AI in Agricultural Engineering

Reality, Limits and Outlook

AI in technical design - riding a bicyle –

The parent

- Explain the „how to“, show
- Help and adjust
- Trust

The Kid

- Try, fail,
- improve, learn

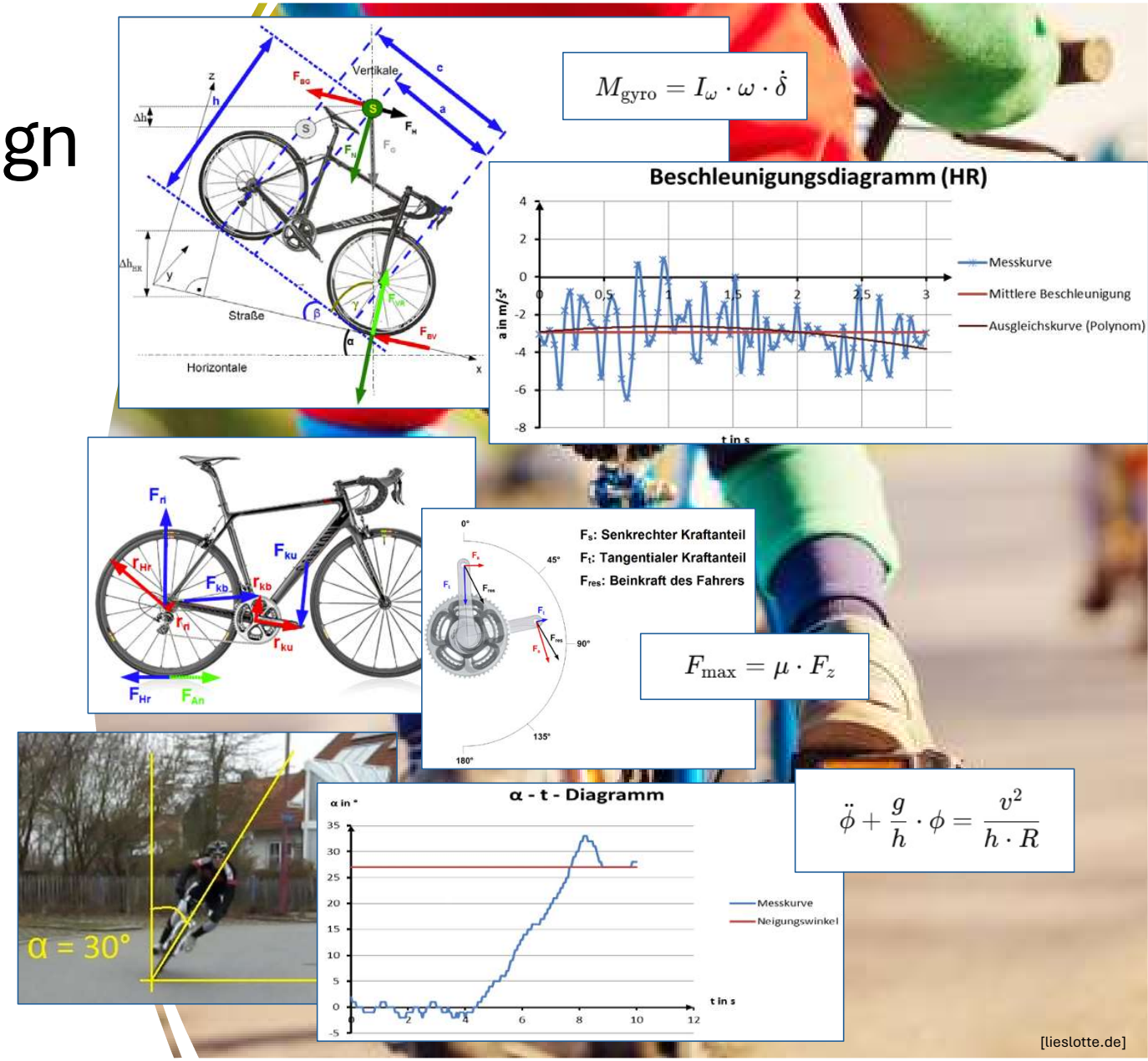
AI in technical design - riding a bicyle –

