



International Committee for Animal Recording

Business Plan for the Implementation of International Genetic Evaluation Services for Beef Breeds and Traits by Interbull

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Recommendation

Based on results of the following document, the ICAR Task Force for Establishing the Business Plan recommends that the ICAR Executive Board:

1. Requests that the Interbull Steering Committee of Interbull proceed to establish an international beef genetic evaluation service along the lines described in the report, subject to satisfactory funding being established in consultation with potential service users.
2. Supports the establishment of a fund to cover the capital cost of Interbull developing international genetic evaluation services for beef cattle.
3. Agrees in principle to expand the Interbull Steering Committee by two persons in order to ensure fair representation of beef breeding interests.
4. Endorses the Report of the Task Force and approves its distribution to ICAR members with an interest in beef cattle breeding.

Summary

Biennial ICAR surveys show that many countries apply beef recording schemes that in principle would allow for international genetic evaluation. Current attempts to develop across country evaluation can be observed in Australia (ABRI) and USA (National Beef Cattle Evaluation Consortium). Interbull recently became involved in this field of application through a pilot study for weaning weight in the Charolais and Limousin breeds sponsored by Ireland, UK and France.

The pilot study demonstrated that international evaluations using phenotypes from several countries and fitting them to an appropriate statistical model is a practical proposition. Further, this research demonstrated these methods are preferred over a number of others including the MACE method currently used by Interbull for dairy breeds. It is envisaged that the countries will choose either to use the International Evaluations as their National Evaluations, or to incorporate the International Evaluations into their National Evaluations. Over time the methods to be used will evolve in accordance with normal Interbull processes for improving the quality of the international evaluations.

In order to assess the demand for, and ability of, beef breed organisations to participate in international evaluations provided by Interbull, a questionnaire was sent to 154 major national and international breed associations. From 103 replies it could be concluded that there is much interest, growing demand and support for international evaluation. Most respondents saw their populations as sufficiently connected with foreign populations. Accordingly, international evaluation was mainly appraised as useful, providing additional benefits to the breed. Eighty percent (80 %) of respondents wished to participate in international genetic evaluation services of Interbull. Although there was no indication of the magnitude of costs (as, the level of service fees was not predictable in the questionnaire as it is dependent upon the number and population sizes of participating breeds), 44 % thereof even affirmed appropriate financial involvement.

Strongest demand for international evaluations was indicated for the Charolais and Limousin breeds, making it a natural choice to consider these two breeds from the start, thereby building upon the progress of the pilot study. For both these breeds 5-6 new countries indicated an interest in participating in the development of the service on a cost sharing basis. Besides the addition of new countries, several outstanding research questions need to be addressed in preparation for a first routine evaluation. It is estimated that three man-years are required, corresponding to approximately 300 thousand Euros. For this estimate to hold, it is important that countries take full responsibility for providing complete and accurate pedigree information and developing a statistical model (fixed and random effects) for their data in close collaboration with the group developing the international evaluations.

To capture the momentum it is recommended that activities related to the development of the new service be outsourced to one or more organisations experienced with international evaluations based on performance data. Once an evaluation system has been developed, the Steering Committee needs



to take a position whether or not to outsource (part of) the routine evaluations, keeping in mind its strategic plans and the options available through partner organizations to offer a cost-effective service.

Interbull has an ideal structure to perform international genetic evaluations. A number of activities are set up to ensure international evaluations of high quality. It is therefore the most efficient option for Interbull to carry out international genetic evaluations for beef. Representation on the Interbull steering committee aims to have a fair representation of countries and of breeds. However, when international beef evaluations are carried out by Interbull, two extra representatives on the steering committee from the beef world are recommended to achieve a more fair representation amongst breeds and countries. In addition, expertise in beef evaluation should be at the Interbull technical committee level, either by extending the current technical committee, or raising a new beef technical group.

International evaluation of beef traits offers an opportunity for Interbull to extend its services and to also gain new expertise and reputation for beef cattle. The key issues for doing so will be to create a sufficient budget, to ensure that the new organisations are adequately represented in the Interbull structures and to rapidly integrate that with the need to include more countries, traits and breeds. It is expected, that once a critical mass of member organisations is exceeded, this would exert a pull to distant beef breed organisations to become involved in Interbull evaluation services as well.

