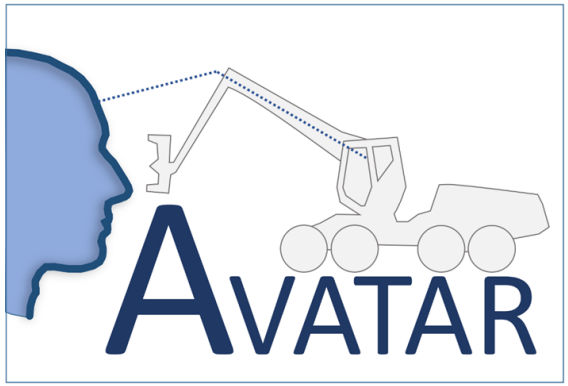

AVATAR – Advanced Virtual Aptitude and Training Application in Real-time

Madrid, September 28, 2022

Marius Kopetzky (UNIVERSITY of GÖTTINGEN, GERMANY)

UNIVERSITÄT GÖTTINGEN

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Project partners

UGoe - University of Göttingen, Germany (Project lead)

IfADo - Leibniz Research Center for Working Environment and Human Factors, Germany

NIBIO - Norwegian Institute for Bioeconomy Research, Norway

Optea, Sweden

Skogforsk - Forestry Research Institute of Sweden, Sweden

Skogkurs - Forestry Extension Institute, Norway

WH-NRW - Forestry and Timber North Rhine-Westphalia, Germany

Mar 2019 – Oct 2022 (8 months extension)

Introduction

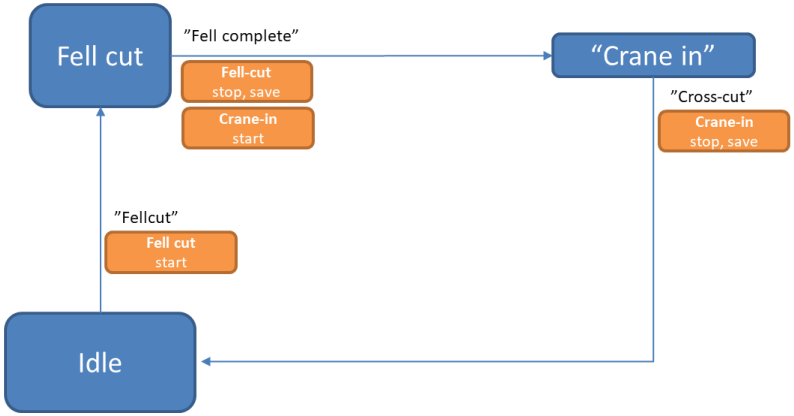
- Main objective: **Reduce training and skill demands on new machine operators and also mental workload on experienced operators**

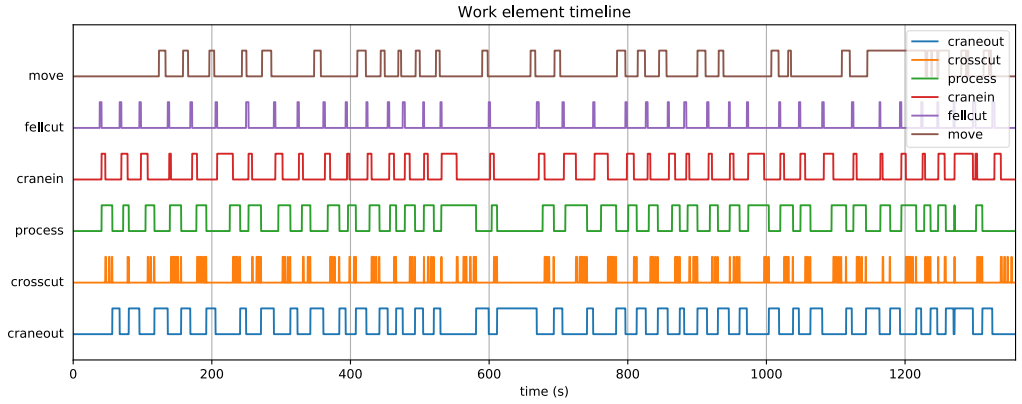
Therefore:

- **Investigate operators' need for feedback** and definitions for high performance and quality of work
- **Develop and implement sensors** to detect machine position and movement
- **Investigate several aspects** to improve log positioning, crane movement, bucking and harvester head measurements
- **Design a Digital Coach** that gives feedback about performance and quality of work
- **Install head-up display** in the cabin to show helpful information