The Engineer

- Model forces and inertia
- Measure velocities, accelerations, ratios
- Define equations
- Calculate forces and stability criteria
- Validate model
- Varify in real world scenario

The System

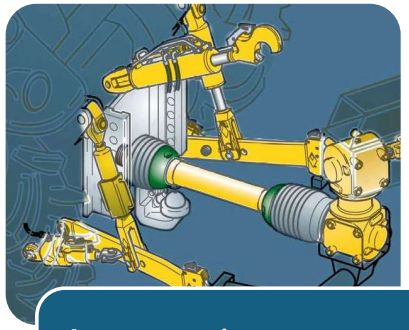
- Perfect in given scenario,
- Adoption to change??



Technologies in Agricultural Engineering

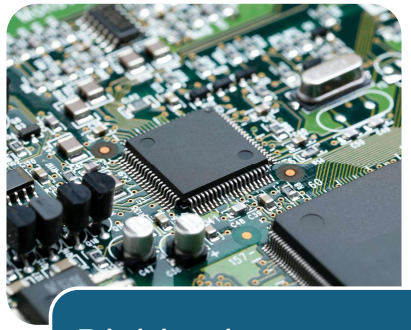
Mechanisation

⟶ Force, Torque



Automation

⟶ Repetition, Rate



Digitization

⟶ Precision, Control

Artificial Intelligence and Machine Learning may change paradigms in general

Artificial Intelligence and Machine Learning - evolution of engineering

[Deere&Company, ReberAG, RFH]

AI in Agriculture – already today

- Multiple domains use AI already
- Wide landscape of applications
  - Crops
  - Livestock
  - Post harvest
  - Management
- What is AI realy doing – some examples

