

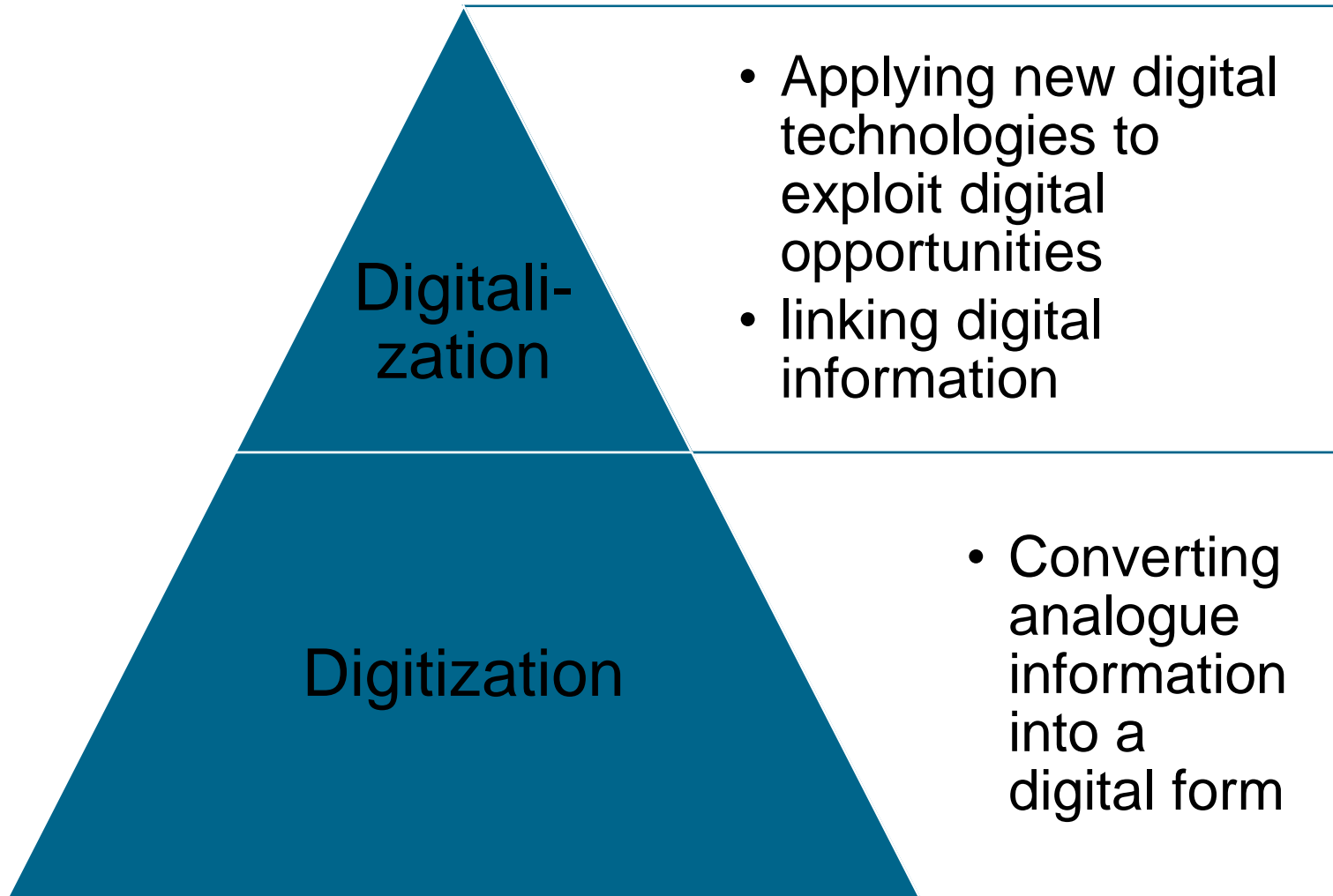
# **Digitalization as a Toolbox for the Autonomous CSP Plant**

