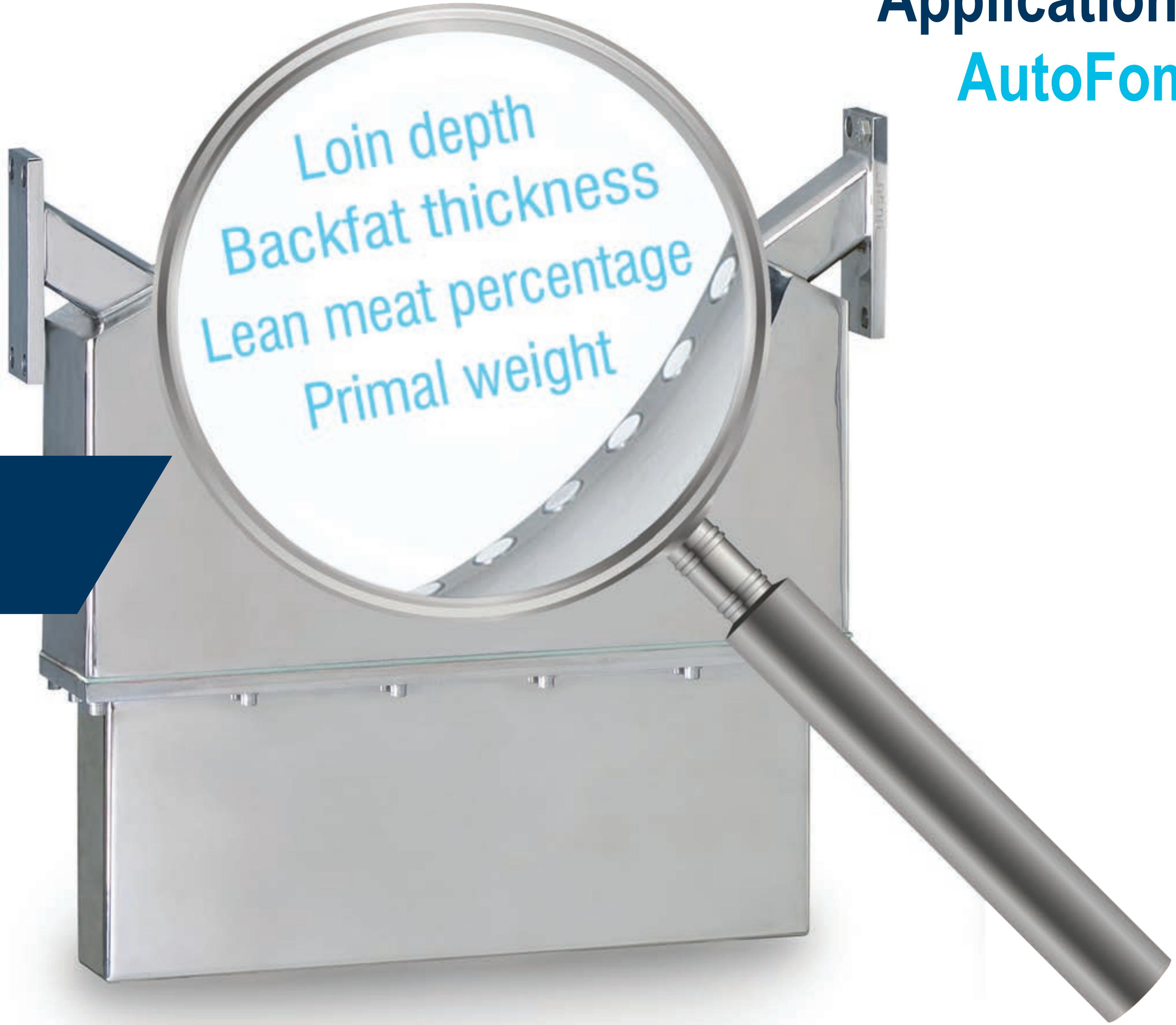
FRONTMATEC

# Application Note

## AutoFom III™



## AutoFom™ Application note by

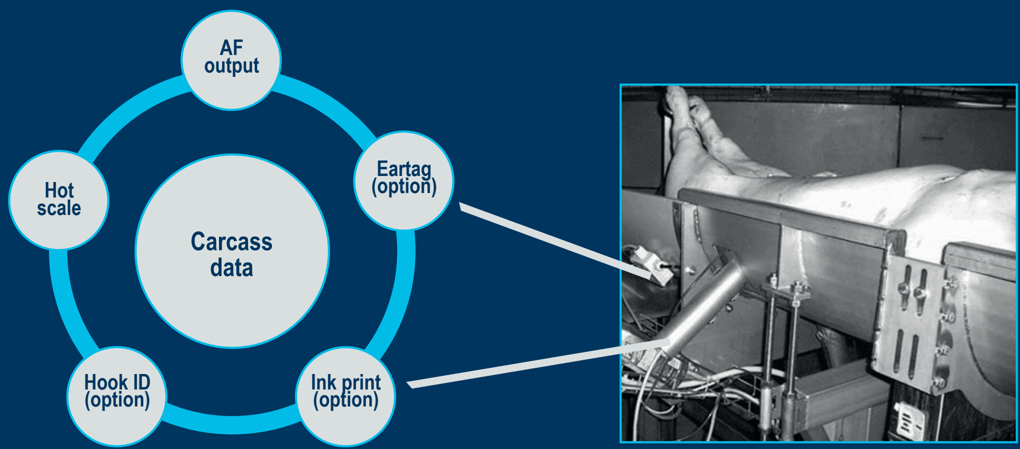

- Henrik Andersen, CCO Frontmatec


## Data output from the AutoFom III™

Table 1: Example of data output from June 27, 2012

| Kill no/ID | Sequence | Date | Time | Status | MTOK | UMFP | SPKC | FLHC | SCKG | SCSI | KOKG | LACH | BAUC | BAFL | TEKG | TESI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15112 | 39889 | 20120627 | 54810 | 0 | 0 | 52.69987 | 18.24479 | 52.41047 | 0.564907 | 0.274499 | -0.33492 | -0.14285 | -0.99032 | 47.17452 | 0.13359 | -0.33046 |
| 15113 | 39890 | 20120627 | 54822 | 0 | 0 | 60.89887 | 11.78831 | 56.90783 | 1.010459 | 1.350174 | 0.362334 | 0.252319 | -1.88054 | 59.46148 | 0.309522 | 0.202319 |
| 15114 | 39891 | 20120627 | 54838 | 0 | 0 | 62.99077 | 12.44654 | 70.46547 | 1.693858 | 2.066512 | 0.416933 | 0.685913 | -1.8924 | 60.75374 | 0.275592 | 0.068241 |
| 15115 | 39892 | 20120627 | 54846 | 0 | 0 | 63.10577 | 22.66853 | 69.41668 | 1.489178 | 1.945122 | 0.331036 | 0.726899 | -1.37296 | 61.79319 | 0.213862 | 0.101218 |
