7th European Conference on Precision Livestock Farming (EC-PLF)

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Milan, ITALY

Near real-time large scale (sensor) data provisioning for PLF

Matthijs Vonder (TNO)
Bram van der Waaij (TNO)
Edwin Harmsma (TNO)
Gerben Donker (Rovecom)

UNIVERSITÀ DEGLI STUDI DI MILANO

MILANO 2015

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This project is made possible by:

Near real-time large scale (sensor) data provisioning for PLF

Contents

- Smart Dairy Farming (SDF) project
- InfoBroker concept
- SDF/Infobroker in practice
- Conclusions
- Next steps: SDF 2.0

SDF 1.0 (2011 – 2014)

- **SDF = Smart Dairy Farming**
- Collaboration project
  - 3 Cooperations
  - 5 Research institutes
  - 7 SME's
  - 7 Real farmers
- Timeline:
  - SDF1: 2011 – 2014
- Nothern part of the Netherlands
- Website (in Dutch):
  - http://www.smartdairyfarming.nl/nl/

agrifirm CRV FrieslandCampina

Livestock Research Wageningen UR · Universiteit Utrecht

DairyCampus · Hogeschool VHL University of Applied Sciences · TNO innovation for life

rovecom · Gallagher · Nutrifeed · Lely · accon avm adviseurs en accountants · smaXtec animal care · S&S Systems

Antonides Bakker · Hof · Bruunshoge Stokman · DairyCampus · Den Hartog

SDF 1.0 (2011 – 2014)

- **Goal of SDF:**
  - to support dairy farmers in the care of **individual animals.**
  - with the specific goal of a **longer productive stay** at the farm due to **improvement of individual health**.

- **To do so want to provide**:
  - cow specific work instructions
  - to the farmer
  - based on near real-time analysis models
  - using near real-time sensor data.

Numbers for the Dutch situation:
- 15000+ farmers
- in total more then 1.5 million milk cows
- 20 to 200+ datafields per cow
- many different stakeholders in the chain

- **Challenge:**
  - make it possible for the whole sector
  - in SDF2 (2015-2017):
    - more farmers: from 7 to 60 (and prepare for 2500)
    - more sensor suppliers and more data consumers

Approach *(explained in paper and next slides)*

- 2 design principles
  - Be as flexible as possible:
    - Farmer is in control: he decides which sensor devices and analysis models he wants to use and who is allowed to to use the data
  - Sensor data is not copied and/or stored centrally,
    - but remains at the original storage location (e.g. of the device supplier).

- Methodology
  - Convert device centric sensors in *cow centric sensors;*
  - *Decouple* direct link between sensor sources and analyses models, by making a broker which routes data requests towards the correct source(s);
  - *Semantically integrate* sensor data from different sources.

Chain integration

SmartDairyFarming

InfoBroker: Open platform for (sensor) data producers and consumers

Other data sources

Real time models (at different organisations)

