New traits related to feed efficiency

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Wageningen Livestock Research

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Feed-a-Gene

WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018

Introduction

- EU Feed a Gene
- (New) traits related to feed efficiency
- Some examples of research
- Future application

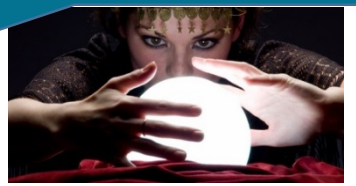
Objectives of the Feed-a-Gene project

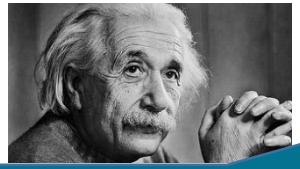
- Feed:
  - Develop new local feed resources that are not/less in competition with food
  - Improve the nutritional value of feed resources
- Gene:
  - Use of novel traits indicative for feed efficiency and robustness that can be used as selection criteria
  - “Do better with feeds that may be worse”
- Traits, models, and feeding techniques:
  - Appreciate variation among animals
  - Develop precision feeding techniques
  - Evaluate the overall sustainability

It is all about variation

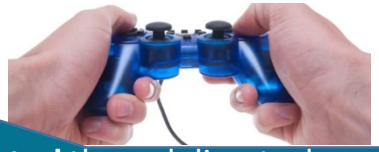
Observe variation in feeds, animals, and the environment

Predict using data-driven models and quantify interactions and variation





Understand the underlying mechanisms of variation



Control through livestock management (e.g., feeding, breeding)

Traits

- A trait in biology is a feature of an organism.
- The term phenotype is sometimes used as a synonym for trait, but is the state of a trait.
- A measureable or visible trait is the final product of many molecular and biochemical processes.
- Information starts with DNA traveling to RNA and finally to protein, ultimately affecting structure and function of an organ, tissue or an animal as a whole.
- Cell products and metabolites are released into tissues and organs of an organism, to finally affect the physiology in a way that produces or results in a trait.

https://www.sciencedaily.com

P = G + E

- Phenotype (P)
- Genotype (G) – the genetic makeup of an animal
- Environmental effects (E)
  The effect of an external (non-genetic) factor has on phenotype (e.g. nutrition).