Background

Establishment of a Task Force

The Irish Cattle Breeding Federation (ICBF) initiated a pilot study about joint international evaluation for beef breeds and beef traits based on raw data of Irish, French and British Charolais and Limousin cattle. Apart from overcoming the difficulty to identify identical sires that were used across the involved countries, the study clearly showed the feasibility of joint international evaluation.

After completion of the pilot study, it was proposed that Interbull implement genetic evaluation services for beef breeds and beef traits. In order to make a decision, a business plan was requested by ICAR. The following persons were involved in a task force establishing the present business plan:

Germany	Hans Schild (LKV-Bayern: Convenor)
Ireland	Brian Wickham (ICBF)
Netherlands	Hans Wilmink (NRS)

In addition to these members, the following persons were consulted during the formulation of this report:

France	Gilles Renand (INRA)
Australia	Hans Graser (AGBU)
South Africa	Japie Van der Westhuizen (ARC)
Sweden	Freddy Fikse (Interbull Centre)

Objectives of this business plan

The new Interbull services shall provide international evaluation of beef cattle. Provided there are sufficient links across national cattle breeds, and sufficient data structure of the pedigree and performance data, Australian studies (Florence Phocas and Kath Donoghue, 2003) clearly showed advantages for use of raw data compared to aggregated sire information.

The business plan aims to account for the following issues:

Establishment of market for international genetic evaluation services for beef breeds and beef traits.

Establishment of operational and financial basis for the provision of these extra services by Interbull.

Identification and evaluation of the risks and opportunities associated with these extra services by Interbull.



Genetic evaluation of beef cattle

In contrast to dairy production, where AI and dense performance recording of production herds is applied, beef cattle production is mainly based on natural mating, and performance recording is primarily done in breeding herds serving as a tool for genetic evaluation. Sharp distinction between breeding and production herds results in big demand for male breeding animals. Accordingly, sale of performance tested young bulls forms the more important activity for breeding farms and breeding societies. Beef cattle breeding therefore mainly focuses on the individual performance of young breeding bulls, whereas progeny information – apart from its importance for AI bulls – only slightly improves the BV (Breeding Value) accuracy of young bulls as it provides additional information on relatives.

Nevertheless, there is an increasing demand for joint international genetic evaluation because of increasing genetic exchange across countries of live animals and AI bull semen. Breeders want to be able to compare their animals on common scales.

Currently, some efforts to establish routine international genetic evaluation of beef cattle can be observed in some genetic evaluation centres such as BREEDPLAN and the US National Beef Cattle Evaluation Consortium (Cornell University, Colorado State University, Kansas State University, University of Kentucky, Iowa State University, University of Georgia, Michigan State University, US Meat Animal Research Center). Interbull became involved in genetic evaluation of beef cattle through initiation of the pilot study.

Interbull, the appropriate organisation for joint genetic evaluation of beef traits

At present, Interbull's Genetic Evaluation Services comprise sire evaluation for milk production traits, conformation traits, udder health, longevity and calving ease by using a MACE approach based on degressed national evaluations of sires.

In this context, Interbull has gained considerable expertise and excellent reputation in joint international genetic evaluation of cattle since its founding in 1983. Therefore, in 1996 EU authorities designated Interbull as the reference body responsible for rendering uniform testing methods and assessment of the genetic results for pure-bred breeding cattle.

Interbull has an operational unit, Interbull Centre, which is situated in Uppsala, Sweden, where – apart from functioning administration – a highly skilled staff provides the expertise for solving problems that are associated with international genetic evaluation of cattle.

With the inclusion of beef cattle, spin off effects in both beef cattle and dairy cattle, are expected as many problems regarding the data structure, data modelling etc. may also impact on dairy cattle evaluation.

Significant cost reduction can be expected by common administration, operational device and office costs. Accordingly, the establishment of joint international genetic evaluation of beef cattle, should be performed by Interbull. Any alternative approach would lead to an immediate increase in costs and loss of momentum.