weeding, spraying, autonomous navigation

monitoring, health, welfare

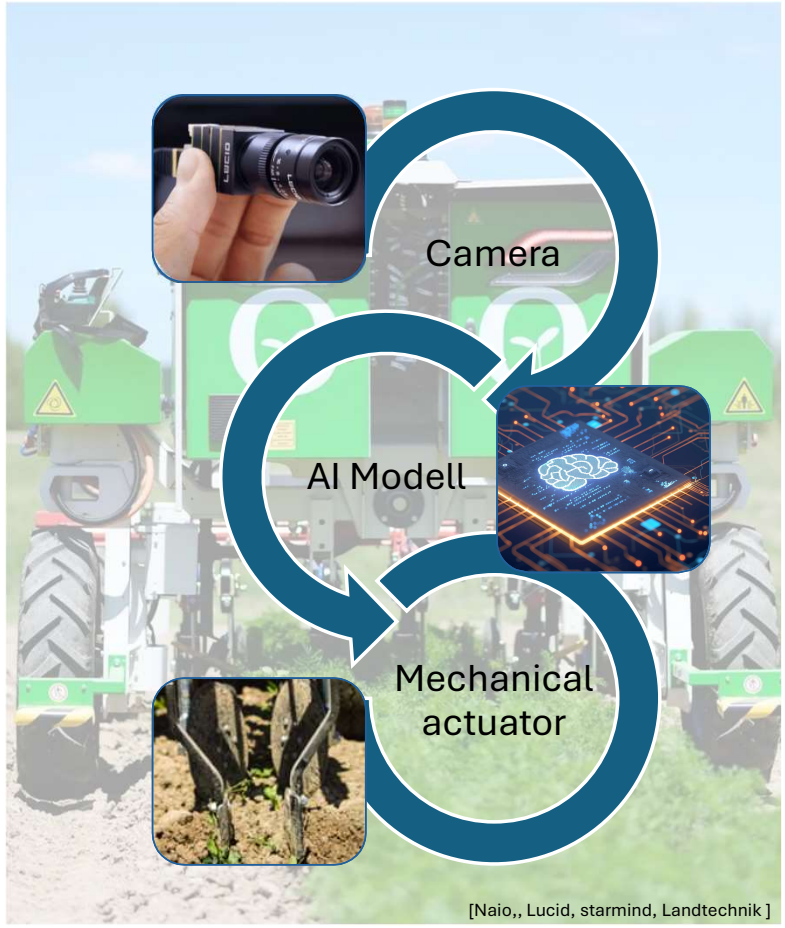
sorting, grading

yield forecast, decision support

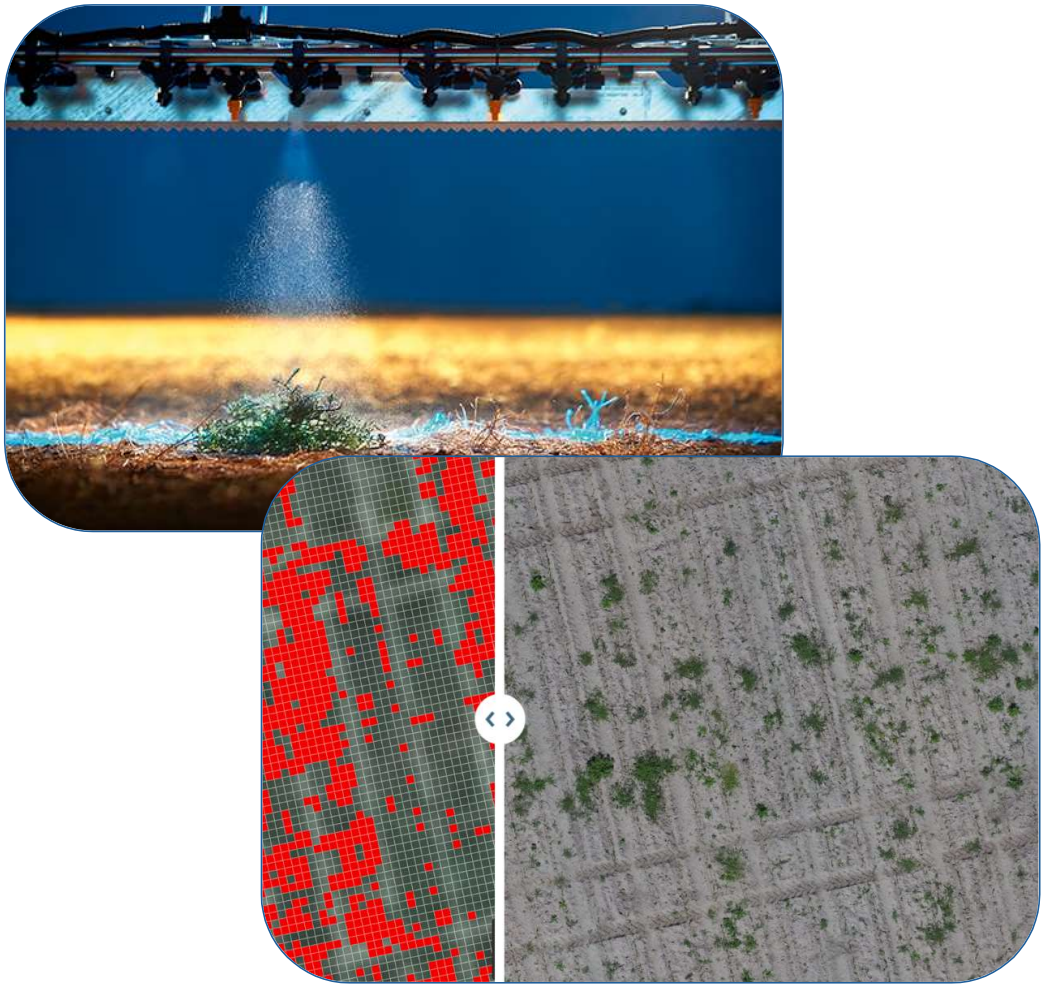
[YorkAC, wikifarmer, WUR, NEXT]