Results – Defining the basics

- **Algorithms for automated work phase detection**



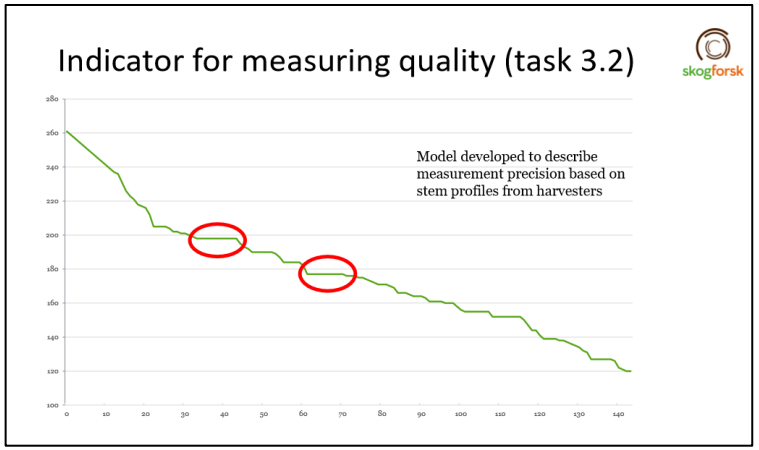


Depictions: Skogforsk

- **List of advantageous and disadvantageous work patterns**
  - A comprehensive list of „beneficial" and „negative" machine operator behaviour and teamwork aspects was collected via operator interviews in three countries

Results – Aids for detection

- **Diameter measuring accuracy algorithm**
  - An algorithm detects inaccuracies in stem diameter measurements of harvester heads in real-time



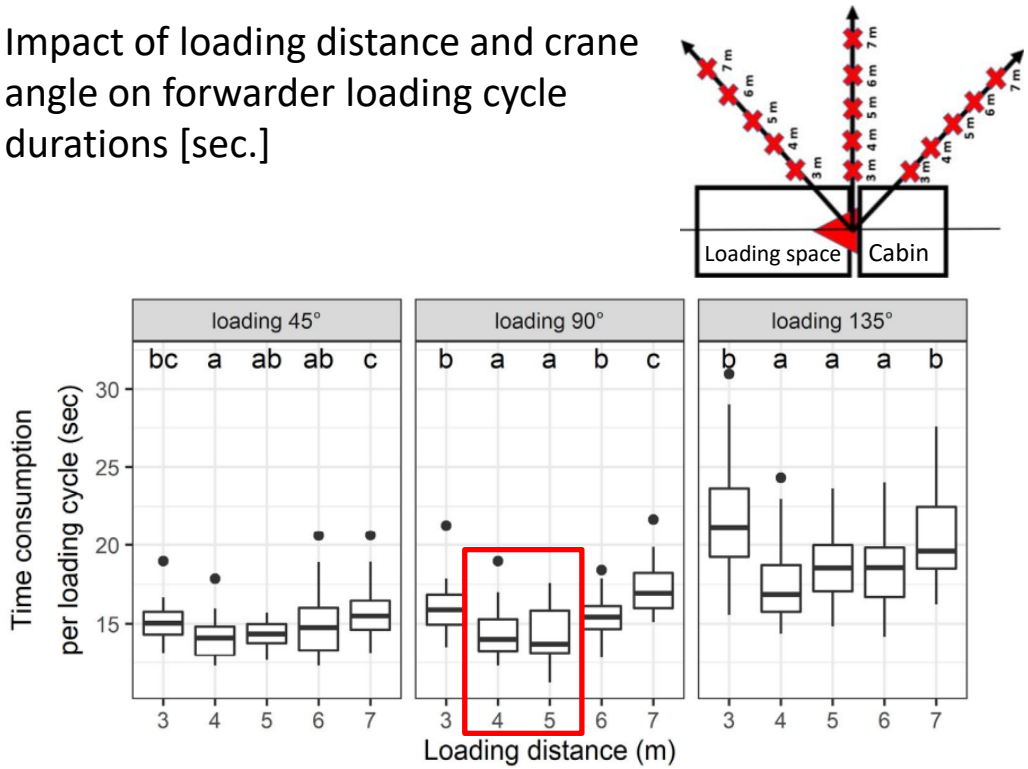
- **LiDAR sensor**
  - A LiDAR sensor was developed to detect the machines environment as well as machine position and movement