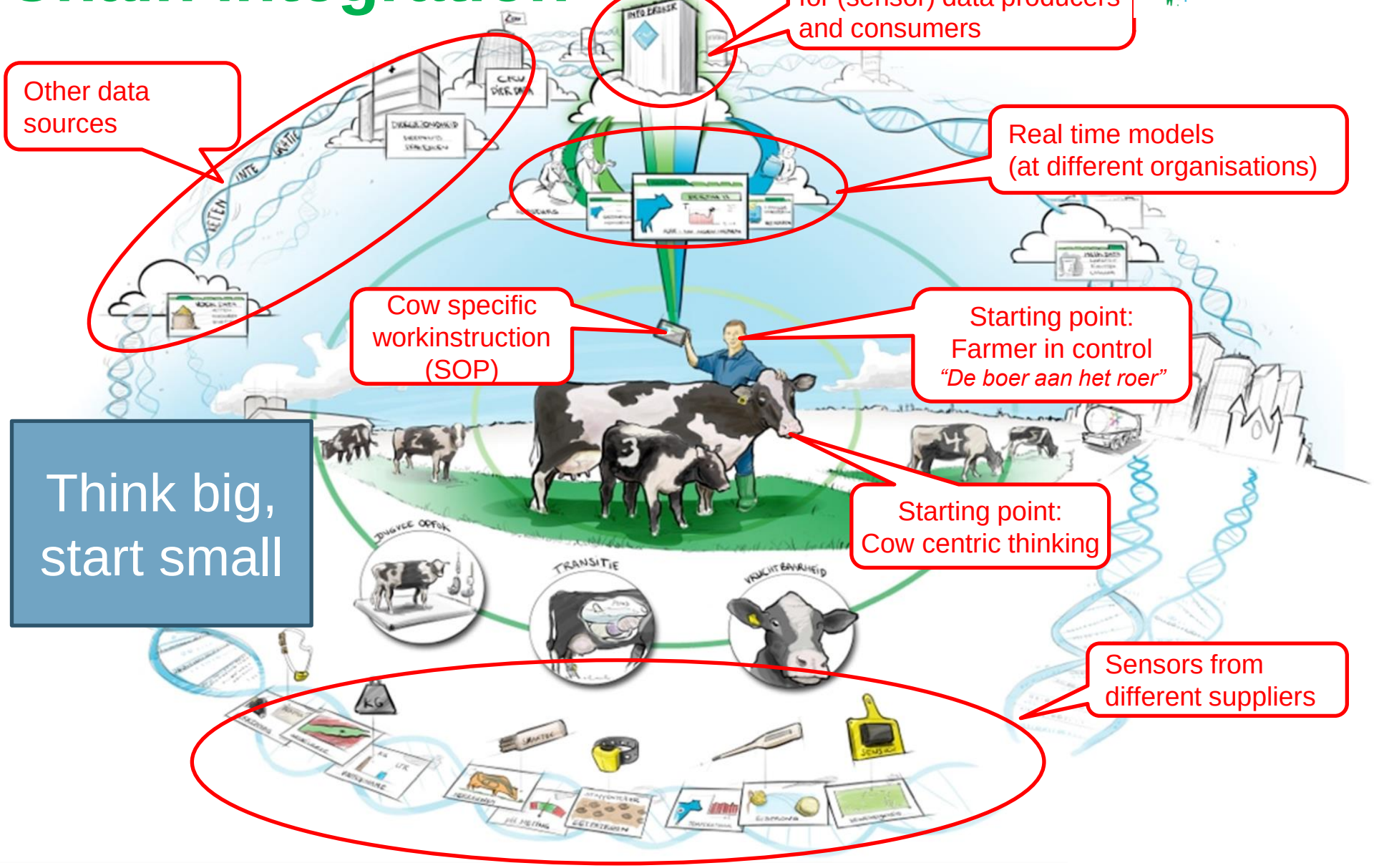
Cow specific workinstruction (SOP)

Starting point: Farmer in control
"De boer aan het roer"