Example 1 | Precision Weeding Robot

Problem	Traditional Weeding: either labor intensive or with chemical usage
Solution	Robot covers field autonomous, detects plants and/or weeds, acts precisely
Benefits	Chemical‘s reduce, sustainabilty, automation of work
Limitation	Light and soil condition
	Training data is THE factor



Example 2 | Smart Spraying



Circumstances

- Use classic single nozzle control spray boom

Intelligence

- Cameras image recognition; AI/ML weed OR crop detection

Setup

- Known traditional flow control on spray pumps

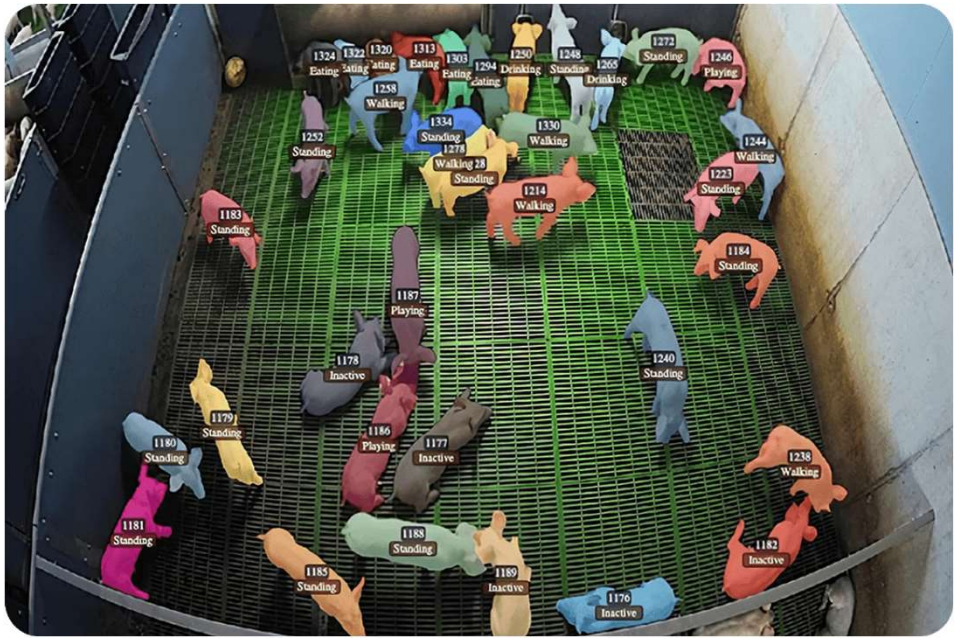
Limitation and

- Light and soil condition
- Training data is THE factor

[Pix4D, o'connors]

