



# **Genomic Selection – changes and challenges in Cattle Breeding**

**Søren Borchersen, Head R&D  
VikingGenetics**

# • VikingGenetics owned by more than 30.000 farmers



**Assentoft – head office**



**Skara – Office in Sweden**



**Hollola – Office in Finland**

- Bull stud and semen production
- Bull stud with waiting bulls/quarantine facilities



**VikingDanmark, Faba and the Swedish livestock coops are responsible for advising and insemination on farms**

## • A complete breeding program – number of cows

	Denmark	Sweden	Finland	In total
Holstein	371,000	141,000	81,000	593,000
Jersey	65,000	2,000	-	67,000
VikingRed	37,000	113,500	143,000	293,000
Red Holstein	5,500	-	-	5,500
SKB/Finncattle	-	1,100	2,700	3,800
<b>Total</b>	<b>478,500</b>	<b>257,100</b>	<b>226,700</b>	<b>961,900</b>



Holstein



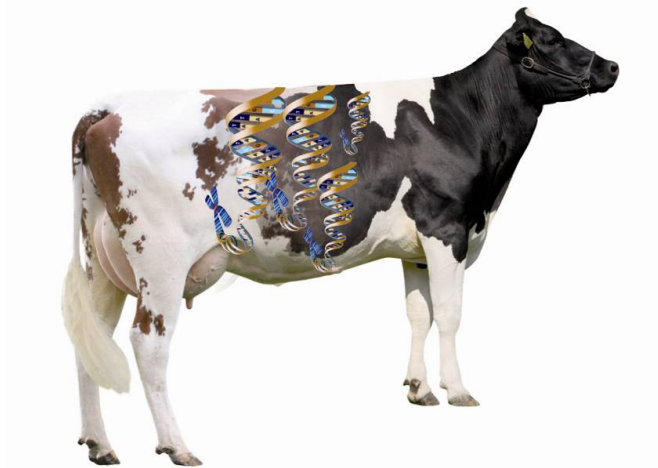
Viking Red



Jersey

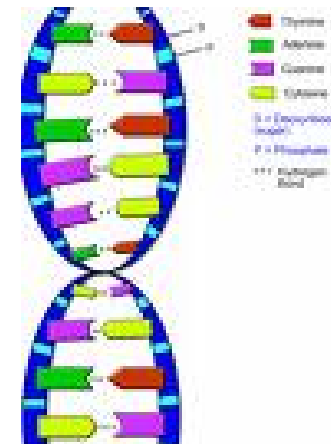
# • Genomic Selection – Keys to improvement

- **Genomic Prediction:**
  - Increased selection accuracy of young breeding candidates compared to only use of Parent Average
- **Genomic Breeding Scheme**
  - Focus on use of young breeding candidates
- **Structure**
  - Change in conducting breeding in practice



# • Genomic Prediction – key factors

- Quality and quantity of data-registration
- Size reference population
  - Sire reference
  - Cow reference
- Efficiency of the methodology
  - Chip technology
  - Model and Calculation methods



