Norsvin now enters its 7th year with computed tomography (CT) used as a high-intensive tool for selection. What are the main factors behind this success?

Norsvin implemented full body volume scans, CT-scanning, of live boars in 2008. Since then, over 16,000 pedigreed animals have passed through the X-ray tube. Implementing CT in the Norsvin genetic program, was a crazy concept in Norwegian agriculture, and a highly ambitious project. Looking back on these years, we can for sure call it a success story. Why?

*It is all about the (big) data*

In general, the success of quantitative and genomic selection depends largely on the ability to “assess accurate phenotypic data from sufficiently sized populations of animals”. In Norsvin, big data has been the foundation of the development of all Norsvin’s lines and products.

In the Norsvin genetic program, potential AI boars are tested at the high technology test station Norsvin Delta. This includes both the maternal line, Norsvin Landrace, and the terminal line

**Dr. Jørgen Kongsro, Scientist (CT), Norsvin**

«The main factors behind Norsvin’s success with CT-technology are people, infrastructure, implementation (follows the Norsvin tradition; short way from science to practice), and culture for ‘bold’ decisions.

For further development, we will seek to obtain more information and traits in 3D: value and yield of cuts (ham, belly, loin, shoulder), and morphological traits (shoulder sores etc.).

Further developments also require more focus on infrastructure and positioning of animals. This must be seen in relation to sedation vs. anesthesia, and regulation with respect to quarantines for non-selected animals sent to abattoir. More computing power due to ‘bigger’ data sets in is also required. More knowledge is also needed to reduce computing time from days to hours to minutes for the ‘biggest’ 3D data sets.

A PhD study is currently underway studying possible ways to obtain traits from 3D CT data, and Norsvin is an active part of this study». 
What do you consider to be the main factors behind Norsvin’s CT-success? And how can Norsvin develop the CT-platform even further?

Norsvin Duroc. One hundred boars per line are selected as Elite AI boars. These animals then have phenotypes from FIRE, CT, highly detailed exterior scoring and Norsvin’s MQ-platform. Currently, all animals off-tested using CT is genotyped using a 60K SNP-chip.

The CT-scanning alone generates a tremendous amount of data: 1,100 images per animal, 1 image for every 0.05 inches. This equals to approximately 500 MB data per animal. Big data – for sure.

**In-house knowledge and technology**
Complex imaging systems requires a robust and versatile data collecting system to bring these data types together. The data program reading the CT-images is a unique in-house developed software, which obtains virtual carcasses from the live pigs scanned. Norsvin’s investment in supporting IT systems has been crucial to enable the use of big data efficiently. The properties of CT images, and manipulation of these matrices require interdisciplinary knowledge, and progress cannot be made without acquiring and nurturing this knowledge.

Quality control is the key - a tremendous task in a big data system requiring a tech support department. Automatic and manual routines are very important to ensure the best quality of data from our system.

**Estimated breeding values for CT phenotypes day after scanning**
New phenotypes generated from the in-house developed program gives us data available for breeding value estimation the same day, and updated EBV’s (estimated breeding values) the day after scanning. Norsvin is the only genetic company utilizing high quality CT data so fast. Some phenotypes are automatically generated. These are lean meat percentage and yield, used in the breeding goal. In addition there are several parameters of body composition automatically generated, like weight and density of bone, muscle and fat, and size of some premium cuts. Also, there is continuous research in making new phenotypes automatically measured from CT data.

**The retroperspective**
Norsvin focuses on a wide use of CT. By storing data and images of animals, we are able to look for new or improved traits retrospectively. The use of the historical database of images allows for new traits to be implemented more quickly. Custom made traits can be measured by using this database of images, i.e. carcass, morphological, meat quality and robustness related traits. Future traits are only limited by our imagination and our ability to grasp what is in front of us and how specific markets in the future will valuate carcass and pork.

**CT increases annual genetic gain for sow performance and robustness**
Using CT helps Norsvin to focus on broad, long term and sustainable breeding goals and genetic improvement for our customers. One result of the high accuracy using CT is a higher heritability for CT measured traits. In addition, having the phenotypes on the selection candidate itself, has made it possible to reduce the relative weight on carcass quality in the breeding goal while obtaining an even higher annual genetic progress. This has an indirect effect on the other traits as well, especially low-heritable traits like robustness, reproduction and maternal ability, enhancing annual progress for these traits. Going forward, measuring meat quality and osteochondrosis using CT, Norsvin again increases data accuracy and is able to measure directly on the selection candidate, thereby adding more annual progress to these and other low-heritable traits.

**Genomic selection boosts CT appliance**
With full implementation of genomic selection for all traits in Norsvin’s genetic program, the accuracy of the breeding values is increased. This is due to more precise estimates of relationship between relatives, compared to using a traditional pedigree file. The CT-registered traits, as carcass quality and osteochondrosis, are now more efficiently included in the breeding value estimation also for un-scanned individuals. Thus, genomic selection leads to more efficient selection for CT-registered traits, also on selection candidates abroad.