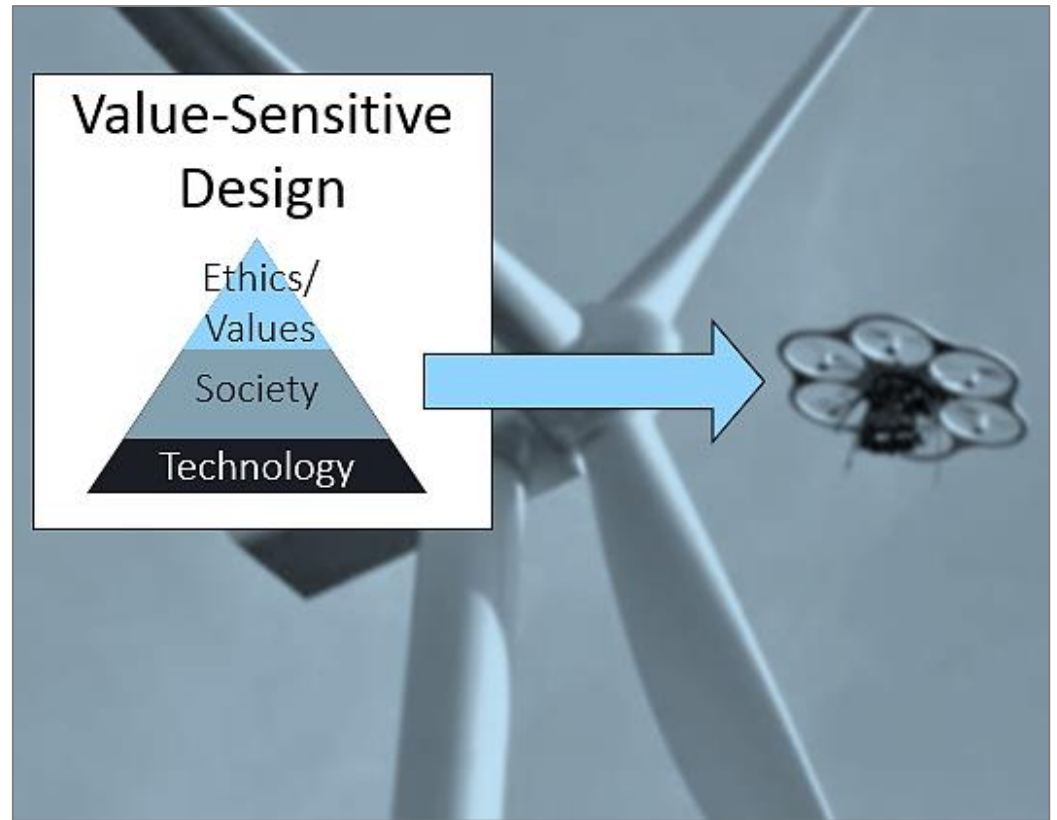


# Making drones ethical by design



*Wind Energy Denmark*

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# SDU Unmanned Aerial Systems Center

## Mission Statement:

*Research, education, innovation, & collaboration in the UAS domain for the benefit of society.*



# The problem

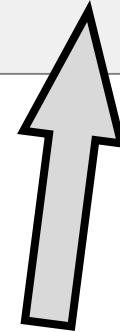
## Risks of drone technology

- Philosophical and social risks
- Human welfare
  - Jobs
  - Physical safety
  - Privacy