Starting point: Cow centric thinking

Sensors from different suppliers

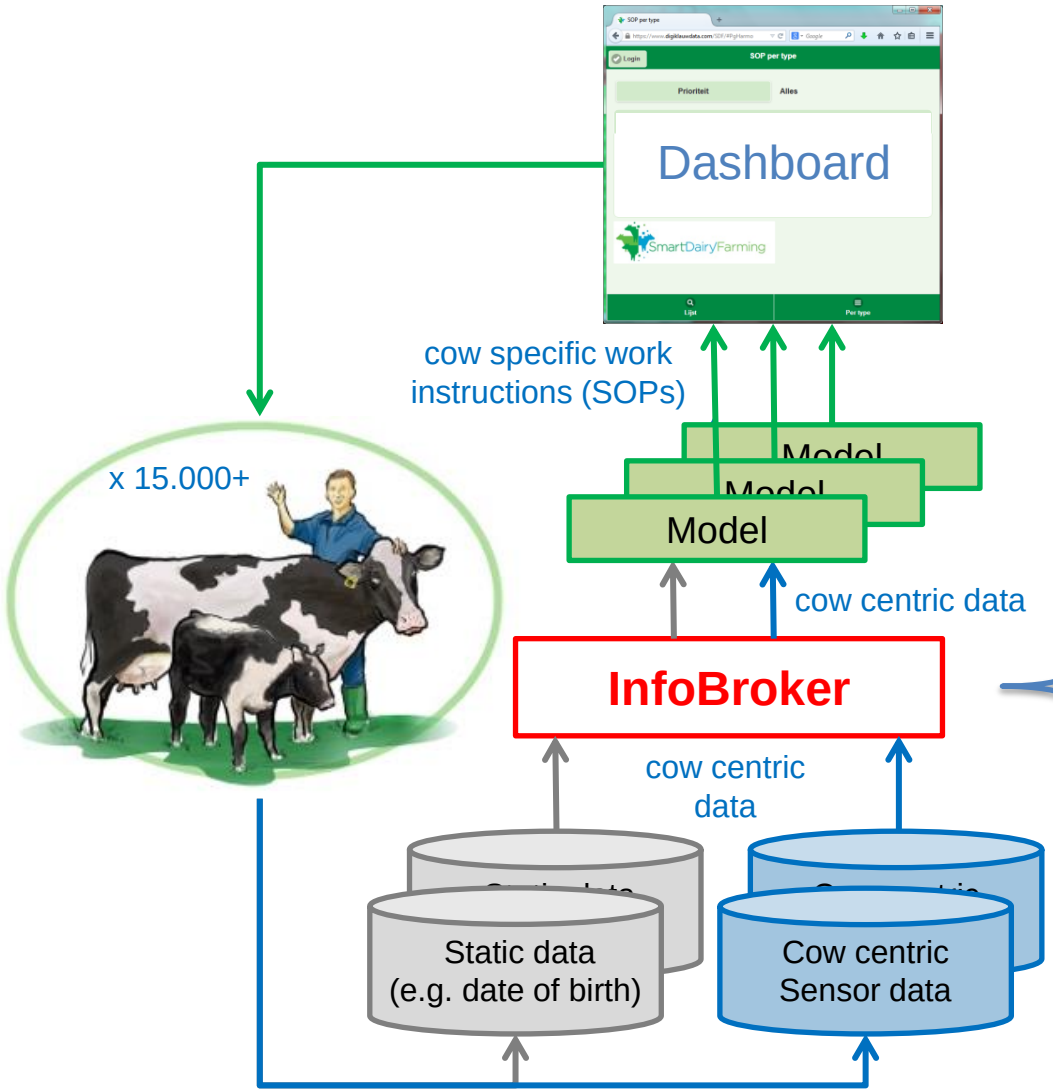
Think big, start small



This project is made possible by:

provinsje fryslân
provincie fryslân
provincie groningen
provincie Drenthe
Ministerie van Economische Zaken, Landbouw en Innovatie
SNN
landbouw, natuur en voedselkwaliteit
Mesdag
Productschap Zuivel
LTO Nederland

InfoBroker concept



InfoBroker functionalities:

- Open interfaces for data exchange (API)
- Authentication
  - who are you (are you allowed to login)
- Permissions
  - which data may be used by whom
  - to be set by the farmers
- Namingservice
  - location where the data can be found
    - static data
    - cow-centric sensor data
- Integration
  - combining info from different sources
- Pay-per-use
  - fixed costs (connections)
  - variable costs (used data)

So:

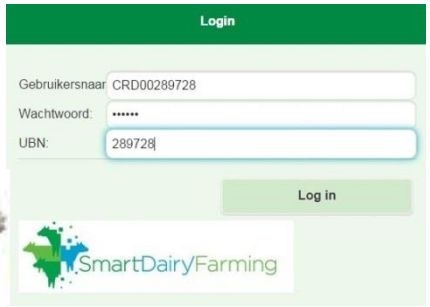
- no central datastore for (sensor)data!
- but indeed a broker
- and reduces/prevents duplication

SDF in practice

Farmer: Dairy Campus

SmartDairyFarming

Dashboard

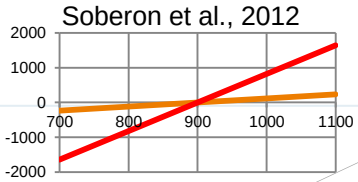


SOP-generation by models

Speenschema aanpassen
Krachtvoer aanpassen
Ruwvoer aanpassen
Pink insemineren
Kalf/pink behandelen
Voeradvies inwinnen
Selecteren voor afvoer

SOP-application
SOPs

Soberon et al., 2012



Fertility model CRV

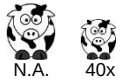
Transition model agrifirm

Young stock rearing Nutrifeed

Hogeschool VHL
DAIRY CAMPUS
Universiteit Utrecht
LIVESTOCK RESEARCH WAGENINGEN UR

- give me all life-nrs on this farm
- for all these cows (on this farm)
  give me the data-of-birth
- for all these cows (on this farm)
  where (age < 12 weeks)
  give me weigth over time