Feed efficiency

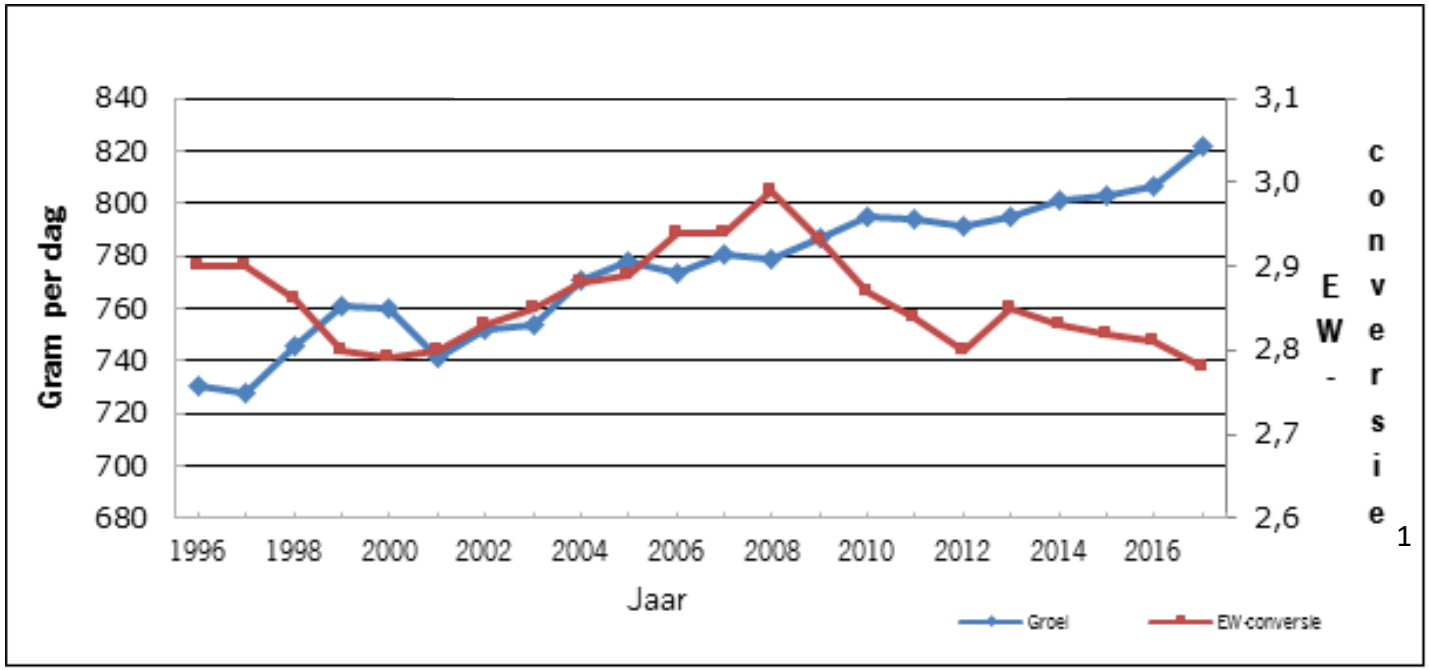
Expressed as a ratio

- **Feed conversion ratio (FCR) = Feed / Gain** => (biochemical or economic) representation of « cost of production »
- **Feed efficiency (FE) = Gain / Feed** => representation of the efficiency of a biological process

Different units of expression

- **kg feed / kg gain**
- **MJ Energy / kg gain**
- **€ of feed / kg gain**

Development in ADG and FCR in pigs in NL



[1]EW conversion: FCR corrected for energy intake

Agrovision (2018)

Feed efficiency

Geno-type | Sex | Age | Health | Climate | Manage-ment

Dietary supply of nutrients ⟷ **Requirements for nutrients**

- Ingredient composition
