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USE OF NEW TECHNOLOGY IN ANIMAL BREEDING

Breeding for better lives

INTRODUCTION

> The aim of a breeding program is to obtain genetic progress:
> ❖ Identify the superior animals
> ❖ Use these as parents in the next generation

- Currently new methods are implemented to identify the superior animals:

  ➢ Utilize genotypic information

  ➢ The method id based on the associations between genotypes og phenotypes

- This change is made possible by technological developement in different areas
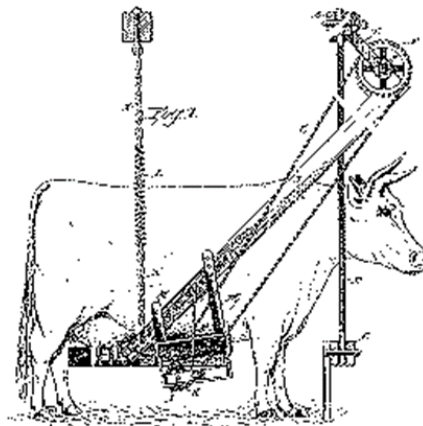
INCREASED POSSIBILITIES AND NEEDS FOR TECHNOLOGY

- Before the genomic era (progeny testing)
  - Reproduction technolgy (AI)
  - Registration, organisation and storage of field data (phenotypic observations, relationships)
  - Computing power (when implementing BLUP)

- In the genomic era
  - Access to DNA-information (*Genotype technology*)
  - Increased benefits of new/different reproduction technics *(Reproduction technology)*
  - New kinds of phenotypes based on new technology are being generated *(Phenotype technology)*
  - Extremely high demand of computing power *(IT technology)*

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GENOTYPE TECHNOLOGY IN CATTLE BREEDING

- Utilize DNA-information:
    - QTLs
    - Access to high-density SNP genotyping (25k-54K-55K-777k)
    - Imputing
    - Single gen analysis (polled/horned, varities of casein, BTA12-deletion etc)
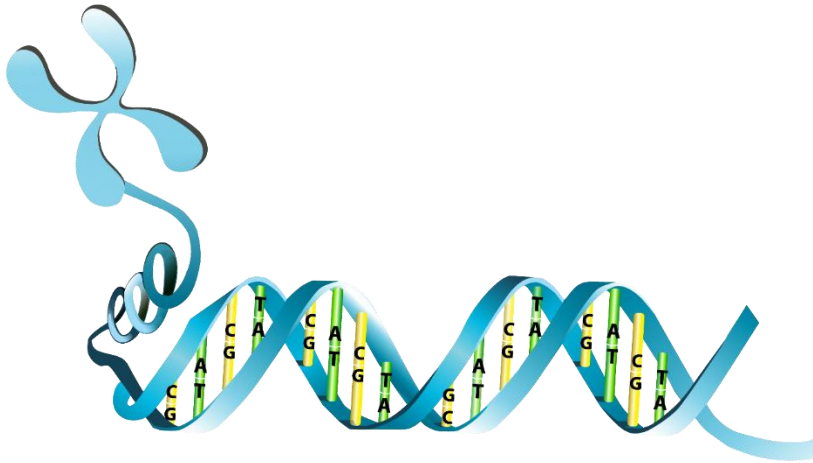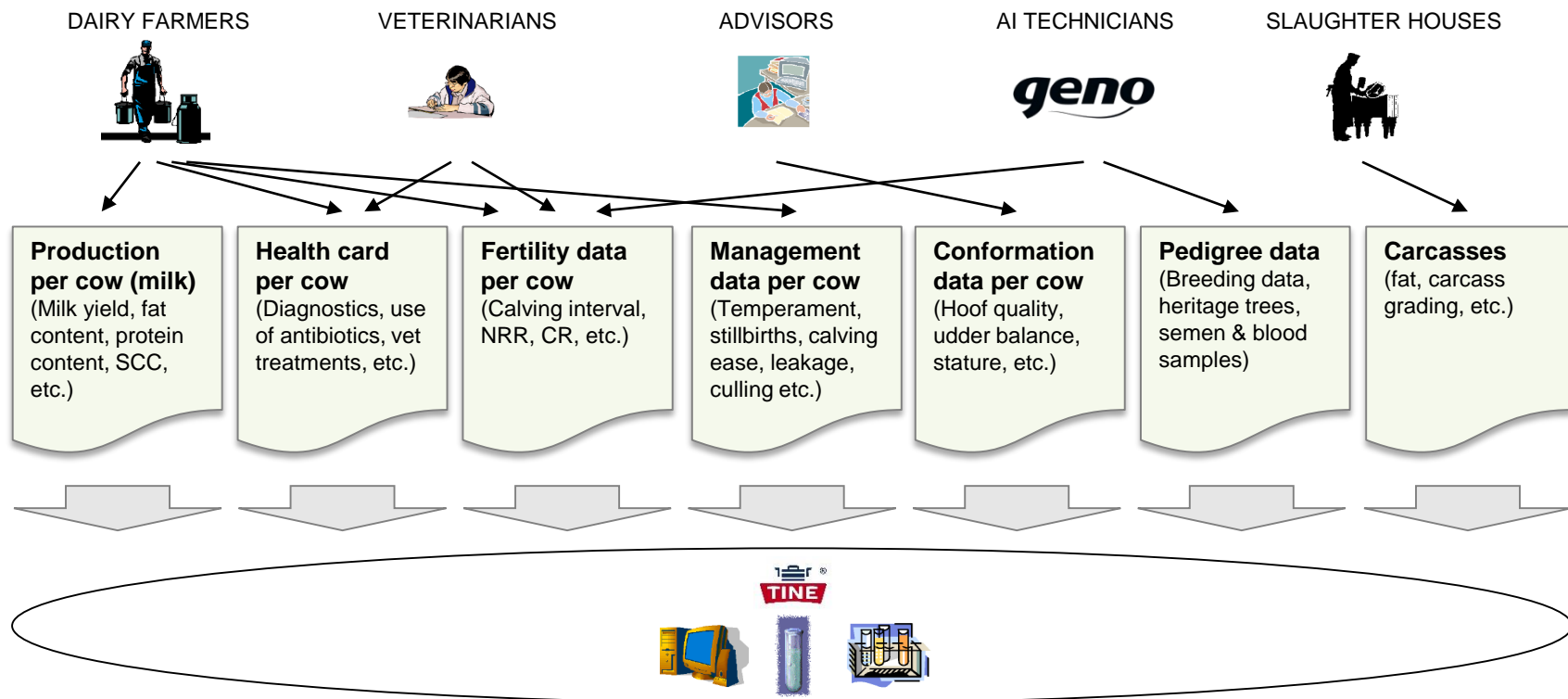
REPRODUCTION TECHNOLOGY