25th Cologne Solar Colloquium

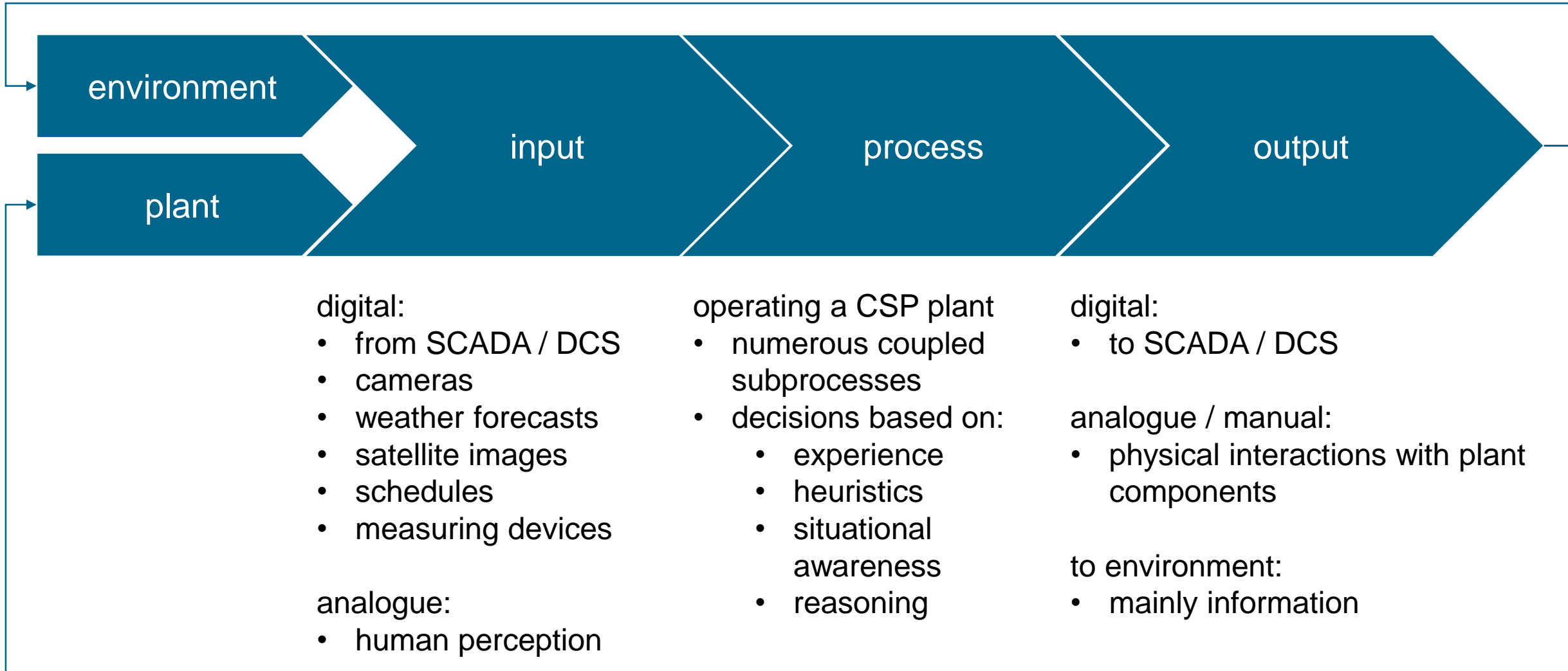
Kevin Iding, DLR Institute of Solar Research