- Nutrient composition and energy content
- Nutrient digestibility
- Feed intake and feeding strategy

- Maintenance requirements
- Locomotion and behaviour
- Growth of organs and tissues
- Deposition of protein, fat, ash and water in the body

New animal traits for innovative feeding and breeding strategies

behaviour and welfare

image analysis
serotonin, cortisol

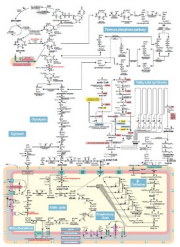
individual feed intake

feed intake patterns
feeding behavior

digestive efficiency

digestibility markers
gut health
microbiota

metabolic efficiency



metabolomics

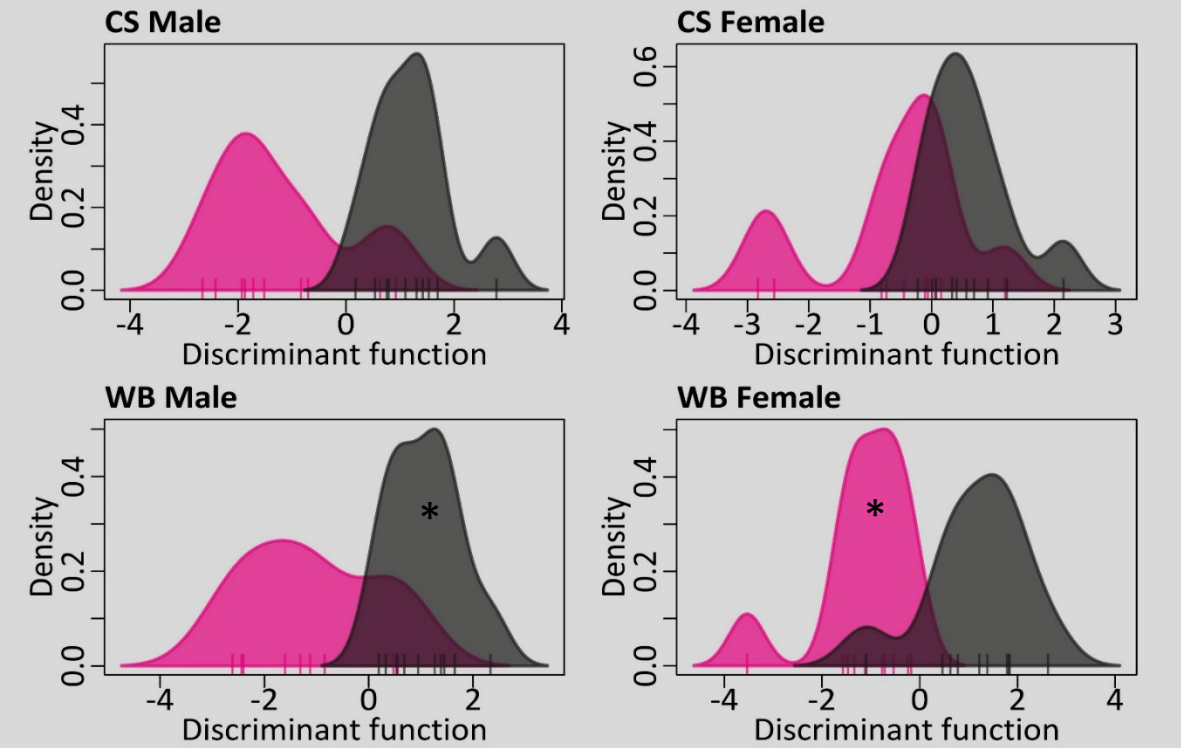
Individual feed intake in broilers and rabbits

