

PROTEUS



# Holistic Animal Management with Agentic AI

*Unifying heterogeneous farm data into dynamic, multi-scale digital twins*

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**2nd Artificial Intelligence For Animal Science Conference EAPP · Ghent, Belgium 29-30 June, 2026**

## MOTIVATION



# Livestock is now data-rich — yet the data stays fragmented

Modern livestock systems continuously generate biological, environmental, and operational data. But it remains siloed across sensors, equipment vendors, and manual records — limiting holistic, real-time decisions.



### Fragmented data

Sensors, vendors & manual records act in isolation



### Reactive monitoring

Problems surface only after they become critical



### Manual workload

Time lost to manual logging, transcription & search



### Isolated alerts

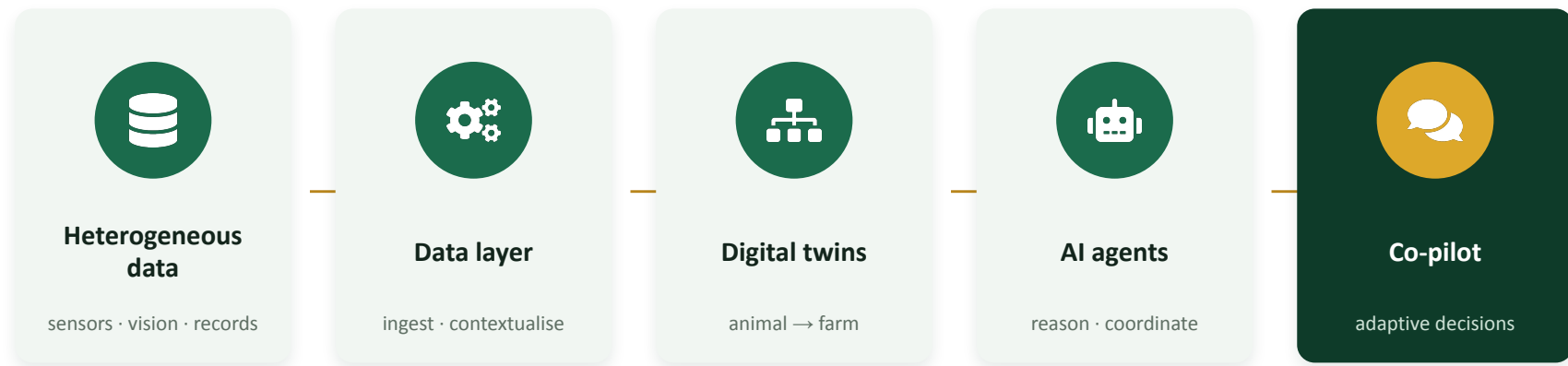
No correlation across variables — no root cause

## OUR CONTRIBUTION

# An Agentic AI framework for farm-level intelligence



A farm-centric data layer turns heterogeneous inputs into multi-scale digital twins, on top of which specialised AI agents reason, coordinate, and deliver adaptive decision support.



*Interoperable with existing infrastructure · learns farm-specific patterns*

## FARM-CENTRIC DATA LAYER



# Ingesting heterogeneous, multi-source data

A single contextualising layer ingests every relevant signal across the farm — turning disconnected streams into a coherent, queryable model.