Datacollection on the farm

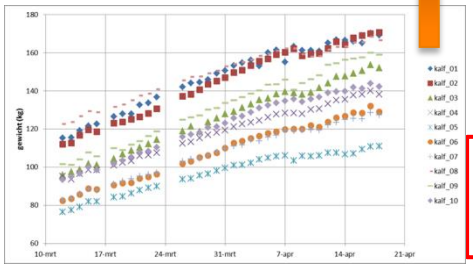


FÖRSTER TECHNIK
Milk intake

GALLAGHER
Weight 4x

Water intake 4x

Sensor data logistics



InfoBroker
rovecom

```
life_number,sensor,date_time,wcorr,wstable,wzero,wavg,wavgmin,wavgmax,werrors,wnousecounter,wnousetime,wusetime
NL 916075572,dc_roostervloerhok1_weegschaal1,2013-11-04 04:18:35 UTC,129.0,129.0,0.0,102.3,30.8,129.0,0,0,470,18590
NL 916075572,dc_roostervloerhok1_weegschaal1,2013-11-04 04:18:40 UTC,129.5,129.5,0.0,129.6,129.5,130.0,0,0,475,18590
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```
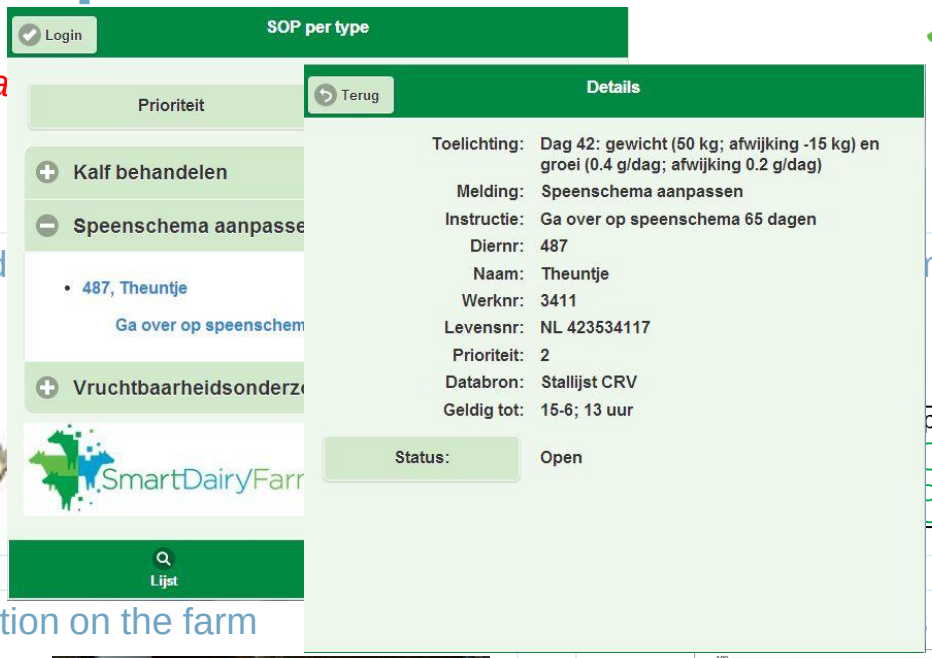

Realtime cow centric sensor data
AnySense
TNO

Static data
CRV_Animalregistry
CRV_Diagnosys
CRV_Treatment

SDF in practice

Farmer: Da



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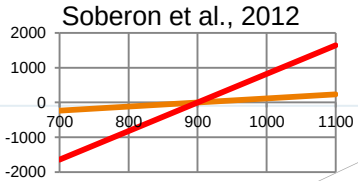
Dashboard

models



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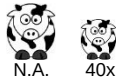

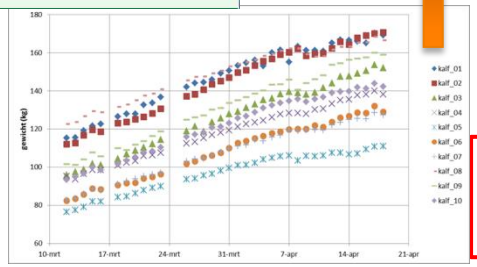

InfoBroker rovecom

FÖRSTER TECHNIK

Milk intake

GALLAGHER

Weight 4x

Water intake 4x

```
life_number,sensor,date_time,wcorr,wstable,wzero,wavg,wavgmin,wavgmax,werrors,wnousecount,wnousetime,wusetime
NL 916075572,dc_roostervloerhok1_weegschaal1,2013-11-04 04:18:35 UTC,129.0,129.0,0.0,102.[illegible],30.8,129.0,0.0,470,18590
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```

In SDF 1.0 a temporary route and storage
- to make it possible with existing/new sensor systems

Direct coupling with InfoBroker in SDF 2.0
- storage at the sensor system/provider
- and registration at the InfoBroker

