan (objects and parts)
  - Other functions and usage
  - An on-going replacement task, thus other issues to be handled

- Learn from others but translate to Rijkswaterstaat environment
- Consider knowledge and capacity coming along with new technologies
- Regulating and managing large renovation and replacement works efficiently
- Helping with good commissioning (in capacity and personnel challenges)

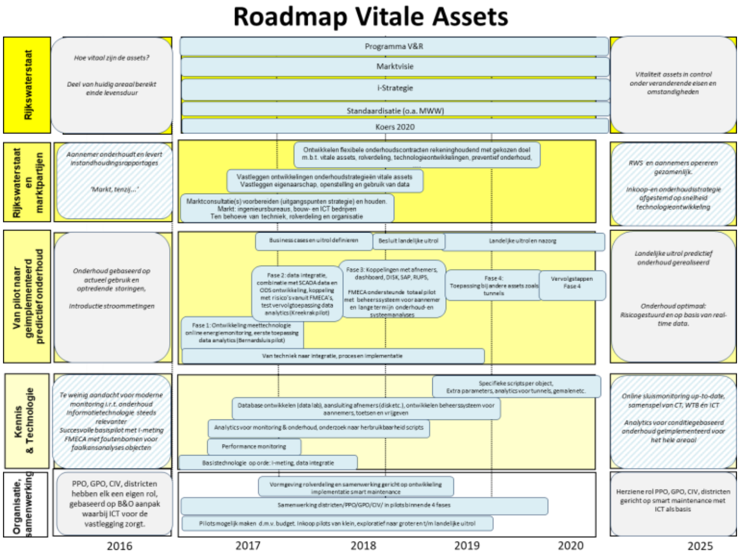
TRANSLATING TO RWS ENVIRONMENT

- There is technology available to possibly improve the asset performance.
- There are already well-established maintanance and asset management methods at RWS.

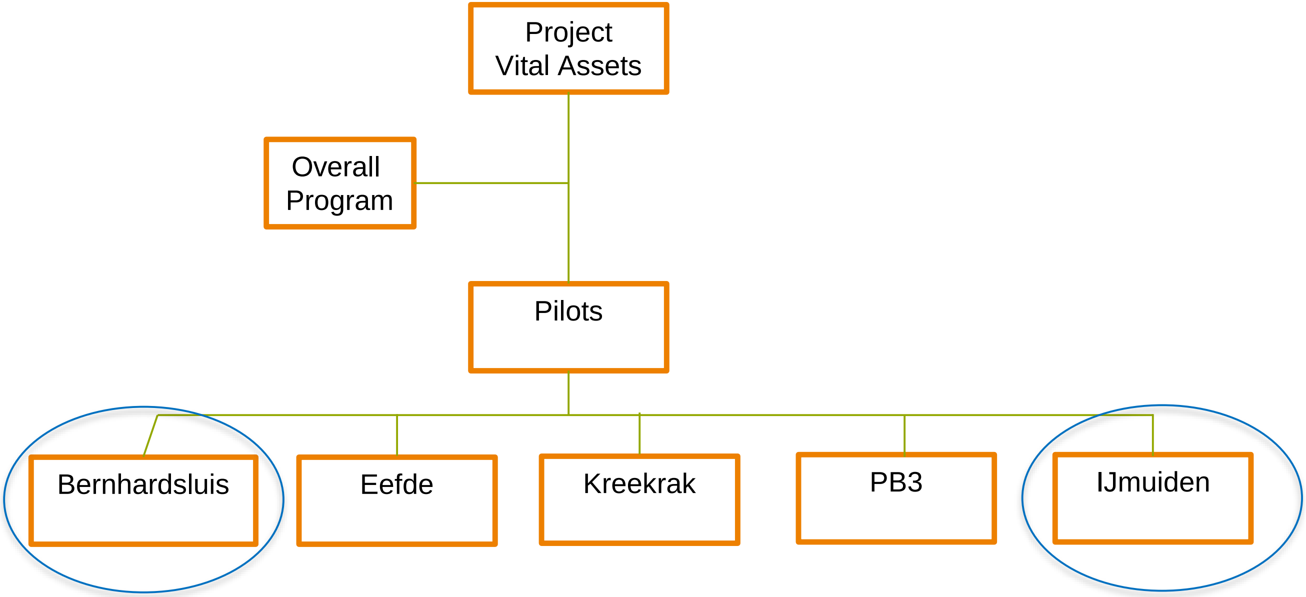
- How to combine the two in order to improve further?

ROADMAP

- Provides a stepwise application and implementation strategy for Rijkswaterstaat
- Distinguish different layers:
  - Strategy
  - Relation with commercial partners
  - Knowledge & Technology development
  - Steps from pilot to implementation
  - Organisation & internal collaboration
- A means to communicate internally and externally
- A basis for continuity and project plans



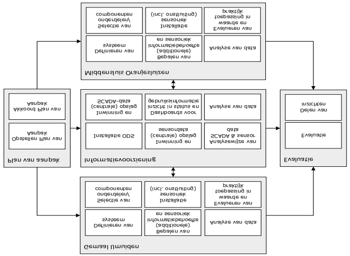
PILOTS: ESSENTIAL COMPONENTS TO PRACTISE AND LEARN (1)



PILOTS: ESSENTIAL COMPONENTS TO PRACTICE AND LEARN (2)

- Pilot Bernhard lock:
  - Advanced measurements of electrical energy usage (together with a commercial partner)
  - Test of a HW/SW new interface to combine existing control (SCADA) data with data from additional installed sensor- and data acquisition systems
  - Data analyses already detected a failing dryer that was not recognized by inspection
  - Lessons-learnt on aspects to arrange between market parties and RWS, particularly on data and integration to RWS processes
  - On-going

- Pilot IJmuiden (lock and pumping station):
  - Goal asset manager: decrease of down-time
  - Focus on critical components (hydraulic actuators lock doors, frequency converter of pumps)
  - Unlocking of usage data and additional sensor data
  - Development of dash boards and data analytics
  - In collaboration with maintenance contractor(s)
  - Implementation involves many steps (see diagram)
  - 2018: implementation, 2019: pilot year



BE-GOOD is a pioneering project aiming to unlock, re-use and extract value from Public Sector Information (PSI) to develop data driven services in the area of infrastructure and environment

SUMMARY/CONCLUSION

- Other industries offer interesting and useful insights for application in the Dutch transport infrastructure.
- Drivers are similar but the context of Rijkswaterstaat is different.

- New technologies can increase the knowledge of systems' performance.
- New technologies can also improve maintenance strategies and approaches.

- Integration of new technologies into the existing maintenance practice is essential.

- Monitoring & predictive maintenance: not a holy grail, but an interesting tool for asset management.

TECHNOLOGY ENABLES, BUT…

- Turn-around time between space shuttle flights was much longer than originally planned due to the fact that the 3 main engines had to be taken out for inspection after each flight.

  - Use of additional sensors for monitoring of engine behaviour during flight could have prevented this…………………..

  - …….However, the only in-flight shut-down of a main engine happened because of a failing sensor……

- Additional monitoring systems for critical (sub)systems must be fail safe !