

An aerial night photograph of the TU/e campus in Eindhoven, featuring modern buildings, a canal, and a road with light trails. A semi-transparent red rectangle is overlaid on the upper half of the image, serving as a background for the title and subtitle.

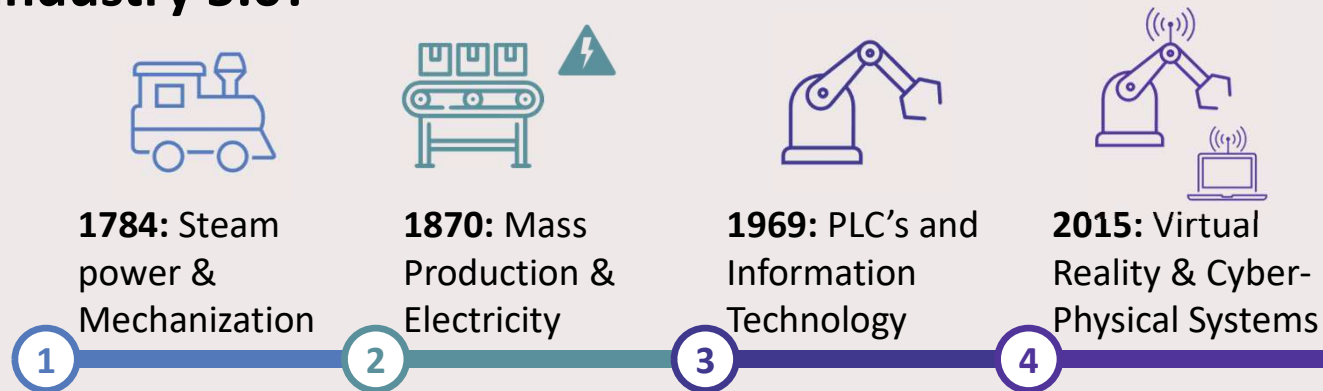
Predictive Maintenance for Industry 5.0

BEHAVIOURAL INQUIRIES FROM A WORK SYSTEM PERSPECTIVE

Bas van Oudenhoven, Philippe Van de Calseyde, Rob Basten, Eva Demerouti

School of Industrial Engineering and Innovation Sciences

What is Industry 5.0?



- Industrial revolutions have been driven by **technological progress**
- This progress is marked by **positive** developments in productivity and automation, but many **negative** consequences for humans often ensued
- New paradigm **Industry 5.0** puts **humans** at the centre of technology development to improve human **well-being** and enhance human **capabilities**
- With this perspective we looked at the implementation efforts of PdM