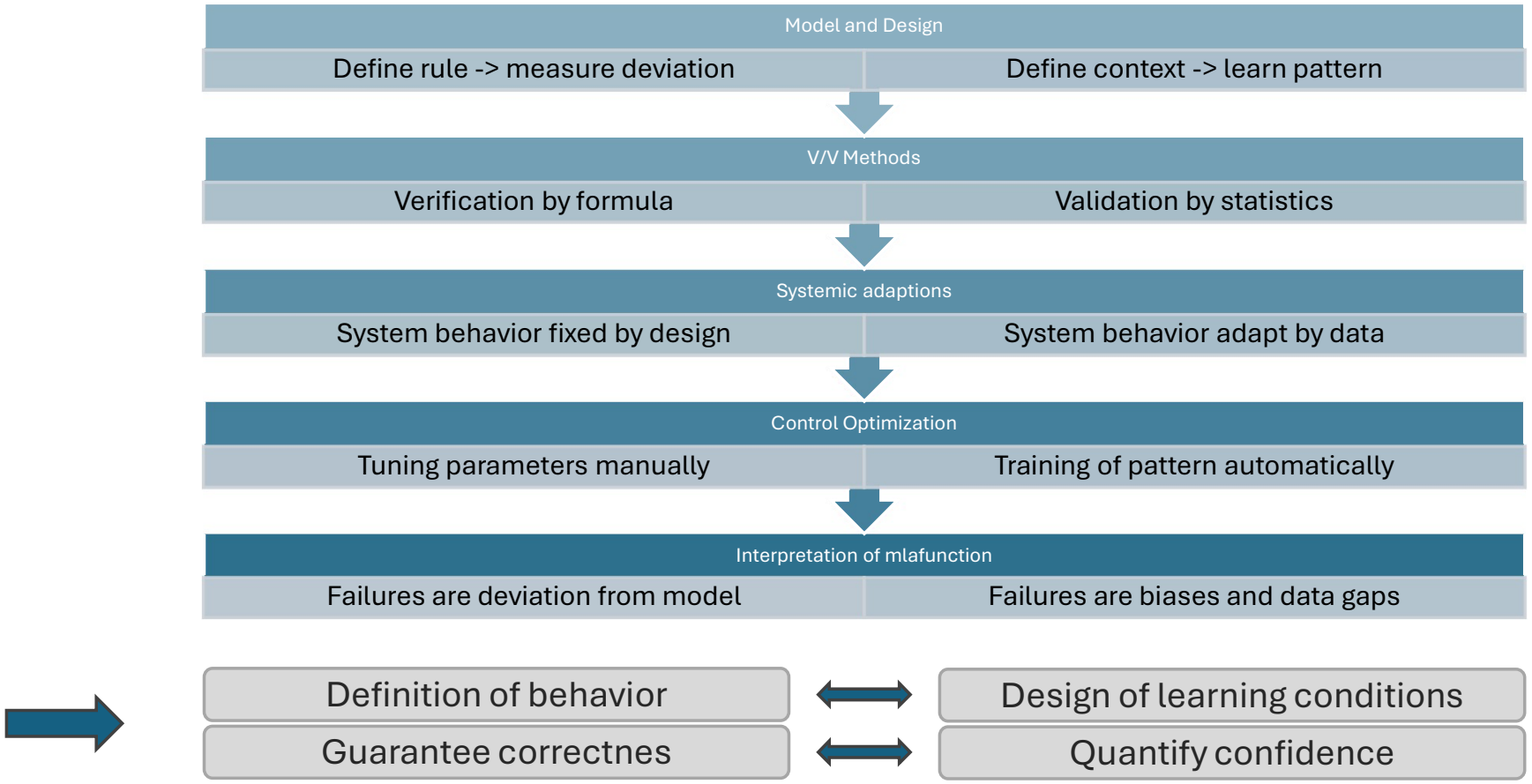
Example 3 | Livestock Monitoring

Challenge	Health changes are subtle
	Early detection needed
Solution	AI tracks movement, activity, vocalization, body condition, etc
	(Behaviour) anomaly detection
Benefits	Early detection of diseases
	increase in animal welfare at lower costs
Restrictions	Device robustness, data protection,
	technical complexity, farmer‘s acceptance



[ultralytics2025]

AI Engineering | A Paradigm shift

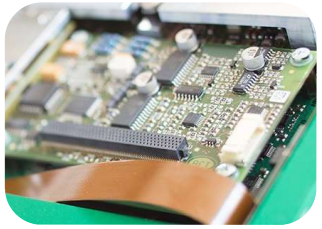


[Lipporld]

AI in Ag | Challenges and Restrictions

Variabilty

Explainability



Hardware

[agroIntelli, 20min, Stern, plantura,Schaeffler,DOG]