# Digitalization



# Information processing in CSP plants



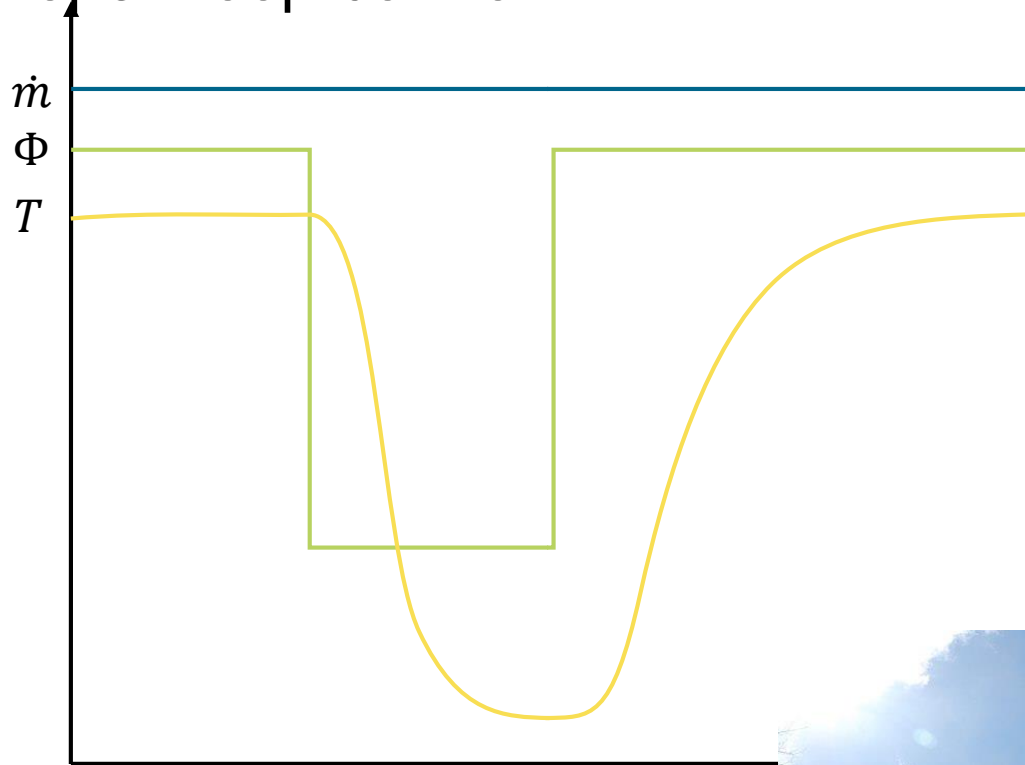
# Dimensions of (partial) autonomous plants



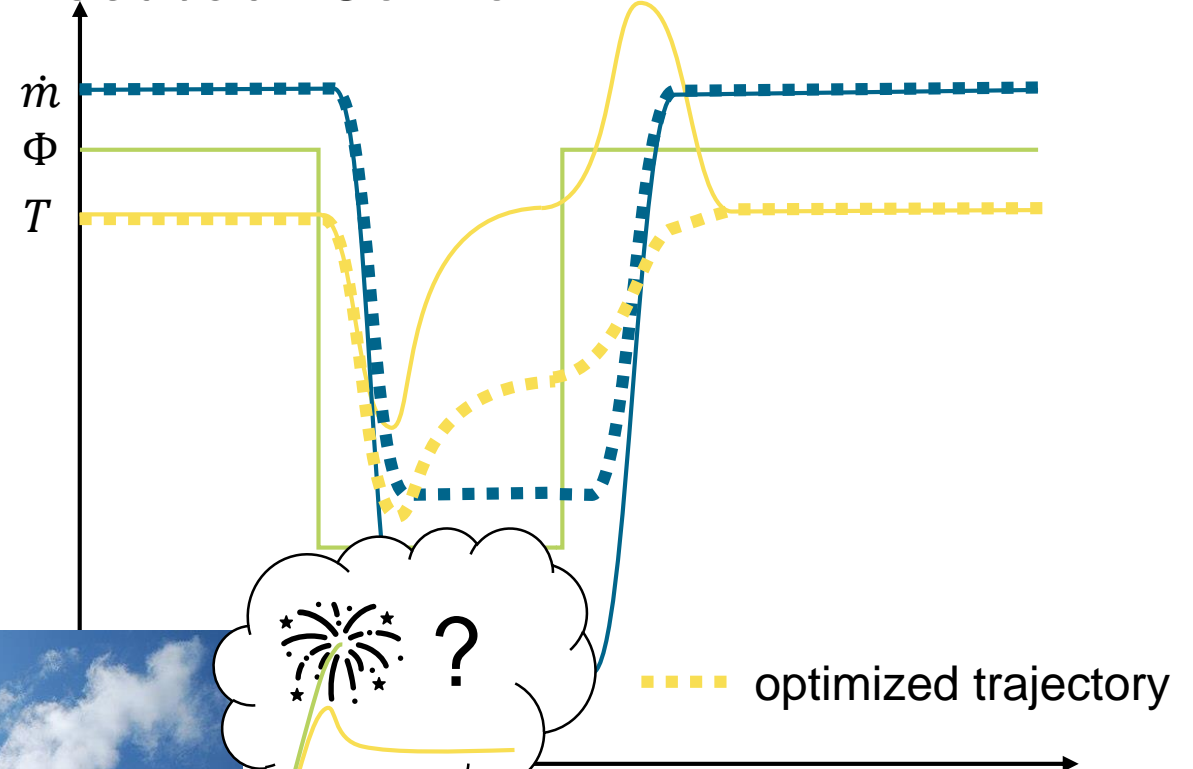
- lifecycle:
  - commissioning
  - operation
  - maintenance
- field of activity:
  - control room
  - field operations
  - planning and scheduling
- situations:
  - startup / shutdown
  - transients
  - steady state
- responsibilities and tasks of human operator:
  - execution of proposals
  - confirmation of proposals
  - supervision and intervention
- time:
  - time limits for reaction
  - frequency of recurrent manual tasks
- psychological implications:
  - loss of knowledge
  - situational awareness / attention
  - suitability of task for human

# Example: improving mass flow control of open volumetric air receiver with digital technologies

## ■ open-loop-control



## ■ feedback-Control



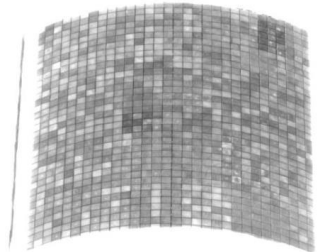
# Example: improving mass flow control of open volumetric air receiver with digital technologies

## Digitization:

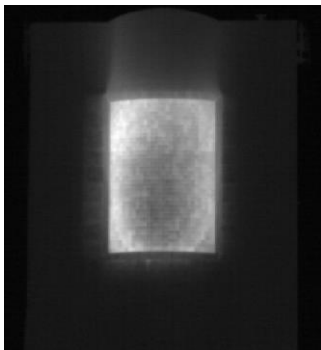
all-sky-image



photography of receiver



ir-image of receiver



## Digitalization:

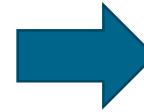
DNI-map + forecast

flux prediction

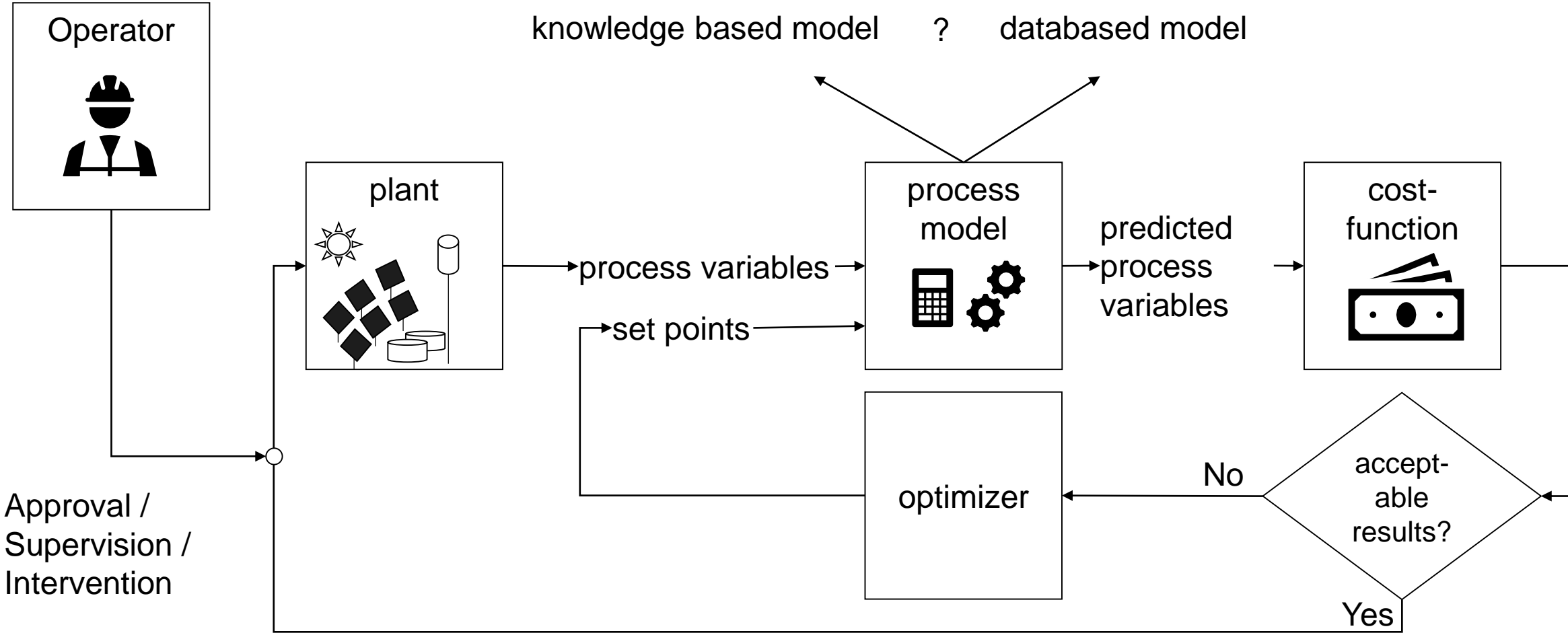
flux on receiver

temperature on receiver

determining optimal mass flow trajectory

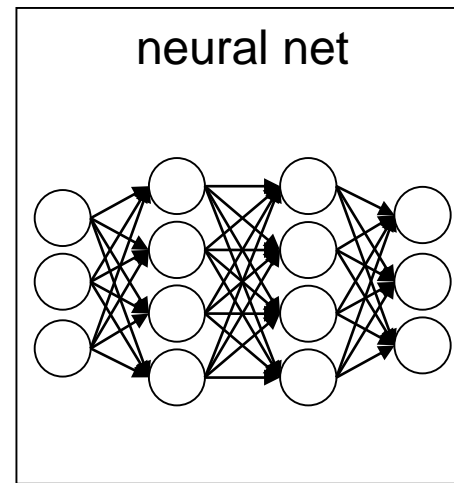
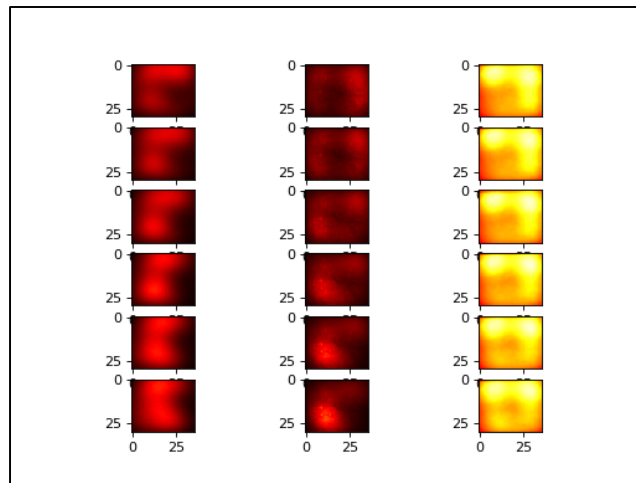


# Example: improving mass flow control of open volumetric air receiver with digital technologies



# Databased modelling of the open volumetric receiver

series of ir-images,  
measured flux and  
flux forecasts



forecast of  
temperature

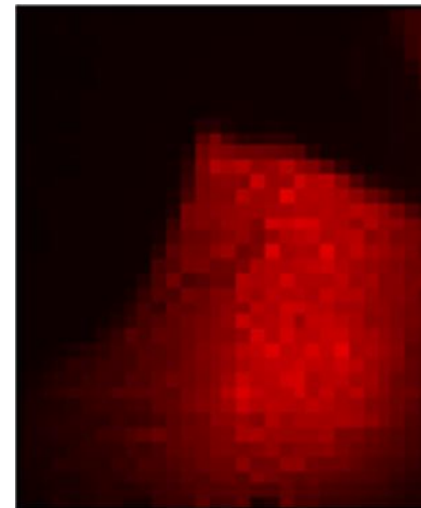


# Conclusions

- Digitization is the foundation for digitalization and automation
- Linking and processing of information generates additional value
- Start with automation of processes not well suited for human skills
- Digital processes add complexity → robust technologies and fall back strategy



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- Reasoning and finding new measures in case of unforeseen are true strength of human operator → support situational awareness

# Questions welcome!

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