Using DNA Technology as a Complimentary Tool in the Value Chain for Source & Content Verification

SYGEN International plc

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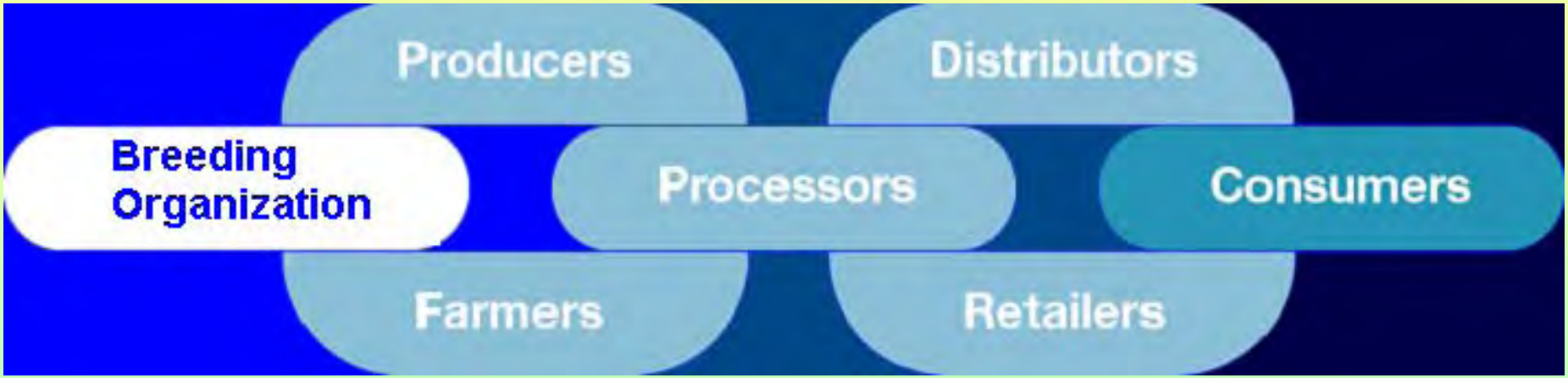
Director of Biotech Research Business Development

SYGEN Mission

Leadership in creating value
through the innovative application
of
quantitative genetics & biotechnology
to
animal breeding

SYGEN Business Model

Global Meat/Protein Supply Chain



SYGEN genetic, health and biotechnology improvements add value across the entire Global Supply Chain

DNA link throughout the value chain

SYGEN Companies Around the World

Meat trade is becoming increasingly international

Multi-Species Strategy & Application

Biotechnology/Genomics

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Quantitative Genetics

PIC

Syqua

- ✓ **Acquisition**
- ✓ **JV**
- ✓ **License**

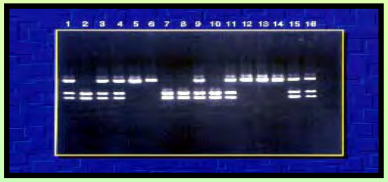
Leading R&D Team

- 25 Molecular Biologists
- 25 Quantitative Geneticists
- 20 Veterinarians/Nutritionists
- 15 Reproduction/Meat Scientists
- 50+ PhDs
- Laboratories in US and UK

R&D How we select

- **Quantitative Genetics**

  - **Leverage 40 years of quantitative genetics experience**
  - **"*Statistical sampling*" of groups/herds of animals**
  - **Identify individual animals with trait of interest**



- **Biotechnology**
  - **Leverage 15 years of biotechnology experience**
  - **Utilize biotechnology and genetic research**
  - **Identify individual genes responsible for trait of interest**

- **Utilize *technology transfer vehicles* (e.g. Animals) to transfer/sell our technology products to our customers**

Genome Research in Perspective

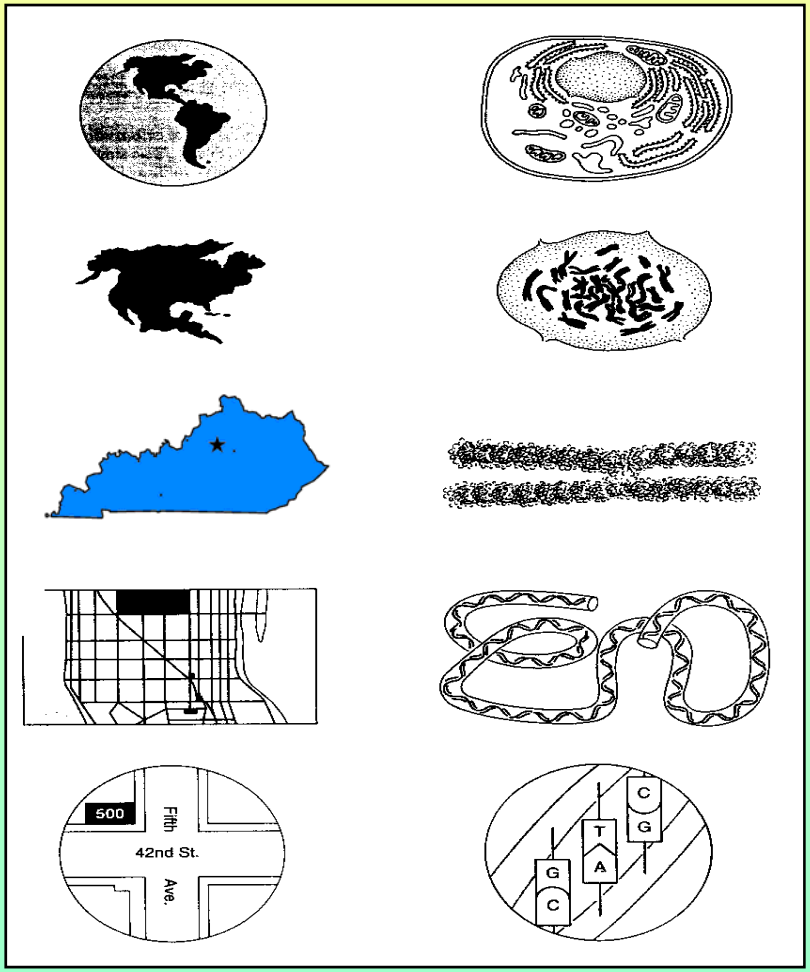
Earth

Continent

State

City

Street Address



Cell

Cell Nucleus

Chromosomal DNA

Chromosomal DNA Fragment

Nucleotides

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- A Tool to Verify Traceability Systems
- A DNA based identity preservation program *(patent applied for)* capable of linking a DNA sample from an animal, carcass or cut of meat back to its genetic origin
- Assigns individual animals as parents to a resulting DNA sample and/or links a DNA sample collected at the packer or retail level back to the individual from whom the tissue was originally derived

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Value Chain Questions

- Are you who you say you are?
- Are you where you say you are from?
- How do I substantiate the claims you make?
- Are you safe?