Development of feed station

October-November 2016: 1st test of feed station

5 weeks
Cobb birds
Standard diet (corn+soy)

Faecal microbiota as a trait to differentiate

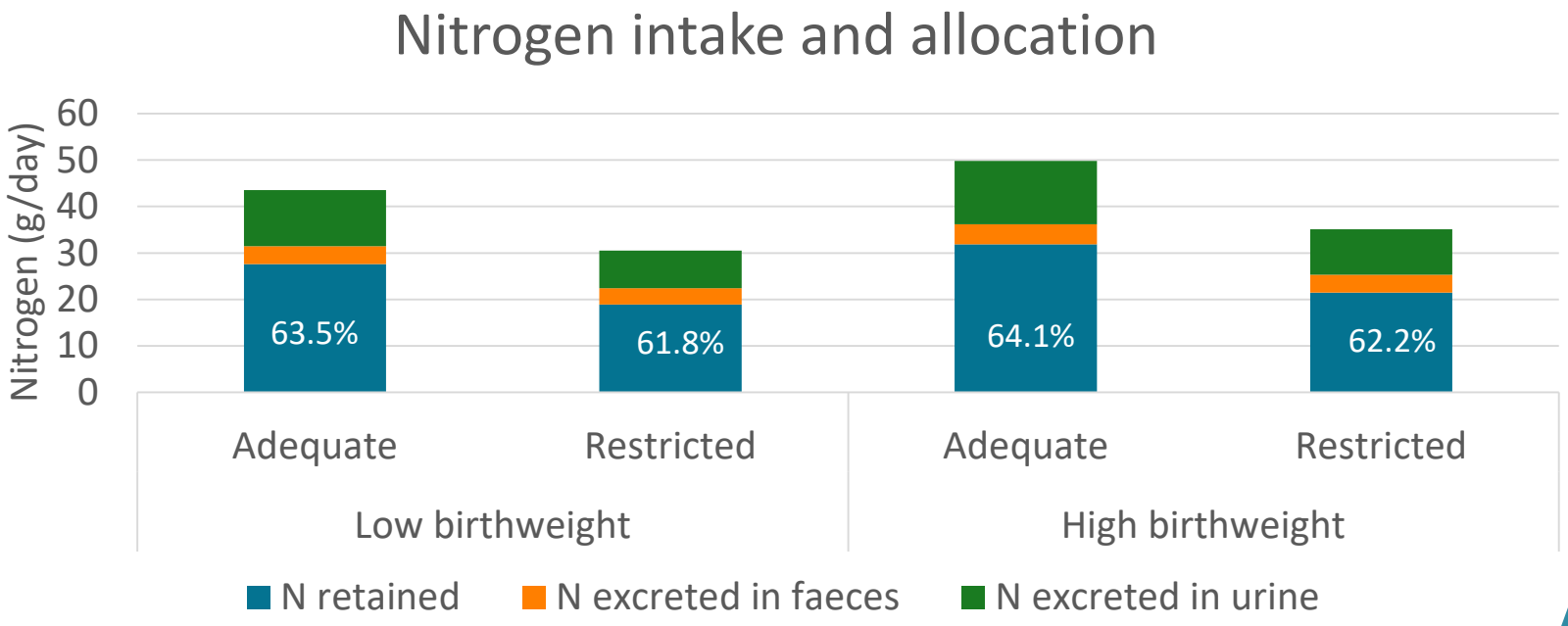


Feed efficiency: * = $P < 0.05$

Pink = high feed efficient pigs, **Black** = low feed efficient pigs

Verschuren *et al*. (2018)

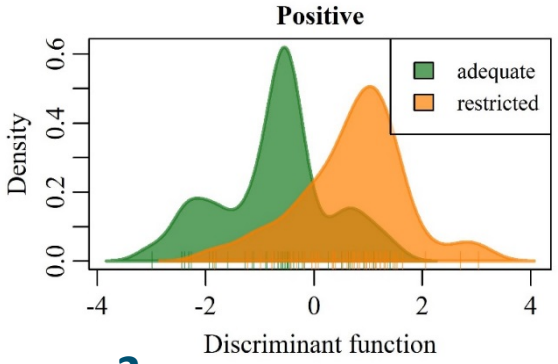
Birth weight of piglets and N-efficiency later in life



Jansman et al. (2018)

Biomarkers for N-efficiency in pigs in blood

- Diet



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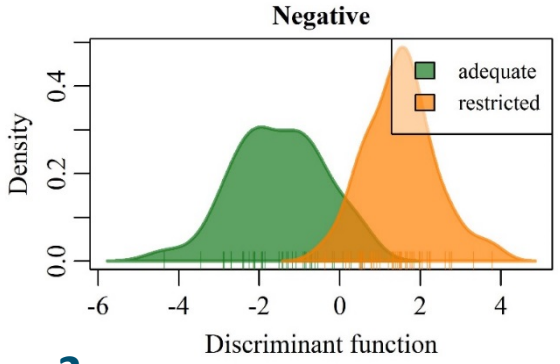

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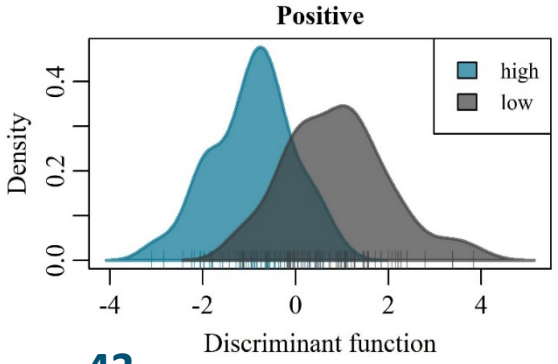
- Birth weight



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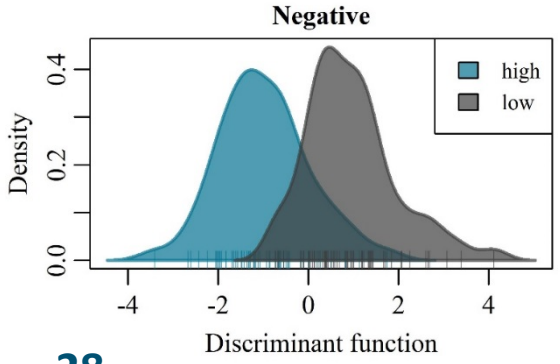