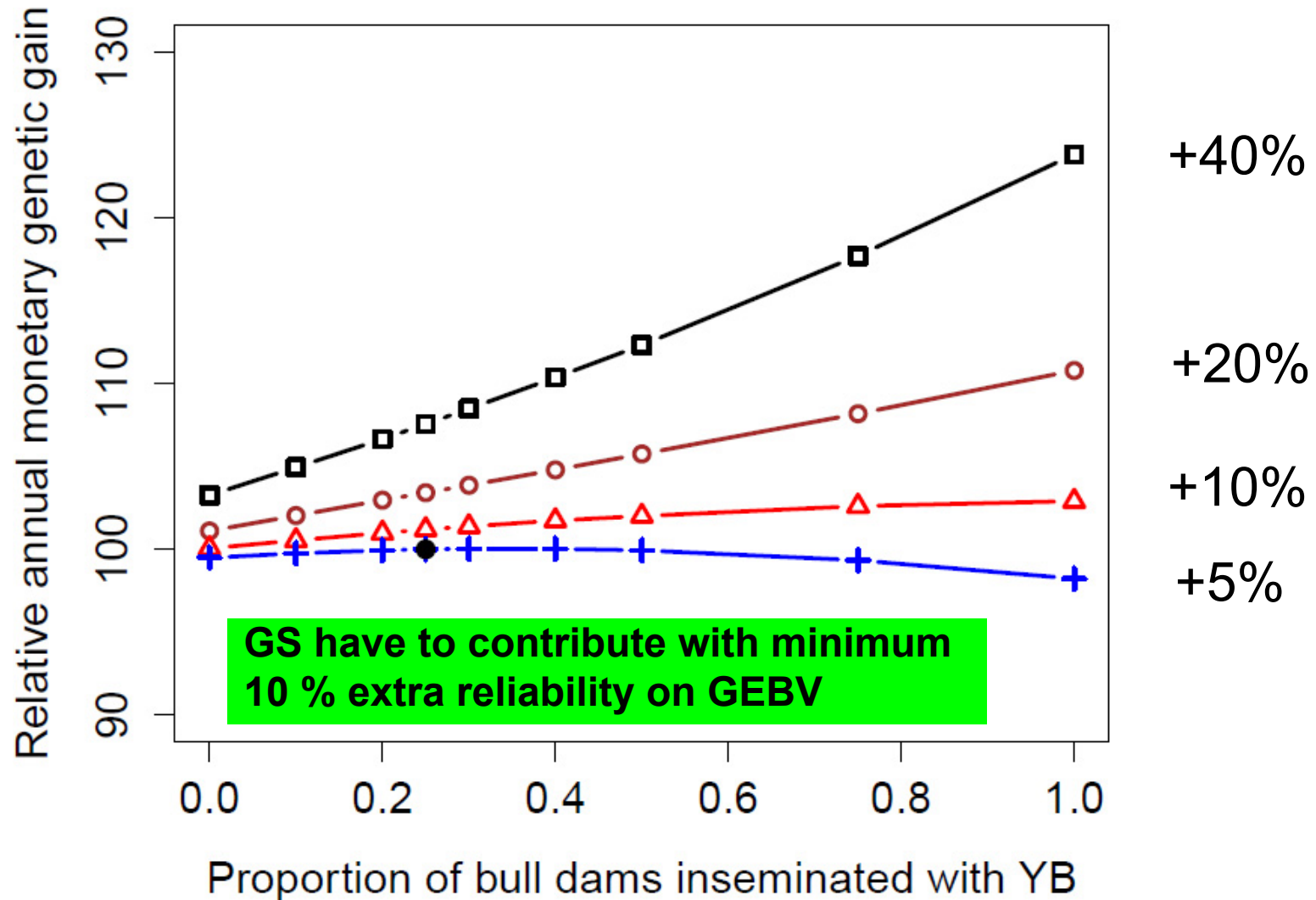
**Challenge: Low reliability specially small breed**

# • Genomic Selection - Development

- **First results for Holstein August 2008 – Start use in Selection**
- **First results for Jersey June 2009**
- **First results for Red Breeds October 2009**
- **First results with EuroGenomics – Reference HF March 2010**
- **Official Breeding Values Autumn 2010**
- **Collaboration common reference with GENO, Norway, 2011**
- **Cooperation with US Jersey, December 2013**
- **Exchange semen on Young bulls with Geno, 2013/14**
- **Cows in reference July 2014**