[illegible] centric sensor data

AnySense

Static data

CRV_Animalregistry
CRV_Diagnosys
CRV_Treatment

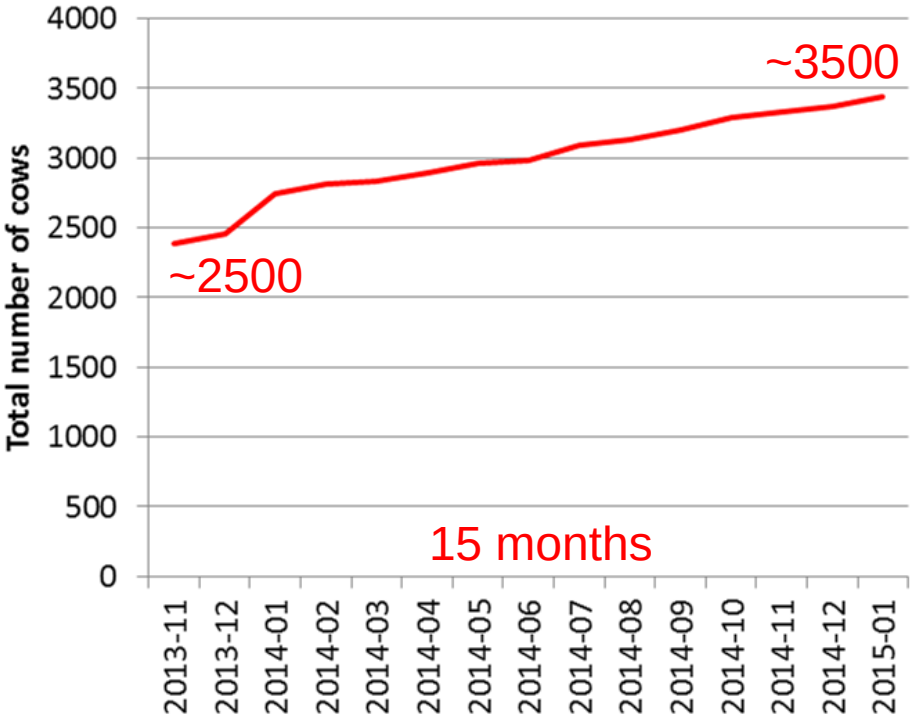
InfoBroker – Facts & Figures

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7
# cows/calves	459	186	315	239	706	202	351
Behaviour	x				x		
Temperature	x				x		
Activity	x	x	x	x	x	x	
Milk production	x	x			x	x	x
Food intake		x				x	x
Weight	x	x	x	x	x	x	x
Water intake			x	x			
Milk intake			x	x			

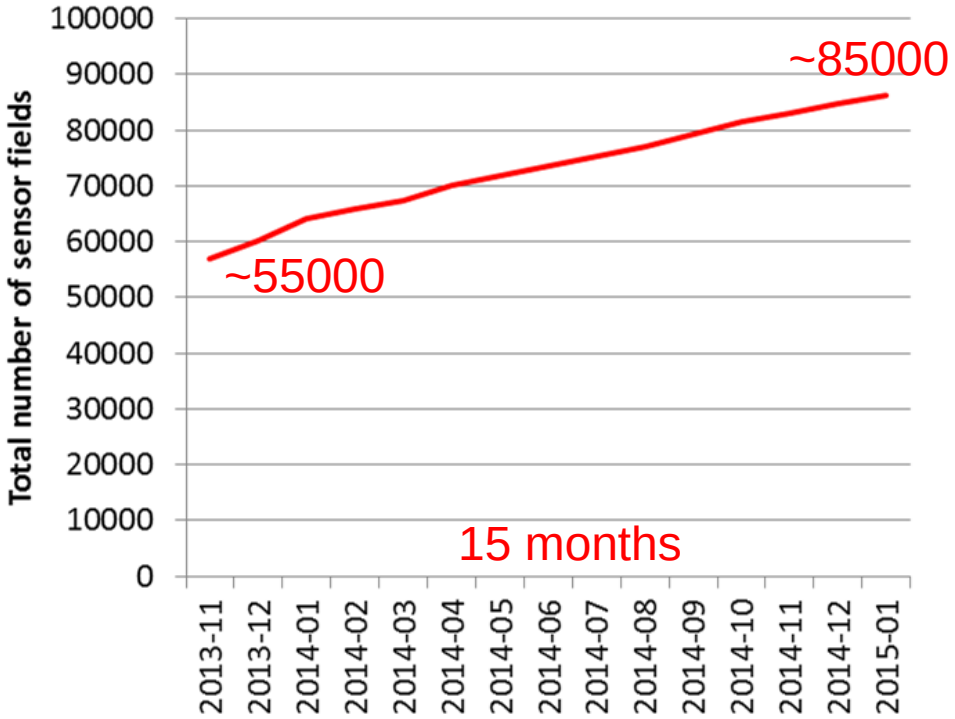
Date: februari 2015
NB1: this are “sensor data categories” at a farm
NB2: not all animals are monitored for SDF (e.g. 3 and 4 only calves)