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Complex Networks with Many Touch Points

- Supply chain verification at first glance seems like a big bowl spaghetti.
- It has many expectations that are varied in content and requirement, some random some constant

Meat (live or fabricated) comes in different flavors

(Species, breeds, programs)

All contains a wealth of information in the form of DNA

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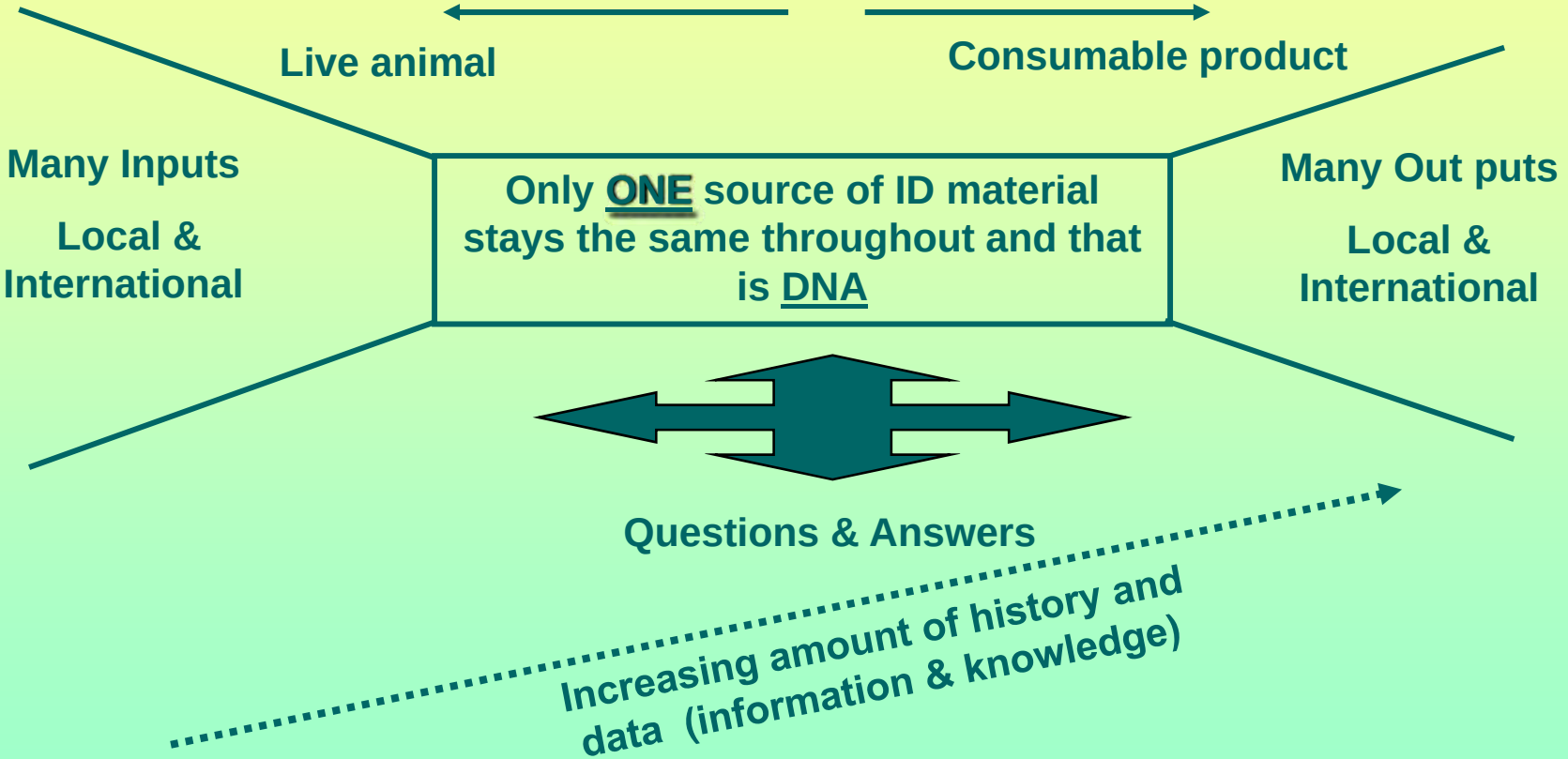
"Bow Tie" Supply Chain



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Using Genetic Markers in Traceability & Content Verification

- **Regulatory Traceability**

  Disease (Control , Diagnosis & Prevention)

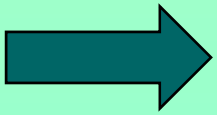
  Product Recall (Non-compliance, Not “in the spec”)

  Supply Chain Security

  (Fraud, Bioterrorism, other acts of Malice)
- **Commercial Traceability**

  Value Attributes

  (Brand Differentiation & Genetic line customization)



Source / Process Verification

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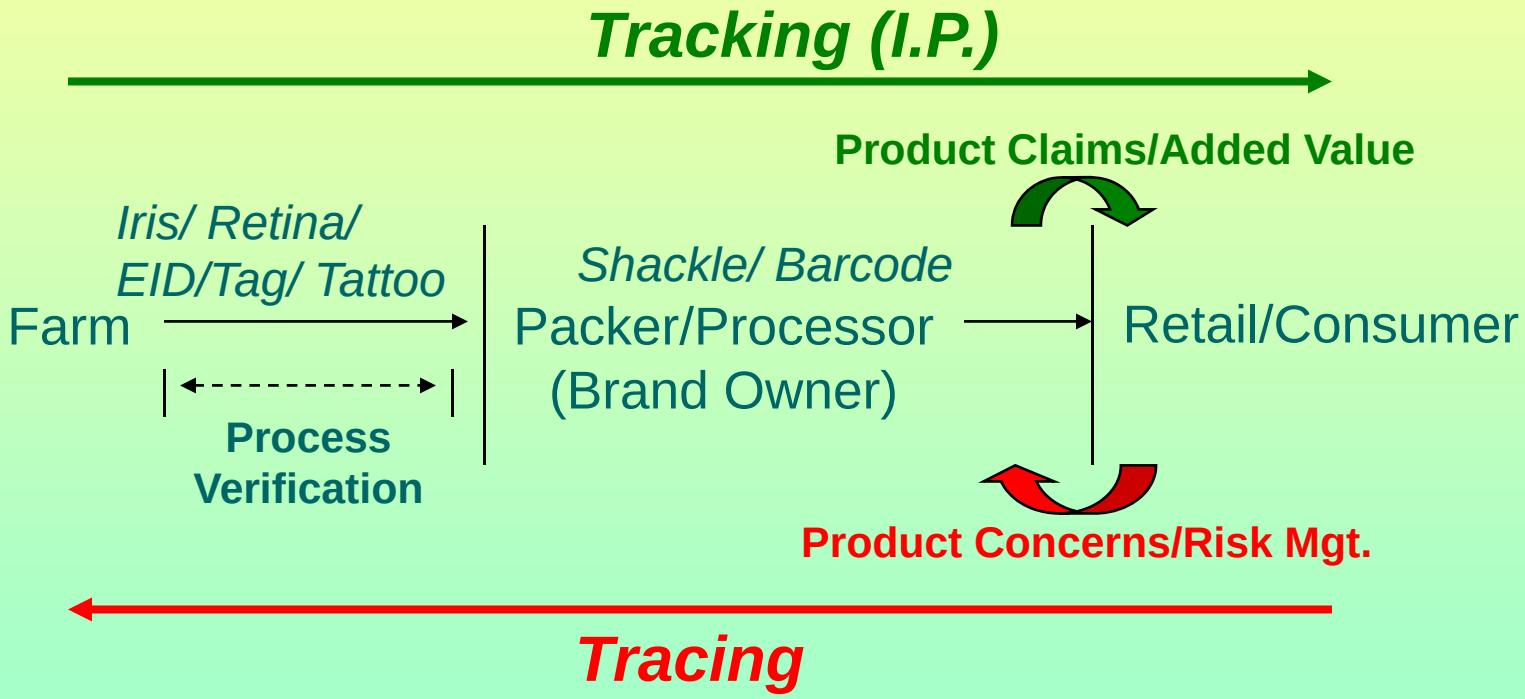
Identity Preservation: Tracking vs. Tracing