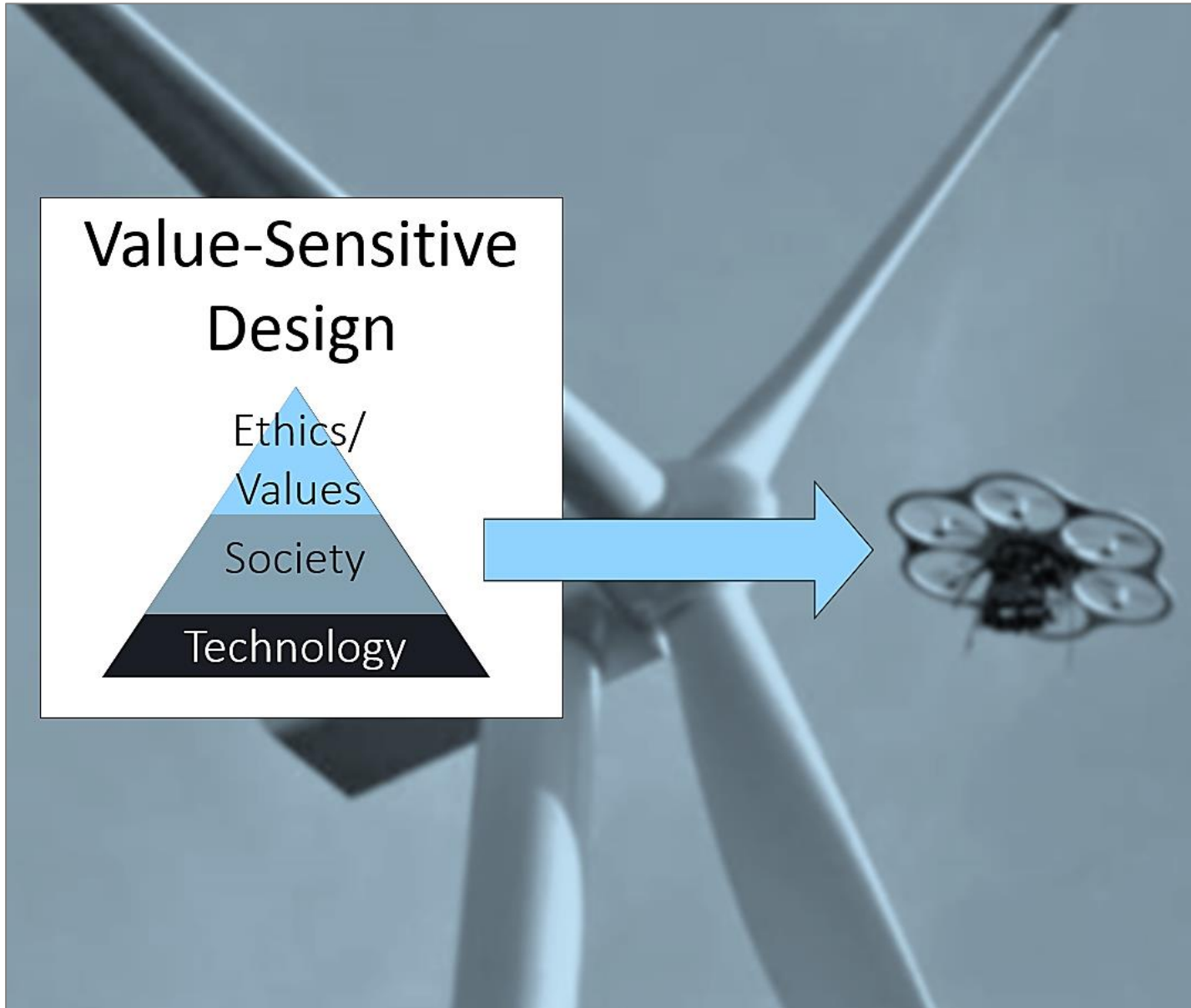
# Background

## Drone functions

- Flying sensor
- Cameras
- Electromagnetic radiation
- Etc.
- Cargo transport



# Methodology



# Value-Sensitive Design

Value-Sensitive Design

(Iterate)

Philosophical  
Phase

Social Impact  
Phase

Technical  
Phase

Non-Value-Sensitive Design Method

Time/Design Maturity

# Values in drone embodiment

- Work (physical health, dignity & respect)
- Autonomy (human VS drone tasks)
- Physical wellbeing (safety)
- Mental wellbeing
- Privacy
- Trust (mission, operator)
- Environmental impacts

# VSD Embodiment

“Privacy by design” – onboard computer vision image processing for blade defects (no raw image data)

Human work – creativity, problem solving; robot work – data collection (high level of autonomy)

Quiet operation – reduced stress, impact on wildlife

Safety – passive + active safety systems; “geo fence” around airports/no-fly zones



Accountability – operator ID, Drone ID

Environmental sustainability - PLA + flax composite; solar charging; modular/repairable design; local materials



# Recommendations

- Add Value-Sensitive Design considerations to the development process
- Interdisciplinary collaboration
  - Change organizational structures
- Educate engineering students in engineering ethics and VSD methodology
- Quantify social and environmental impacts as incomes/expenses
- More regulation of technology, drones
  - Protect human welfare, safety, privacy, jobs etc.

# Future work

- Develop/refine VSD method for drone engineers
- Build a prototype ethical drone 😊



Thank you!