InfoBroker – Facts & Figures

Number of cows vs time

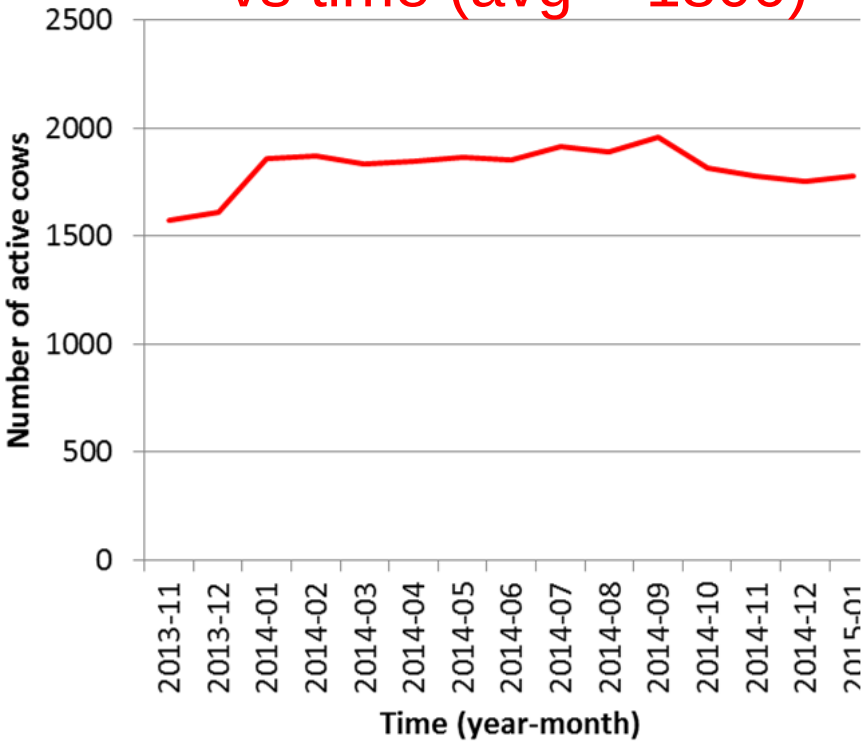


Number of sensorfields vs time

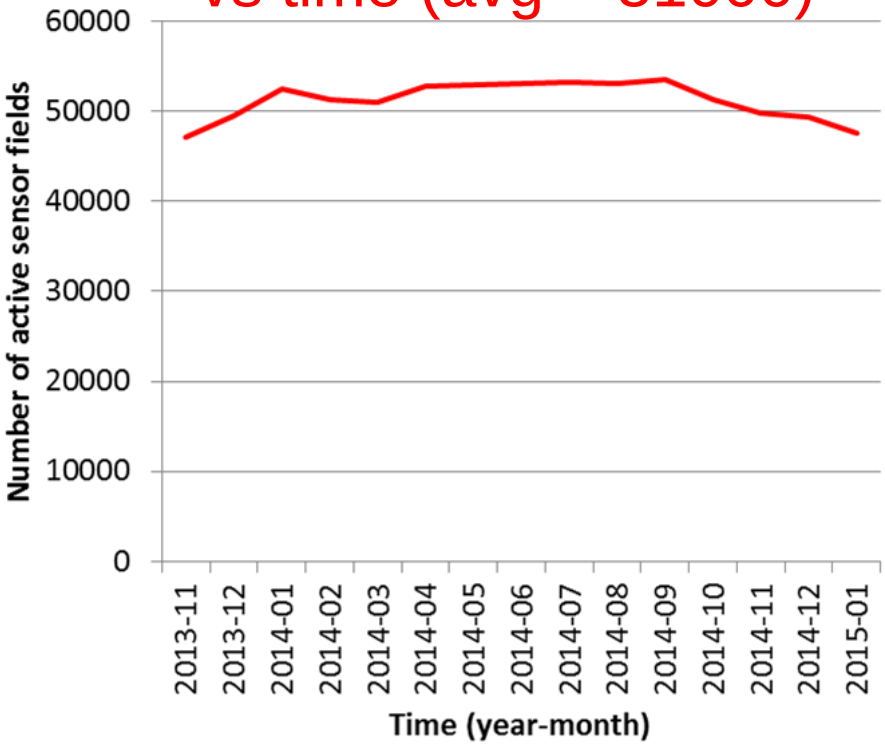


InfoBroker – Facts & Figures

Number of “active” cows vs time (avg = 1800)