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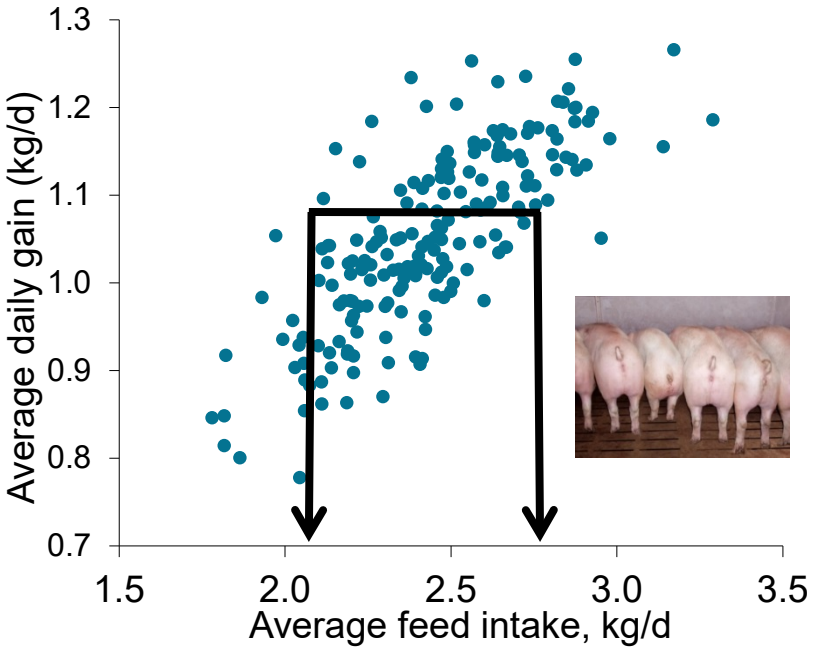