| 15116 | 39893 | 20120627 | 54857 | 0 | 0 | 61.25621 | 13.0228 | 65.94041 | 1.228422 | 1.646074 | 0.248291 | 0.610842 | -1.53805 | 58.26814 | 0.2679 | 0.094706 |
| 15117 | 39894 | 20120627 | 54901 | 0 | 0 | 62.74812 | 12.06294 | 61.62119 | 0.995438 | 1.330138 | 0.246668 | 0.518251 | -1.15518 | 59.98716 | 0.164779 | -0.16707 |
| 15118 | 39895 | 20120627 | 54909 | 0 | 0 | 67.53667 | 9.381349 | 76.88154 | 1.894448 | 2.954855 | 0.8255 | 1.112164 | -2.63158 | 67.01939 | 0.528595 | 0.573163 |
| 15119 | 39896 | 20120627 | 54913 | 0 | 0 | 61.51261 | 12.38978 | 60.59164 | 1.00794 | 1.309039 | 0.452943 | 0.427074 | -1.76322 | 59.43436 | 0.157823 | -0.05222 |

Abbreviations are explained on page 4



# Using data for genetic development and payment for pig carcasses

This note is based on the official German formulas for prediction of total lean meat percentage and primal cut traits of pig carcasses. These models were developed by Max Rubner Institute, Kulmbach, Germany.

The note describes:

- What a data output could look like
- How this data can be associated with IDs, eartags etc.
- How this specific calibration/cut test of primals is defined
- How do we build a formula based on this cut test
- How primal data could be used for value-based pricing
- How this data could be used for/presented to farmers
- What is possible? - An example from a large group of models made with IRTA in Spain, their statistical precision and correlation against a cut test

The data in table 1 is sent to the slaughterhouse host computer where it is associated with the hot carcass weight, supplier and veterinary codes etc. In slaughterhouses using eartag antennas at the AutoFom™ for individual association back to the farmer for genetic improvement, the eartag is associated directly at the AutoFom™ via an antenna built into the trough and a DataMerger supplied by Frontmatec. Obviously, not all eartags will be present after the dehairing machine, but the number of tags will be plenty in order to make qualified validations of genetic performance.

# Detailed description of AutoFom III™ estimates

## German approval 2011

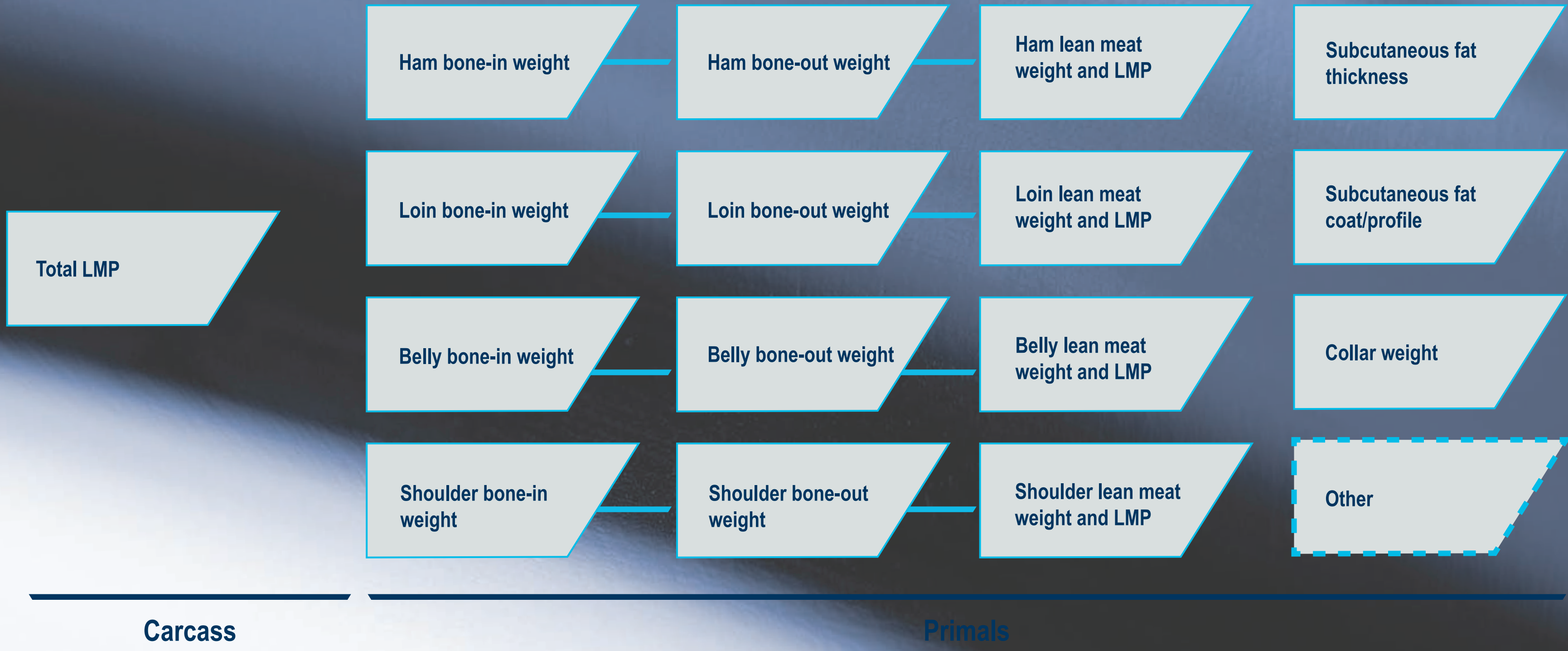
In the following, a detailed description of the estimates from the German AutoFom III™ approval 2011 are presented.

- UMFP = Total lean meat percentage
- SPKC = Fat depth
- FLHC = Muscle depth
- SCKG = Ham weight bone-in
- SCSI = Ham weight de-skinned and de-boned
- KOKG = Loin weight bone-in
- LACH = Loin weight de-skinned and de-boned
- BAUC = Belly weight bone-in
- BAFL = Belly lean meat percentage
- TEKG = Shoulder weight bone-in
- TESI = Shoulder weight de-skinned and de-boned

The dissection protocol is based on full half-carcass dissection.

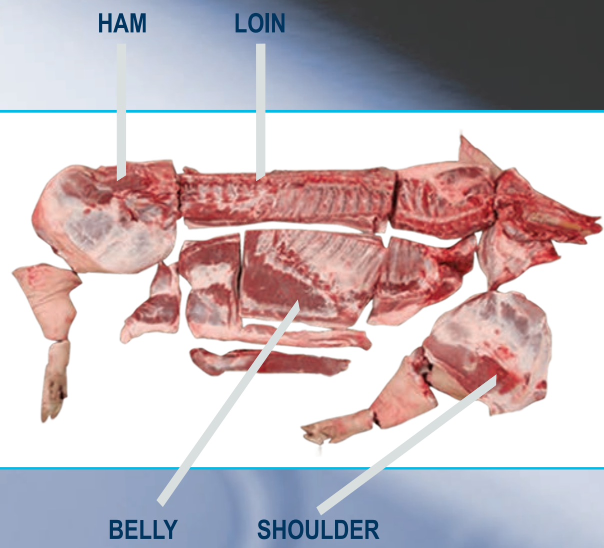
Figure 1 illustrates the possible prediction models which can be developed from a standard or factory calibration test.
The extent of detail or dissection will differ depending on the need of the customer.

Figure 1: Examples of AutoFom III™ models which can be developed from a calibration test




## Primal cuts

The picture illustrates the 4 main primals (shoulder, loin, belly and ham) predicted in the German equations. Leg is separated from loin/belly by a straight cut at a right angle to the longitudinal axis between the 5th and 6th lumbar vertebra. Back is separated from the neck between the 5th and 6th thoracic vertebra at a right angle to the backbone. Jowl, front and hind foot are removed and considered by-products. Total LMP is based on full dissection of a half carcass excluding head, tail and feet.



# Total lean meat percentage

UMFP - Total lean meat percentage:

The total lean meat percentage (LMP) is based on a full dissection of a half carcass and is calculated using this formula:

$$\text{Total LMP} = \frac{\text{Weight of meat from dissected joints (except head, feet and tail)} \times 100}{\text{Half carcass weight}}$$

The lean meat is defined as the striated muscle tissue without connective tissue and tendons.

# Backfat thickness and loin depth

SPKC - Fat depth:

Measurement of subcutaneous fat cover on the loin, 7 cm from the split-line between 2nd and 3rd last rib, in mm.

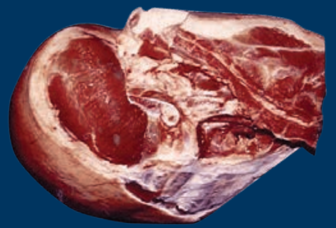
FLHC - Muscle depth:

Measurement of eye (loin) muscle depth, 7 cm from the split-line between 2nd and 3rd last rib, in mm.

# Primal cuts

SCKG - Ham weight bone-in:

The hind foot and hind shank are removed and the leg is separated from back/belly by a straight cut at a right angle to the longitudinal axis between the 5th and 6th lumbar vertebra. The total weight of ham is registered.



SCSI - Ham weight de-skinned and de-boned:

The ham is de-skinned and de-boned and the weight is recorded.

KOKG - Loin weight bone-in:

The loin is separated from the belly by a longitudinal cut following the line of the backbone. Cranially the line starts at a point 2 cm ventrally from the first thoracic vertebrae and ends caudally 4 cm ventrally of the cartilage of the 5th lumbar vertebrae. The backbone is removed and the total weight of the loin is registered.

LACH - Loin weight de-skinned and de-boned :

The loin is de-skinned and de-boned and the weight is recorded. The loin is not trimmed.

BAUC - Belly weight bone-in:

The ventral part of the belly is separated from the remaining part of the belly by a cut starting 4 cm caudally of the last rib first in a straight line to ventral and then following cranially along a line just dorsal from the row of teats. In case of a rudimentary rib this should be considered as the last rib so that no bone is left on the “ventral part of the belly”. The ventral part is removed and the total weight of the belly is registered.

BAFL - Belly lean meat percentage:

The belly bone-in undergoes full dissection and is divided into subcutaneous fat, intermuscular fat, bones and meat ensuring that all meat remaining on the bones is transferred to the meat part and all fat attached to the meat is completely separated from the meat and transferred to the fat part. The weight of lean meat is then recorded.

Lean meat percentage of the belly is calculated after the full dissection using this formula:

$$\text{Belly LMP} = \frac{\text{Dissected meat from belly bone-in x 100}}{\text{Weight of belly bone-in}}$$

TEKG - Shoulder weight bone-in:

The front foot and front shank is removed from the shoulder and the shoulder is separated from back/belly between the 4th and 5th thoracic vertebra at a right angle to the backbone. The total weight of the shoulder is registered.

TESI - Shoulder weight de-skinned and de-boned:

The shoulder is de-skinned and de-boned and the weight is recorded.

# Example of how a primal formula is built (SCSI)

Below is a walk-through of the German formula for de-skinned ham bone-out. The formula uses 9 image variables from the AutoFom III™. For definition of SCSI see page 6.

- R2P3 - Specific fat measure thickness
- R2P7 - Specific fat measure thickness
- R2P9 - The skin thickness at the minimum fat point in mm
- R3P5 - The maximum loin depth
- R3P6 - The average of the meat depth at the two p2 positions
- R4P2 - Fat layer 1 measure thickness
- R4P4 - Average fat layer 1 measurement at the mimimum fat thickness point
- R4P9 - Specific fat layer 1 measure in the ham
- R4P11 - Specific fat layer 1 measure in the ham

These 9 image variables are collated into an estimator:
The formula for SCSI is - example ID 15112 from table 1

((Hot carcass weight x weight regression coefficient[1]) + estimator[2]) * 2[3]

=> (100.2 kg x 0.0813849538)+0.274499)*2 = 16.8585 kg

In this case, the total weight of de-boned hams in the carcass is 16.8585 kg
The precision is roughly ± 1.5 - 2.0%

1: Regression coefficient for HCW
2: SCSI estimator for ID 15112 from table 1
3: Half carcass dissection, multiply by 2 to calculate total weight of hams (left and right) in the carcass

# Using the primal data for payment to farmers

| HAM | |
|---|---|
| Weight (SCSI) | Index per kg |
| <14.5 | 2.1 |
| 14.5-14.99 | 2.2 |
| 15.0-19.5 | 2.3 |
| 19.51-20 | 2.2 |
| 20.01-20.5 | 2.1 |
| >20.5 | 1.8 |

| LOIN | |
|---|---|
| Weight (LACH) | Index per kg |
| <6.2 | 2.8 |
| 6.2-7.8 | 3.5 |
| >7.8 | 3.25 |

| SHOULDER | |
|---|---|
| Weight (TESI) | Index per kg |
| ALL | 1.7 |

| BELLY | |
|---|---|
| Weight (BAFL) | Index per kg |
| <45% | 0.5 |
| 45.0-50.99 | 0.8 |
| >51% | 1 |

Obviously, you can use the lean meat percentage to pay with the AutoFom III™. Since the instrument error of the AutoFom III™ is significantly smaller than with all other methods, and an operator error or influence from processing is non-existent, the individual accuracy and hence variance on a day's production will be much smaller, but should be with the same average, of course.

However, many of our customers in Germany have introduced a pay matrix. The first was Westfleisch SCE - they were the first to use primal weights for payment and started in the year 2000. The purpose of a pay matrix is to utilize the AutoFom capability for primal data to improve the genetic performance, time to slaughter, etc. of the pigs by paying on the basis of the commercial value rather than the traditional total lean meat percentage.

Please note that neither lean meat percentage nor hot carcass weight are part of the payment system.

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This table is based on a particular week where the quoted index point price was EUR 1.44 - this would be quoted on a frequent if not daily basis.

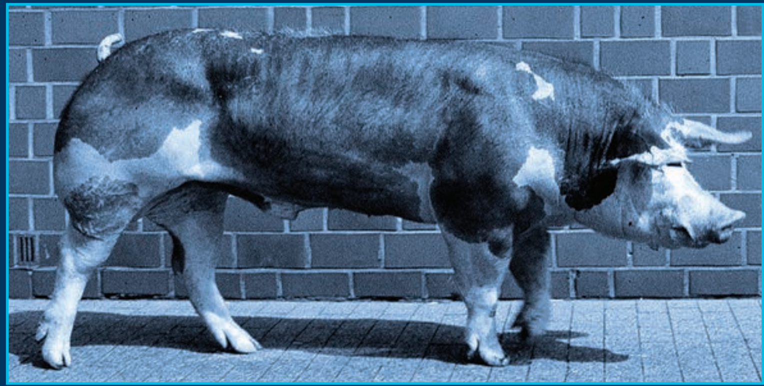
Using the examples from table 1 and including the hot carcass weight, we get a pricing structure per carcass as can be seen in table 2.

Table 2: Pricing structure per carcass

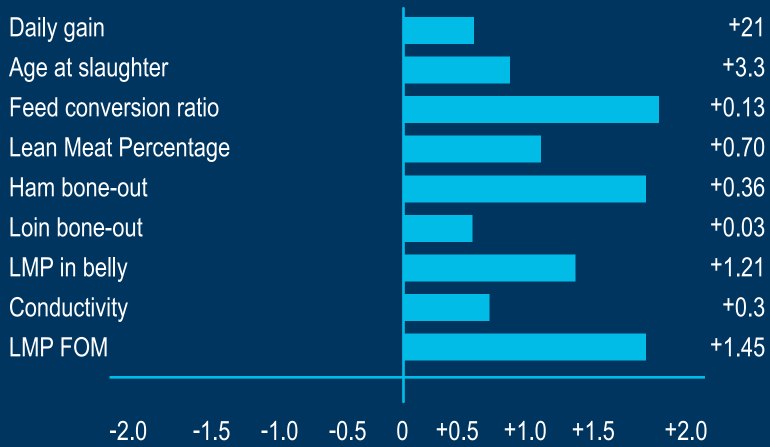
| Kill no/ID | UMFP | HCW | SCSI weight | SCSI index P | LACH weight | LACH index P | BAUC weight | BAFL | BAUC index P | TESI weight | TESI index P | Total index P | Price@ EUR 1.44 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15112 | 52.7 | 100.2 | 16.9 | 38.7746 | 6.4574 | 22.6010 | 15.2815 | 47.1745 | 12.2252 | 8.8775 | 15.0918 | 88.6927 | 127.72 |
| 15113 | 60.9 | 88.4 | 17.1 | 39.3052 | 6.4537 | 22.5879 | 11.4883 | 59.4615 | 11.4883 | 8.8309 | 15.0125 | 88.3939 | 127.29 |
| 15114 | 63.0 | 87.2 | 18.3 | 42.1511 | 7.2401 | 25.3404 | 11.2599 | 60.7537 | 11.2599 | 8.4496 | 14.3644 | 93.1157 | 134.09 |
| 15115 | 63.1 | 87.0 | 18.1 | 41.5178 | 7.3086 | 25.5802 | 12.2646 | 61.7932 | 12.2646 | 8.4967 | 14.4445 | 93.8071 | 135.08 |
| 15116 | 61.3 | 91.0 | 18.1 | 41.6397 | 7.3457 | 25.7099 | 12.6168 | 58.2681 | 12.6168 | 8.8607 | 15.0633 | 95.0296 | 136.84 |
| 15117 | 62.7 | 77.2 | 15.2 | 35.0201 | 6.2318 | 21.8114 | 11.0286 | 59.9872 | 11.0286 | 7.0365 | 11.9620 | 79.8220 | 114.94 |
| 15118 | 67.5 | 76.5 | 18.4 | 42.2317 | 7.3725 | 25.8039 | 7.9564 | 67.0194 | 7.9564 | 8.4510 | 14.3667 | 90.3586 | 130.12 |
| 15119 | 61.5 | 87.0 | 16.8 | 38.5918 | 6.7090 | 23.4814 | 11.4841 | 59.4344 | 11.4841 | 8.1899 | 13.9228 | 87.4801 | 125.97 |
| 15120 | 63.5 | 72.2 | 16.6 | 38.1407 | 6.6512 | 23.2793 | 8.6862 | 61.0055 | 8.6862 | 6.9469 | 11.8098 | 81.9161 | 117.96 |
| 15121 | 67.5 | 77.0 | 18.3 | 42.0511 | 7.3322 | 25.6625 | 6.6646 | 67.3823 | 6.6646 | 8.4067 | 14.2914 | 88.6696 | 127.68 |
| 15122 | 58.7 | 93.5 | 17.8 | 40.9385 | 7.1955 | 25.1842 | 13.8405 | 56.3413 | 13.8405 | 8.7594 | 14.8910 | 94.8543 | 136.59 |

When you study the data, you will note that the variance in payment is in some cases twice what could be explained by hot carcass weight and lean meat percentage.

When you compare 15116 with 15119 you will see that the same LMP and a difference of 4 kg spell into a price difference of EUR 11.



### Use of AutoFom III™ data for improving genetic potential




AI-Station GFS, Ascheberg/Germany

### AutoFom results from Piétrain offspring

| | Today | 5 years ago |
|---|---|---|
| Amount of carcasses | 31,075 | 4,207 |
| HCW, kg | 94.45 | 93.75 |
| Netto gain, g | 465 | 453 |
| Shoulder, kg | 8.19 | 8.08 |
| Loin, kg | 6.99 | 6.84 |
| Belly, kg | 14.76 | 14.84 |
| Ham, kg | 18.1 | 17.7 |
| Belly LMP, % | 52.3 | 50.6 |

Progeny test of AI-boars from Piétrain
Source: GFS/SNW
Technical data may be subject to changes

# Using the primal data for genetic feedback

Opposite, you see an example from the German company GFS's online boar catalogue illustrating how this boar's litter on average performs against an overall average. The data is derived from a test sample, using the ear tag chip from weaner barn to the AutoFom III™. Knowing the pay matrix in table 2 it is easy to calculate the benefit.

The German Piétrain case story was and still is a text book example of how you can move the general quality of a population of carcasses – in this case in particular bellies were a problem – if you start collating data from the primals and build it into a payment/feedback system.

Another example is how PIC utilises data on weight and value of individual cuts from thousands of fully pedigreed slaughter pigs to provide genetic feedback for their breeding programmes. Thereby, PIC optimises the primal quantity of their offspring.

# Precision and correlation (example)

Here are a number of models and their statistical precision developed by the Spanish Meat Institute (IRTA) on the basis of a large dissection carried out in 2012.

| Model (ham) | $R^2CV$ | RMSEC | RMSECV |
|---|---|---|---|
| Outer fat rim thickness ham (2), mm | 0.640 | 2.2 | 2.3 |
| Outer fat rim thickness ham (3), mm | 0.614 | 4.3 | 4.4 |
| Ham total bone-in, g | 0.867 | 370 | 392 |
| Ham total bone-out, g | 0.863 | 359 | 376 |
| Ham lean meat, % | 0.845 | 1.40 | 1.46 |
| Ham lean weight, g | 0.842 | 338 | 348 |

| Model (loin) | $R^2CV$ | RMSEC | RMSECV |
|---|---|---|---|
| Loin total bone-in weight, g | 0.860 | 333 | 345 |
| Loin total bone-out weight, g | 0.865 | 306 | 318 |
| Loin lean meat, % | 0.898 | 1.76 | 1.82 |
| Loin lean weight, g | 0.813 | 219 | 227 |

| Model (shoulder) | $R^2CV$ | RMSEC | RMSECV |
|---|---|---|---|
| Shoulder total bone-in weight, g | 0.884 | 227 | 234 |
| Shoulder total bone-out weight, g | 0.880 | 214 | 221 |
| Shoulder lean meat, % | 0.770 | 1.60 | 1.66 |
| Shoulder lean weight, g | 0.836 | 193 | 199 |

| Model (belly) | $R^2CV$ | RMSEC | RMSECV |
|---|---|---|---|
| Belly total bone-in weight, g | 0.685 | 296 | 308 |
| Belly total bone-out weight, g | 0.696 | 282 | 294 |
| Belly lean meat, % | 0.774 | 2.75 | 2.84 |
| Belly lean weight, g | 0.559 | 198 | 198 |

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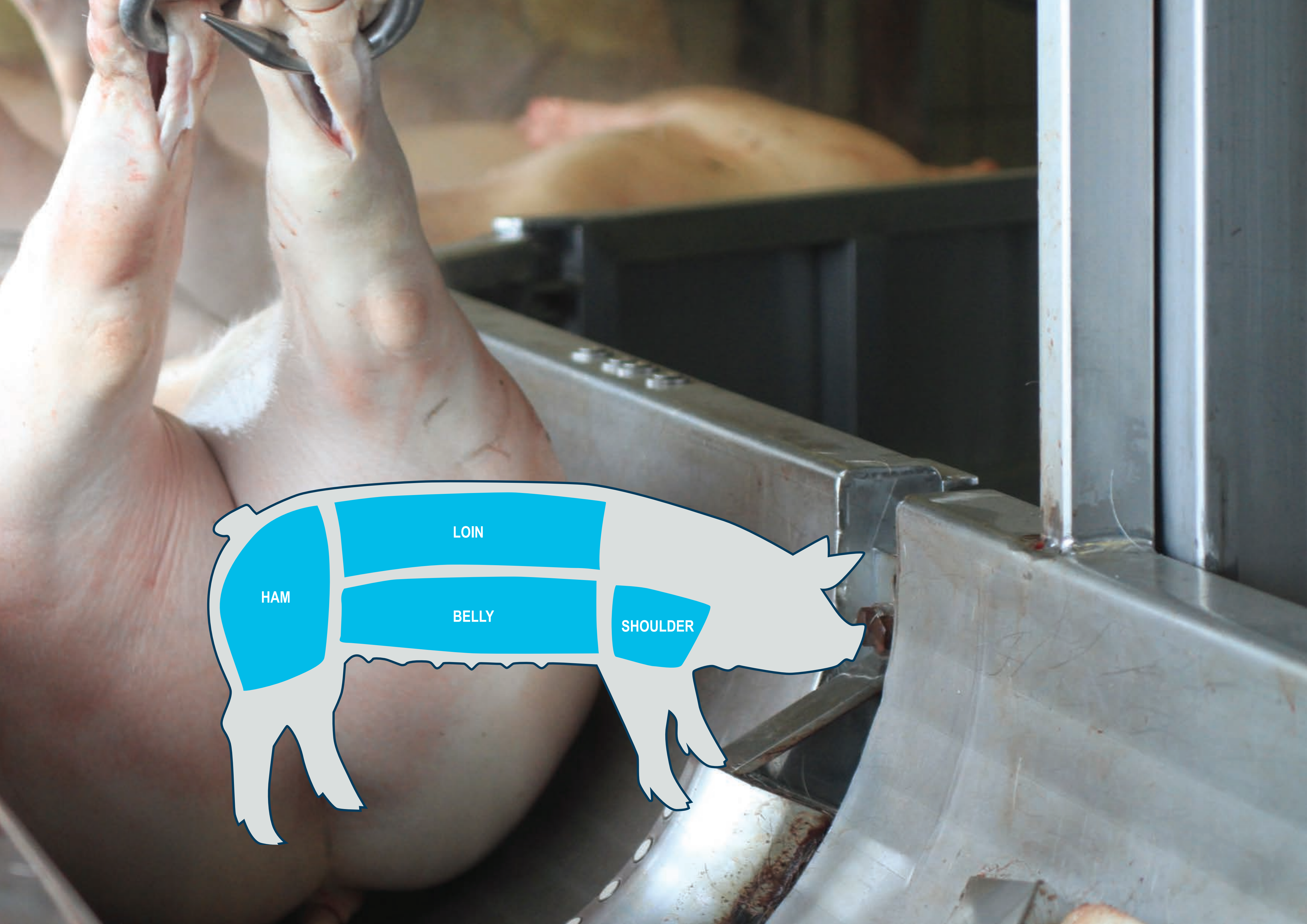
LOIN
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BELLY
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