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From R&I to Impact:
Improving the efficiency and sustainability of monogastric livestock production systems

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INRAE

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EU funded Research project

2015 2020

€10 M Budget

Feed-a-Gene

Adapting the **feed**, the **animal** and the **feeding techniques** to improve the efficiency and sustainability of monogastric livestock production systems

(www.feed-a-gene.eu)

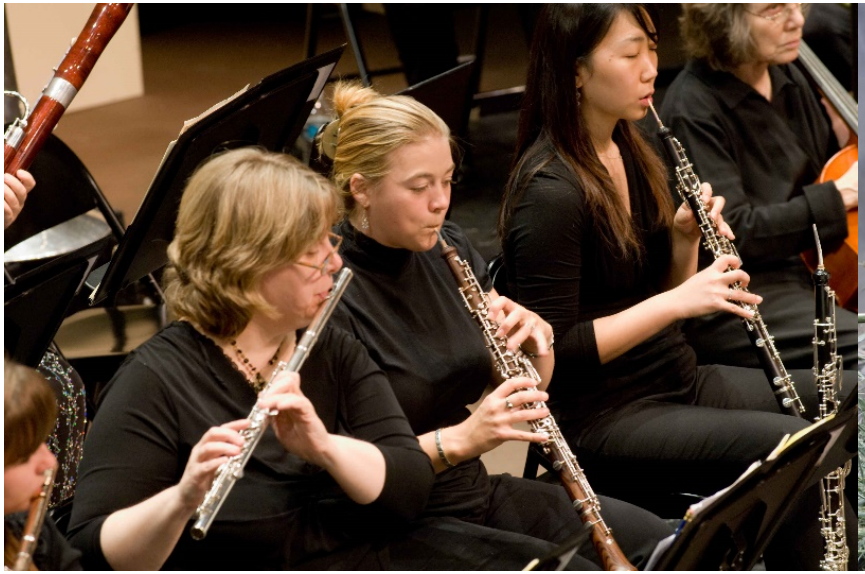
23 Partners EU + China

15 Industry

8 Academic

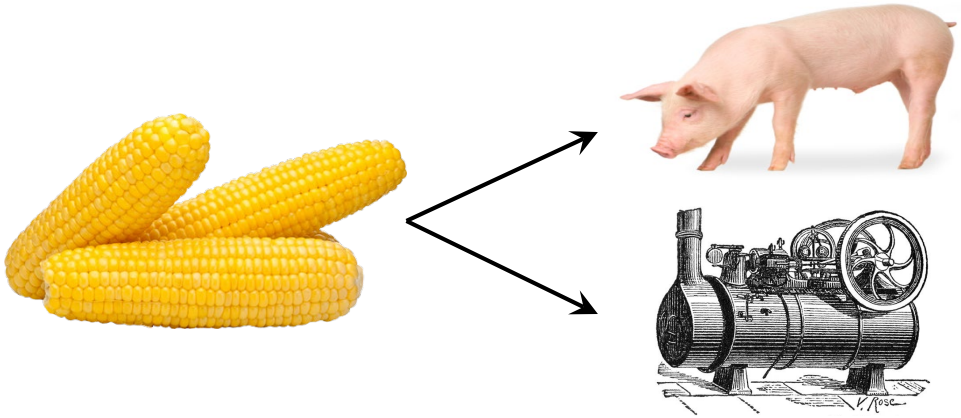
It is about efficiency

feed efficiency = daily gain / feed intake?




The food efficiency of these musicians and giant pandas is zero

It is about sustainability



The Efficiency of the Animal Compared with the Steam Engine.