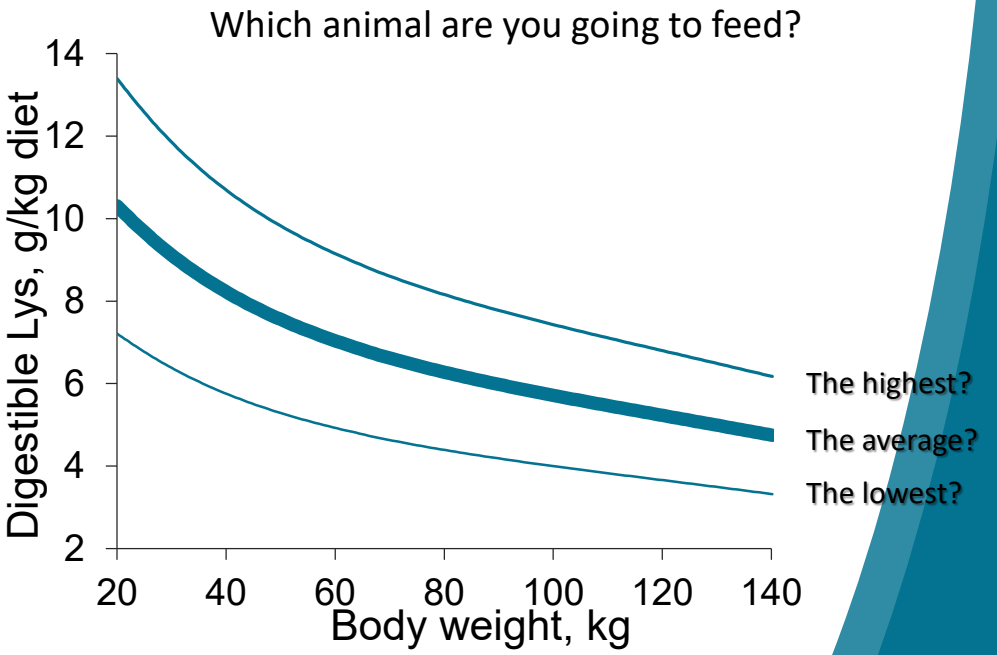
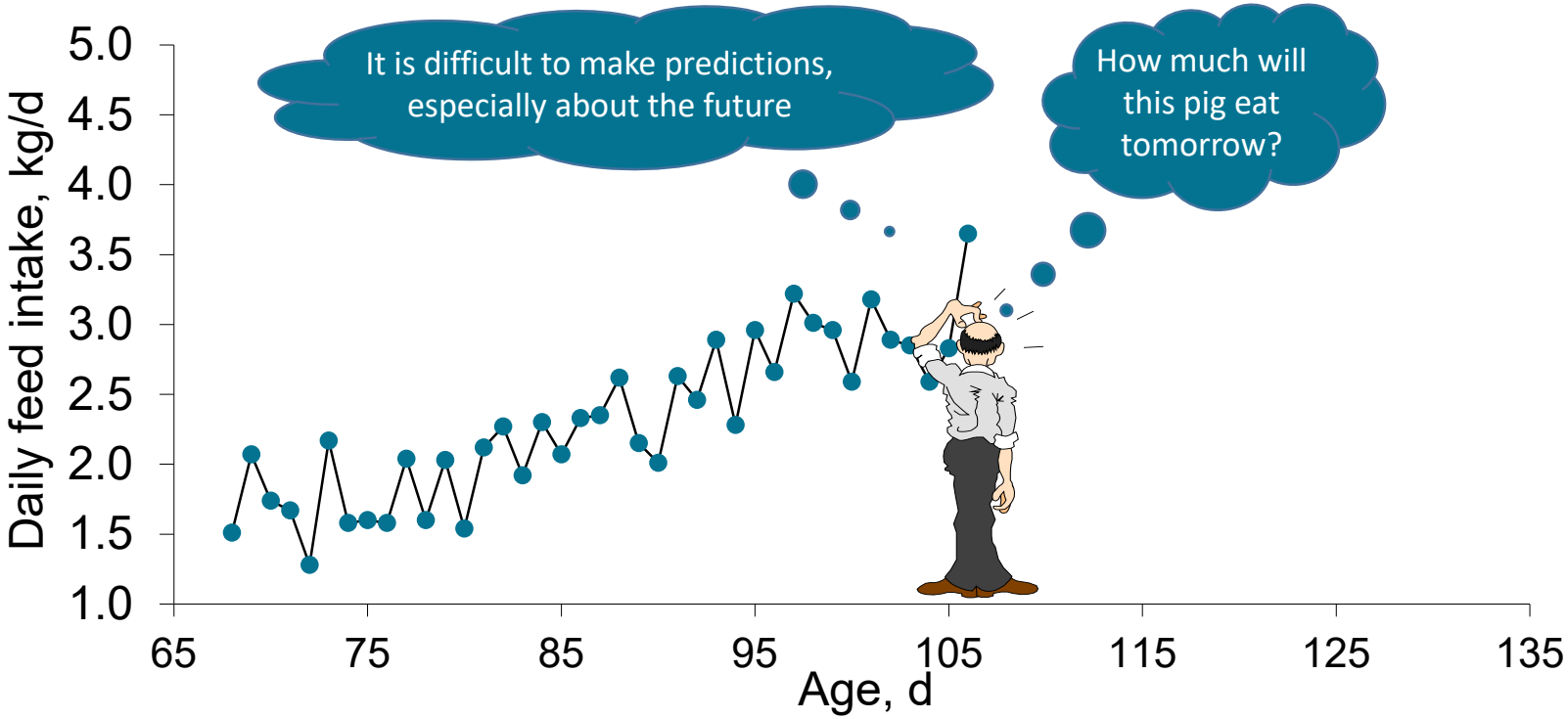
Verschuren et al. (2018)

