# Preparation and Validation of National Data Before an International Evaluation

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## 1. Introduction

Dairy cattle breeding is an international market. The value of AI bulls depends on daughter performances corrected for non-genetic effects. In other words: breeding values add commercial value to bulls.

Genetic evaluation centres have a big reponsibility because they produce the breeding values. These centres therefore need to have a procedure to guarantee the quality of their genetic evaluations and keep their customers satisfied. Dutch AI companies defined two important quality parameters in a research in the Netherlands in 2004. The first was the individual bull change between consecutive evaluations. AI companies indicated that bull changes are only allowed if the daughters have additional data that can justify this change. The second quality parameter was a full publication (national and international results) according to a predefined schedule (NRS, 2004). These two quality parameters form the basic principle of our evaluation and publication system.

Interbull combines the national evaluations of 25+ populations. Potential problems in the evaluations in one of these populations can have detrimental impacts on international evaluation results. It is therefore a shared responsibility of all evaluation centres to have some kind of validation procedure. A quick scan of the descriptions of national genetic evaluation systems on the Interbull website indicated that 13 out of 33 descriptions do not have some kind of system validation (Interbull, 2006). The quality of their national proofs relies on the data checks conducted by the Interbull Centre. This is an undesirable situation, national centres should validate their own evaluations allowing the Interbull Centre to spent their time on the international evaluations.

This paper describes the NRS genetic evaluation system that is used to produce national breeding values for the Netherlands and the Flemish region of Belgium. There will be a special focus on proof validations and the evaluation schedule because of the importance our customers attach to it.

## 2. Quality management system

Breeding values are the product of genetic evaluation centres. A quality management system should be applied to the process creating this product. Such a system means that you can guarantee a constant quality of the product. The definition and the level of quality have to be defined as well and therefore the quality is what you want it to be and as high as you want it to be. NRS uses ISO9001 as quality management system (De Jong, 1999). It ensures that our genetic evaluation process delivers proofs that have a predefined quality level.

An advantage of a quality system is that it forces you to document the process and the changes in the process. It means that you write down the input and output and the actions to get from input to output. The advantage of this documentation is that anybody can run the genetic evaluation without affecting the quality of the proofs.

For our convenience we have added check lists to our documentation. These check lists contain our critical control points and the thresholds we have set. The person responsible for the genetic evaluation has to write down the values of the critical control points in the check list. Another benefit of the check lists is that we have added dependencies between trait evaluations to guarantee correct data processing. An example is the use of type and production data as correlated traits in the fertility evaluation. The first control point in

the fertility check list is a check whether the latest production and type data is available. Check lists are stored electronically so that one can always look back to compare evaluations.

A value for one of the critical control points that is outside the threshold value means that there is an error in the evaluation. If this occurs the error has to be solved and the evaluation repeated. This shows that it is very important to identify the true critical control points and to have realistic thresholds. An example is the number of observations per animal. In theory this number can never decrease. An appealing threshold therefore is that 100% of the animals have at least the same number of observations in the previous and current evaluation. In reality an animal can loose an observation because of data collection errors (observation assigned to the wrong animal). A realistic threshold takes this into account and the threshold becomes for example 99.5%.

Documenting the evaluation system and identifying the critical control points gives a lot of information about your own system and the procedures you use. A quality management system is not essential but it is a valuable tool to help you. Additional benefits of a quality management system are a transparent evaluation system that provides proofs with a constant quality.

## 3. Data validation

### *3.1 Input data*

Input data of the genetic evaluation process are observation records and pedigree records. These records are supplied by data collection centres and herdbooks. Validation of the input data can be done in several ways.

Data editing is the first step. We use it to determine records that can not be correct. Example of data edits in the NRS genetic evaluation system are:

1. Range validations (linear classifications between 1 and 9)
2. Age validations (offspring born after parents)
3. Pedigree validations (animals appearing as male and female ancestor).

All the data entering a genetic evaluation system should at least pass these simple and staightforward edits. Preferably the data supplier does the edits and supplies only the data that matches these edits.

A second step is a comparison of the input from two consecutive evaluations. Currently we do not have this kind of validation in our genetic evaluation system. It is something that we want to develop in the near future although one can argue that it is the responsibility of the data supplier to do this.

### *3.2 Output data*

Output data of the genetic evaluation process are breeding values. Validation of these breeding values is integrated in our quality management system. In fact a lot of our critical control points compare proofs of individual animals between consecutive evaluations. Changes in the evaluation of individual animals should be reasonable given the change in information. We have defined 8 critical control points to validate our proofs. Each critical control point together with the thresholds (in brackets) are:

1. Percentage of bulls present in the previous and not in the current evaluation (Below 0,5%).
2. Correlation between proofs (At least 0.99).
3. Absolute value of the mean standardized change in proofs (Below 25).
4. Reduction in reliability (No bulls with a reduction of 5% or more).
5. Reduction in number of daughters (No bulls with a reduction of 15% or more).
6. Reduction in number of herds (No bulls with a reduction of 15% or more).
7. Absolute value of difference in genetic trend (at most 0,75% of proof standard deviation)
8. Regression of within bull yearly daughter yield deviations, also known as Interbull test II (at most 1% of the genetic standard deviation).