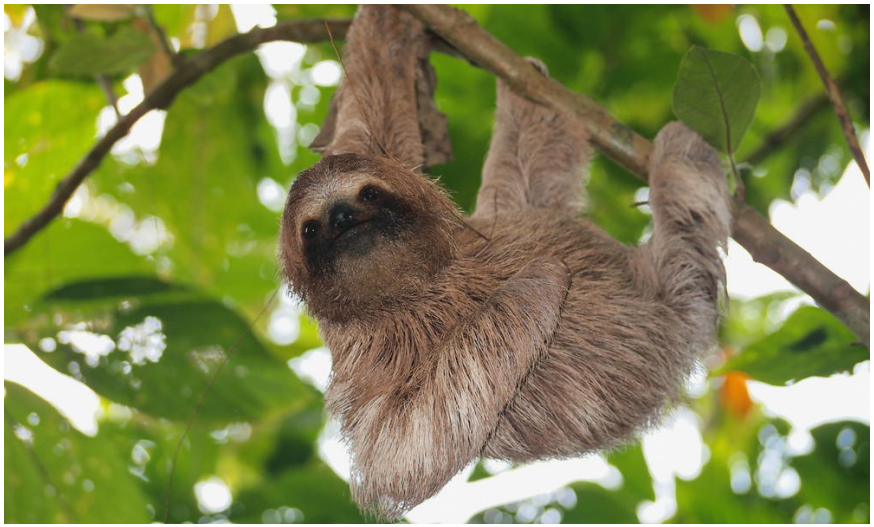
It is of interest in studying the efficiency of the animal as a converter of energy in work and food production to compare it with a mechanical energy converter such as the steam engine. We have recently been confronted with the phenomenon of the burning of corn for fuel in place of the usual use as a food for animals or man. The economy of this substitute conversion might help solve the question of the ethics of such a substitution. Van de Velde [10] has presented some figures to show that

Armsby H.P. & Moulton C.R. (1925). The animal as a converter of matter and energy. A study of the role of livestock in food production. American Chemical Society, New York.

It is about variation

Variation among individuals is natural, essential, and very well controlled

It is about observing



It is about observing

It is about understanding and complexity

The human body completely changes the matter it is made of roughly every 8 weeks, through metabolism, replication and repair. Yet, you're still you --with all your memories, your personality...

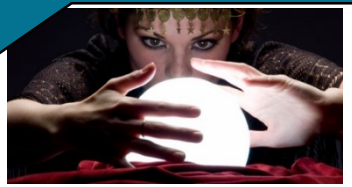
If science insists on chasing particles, they will follow them right through an organism and miss the organism entirely

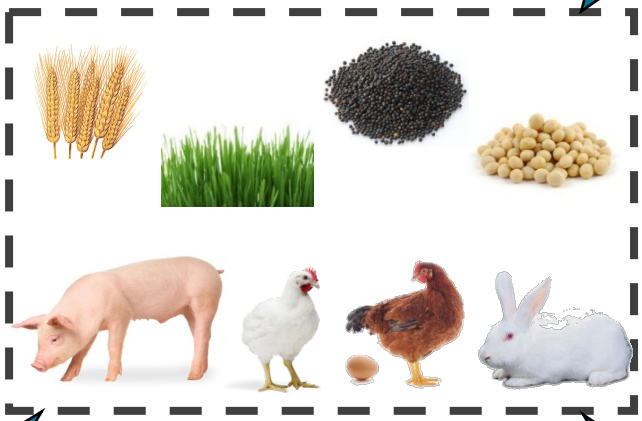
(Robert Rosen)

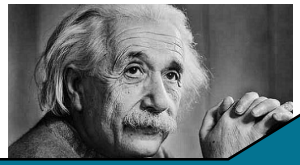
It is about control

Observe variation in feeds, animals, and the environment

Predict using concept-driven and data-driven models







Understand the underlying mechanisms

Control through livestock management

Objectives of the project

Feed:

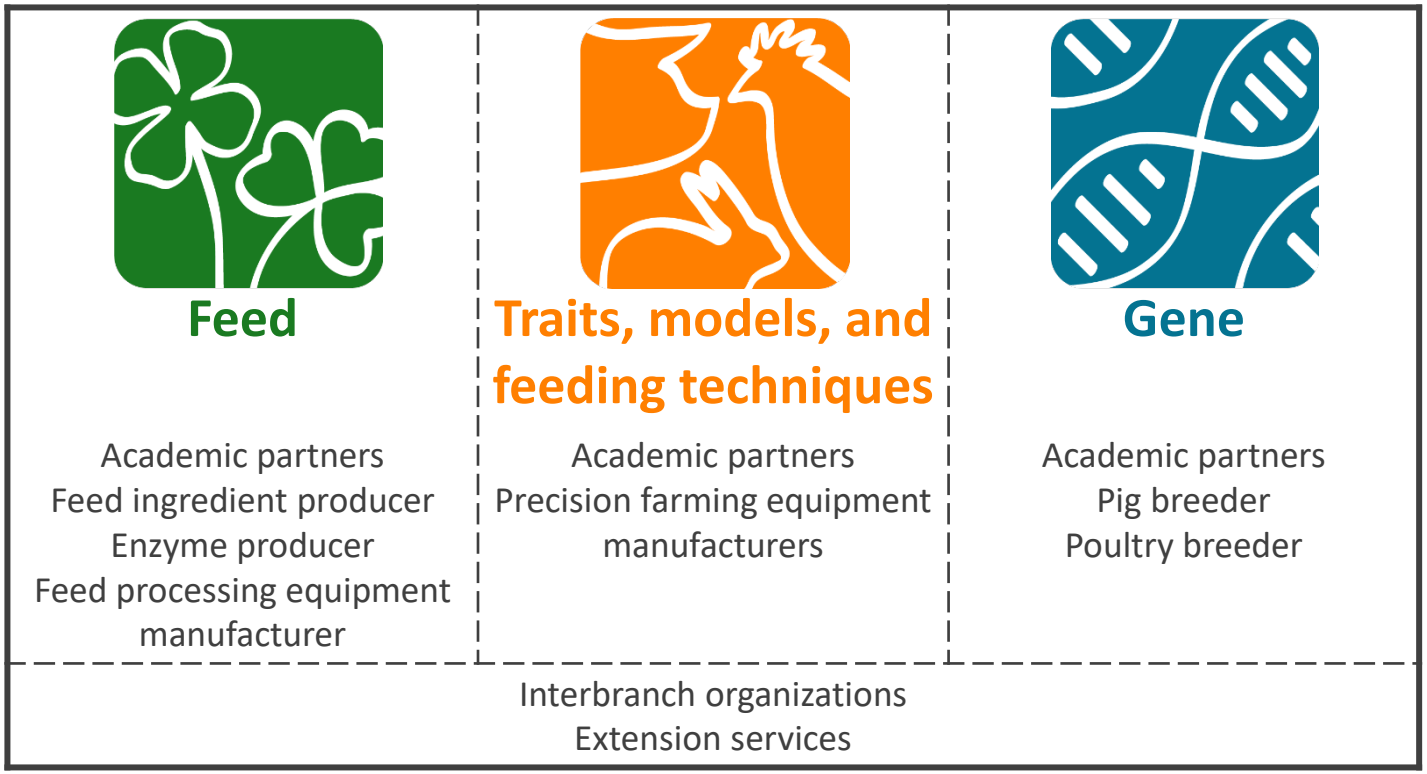
- Develop new local feed resources that are not/less in competition with food
- Improve the nutritional value of feed resources

Gene:

- Identify novel traits indicative for feed efficiency and robustness that can be used in livestock management
- “Do better with feeds that may be worse”

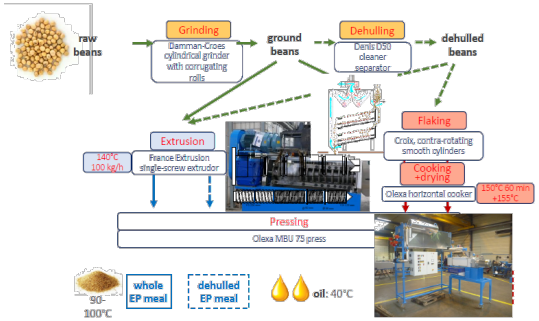
Traits, models, and feeding techniques:

- Appreciate variation among animals
- Develop precision feeding techniques
- Evaluate the overall sustainability