- The exclusivity of the bull as mainstay of genetic gain is reduced

- Genotyping increases the reliabilities of breeding values of cows
  - An increased number of offspring from superior cows is more favorable
  - Different techniques are available
    - In Vivo
    - In Vitro

- Keeping up good results from AI is important to maintain extensive use of AI

SCANDINAVIAN FARMERS HAVE BEEN REGISTERING DATA IN THE MILK RECORDING SYSTEM OVER THE LAST 50 YEARS

Dairy Herd Recording Systems in operation since the 1960s

DAIRY FARMERS	VETERINARIANS	ADVISORS	AI TECHNICIANS	SLAUGHTER HOUSES

Production per cow (milk)
(Milk yield, fat content, protein content, SCC, etc.)

Health card per cow
(Diagnostics, use of antibiotics, vet treatments, etc.)

Fertility data per cow
(Calving interval, NRR, CR, etc.)

Management data per cow
(Temperament, stillbirths, calving ease, leakage, culling etc.)

Conformation data per cow
(Hoof quality, udder balance, stature, etc.)

Pedigree data
(Breeding data, heritage trees, semen & blood samples)

Carcasses
(fat, carcass grading, etc.)

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PHENOTYPE TECHNOLOGY

- Modern technology/ assistive devices in farming produce a new kind of phenotypedata
  - Precise
  - Large volum
  - Objectively assessed
  - No preferantional considerations
  - Timesaving

HIGH RESOLUTION DATA

- **Milking robots /Management systems**
  - Yield from every milking
  - Milkability (kickoffs, quantity, time and flow)
  - Teat coordinates
  - Body weight /Weight changes
  - Body score /Body score changes (Analyzing 3D-picture of the cow's lower back)
  - Cell count, conductivity
  - Physiological parametres (levels of hormons, enzyms, metabolites, temperatur etc)
- **Feeding systems**
  - Exact amount and quality of concentrate
- **Activity measurements**
  - Movements, ruminations
- **Imaging technologies**
  - Udder conformation, stature, body depth, legs conformation
- **FTIR- and NIR-data**
  - Fatty acid content in milk
- **Sensors**
  - Ruman pH
  - Behavior
  - Casein content…….

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VALUE FOR THE BREEDING PROGRAM

Obtain increased genetic gain by in a more precise way identifing the superior animals

- Production
- Quality of products
- Milkability
- Temperament /behaviour
- Fertility
- Health
- Feed efficiency
- ……………..

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«BIG DATA» CONCEPT

"Datasets that have volume, speed, variety and complexity that makes traditional tools unsuitable to capture, process, store, deal with and especially analyze. In addition to the enormous volume of data, they are often unstructured. The fact that the data is unstructured, means that they contain valuable information while it is difficult to automate the understanding and classification of it's content. "

DATA → INFORMATION USEFUL FOR PREDICTION
OF BREEDING VALUES
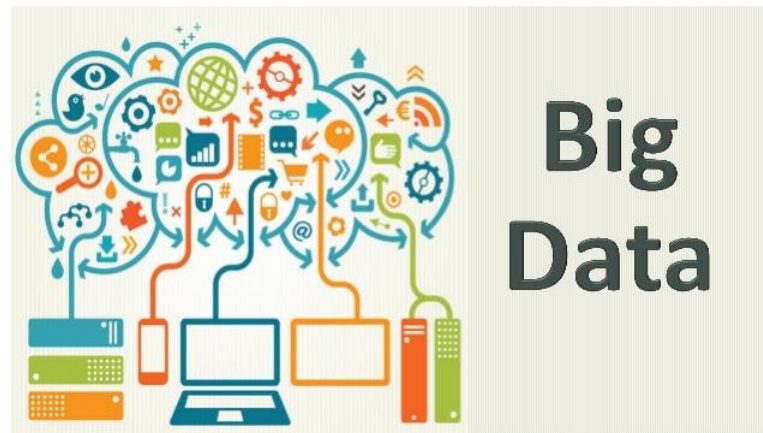
HOW TO UTILIZE SUCH DATA?

1. Develope technical solutions to get access to the data
2. Clarify the ownership to such data (farmers?, companies developing the technology?, …..)
3. Facilitate for storing/accumulating the data (raw data)
   - «Outside» the quality management systems in the cow data base
4. Combine, analyze and identify which data are useful for the breeding program (new methods?)
5. Extract and include this particular identified data in the cow data base

HOW TO SUCCEED

- Construct appropriate platforms to store data
  - Ensure coordination, such that data from different sources easily can be combined (incl. both genotypic- og phenotypic data)
- Ensure that the farm industry /the farmers coop has the ownership to the data
- Cooperate with companies / people with relevant technologial competance
- The farm industry must have will to invest money in technology and projects

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IT TEQNOLOGY

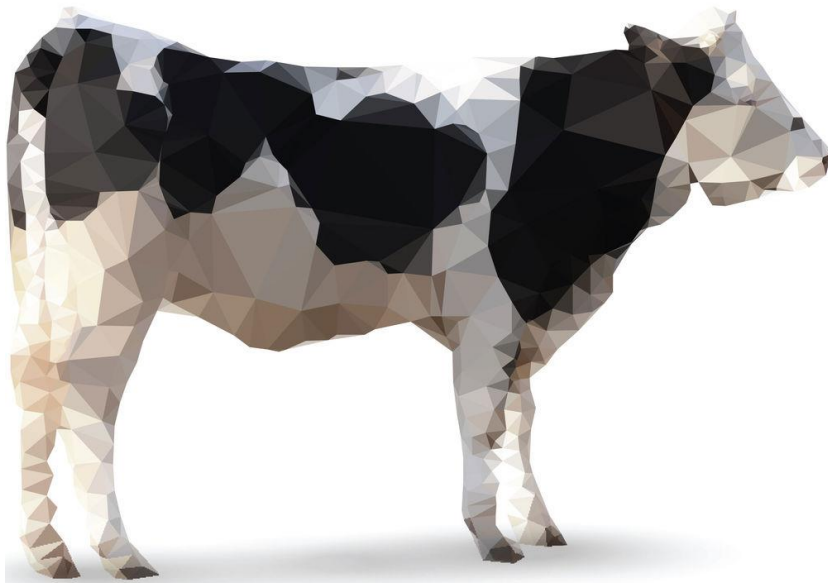Will the demand of computing power be available?

- Moore's law put forward in 1965: «*Processor capacity will be doubled for every 24 months until 1975.*"
- Been the case until now, but experts claim that we are about to reach the point where physical laws limit the validity.
- Parallellprocessering
- Costs

SUMMARY

- New technological equipments in agriculture /livestock industry will create a large volume of individual data on cattle in the future

- This data is expected to have large value for modern breeding programs when combining genotypic and phenotypic information

- It is important that this data are managed in a way so that the farmer control the use, benefit and extract the value

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