# Low reliability GEBV reduce genetic progress



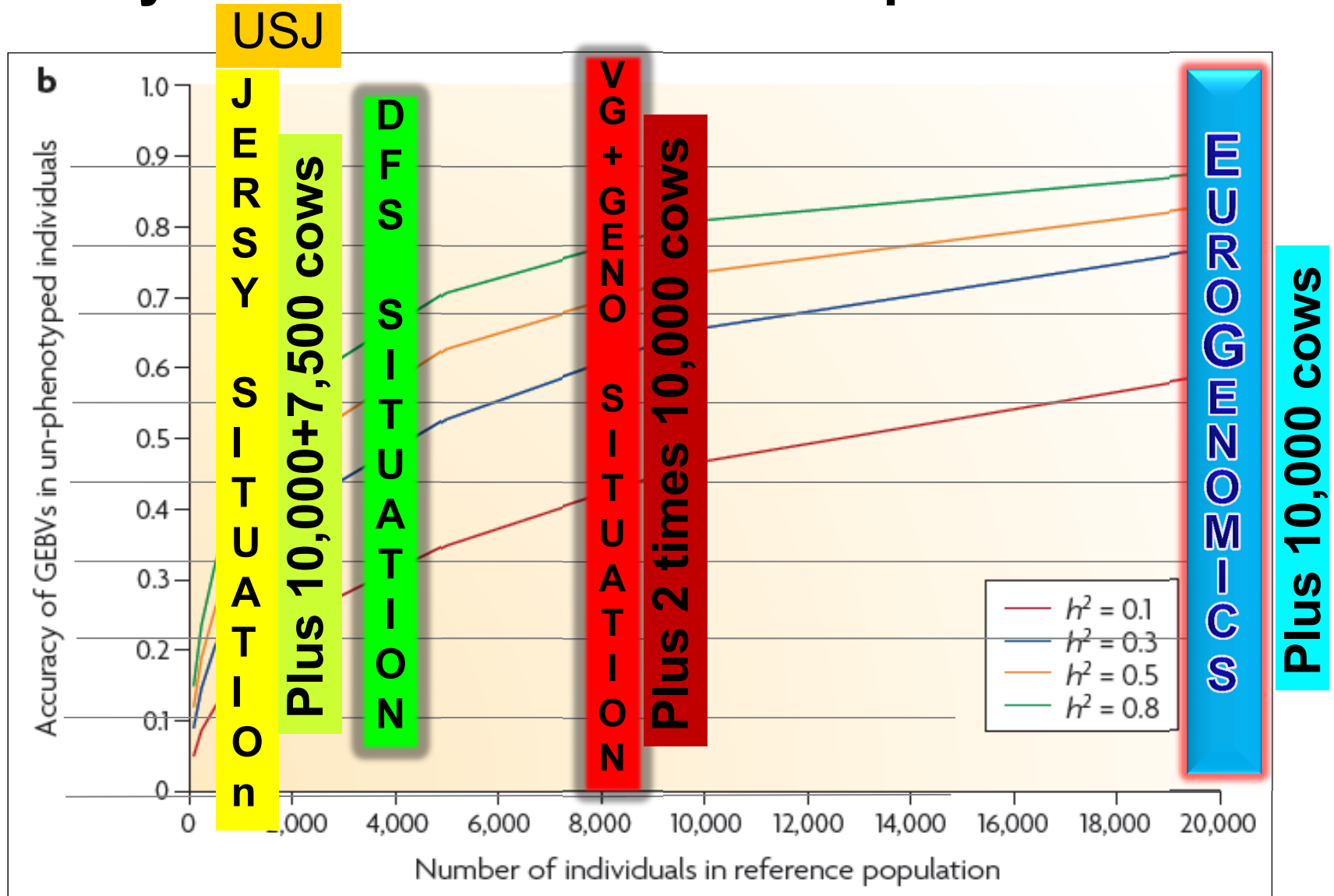


## • **Results Genomic Selection due to prediction**

- **Higher reliabilities (5-10%) due to International collaboration ➡ Increase in Genetic progress**
- **Better methodology due to collaboration with Scientific partners ➡ reliable use of GS**
- **Higher reliabilities (5-10%) due to females in reference ➡ increase in Genetic progress**
- **Chip technologies – development of customerized chip ➡ Higher reliabilities and increase in Genetic progress**



# Reliability and Size of Reference Population



Goddard & Hayes, 2008

# • International collaboration - Scoop EuroGenomics



- Farmer owned Coop's
- Partnership between European A.I. organizations
- Joined forces to improve results with Genomic Selection within Holstein breed
- Improvement of reliable and innovative cattle breeding since 2009 together with scientific partners:

- INIA, Spain
- INRA, France
- Liege University, Belgium
- Aarhus University, Denmark
- Nordic Genetic Cattle Evaluation, NAV, DFS
- Institute Animal Production, Poland



- Exchange of Genotypes



Genomika Polska



# • Reliabilities Breeding values

## Holstein

Trait	Proven bull, 5 years (Traditional Breeding Scheme)	Genomically tested bull calves (Gain compared to PA)
Yield	91	55 (+32)
Udder Health	68	45 (+31)
Fertility	60	46 (+28)

Validation reliabilities,  
Nav 2013

**GS favoring reliabilities for functional traits**

# • Test of females

- Implementation of cows in reference population
- Benefit from test of females:
  - Higher reliability (5-10%) VikingRed and VikingJersey
  - Diversity in our three dairy breeds
  - Fast implementation of functional traits ex. Claw Health and increase of reliabilities



## Use of Genomic Selection in VikingGenetics

# • Genomic Selection - Use on herd level

- **Test of all females in herd:**
  - **Higher reliability for Genomically Enhanced Breeding Values, GEBV**
    - \* Same level for females as for young A.I. Bulls
    - \* Specific advantage for functional traits
- **Optimal selection of animals with low and high breeding values**
  - **Use of sexed semen on females with high Genomically Enhanced Breeding Values, GEBV**
  - **Use of semen from beef bulls on females with low Genomically Enhanced Breeding Values, GEBV**
- **Genomic selection generates need for implementation of new herd selection strategy – and new possibilities in using new mating plans on herd level**





## **Results Genomic Selection due to breeding scheme**

- **Efficient use of Genomic Selection in practice ➡ decrease in number of test bulls**
- **More use of “young” genetic ➡ lowering generation interval and higher genetic progress due to higher ➡ selection intensity among young bull calves**
- **Higher genetic progress due to use of reproduction technology ➡ Select donors more accurate and select among full sibs**
- **Higher genetic progress at lower costs ➡ more profit to farmers**
- **Relative higher genetic progress for functional traits more sustainable breeding**

# • Breeding plan example Holstein VG

1. Screening all born calves in population
2. 3,000 selected based on NTM, and genomic tested
3. 240 calves bought based on GEBV's
4. 175 approved as young bulls
5. 25-30 bulls selected and used as GenVikPLUS Bulls:



6. Registration of daughters for 4 years  
= breeding values for the bulls
7. < 10 best bulls approved as elite bulls





# • Use of bulls on categories in VG

Percent	Before GS	VikingRed	Holstein	Jersey
Proven	70	25	10	50
GenVikPlus	0	51	67	25
Young bulls	30	24	23	25
<b>Young GS bulls</b>	<b>0</b>	<b>75</b>	<b>90</b>	<b>50</b>

**Young bulls is dominating with Genomic Selection**

**GS 100 percent within 1-2 year**

# Genomic Selection effect in VG

- Number of tested young bulls today and before GS



	Before GS	Today
Holstein	350	175
VikingRed	225	175
Jersey	55	55
Total	620	440

Reliability  
level GS:

High

Medium

Low

“High change in Breeding Plans with highest reliability on GEBV”

Challenge is to optimize number of GS Young bulls and females in reference



# Farms participating in registrations

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<b>Milk recording</b>	<b>90 %</b>
<b>Use of AI</b>	<b>88 %</b>
<b>Health registrations</b>	<b>92 %</b>
<b>Insemination plan</b>	<b>88 %</b>

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**"Phenotyping is King"**

# Focus R&D together with scientific partners

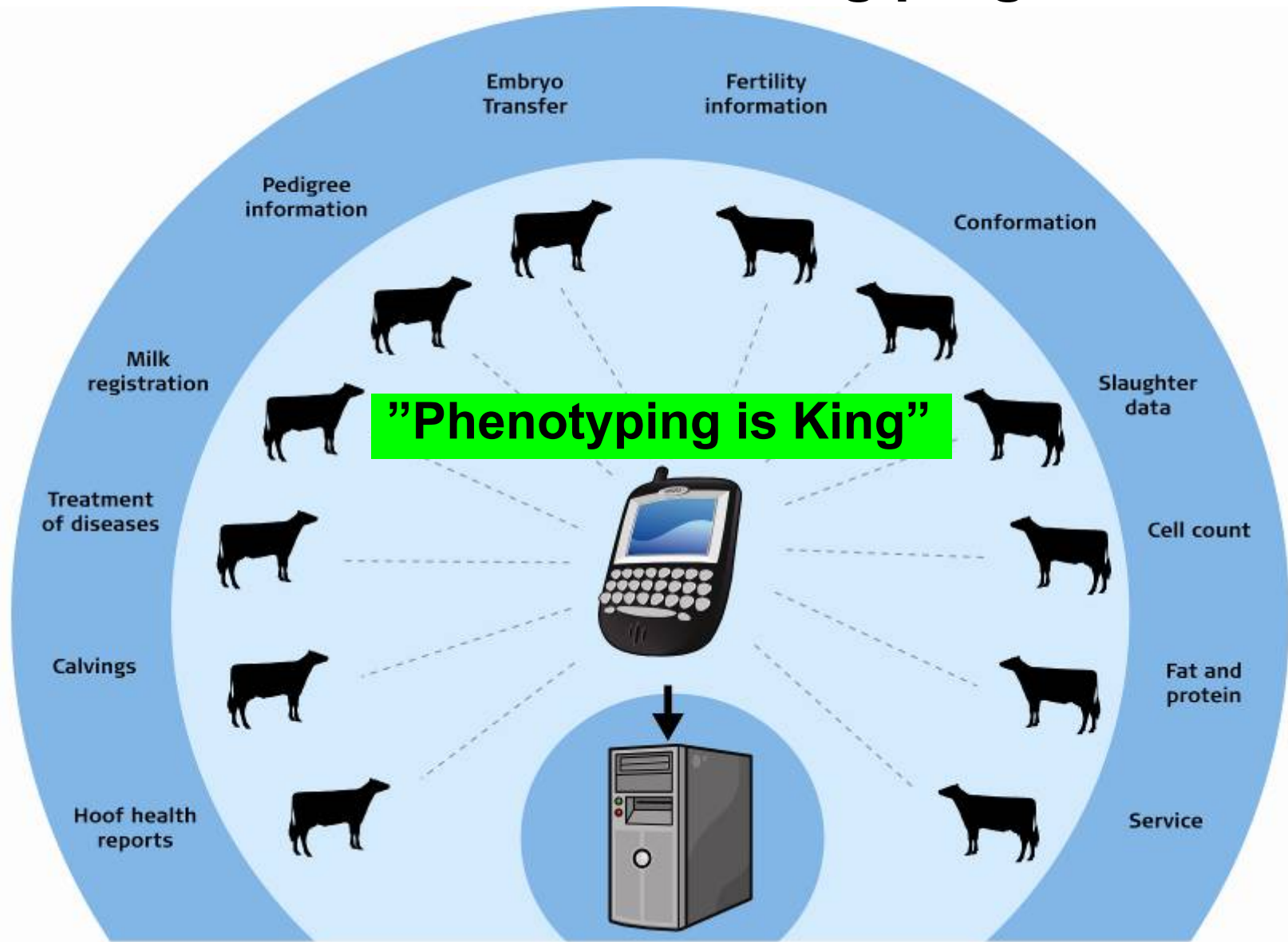
- Harmonization of registration and key traits
- Implementation of new traits like Claw Health, Feed Efficiency, Para tuberculosis
- Development of methodology and comparison of calculation methods
- Expand reference population with females
- Implement output from sequence data
- Breeding plans and long term consequences
  - Implementation and development of new chip
  - Inbreeding – managed at SNP Level
- ...



• **Thank you for your attention!**



# • The Database - effective breeding programme





# • NTM – Nordic Total Merit

- **Compares all economically important traits**
- **Common breeding goal**
- **Use data registrations from all 3 countries**
- **Takes genetic correlations into consideration**
- **Best tool for selection of bulls and cows for the breeding programme**
- **Permits comparison of cows and bulls directly in Sweden, Denmark and Finland**