### Microclimate

humidity · ammonia



### Feeding & watering



### Production logs



### Veterinary inputs



### Computer vision

camera streams



### Activity & behaviour



### Welfare indicators



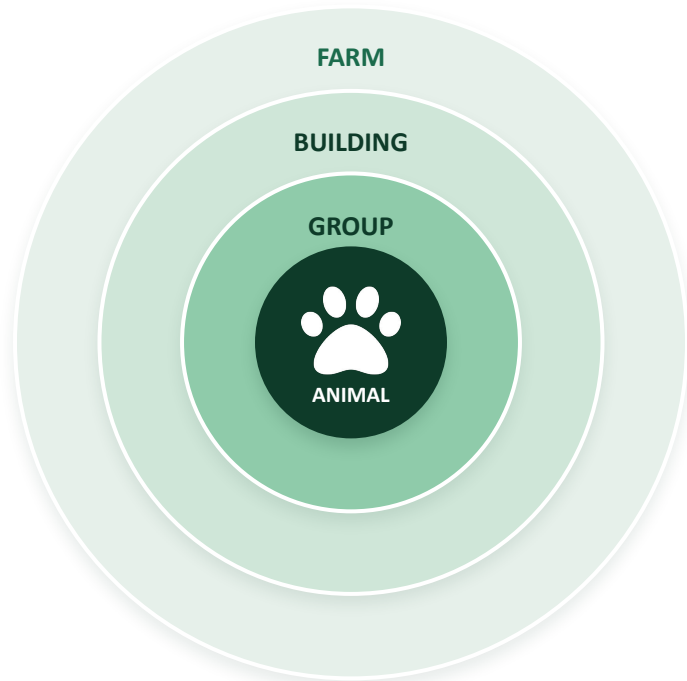
### Operational & economic

**Heterogeneous sources** → **one contextualised, interoperable data layer**

# Multi-scale digital representations

Contextualised data is organised into nested, living representations — from the individual animal up to the whole farm — a single, real-time source of truth.

- One coherent view across four scales
- Each twin aggregates all of its data sources
- The substrate on which AI agents reason



## AGENTIC AI LAYER

# Autonomous reasoning, coordination & root-cause analysis



### FROM — static dashboards

- Isolated alerts, viewed in isolation
- Manual correlation across tools
- Reactive — after the fact
- One generic view for every farm



### TO — agentic decision support

- Auto-correlation across all variables
- Root-cause analysis, prioritised interventions
- Proactive — learns farm-specific patterns
- Supports compliance documentation



**Specialised welfare & performance agents**



**Autonomous reasoning & task coordination**



**Feed efficiency × microclimate × behaviour**

## OPERATIONAL CO-PILOT



# AI you talk to — not a dashboard you maintain



PROTEUS co-pilot

*"Pen 4 looks off this morning."*

Activity in Pen 4 dropped 18% overnight and  $\text{NH}_3$  is rising.

**Likely a ventilation issue.** I've flagged a check and logged it for compliance.



### Natural-language & voice

Query and command in plain speech



### Photo → structured data

A single photo fills the record



### Autonomous task coordination

Correlates, prioritises, and acts



### Learns farm-specific patterns

Adapts to each operation over time

*Zero learning curve — AI as an operational co-pilot.*

## EXTENDING THE SENSING LAYER



# Product & research pipeline

With the agentic layer already operational, the next step is the physical layer — sensors that feed the data layer automatically, toward zero manual entry.

01



### Feed-silo sensors

Continuous monitoring of feed stock  
& consumption — automatically

✓ Mature · pilot-ready

02



### Welfare cameras (CV)

Detecting abnormal behaviour &  
indicators such as Body Condition  
Score

✓ Mature · pilot-ready



## EDGE-BASED VISION MONITORING

# Continuous camera feeds → welfare & performance signals



On-device models analyse camera streams in real time, at the edge — low latency, data kept local — extracting indicators no manual logging can match.



Weight estimation



Growth tracking



Mobility & gait



Activity levels



Early health  
(lameness)



Abnormal clustering

Detected anomalies are correlated with environmental & production variables → **root-cause analysis, not isolated alerts.**

## PRELIMINARY RESULTS



# Early deployments in intensive livestock systems



### Improved situational awareness

One real-time view across animal, group, building & farm



### Earlier welfare detection

Deviations surfaced before they escalate



### Reduced manual workload data entry errors

Voice + photo capture and auto-reporting cut data entry



*"In livestock, the most expensive part of information isn't the analysis — it's the data entry."*

CEO Epirus Farm,,  
pilot site (intensive dairy)

*Preliminary, qualitative findings from ongoing deployments; controlled quantitative evaluation is in progress.*

## CONSORTIUM & DEPLOYMENT



# Science, field, and industry together



**Laboratory of Animal Production and Environmental Protection, School of Veterinary Medicine, Faculty of Health Sciences, Aristotle University of Thessaloniki**

Welfare science & validated health/welfare indicators



**Robotics, Automatic Control and Cyber-physical Systems Laboratory, National Kapodistrian University of Athens**

Automatic control, sensing & cyber-physical systems



**Pilot farms**

Intensive units (e.g. Epirus, Domokos) for field deployment

## CONCLUSION

# From reactive monitoring to proactive orchestration



Heterogeneous data unified into multi-scale digital twins (animal → farm)



Edge vision enables early welfare detection (lameness, clustering, activity)



Agentic reasoning delivers root-cause analysis & autonomous coordination



AI as an operational co-pilot for scalable, welfare-centered production

*Agentic AI shifts livestock management from monitoring to data-driven orchestration.*

# Thank you

*Questions & discussion*



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