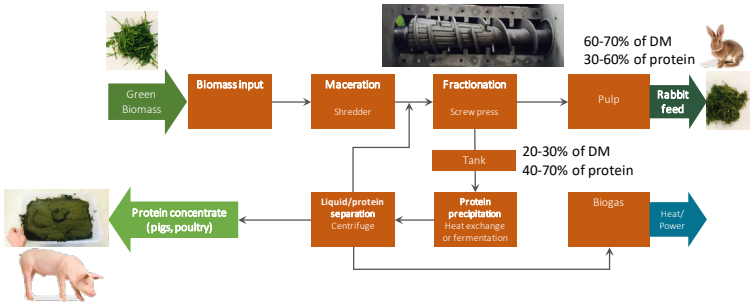

Feed
Traits, models, and feeding techniques
Gene
Academic partners
Feed ingredient producer
Enzyme producer
Feed processing equipment manufacturer
Academic partners
Precision farming equipment manufacturers
Academic partners
Pig breeder
Poultry breeder
Interbranch organizations
Extension services

Diversify to increase protein autonomy

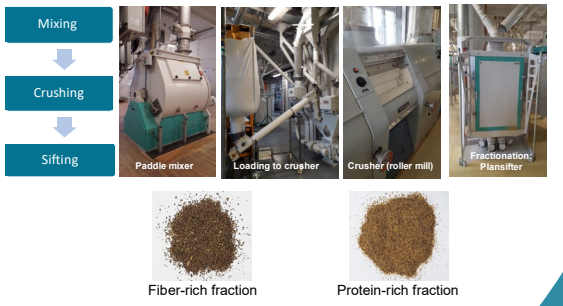
European-grown soybean



Protein from green biomass



Rapeseed meal



Novel traits to observe variation

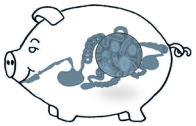
behavior and welfare

image analysis
serotonin, cortisol

individual feed intake

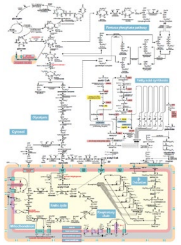
feed intake patterns
feeding behavior

digestive efficiency



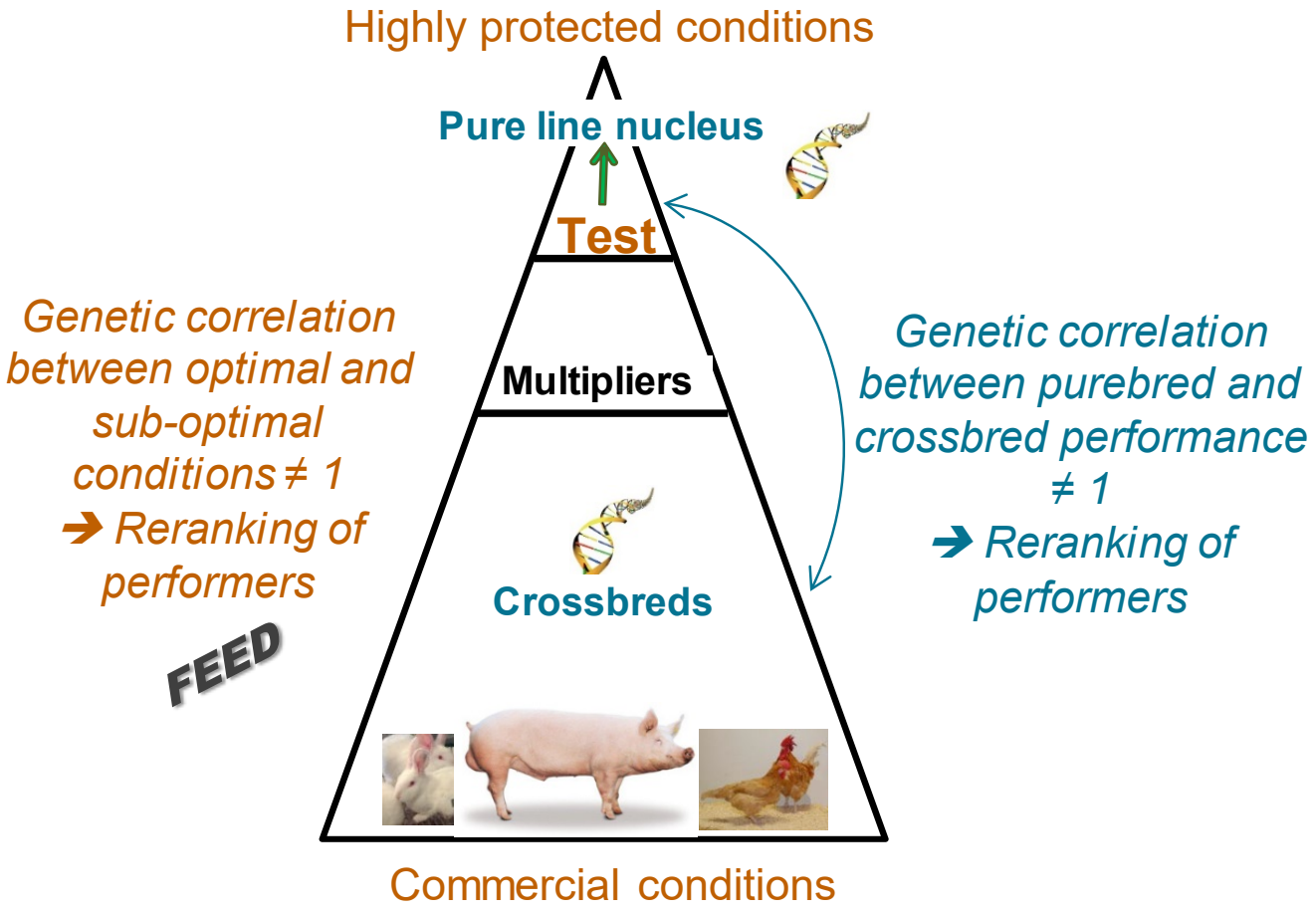
digestibility markers
gut health
microbiota

metabolic efficiency

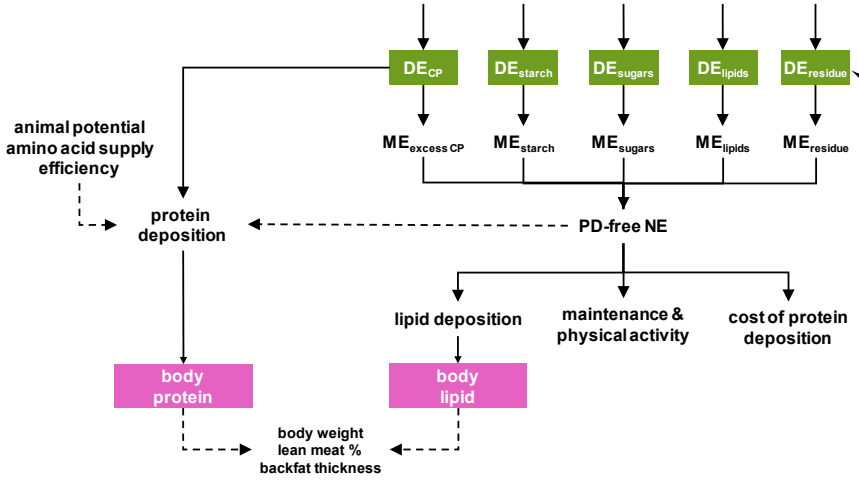


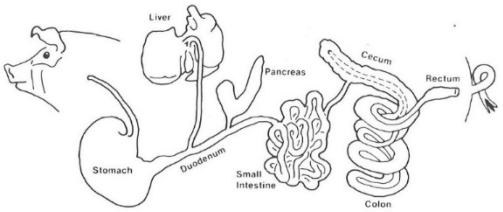
transcriptomics
proteomics
metabolomics

New traits and models for the genetic improvement of feed efficiency

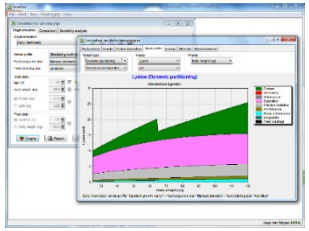


Modeling biological functions to understand and to predict



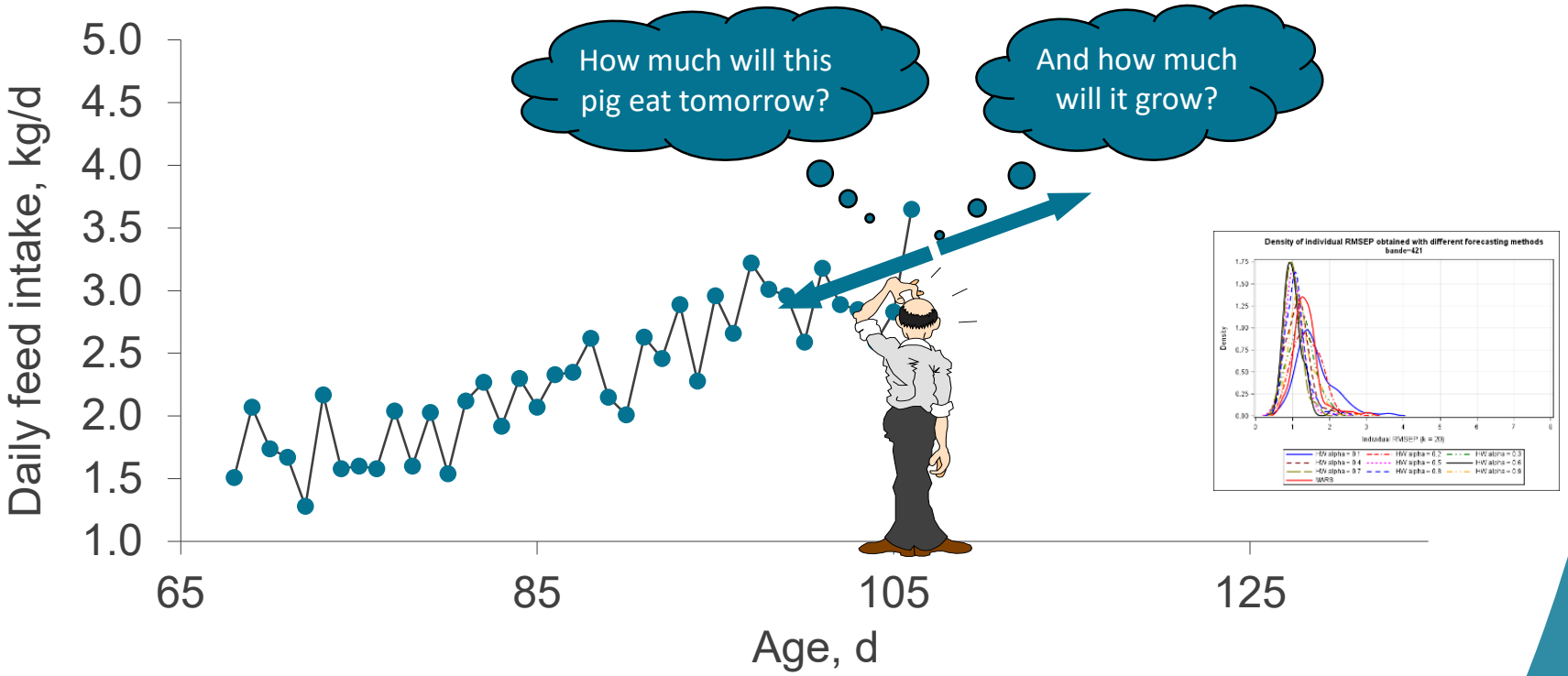


Nutritional growth models such as InraPorc use digestible nutrients as model inputs …