Managing variation among individuals through precision livestock feeding





Precision livestock feeding is about observing, predicting, and control



Precision Livestock Feeding

Animal
- Birth weight
- Sex
- Line and genotype
- Age
- Health status
- "History"
- Feeding behaviour

Diet
- Ingredients
- Nutrients/energy
- Protein and AA
- AA profile
- Intake level

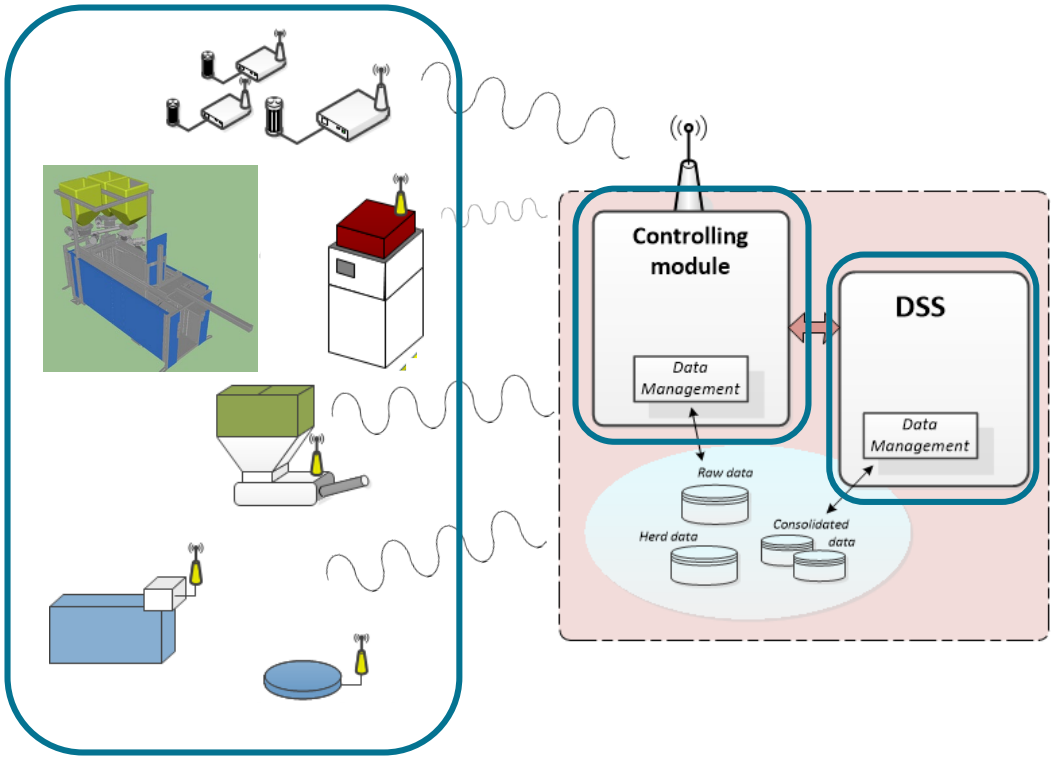
High

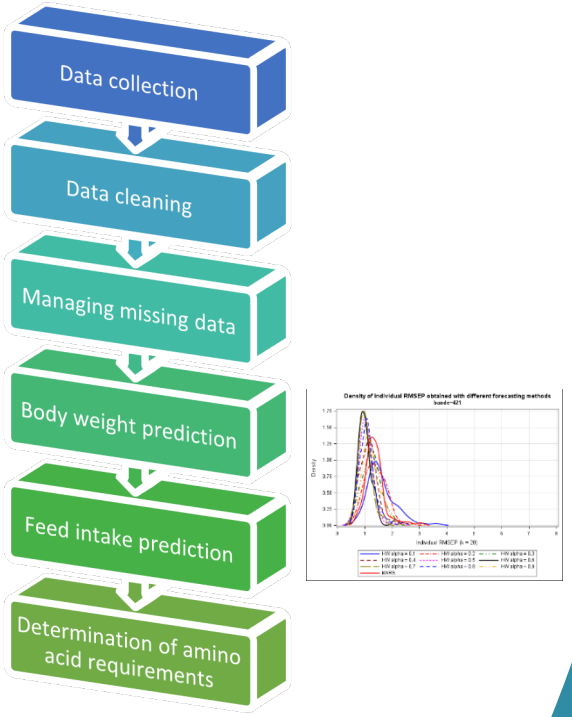
Response or marker of response

Low

Environment
- Climate and housing
- Light regime
- Pathogen pressure

Management systems for precision livestock feeding





Application of results

- Scientific knowledge with regard to improvement of feed and nutrient efficiency is to be translated to practical applications in the animal production chain considering biological variation.
- New concepts for precision feeding contributing to further improvement of nutrient efficiency (characterise and monitor the feed and the pigs e.g. in relation of health and nutrient status) are being developed.
- New targets for animal breeding e.g. in relation to feed intake, nutrient digestion and animal behaviour will be identified.

Thank you for your attention!