These 8 control points are our interpretation of our customers quality parameters. All traits must meet these criteria. These control points are not fancy at all and they can easily be implemented by individual countries. In fact

most of the criteria have an equivalent criterium in the software that Interbull provides for the verification of national evaluations based on Klei *et al.* (2002).

Identifying the correct critical control points with realistic thresholds is the key in proof validation. It is easy to define a lot of statistics but that is not important in proof validation. What is important is that you have a mimimum amount of statistics and still can detect potential problems in the genetic evaluations.

Another issue is what to do when one of the control points indicates a potential problem. You need a procedure to ensure that you give proper attention to potential problems. In a quality management system this is one of the prerequisites of the system. You have to proof that you have taken all necessary measures to ensure that a particular problem will not appear again.

Validation of national proofs is not very difficult and it is therefore my opinion that it should be part of the standard procedure of any evaluation centre. In fact any evaluation centre that does not seriously validate their national proofs is a hazard to the complete Interbull community because of the potential impact on international evaluation results. The only difficulty in proof validation is that you yourself have to be consistent. A quality management system can help you with that.

## 4. Evaluation schedule

An evaluation schedule is considered a vital part of our genetic evaluation system. Our schedule covers the whole process starting with the due date for data supply, the time we need to prepare and validate the national proofs, the time Interbull needs to prepare and validate international proofs and the time we need to determine and publish official proofs.

The evaluation schedule is published one year in advance. Both our data suppliers and our customers know when their data is due and what the target time for the official release is. Our customers appreciate the schedule and find it very important that we meet the target times.

Our evaluation process is set up in such a way that we have enough time to overcome most of the problems associated with genetic evaluations. We have identified data errors, software errors and hardware failures as the main sources of delays in our evaluation schedule. Each of these require their own solution.

Data errors have to be identified as early as possible. In our current evaluation system we sometimes detect them in the validation of the output data. That is of course too late and that is our main reason for the development of input data validation tools. You need to have enought time to rerun the evaluations with the corrected dataset or with the best alternative dataset.

Software errors are inevitable. The only thing you can do is try to minimize them and to minimize their impact on the evaluation schedule. It means that you should never introduce changes during the routine evaluation. Software that is used in routine evaluations should always have been used in a testrun. The results of that testrun should have been reviewed by the AI companies. They can help you detect unexpected results which might be the result of software errors. Besides minimizing software errors it is also important to minimize the impact of a software error on the evaluation schedule. A good way to do that is to divide an evaluation in sub processes from which you can restart. Sub processes you can consider are data validation, data editing, pedigree selection, model definition, iteration, reliability calculation, post processing, output preparation, proof validation. Suppose the proof validation identifies an error in the reliability calculation. If you have the possibility to restart the evaluation from that particular point you save all of the time spent in the first sub processes of the evaluation. This reduces the impact of software errors on the evaluation schedule.

Hardware failures are our final main source of delay. Just like software errors, hardware failures are inevitable. Again you can try to minimize them and minimize their impact on the evaluation schedule. Minimizing hardware failures very often means that you spent a lot of money on backup systems, service level agreements, maintenance contracts and so on.

Another option is to minimize the impact of hardware failure on the evaluation schedule. One way to do that is to write intermediate results to disk. Our iteration software for example writes the solutions to disk at least once every 12 hours. Together with a daily backup and a restart option it means that we can never loose more than one day computing time.

## 5. Utopia

What would the process of genetic evaluations look like in the perfect world? Every organisation in the chain from data collection to proof publication should know their responsibilities and should act accordingly. Currently there are at least 4 organisations involved in the process of genetic evaluations. National data collection centres (including herdbooks), national genetic evaluation centres, the international genetic evaluation centre and national publication units have a joint responsibility in the process of genetic evaluations.

In a perfect world each organisation determines the quality standard of its input data. In such a system it is very important that you know what the end-user wants and you have to translate that into quality parameters of your input data. These parameters must have very strict definitions that leave no room for interpretation. Together with your data supplier you must agree that these parameters are realistic and feasible. Your data supplier must also know what the consequences are if the data fails to meet the parameters. Finally your data supplier must be able to show the results of the quality parameters immediately at your request. In the world of genetic evaluation the farmers and AI companies are the end-users. Their demands have to be translated into quality parameters that publication units demand from the national and international genetic evaluation centre. The international genetic evaluation centre must translate the demands of the publication unit into quality parameters that they demand from the national genetic evaluation centre. These in turn must set the quality parameters that they demand from the data suppliers.

In such a system nobody has to validate their input data because the input data always meets the quality standards. Everybody can dedicate all their time to their part of the process and the total time needed for the entire process can be reduced.

## 6. Conclusions

- 13 out of 33 countries/populations rely on the Interbull Centre to validate their national evaluations.
- Defining critical control points with realistic thresholds is the key in proof validation.
- A quality management system ensures that you publish proofs that have a predefined quality level.
- In a perfect world everybody supplies data that passes the quality standards of the receiving party.

## 7. References


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