Number of “active” sensorfields vs time (avg = 51000)

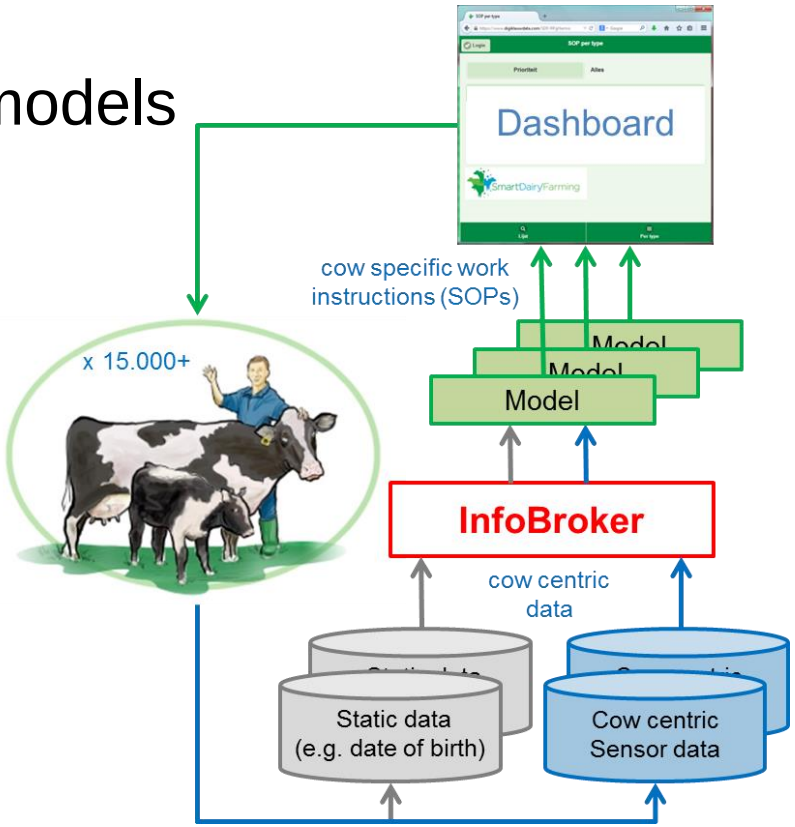


“active” = there is data in specific month for cow or sensor

on average: 28 sensorfields per cow available

Conclusions

- We developed a platform (architecture, approach and first implementation) for *Near real-time large scale (sensor) data provisioning for PLF*.
- Used by several near real-time models
  - to create work instructions (SOP's)
  - on individual cow level
  - in the field of
    - young stock rearing
    - heat detection
    - transition.
- For 7 farmers (in SDF1.0), with
  - 1800 actively monitored cows
    - and a history of additional 1700 cows
  - 51000 active sensor fields
    - on average: 28 sensor fields per cow



Next steps a.o.

- **SDF 2.0:** “From Proof of Concept to Proof op Practice”
  - **More farmers**, more sensors
    - from 7 to 60 farmers in SDF2 (and be ready for 2500 farmers in 2018)
  - Additional **InfoBroker functionalities**
    - e.g. permissions, billing
  - SDF 2.0 is 1 of the 10 **Fieldlabs** of *Smart Industry (Dutch industry fit for the future)*
    - vision/lessons learned from SDF in the “Actieagenda” (p.44/45)
      - see: http://www.smartindustry.nl/wp-content/uploads/2014/11/Smart-Industry-actieagenda-LR.pdf

- TNO is a strategic partner in SDF 2.0
  - Development of new knowledge:
  - **IT**-perspective
    - Data Driven Analysis
    - Semantic interoperability of sensordata (e.g. Linked Data)
    - Quality Aware Sensor data Processing
  - **Economical**-perspective
    - Value propositions
    - Distribution of costs and revenues
  - **Organizational**-perspective
    - Connection system and behavior
    - Open innovation and upscaling

Presentation of the “Actieagenda” to minister Kamp (11-11-2014)