Photo: UGoe Sensor: NIBIO

Results – Work optimisation

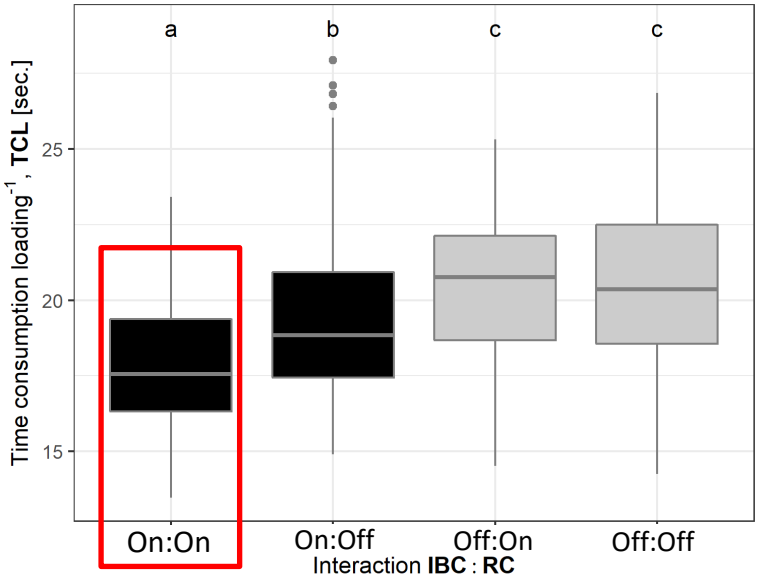
- **Optimal working angles, distances and log orientations for forwarders**

Impact of loading distance and crane angle on forwarder loading cycle durations [sec.]



Hartsch et al. (2022)

Impact of intelligent boom control (IBC) and rotating cabin (RC) on forwarder loading cycle durations [sec.]

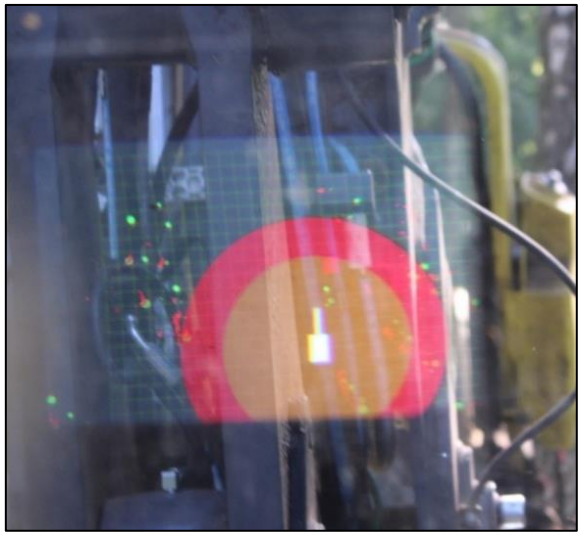


Hartsch et al. (2022, pending)

Results – Proof of concept

- **Final field trials in Germany**
  - Pilot study for LiDAR system under German forest conditions
  - Pilot study for head-up display in the cabin

Head-up display in John Deere Harvester during harvesting operation and display content provided by the LiDAR.



Photos: UGoe Head-up display: Optea

Unexpected peculiarities / barriers

- **Challenges:**
  - Unwillingness of machine manufacturers to provide access to CAN-Bus data.
  - The shortage of sufficient computational power (computer chip shortage due to COVID-19 crisis) for live data collection, computation and projection on the head-up display

- **Solution strategy:**
  - Omit work phase detection based on CAN-Bus data
  - Use of external LiDAR System to additionally detect crane position

- **Compromise:**
  - Could only collect and save data from LiDAR during harvest for post-hoc computation, but no live depiction on head-up display

Impacts

- **Deep understanding of work patterns and performance factors**
  - This could help to further develop and improve operator assistance and reduce mental workload for machine operators

- **Technical feedback in forest machines by head-up displays**
  - After our first trials with head-up displays we can go on to make it a standard equipment in forest machines

- **Concept of Digital Coach for machine operators developed**
  - The drafted design could now be transformed into a real Digital Coach for machine operator support, steady customised feedback and performance improvement

The value of scientific cooperation

- **Base for competence network and future collaboration of partners**

  For:
  - Tackling of problems by utilising diverse competencies of project partners
  - Synergies by combining regional perspectives for robust and upscalable solutions

Thank you!

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