DNA is a link through different parts of the chain

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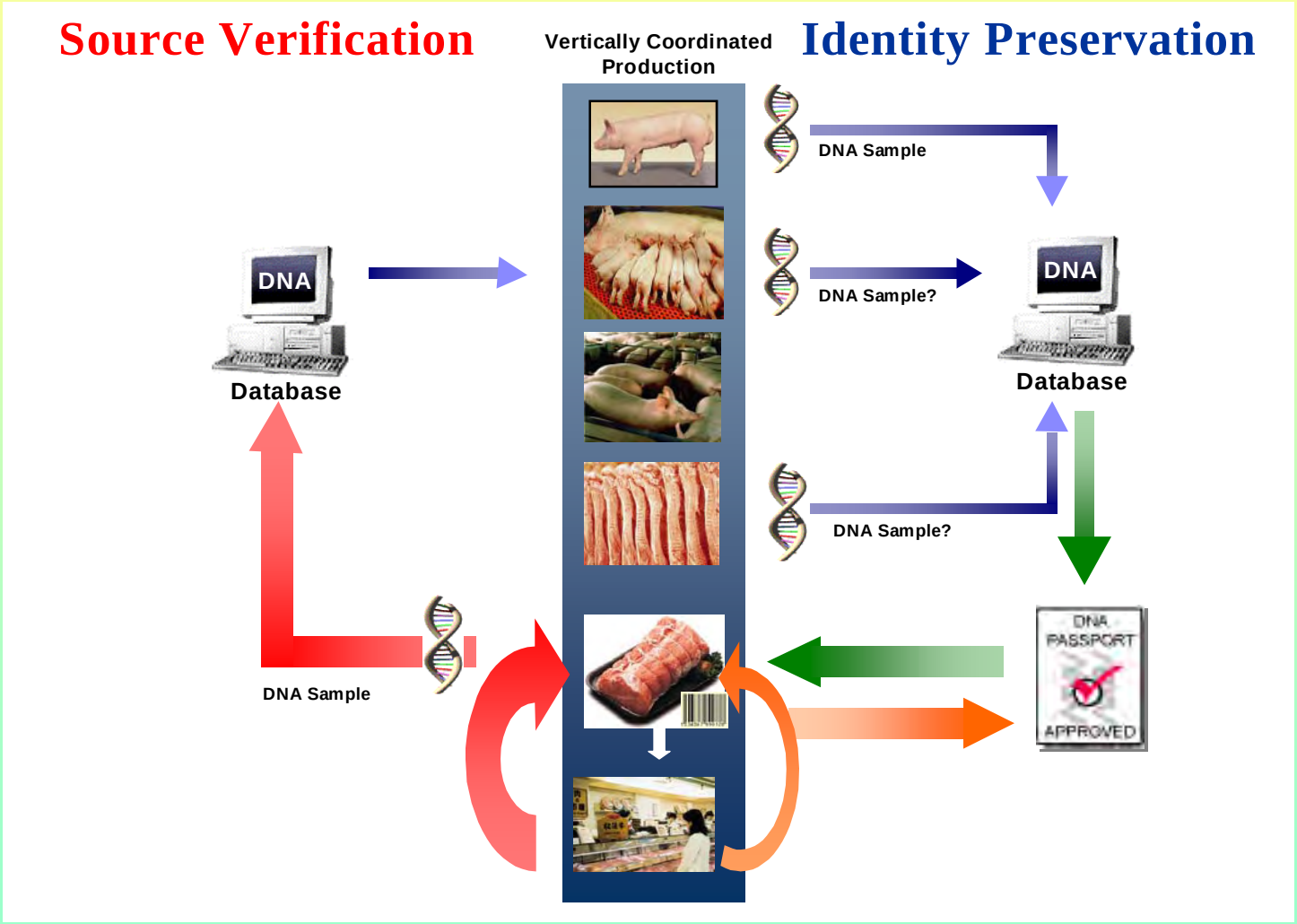
DNA Markers and Traceability in the Pig Industry



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DNA Markers and Traceability in the Pig Industry- Lessons Learned

Identification Programs

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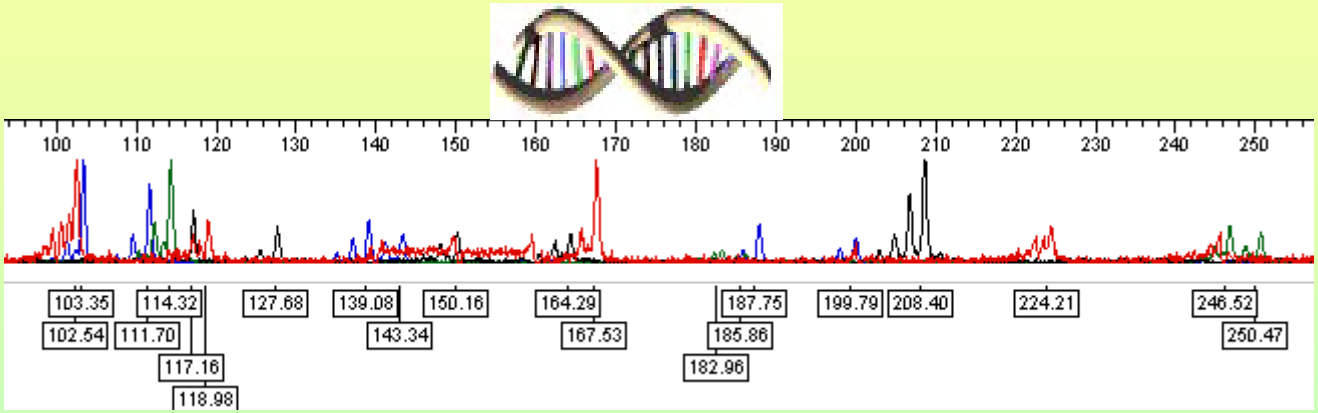
Analysis of DNA
Sequencing DNA e.g. CATCATCATCATCATCATCAT



Establish the presence of genes associated with breed determination

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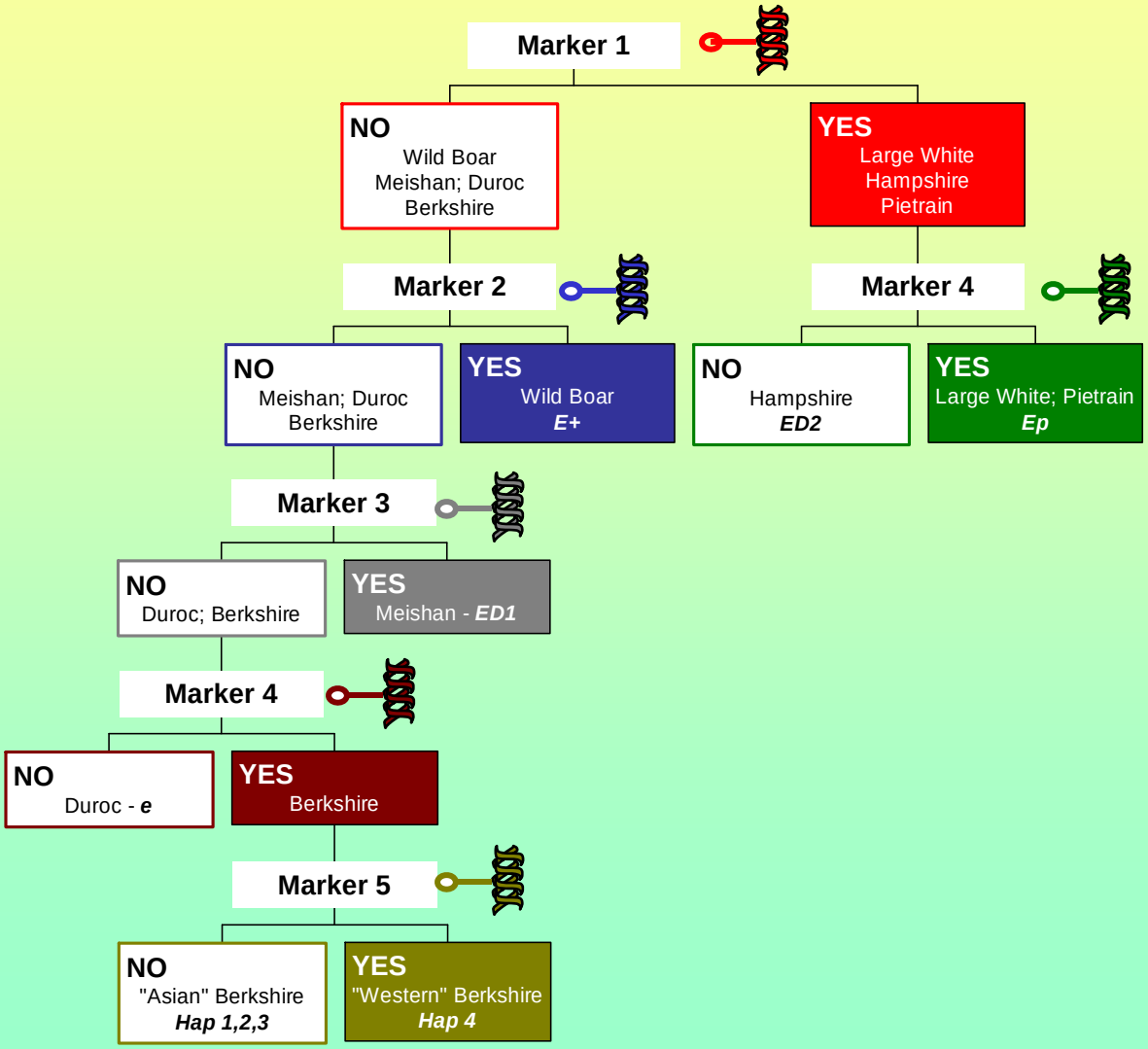
Breed Identity Preservation Test



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Sygen
Breed Identity Preservation Programs

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Genetic Methodology
Understanding Microsatellites and SNPs

- Microsatellites
- SNPs (Single Nucleotide Polymorphisms)
  - Informative & Non-informative

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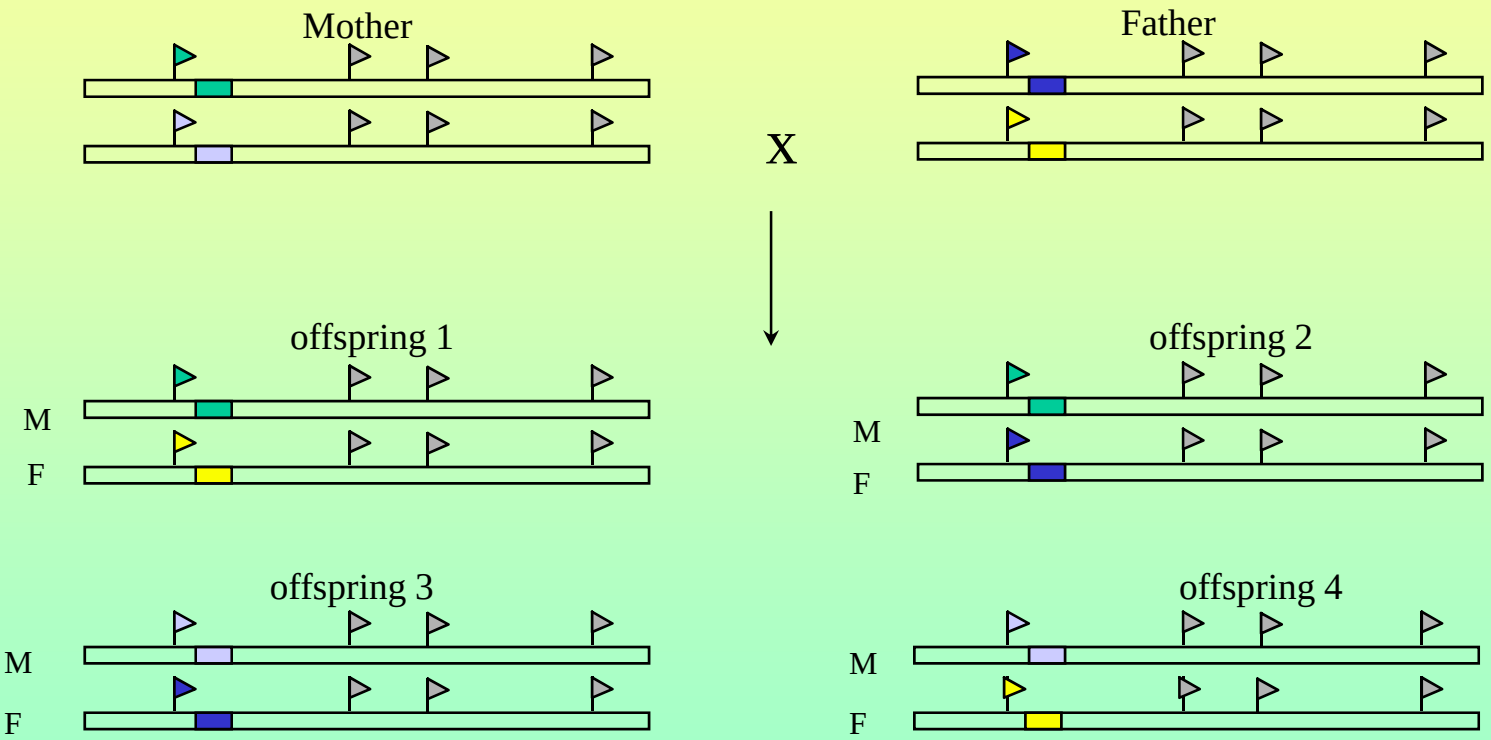
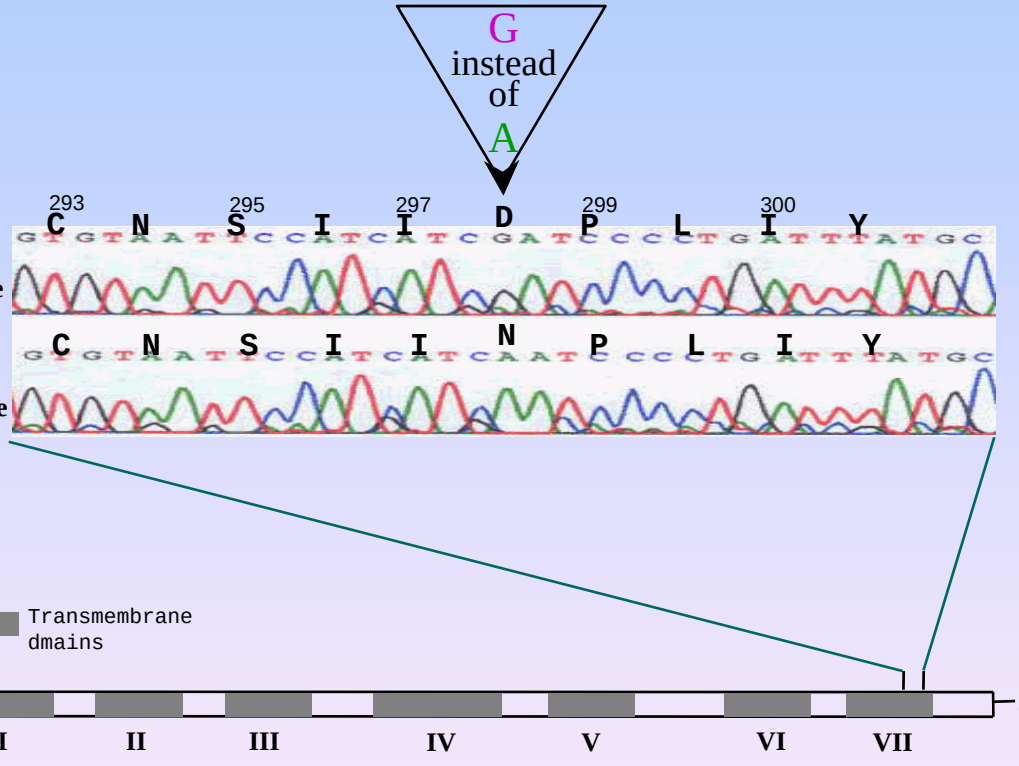
Microsatellite Markers

BACKGROUND -Parentage



A Single Nucleotide Polymorphism (SNP)



A marker that affects appetite and therefore leanness

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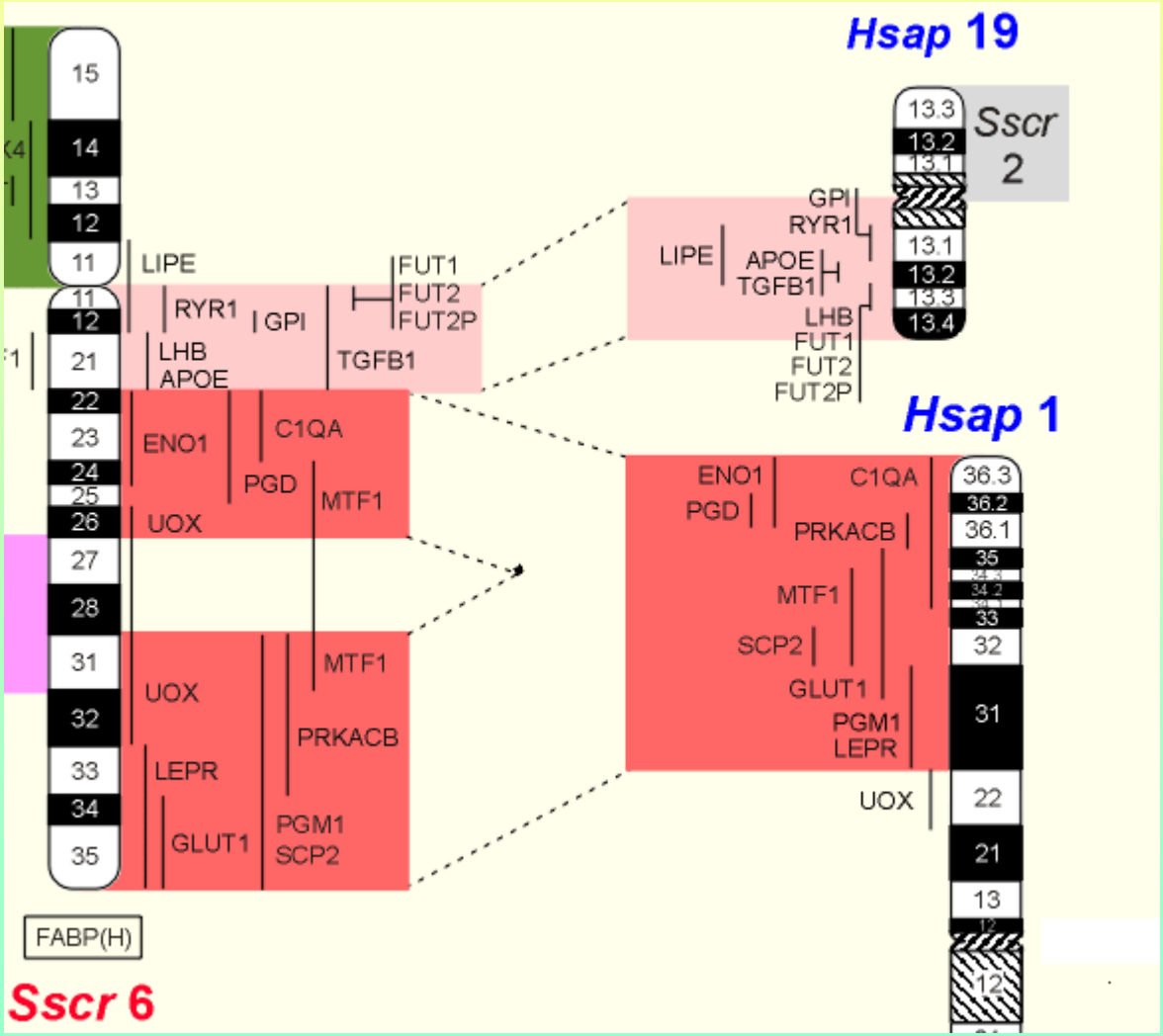
Different Species / Common Genes



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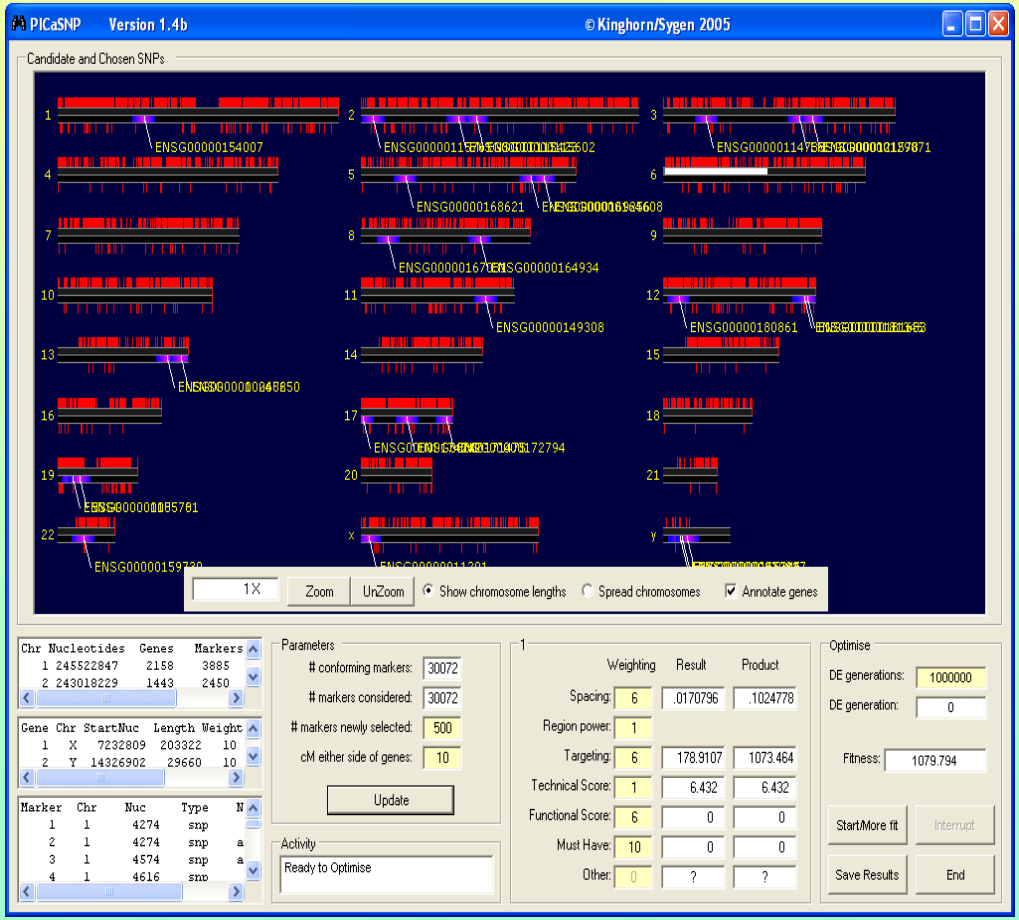
Genetic Markers in Beef Cattle Improvement Programs & Customized Line Development

- Growth & appetite
- Ultimate pH
- Japanese meat quality
- Data base of >40K markers
- Unique sample selection & association analysis tools
- Continuous discovery
- Traceability
- Food safety



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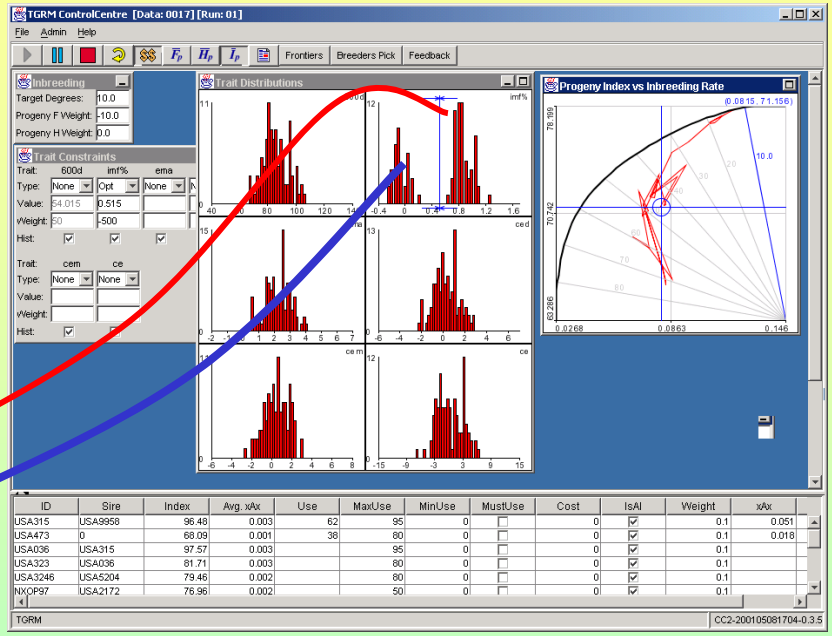

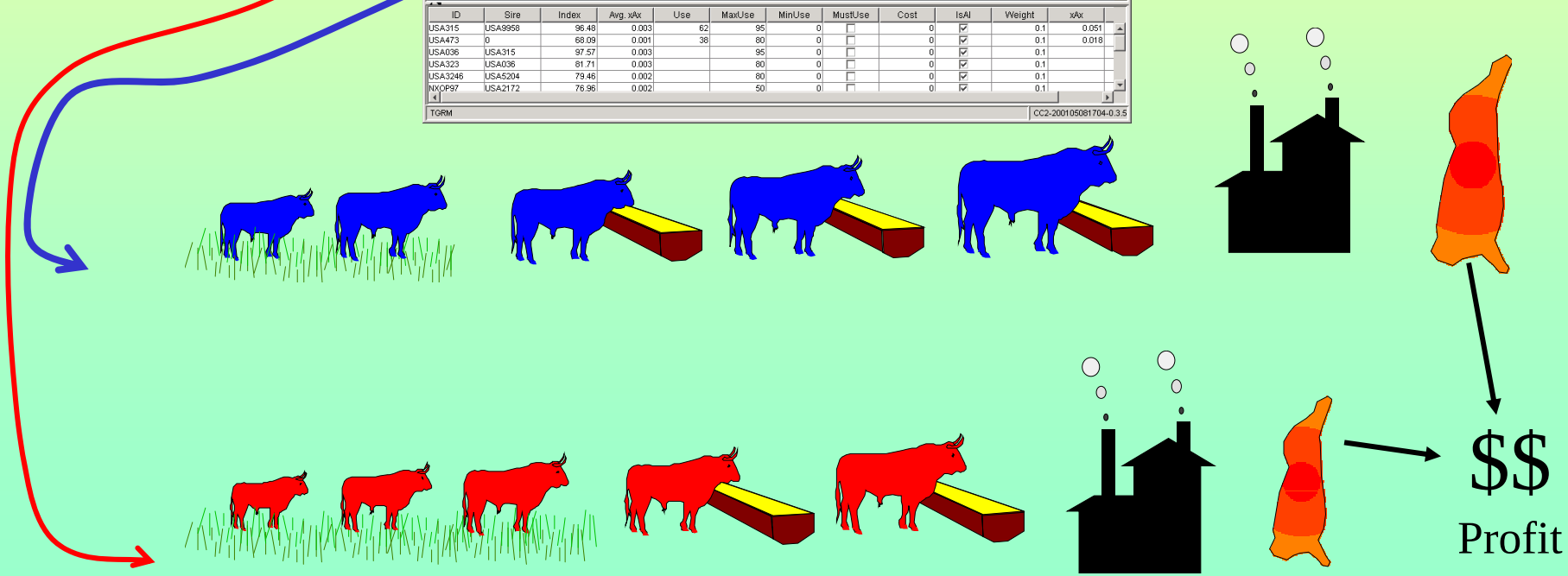

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Traceability to the farm of origin
Dams vs. Sires

Dams

•Need for testing ALL dams in the system to form a reference database, so high number of reference tests required

Sires

•If sires are dedicated to a system, traceability to the system is the least-cost option. All sires need to be tested to form a reference database

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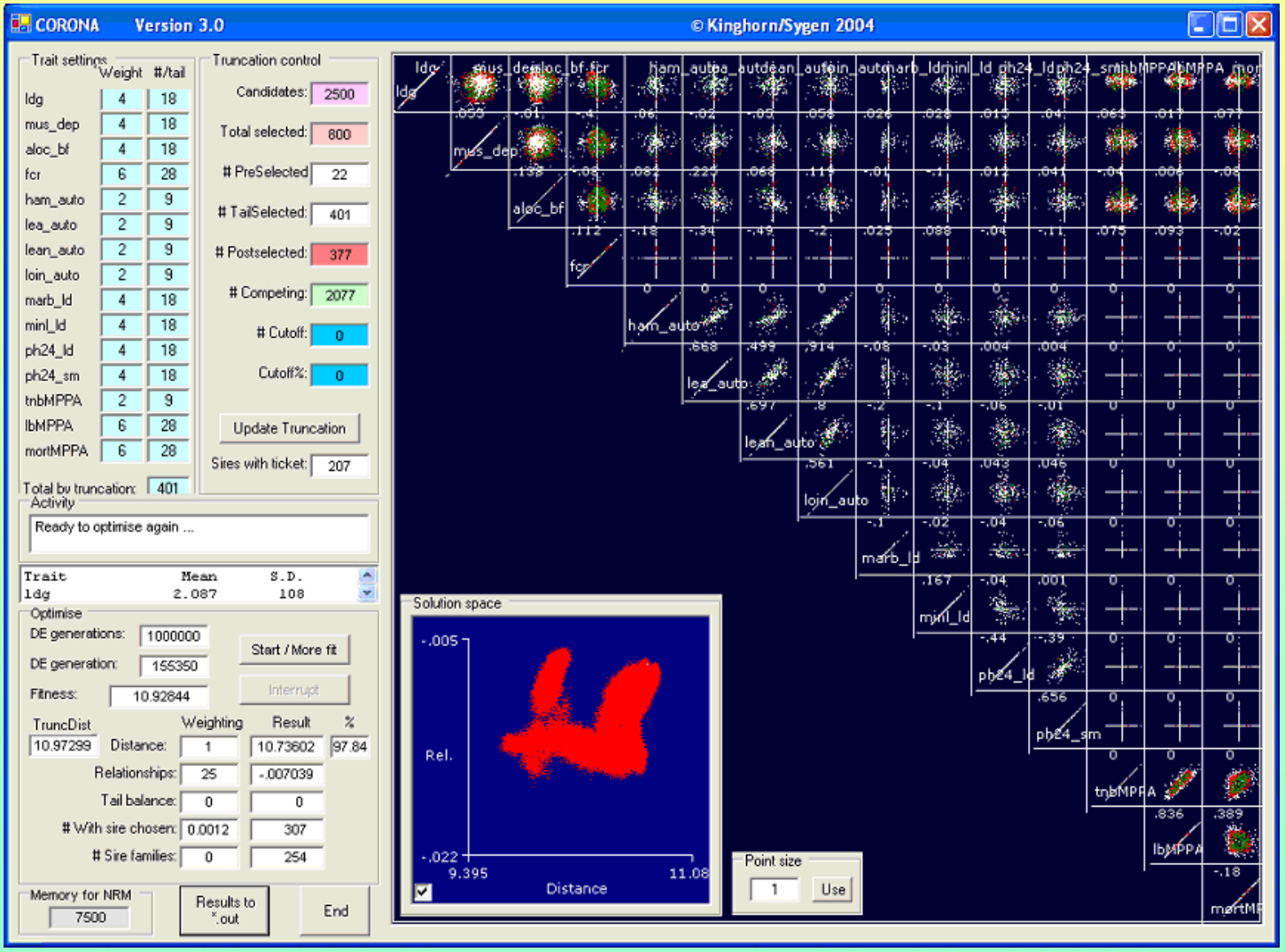

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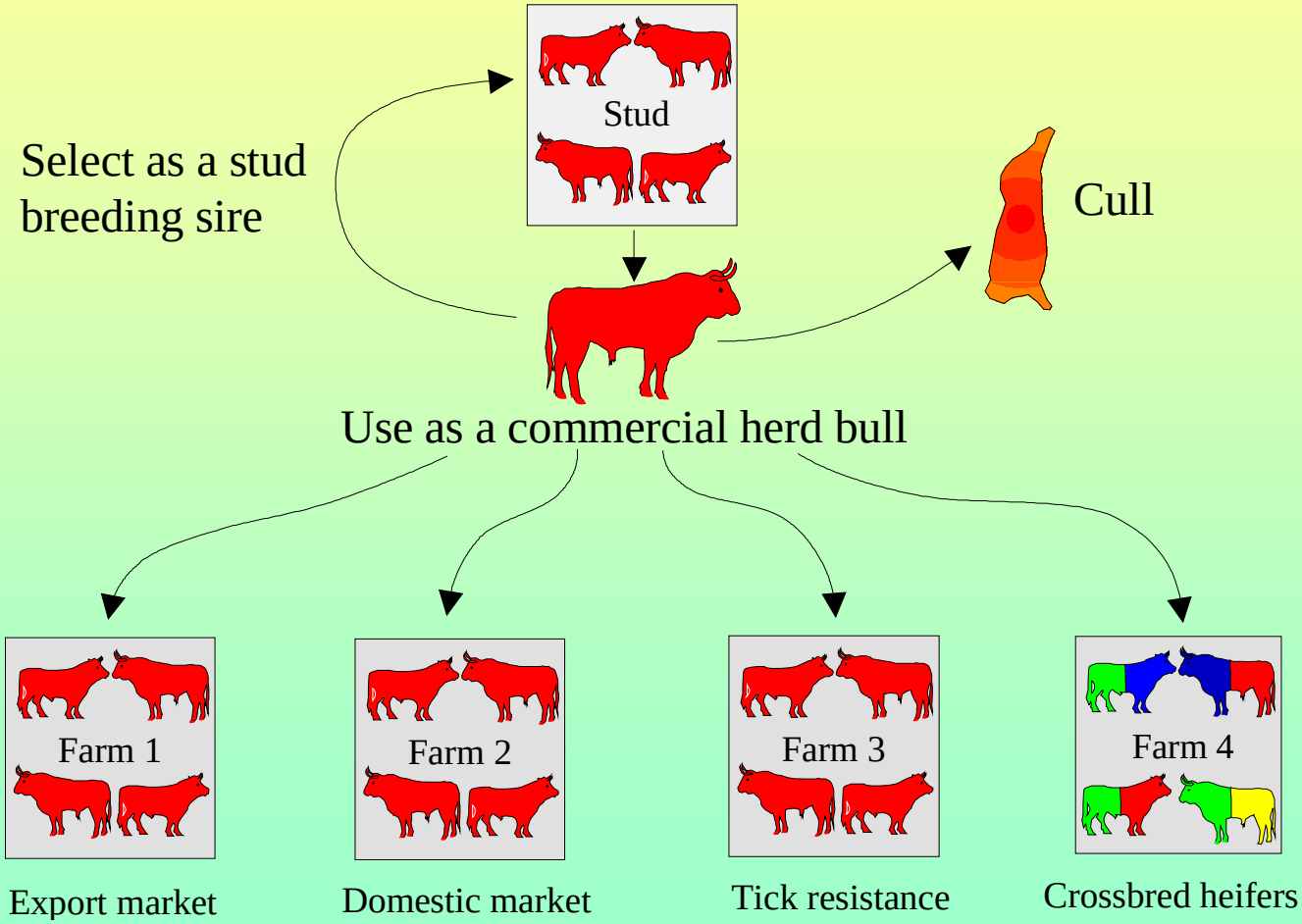

Combines in to one program

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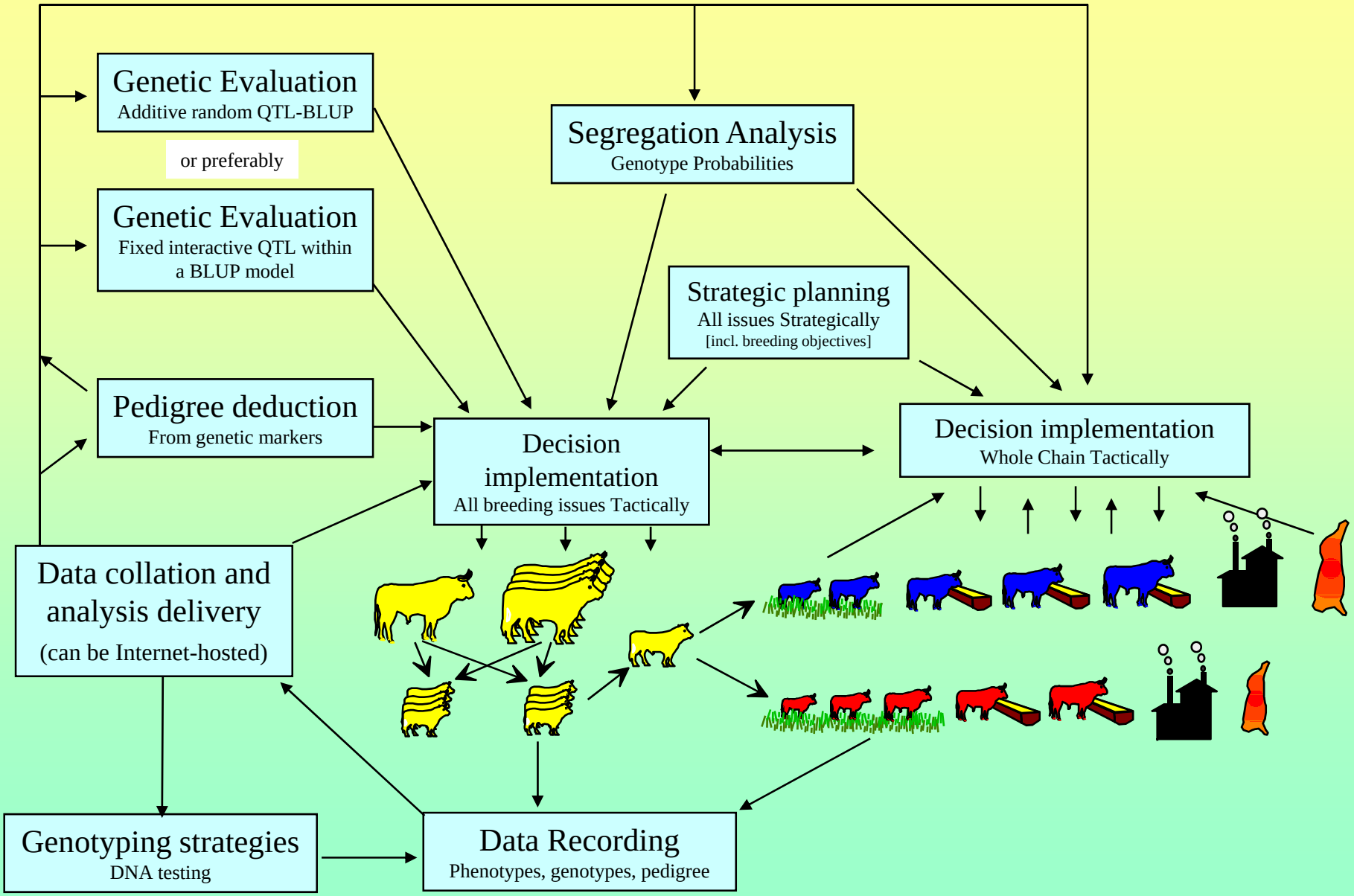

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DNA Markers and Traceability in the Pig Industry

Lessons Learned

- DNA-based traceability programs are in place now and working in Pork Supply Chain systems
- Applications of DNA-based traceability programs depend on the intrinsic control of genetics within the system
- Speed of implementation will depend on the Supply Chain's ability to define value of 'Farm-to-Consumer' DNA-based traceability programs
- DNA verification may assist with issues of animal health, zoonoses, security, as systems develop – timing is the issue
- DNA technology will continue to improve in the future enabling its wide application in the Meat Industry