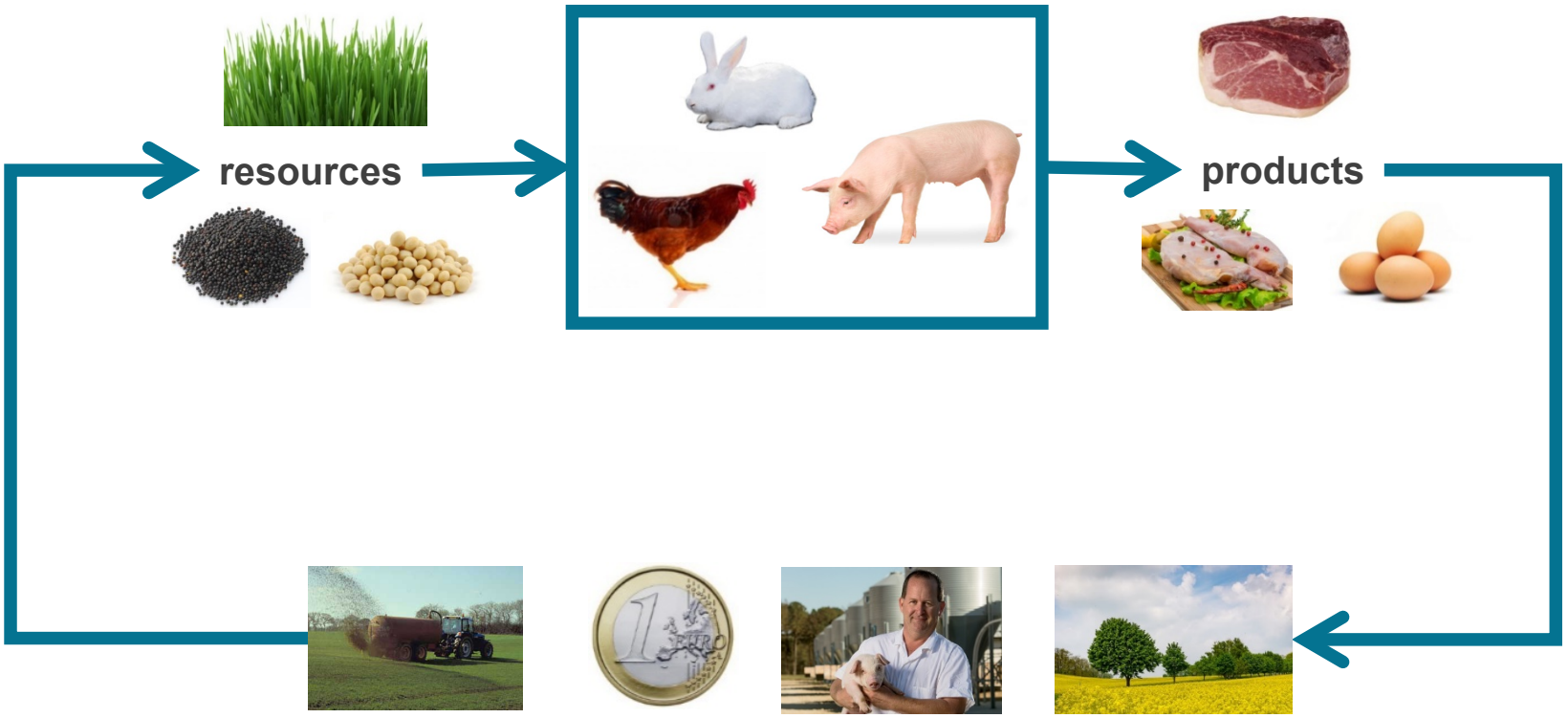


… to predict performance traits of a single animal in a “standard” environment

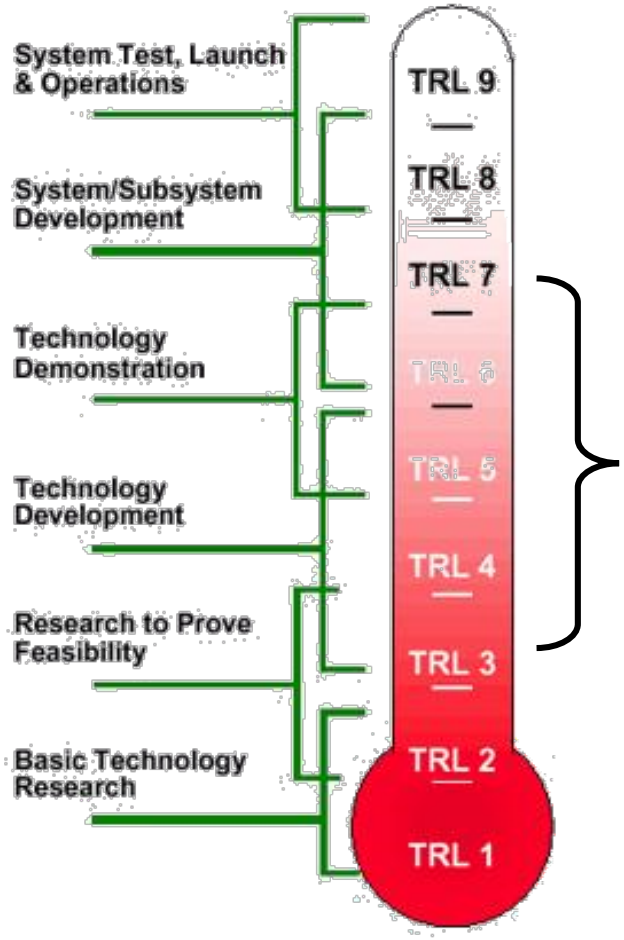
Precision livestock feeding is about observing, predicting, and control



Sustainability assessment



Objectives of the final conference



Technology Readiness Levels

Impact

Feed-a-Gene

R&I project

Program

- Wednesday January 22, 2020
  - Plenary session
  - Interactive coffee session
  - Presentation of results of the project
  - Lunch
  - Discoffeery session
  - Workshop session 1: from R&I to impact (2 themes)
- Thursday January 23, 2020
  - Workshop session 2: from R&I to impact (2 themes)
  - Coffer break
  - Sustainability appraisal
  - Wrap-up of the workshops
  - Foresight discussion: What is the future for livestock production?

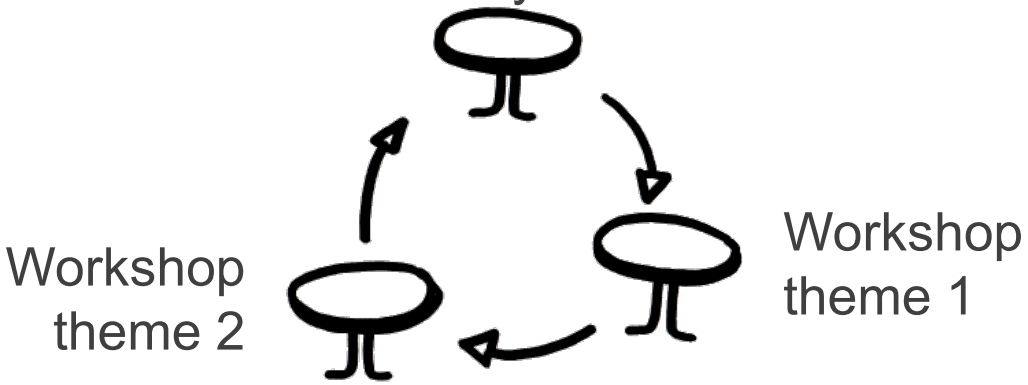
Themes of the workshop sessions

- New feeds and processes and nutrition: protein supply, assessment of nutritive value
- Big data and modelling
- Genetics and breeding: new traits, bioindicators, and breeding schemes
- Novel feeding technologies: precision feeding

From R&I to impact

World café setting

Plenary sessions
Discoffeery session



SWOT analysis

	Positive	Negative
Internal	Strengths (S)	Weaknesses (W)
External	Opportunities (O)	Threats (T)

Organization of the workshop sessions

- Workshop session 1:
  - S and W identified by the Feed-a-Gene partners
  - Amendment of S and W by participants
  - Identification of O and T
- Workshop session 2:
  - Presentation of SW and OT elements identified in session 1
  - Amendment of O and T by participants
  - Identification of “How to capitalize on O and minimize T”
    - Further development and application
    - Future research priorities
    - Legislation