AI in Ag | Data accessibility

Data ownership

- Machine data,
- farm data,
- platform restrictions

Data acceptance

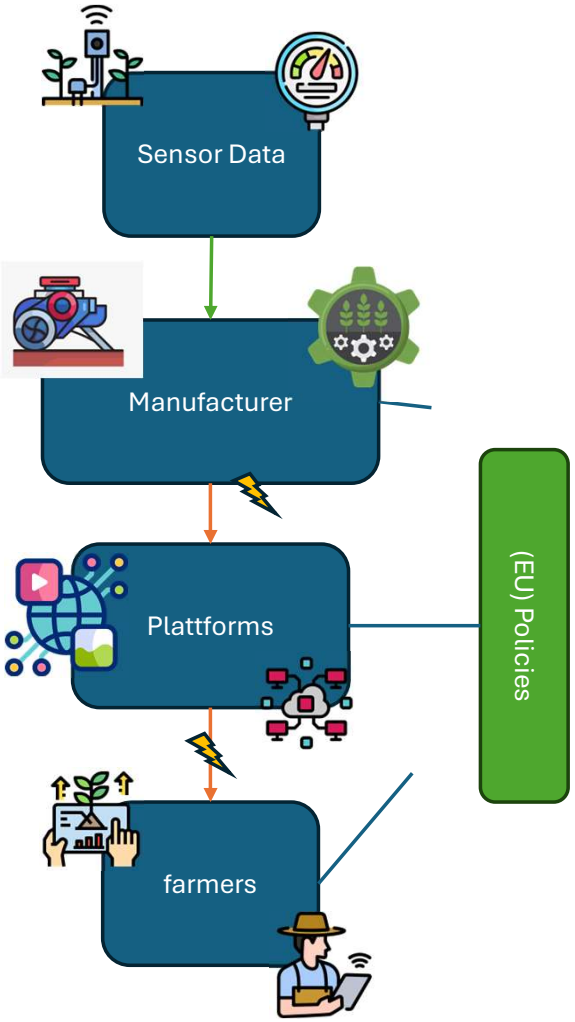
- Reluctance to share,
- fear for dependencies

Data quality

- Rare annotated training data,
- biased data sets,
- context relative data sets

Data fragmentation

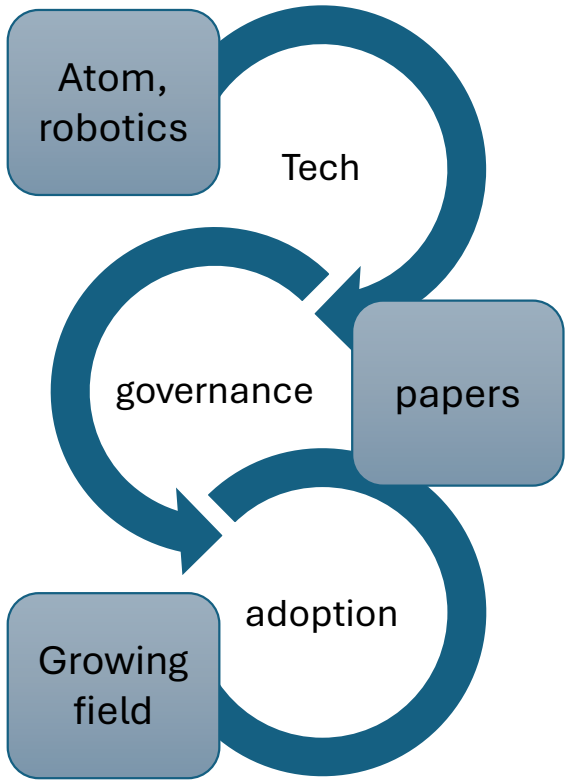
- Lack of standards,
- presence of dialects,
- interoperability



[@Flaticon: Anadara, Eucalyp, Rmpp, Uniconlabs, Sea.icon, Payungkead, Afian; Freepik: Paul J.]

AI in Ag needs Rules and Trust

- Technical limits & organizational barriers
  - Variability
  - Data quality and availability
  - Privacy and interoperability
- Governance can unlock adoptions
  - standards, trust, legal clarity for all players
- EU vision
  - Value based framework
  - Balancing innovation vs safety & fairness



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