SmartDairyFarming

SDF related presentations

Date	Session	Time	Titel
16-9	7	now	Near real-time large scale (sensor) data provisioning for PLF *(this presentation)*
	8	16:00	Real time operational support in young stock rearing
	8	16:20	Effect of sensor systems on production, health, reproduction and economics on Dutch dairy farms
17-9	9	9:00	Application of multivariate analysis of sensor data for the detection of metabolic disorders in dairy cows
	Poster 1	10:20	Focusing on behaviour to ensure adoption of Big Data information services in Precision Lifestock Farming
	10	11:00	Using successful inseminations to evaluate sensitivity of automated heat detection systems
	17	11:00	Chain cooperation as critical success factor in Smart Dairy Farming
	10	11:40	Development of a predictive model for the onset of calving

Thank you for your attention

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The SDF1.0 project is made possible by:

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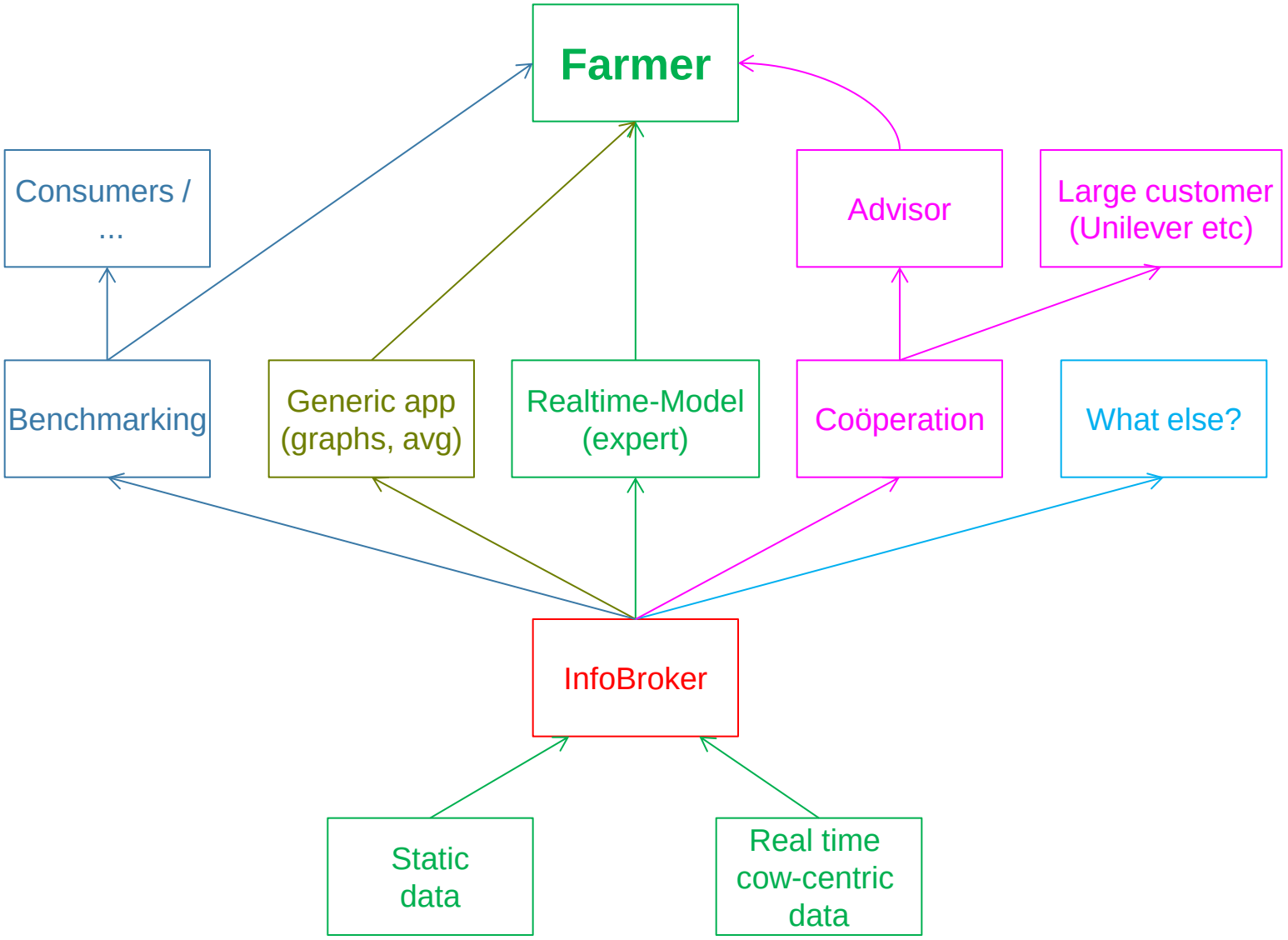
Examples for using the InfoBroker: