Use of automated systems for recording of direct and indirect data with special emphasis on the use of MIR milk spectra (OptiMIR project)

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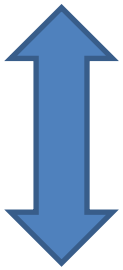
Why this presentation ?

- Current tendency development:
  - tools to support farm management
  - making use of advanced technologies
- On-farm but also off-farm:
  - on-farm ⇔ sensors

Precision Livestock Farming

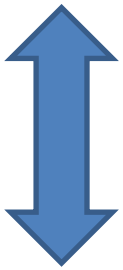
- Automatic acquisition of (health) data
  - on-farm ⇔ off-farm
  - data exchange issue

Automatic acquisition of data



Precision Livestock Farming

Automatic acquisition of data



Precision Livestock Farming

But what is Precision Livestock Farming?

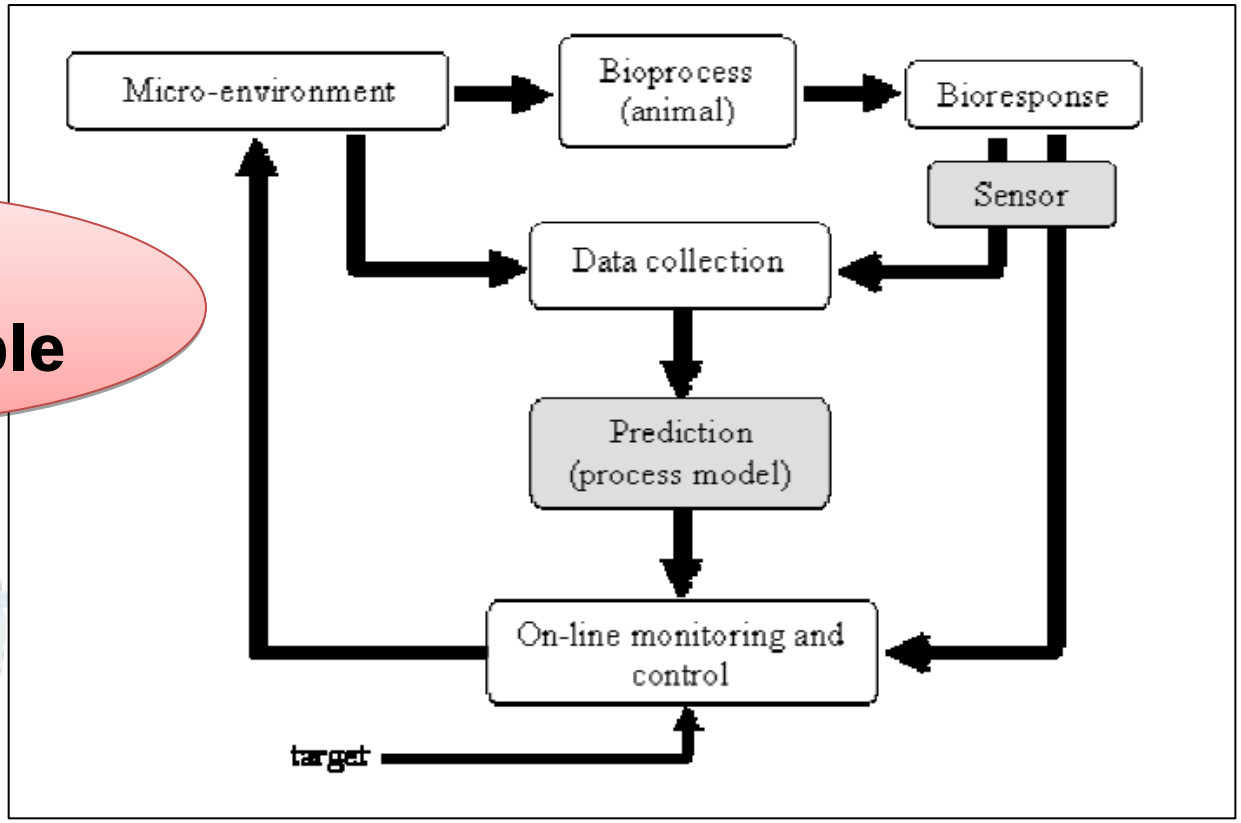
What is Precision Livestock Farming?

No easy answer!

Reply depends who you ask

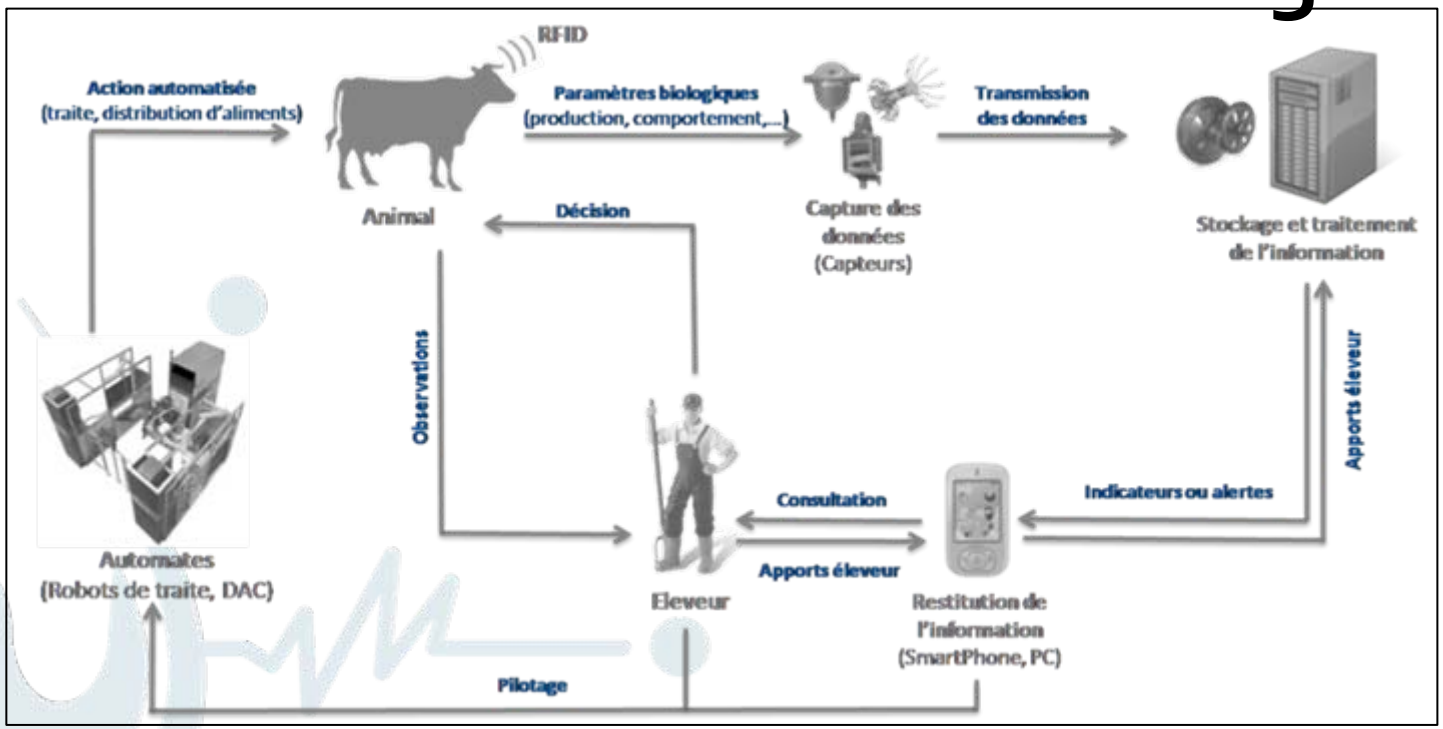
What is Precision Livestock Farming?

If you ask 'Sensor' people



Aerts et al. 2003. Biosystems Engineering 84(3): 257-266.

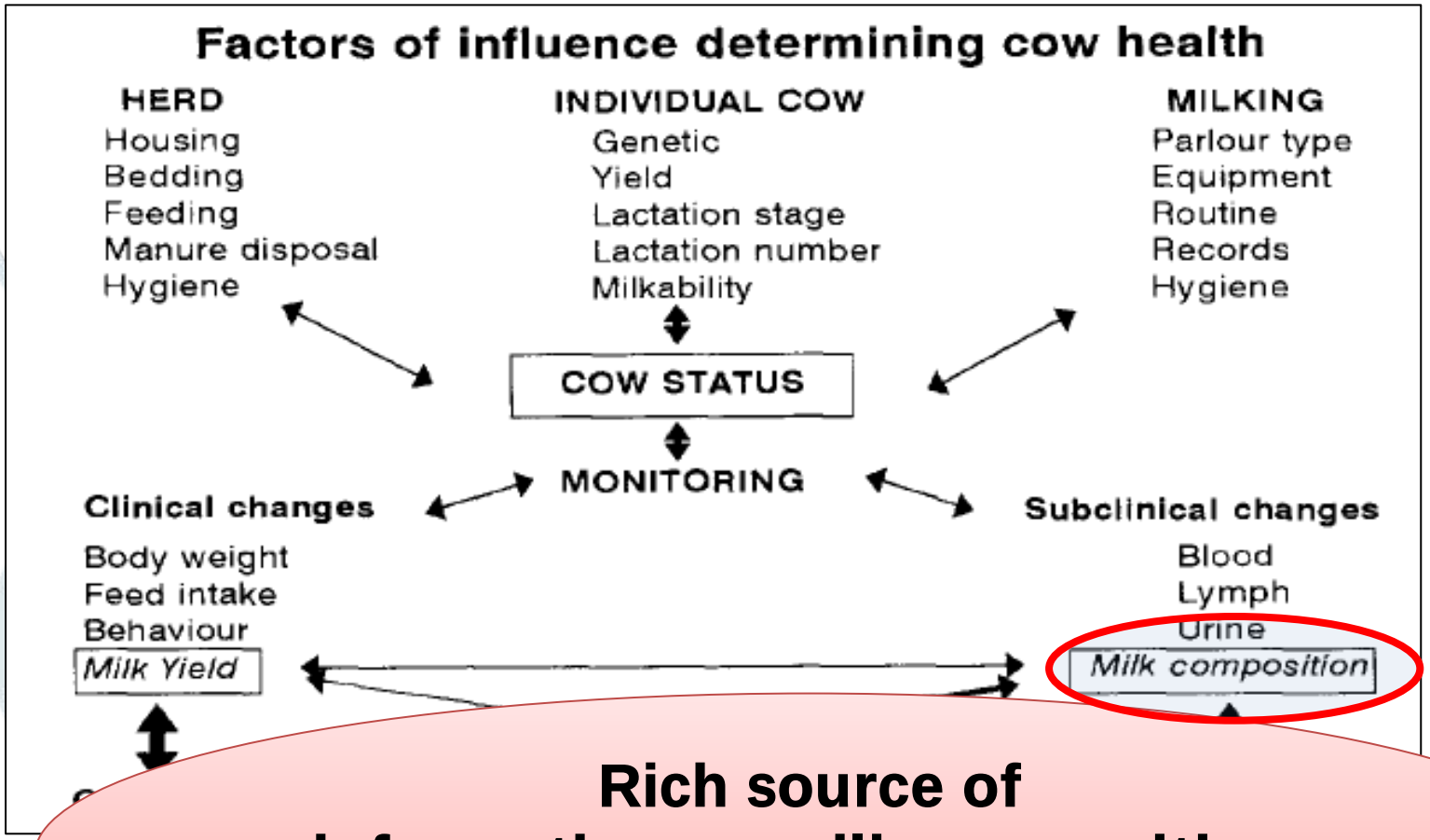
What is Precision Livestock Farming?



http://idele.fr/typo3temp/pics/Schema_elevage_de_precision_01_613f18d881.png

If you ask
'Advisory' people

Milk composition as 'Bioresponse' to cow status



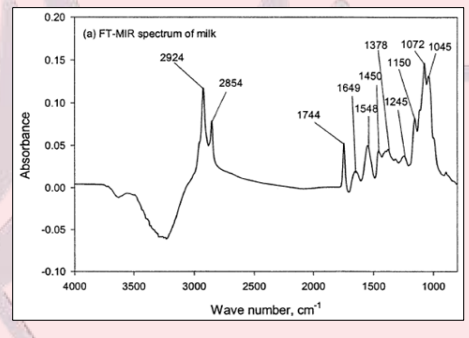
Rich source of information on milk composition: MIR spectra

Use of MIR spectra

Milk recording

Mid infra-red spectrometry

MIR spectra



Calibration equations

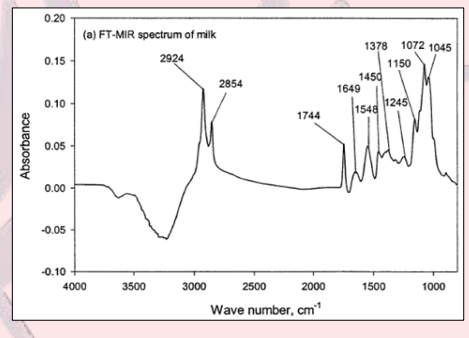
Milk components

Fat
Protein
Urea
...

Reference data

Predict fine milk composition …

MIR spectra



Calibration equations

Calibration equations

Reference data

Milk components

Fat
+
Protein
Fatty acids
Urea
Minerals
Lactoferrin
….

First predict milk composition …

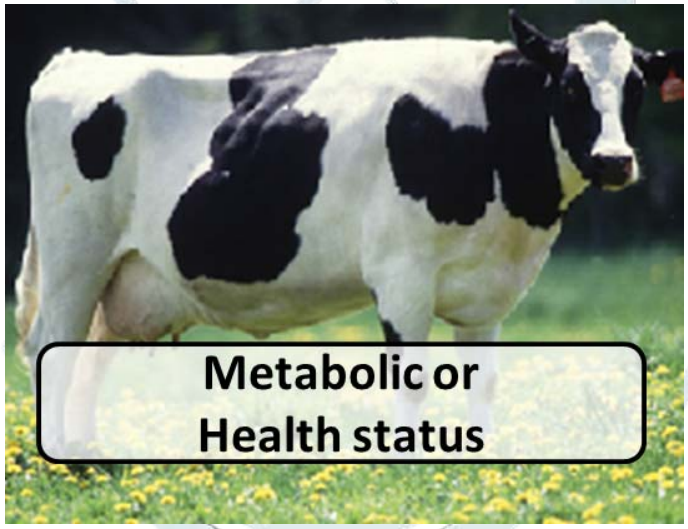
Milk components

Fat
Protein
Urea

+

Fatty acids
Minerals
Lactoferrin
….

First predict milk composition …
Then predict status of the cow



Reference data

Prediction equations

Milk components

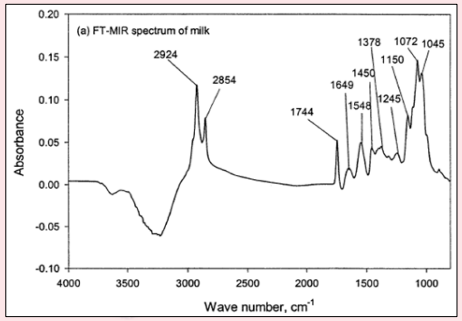
Fat
Protein
Urea

+

Fatty acids
Minerals
Lactoferrin
....

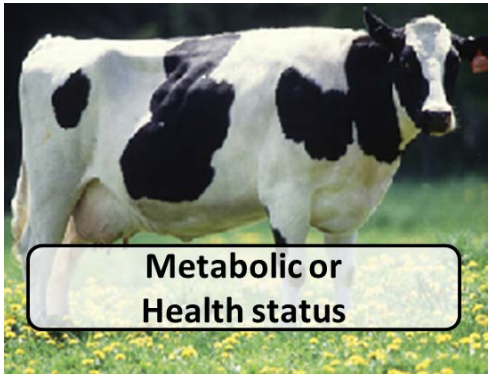
Alternative …

MIR spectra

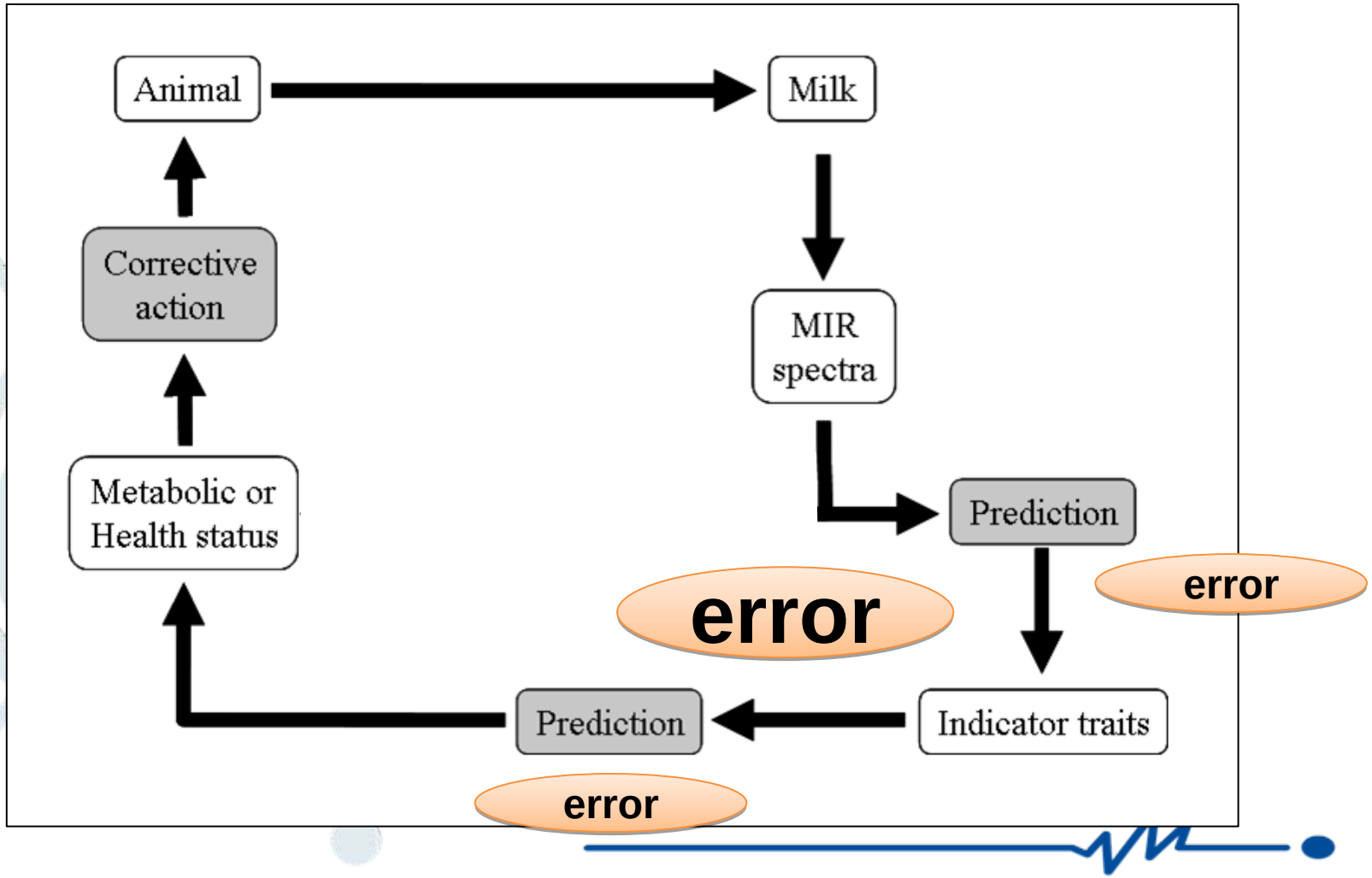


Reference data

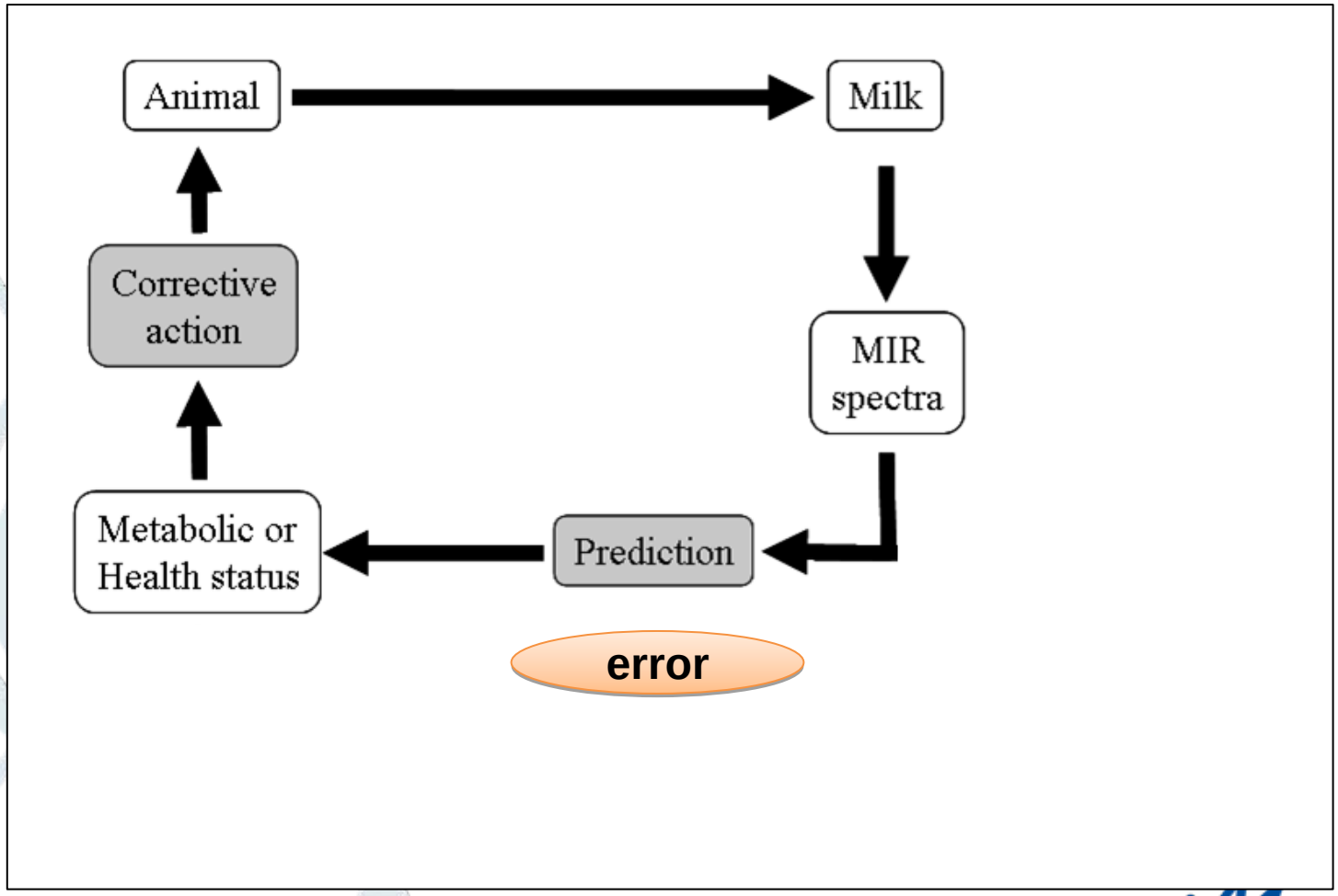
Prediction equations



MIR ⇨ Indicator traits ⇨ Status



MIR ⇨ Status


Animal
Milk
Corrective action
MIR spectra
Metabolic or Health status
Prediction
error

From January 2011 to September 2015

www.optimir.eu

OptiWIR

WITH THE SUPPORT OF

Several specific features

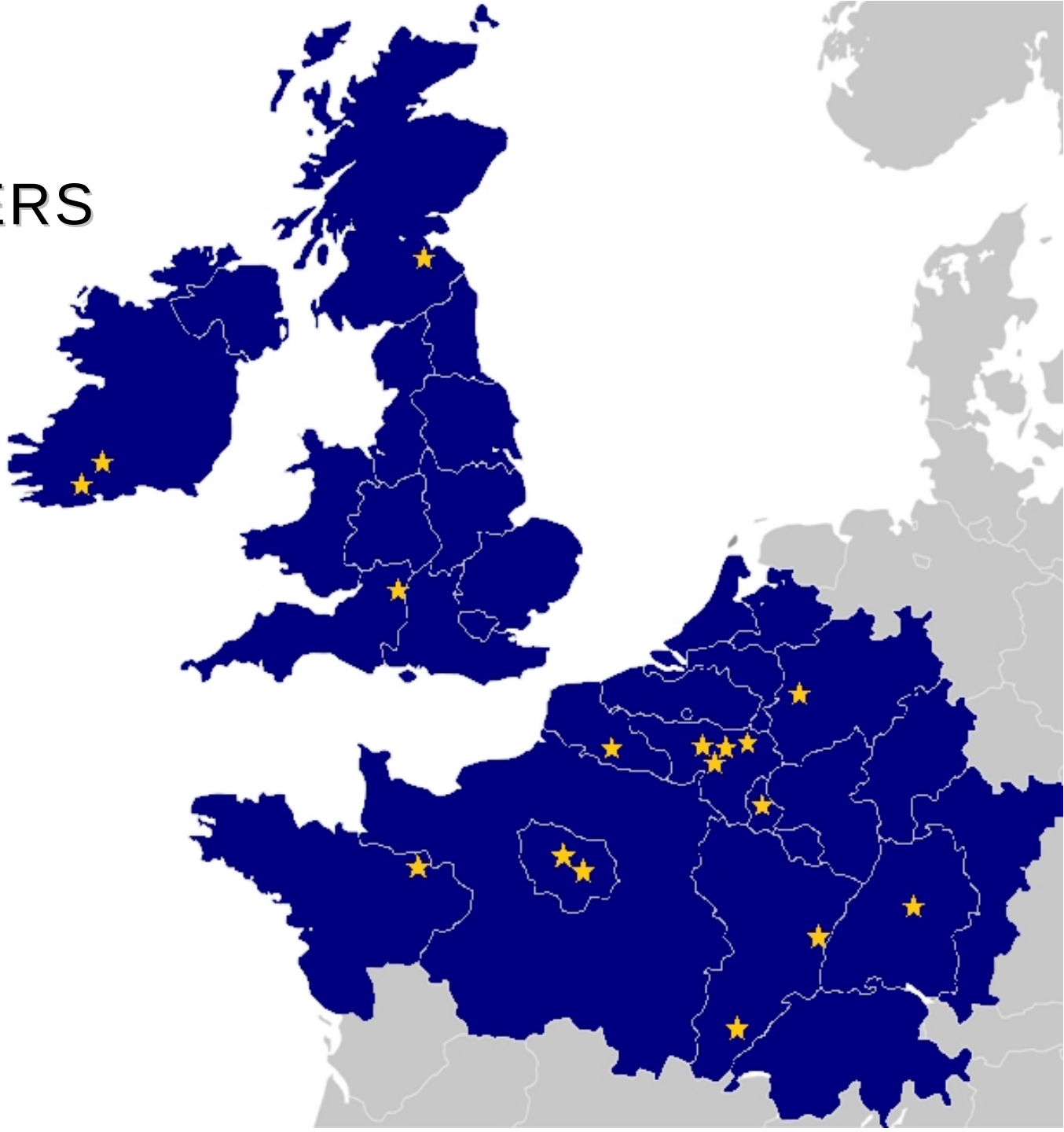
1. Clear path:
   - from acquisition of data towards dissemination of results
   - therefore all relevant partners in partnership

becoming major priority in many European research frameworks

EUROPEAN PARTNERSHIP

11 milk recording organizations
6 research centres and universities
1 laboratory

PARTNERS



Several specific features

1. Clear path:
   - from acquisition of data towards dissemination of results
   - therefore all relevant partners in partnership

2. Management information traits (MIT):
   - clear concept
   - traits that are directly describing status of cow
   - predicted directly from MIR

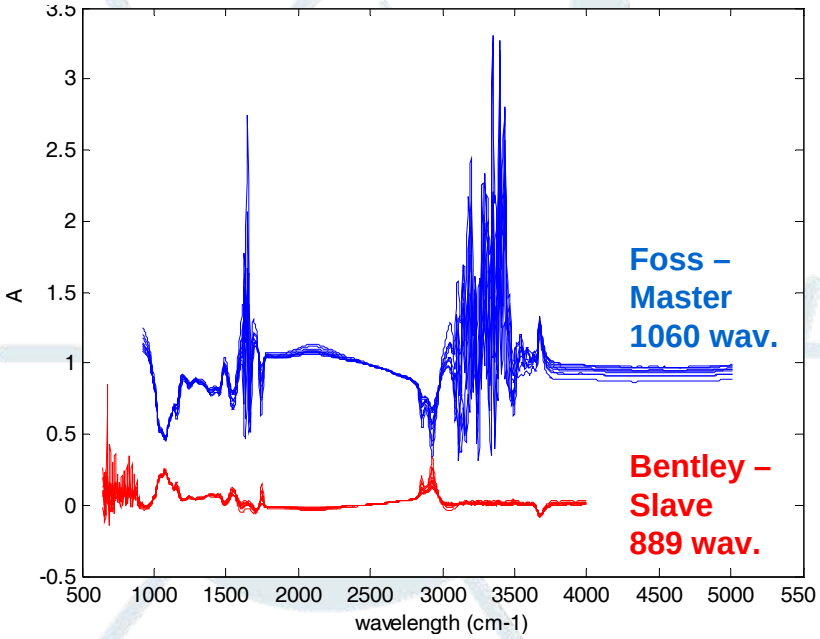
easier to use inside an advisory tool

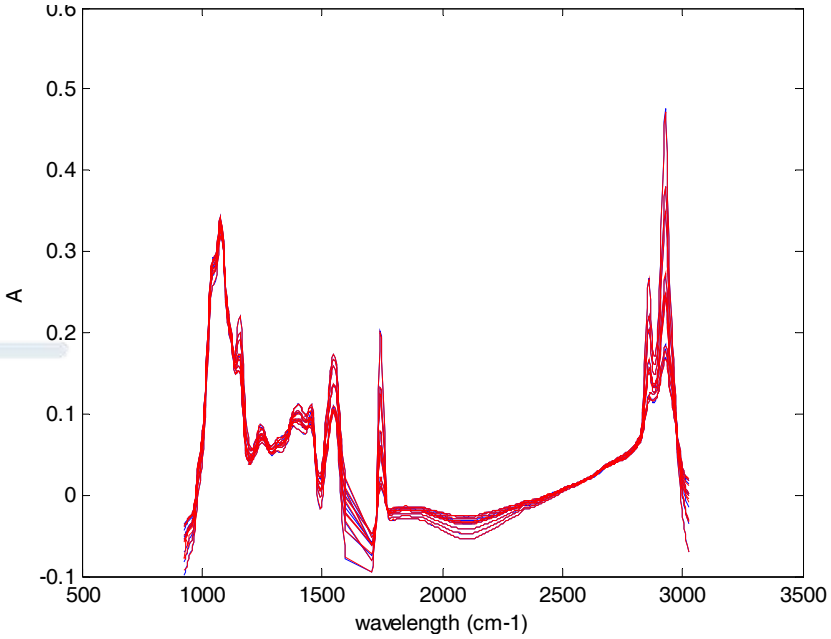
- No common format
- Different brands
- Different spectrometers
- Stability over time

Spectral standardization step necessary

First step: standardization of the spectra …

Standardization





Several specific features

3. Collating and storing relevant data:
   - creation of a transnational research data base
   - respecting original data ownerships, data base will continue to exist
   - stored data, at least partially, potentially contribution to other projects
   - in exchange, use by the OptiMIR partnership as dissemination channel of results

type of collaboration between projects, a demand by Europe

Current status of data base

11	• Milk recording organizations
1 321 736	• Cows
7 595 119	• MIR spectra

Advantages (most important):

- Covering largest possible variation
- Allow joint research and development
- Improved robustness of tools
- Harmonized spectral and reference data (i.e. health)

Standardization of reference health data: major issue

Type	English	OptiMIR
Fertility	Abortion	F1
Fertility	Parturition disorders	F2
Fertility	Disorders in the postpartal period	F3
Fertility	Retained placenta	F4
Fertility	Endometritis	F5
Fertility	Vaginitis	F6
Fertility	Disturbance of the ovarial reproductive cycle	F7
Fertility	Ovarial cysts	F8
Fertility	Other disturbances of female fertility	F9
Fertility	Uterine Inversion	F10
Fertility	Anoestrus	F11
Fertility	Infertility	F12
Fertility	Other	F13

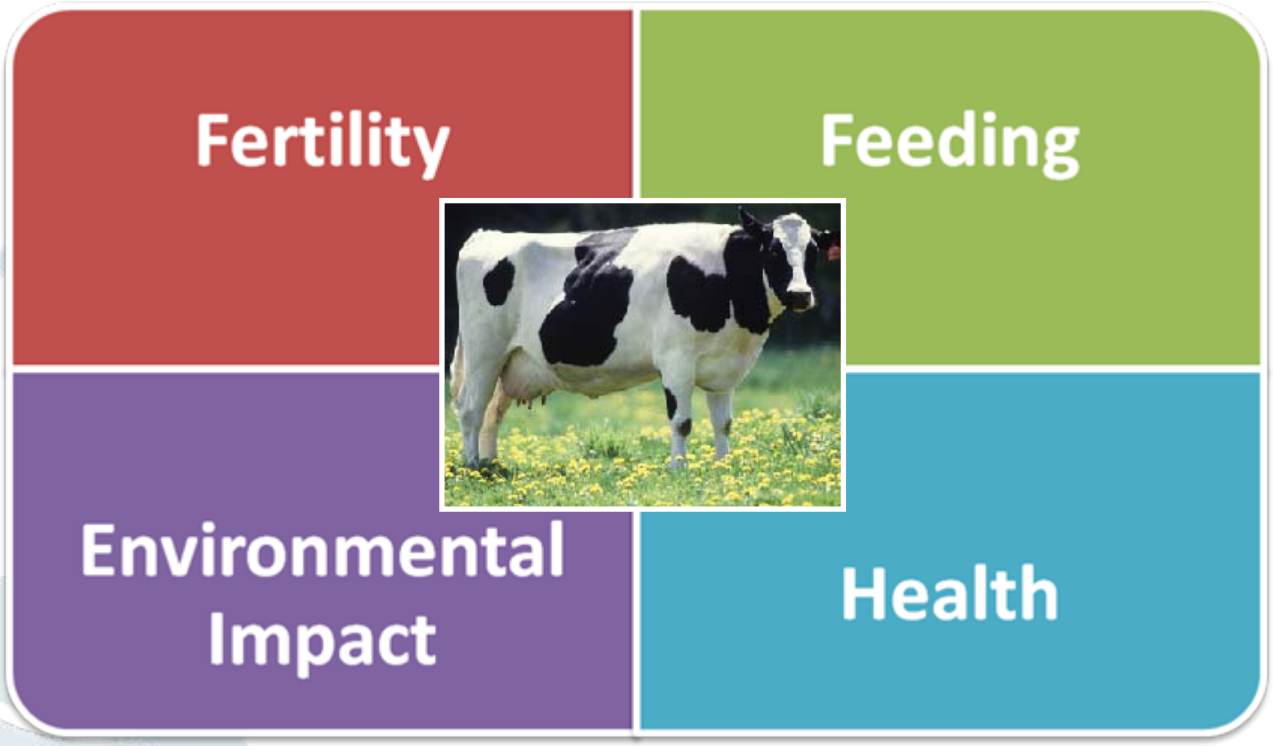
Work done by OptiMIR
topic under scrutiny by FT WG

Several specific features

4. Developing jointly expertise and tools based on MIR:
   - project will help creation and use of health MIT from MIR
   - through direct prediction of health status
   - but will also act as dissemination vehicle of expertise and tools to predict indirect indicator traits

MIT generated in routine and stored in central databases

Not only health!

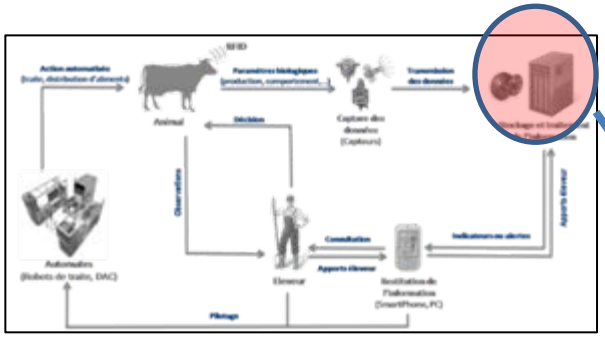


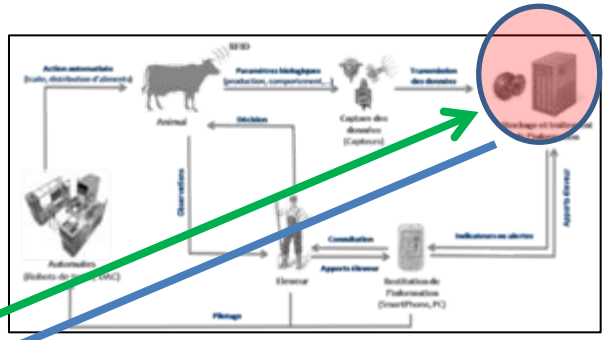
Milk composition on-farm?

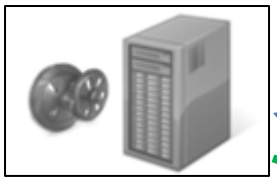
- Many manufacturers working on this issue:
  - objective: sensors for (major) components
- Currently MIR not (yet) practical:
  - costs, environment
- Research done replacing MIR by Near infra-red (NIR)
  - gives also a global view of milk composition
  - first results promising but further investigations needed

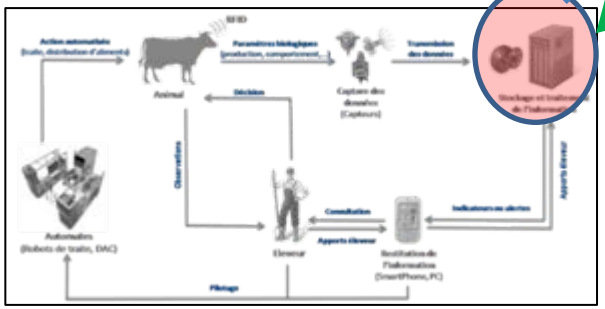
Usual bottleneck:
bi-directional exchange between farms and central data bases needed