Purpose and Method of the Paper

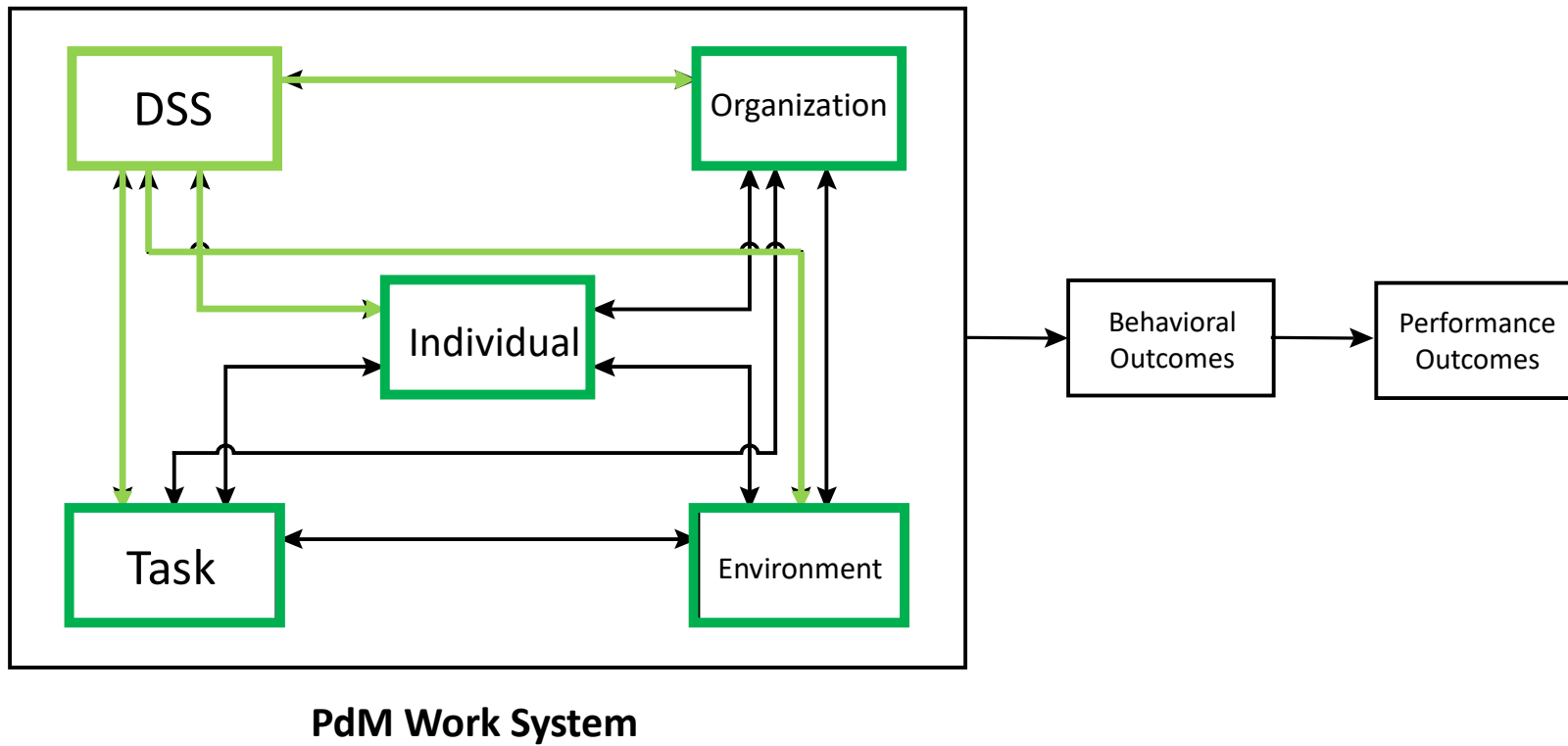
- When studying PdM use by decision-makers, we often observed **rejection** of advice by decision-makers
- Maintenance research solution: *“Hey, let’s make our models even better!”*
- Rejection of (predictive) systems by decision-makers is often **unrelated** to their quality, but because systems do not consider their **specific needs**
- We study which needs predictive maintenance systems **violate**, what other problems for **well-being** they impose, and how we can increase the **acceptance** of predictive maintenance systems
- We formulate **ten propositions**, validate them through expert **interviews**, and obtain **four key themes for acceptance** of PdM systems

Some definitions

Decision-makers are the employees responsible for operational maintenance decision-making: instructing mechanics when to perform maintenance actions on what assets and what components

Acceptance is the degree to which decision-makers actually use system-generated advice in their decisions

Smith – Carayon Model of the Work System



DSS: Advice Quality and Source

After observing that advice is poor or incorrect, maintenance decision-makers are more likely to continue using PdM advice generated by human experts than PdM advice generated by a DSS.

- **Literature:** Algorithm aversion, cry-wolf effect
- **Experts:** “This is true, I have seen this endlessly.”
- **Experts’ Suggestions:**
 - On implementation, set an appropriate **timeframe** on failure predictions (weeks rather than days)
 - Do not use PdM system in isolation, always employ a human PdM experts that interprets output and can explain decisions to maintenance staff

Task: Making Maintenance Decisions

Humans tasked with evaluating system-generated maintenance advice will generally adjust prognostic calculations and subsequent system-generated maintenance schedules.

- **Literature:** Judgmental adjustments
- **Experts:** “Decision-makers always adjust, they need to accommodate pre-existing priorities”, or “This is only true when the system is new.”
- **Experts’ Suggestions:**
 - **Allow** adjustments to see where the system can be **improved!**

Support Factors for Acceptance

From the ten propositions and the experts' responses, we distilled the following **factors** that **support** acceptance of PdM:

- Setting an appropriate degree of **human control** in PdM decision-making
- Creating **trust** between the decision-maker and the model (maker)
- Providing sufficient **cognitive resources** to decision-makers to deal with the cognitive **demands** posed by the system
- **Allocating** decision-making responsibilities and capabilities to the appropriate **organisational unit**

Thank you for your attention!

Shameless plug: Links to paper on the right.

If you are interested in doing research with us, please reach out!

Planned future work: design decision-support systems that increase the acceptance of advice

- What level of control over outcome for decision-makers?
- How do we present advice to increase trust?



<https://doi.org/10.1080/00207543.2022.2154403>

E-mail: b.v.oudenhoven@tue.nl