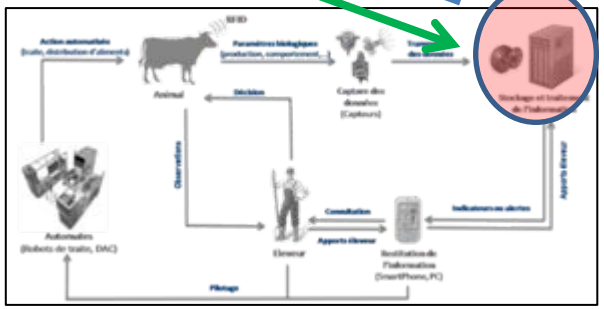
Ideal world: bi-directional exchange



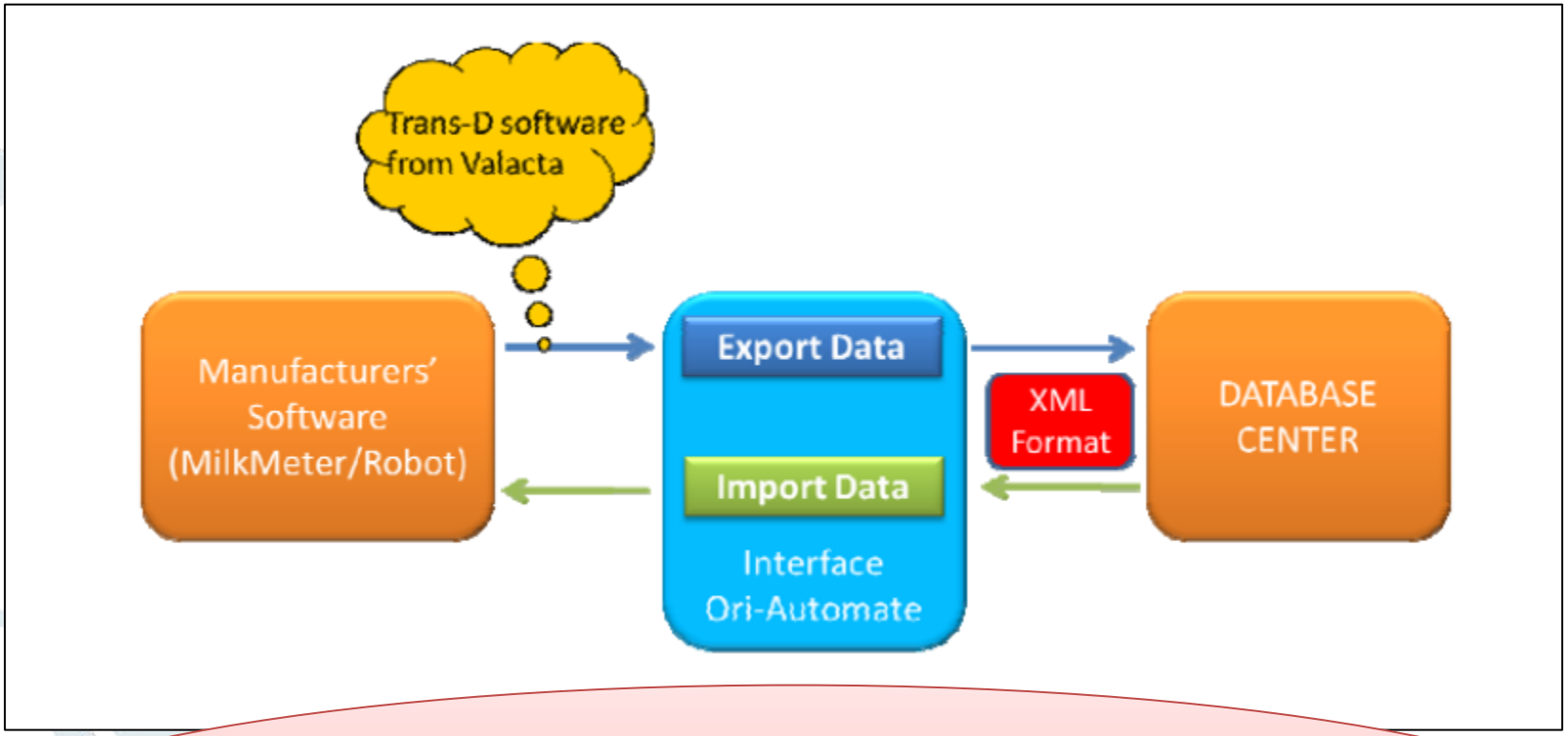








Example of bi-directional data exchange: Ori-Automate



Saunie… …nier.pdf

Ori-Automate will also be implemented by Walloon Breeding Association (AWE)

Use of on-farm sensors and interaction with OptiMIR

- Off-farm MIR spectra reliable:
  - as shown in OptiMIR, can be harmonized / standardized
- On-farm sensors (i.e. NIR based)
  - less precise, given experience from MIR
    - ✓ stability of on-farm sensors to be validated
    - ✓ detailed (fine) composition ?
  - but nearly real-time
- Both sources of data useful for implementation of powerful health monitoring systems
  - by their openness OptiMIR based tools can take advantage of other sensor data (e.g., conductivity)

Conclusions

- Current on-farm systems:
  - Many automated systems / sensors use on-farm to record health related data
  - Interaction between these systems, off-farm systems and centralized databases often still weak
  - Highly depending on powerful data exchange protocols and tools
- On-farm: global view of milk composition
  - research replacing MIR by Near infra-red (NIR)
  - first results promising but further investigations needed

Conclusions

- Off-farm: global view of milk composition ⇔ animal health
  - research on advisory tools based on MIR inside OptiMIR
  - project certain number of specific features including:
    - Close association between MRO + scientific partners
    - Building of a transnational data base
    - Joint development of advisory tools.
  - by its open conception:
    - OptiMIR can take advantage of on farm measurements
    - can also provide useful data back to farms

Conclusions

Use of automated systems for recording of direct and indirect health data on-farm and off-farm

Major source of health relevant data in the future