Assessment of market potential for joint genetic evaluation of beef cattle

Current situation of ICAR member countries

A detailed description of the current situation of ICAR member countries is shown in Appendix 1. There are big differences across countries regarding the extent and size of recorded beef cattle populations. Although weight recording at birth and weaning has become a standard routine in most countries, a huge variety of further traits can be observed. Apart from North and South America on the one hand, where the BIF(Beef Improvement Federation) guidelines apply and Oceania on the other hand, where the BREEDPLAN scheme operates there is limited international standardisation of beef recording methods. Detailed ICAR guidelines covering all major beef recording issues were only established in 2004 and are mostly not yet applied in practice.



International beef cattle breeds

Joint international evaluation primarily refers to international beef breeds that are kept in many countries. Accordingly, preliminary results of the 2003 survey were evaluated to estimate the distribution of the most important international cattle breeds (see table 20 of Appendix 2).

When comparing basic recording results such as birth- and weaning weights as well as linear assessments, the ICAR 2003 enquiry and other investigations from public sources, resulted in 7 breeds with major international importance:

Table 1: Communicated recording size and international distribution of major beef cattle breeds (ICAR enquiry 2003)*

Breed	Countries	Birth weights			Weaning weights			Linear Assessments				
		¹	Min	Max	Countries	Min	Max	Countries	Min	Max		
Aberdeen-Angus	17	19978	103	269392	17	19368	79	269545	4	1117	122	2374
Belgian Blue	5	6684	134	30000	4	299	50	589	2	15146	291	30000
Blonde d'Aquitaine	8	8647	107	64351	8	4149	76	31208	3	11017	86	32872
Charolais	22	16433	180	202588	22	13199	174	150038	8	20319	160	151298
Hereford	12	9220	131	81529	12	8314	46	57197	2	420	179	661
Limousin	21	10845	90	115903	22	7136	75	85177	7	12771	80	80894
Simmental	17	7502	80	66595	17	6640	74	65191	4	914	69	2005

¹⁾ Sweden and Poland did not reply, the 2000 enquiry was used here

A detailed distribution of recording activities across countries that were communicated to the ICAR inquiry is shown below:

Aberdeen Angus

329,256 yearly weaning weights from 17 countries, thereof 82 % from USA:

Table 2: ICAR Inquiry 2003: Angus

Country	Birth weight	Weaning weight	Linear scoring
United States	269392	269545	
Australia	32814	31866	
New Zealand	8206	12281	
Germany	3477	3238	2374
United Kingdom	11300	2730	
Czech Republic	3329	2697	388
South Africa	2494	2622	
Switzerland	2257	1820	1583
Sweden	695	619	
Norway	956	430	
Finland	436	339	
Denmark	1567	300	
Ireland	2137	242	122
Luxembourg	186	160	
Austria	103	157	
Poland	131	131	
Slovak Republic	146	79	



Belgian Blue

33,437 yearly birth weights from 6 countries, thereof 90 % from Belgium:

Table 3: ICAR Inquiry 2003: Belgian Blue

Country	Birth weight	Weaning weight	Linear scoring
Belgium	30000		30000
France	1453	227	
United Kingdom	1300	330	
Ireland	535	589	291
Denmark	134	50	
Luxembourg	15	8	

Blonde d'Aquitaine

33,262 yearly weaning weights from 11 countries, thereof 94 % from France:

Table 4: ICAR Inquiry 2003: Blonde d'Aquitaine

Country	Birth weight	Weaning weight	Linear scoring
France	64351	31208	32872
Czech Republic	762	638	93
United Kingdom	2600	560	
Sweden	399	330	
Denmark	660	150	
Slovak Republic	174	132	
Germany	121	97	86
Luxembourg	107	76	
Austria	8	45	
Switzerland	34	26	21
Ireland	29		



Charolais

290,382 yearly weaning weights from 22 countries, thereof 52 % from France:

Table 5: ICAR Inquiry 2003: Charolais

Country	Birth weight	Weaning weight	Linear scoring
France	202588	150038	151298
Canada	60537	60537	
United States	55367	46739	
Sweden	6291	4800	
Czech Republic	4787	3972	629
Ireland	708	3951	4160
United Kingdom	9800	3300	
Germany	3638	2907	2433
Australia	1758	2597	
New Zealand	2860	2146	
Spain	1500	1500	3300
Italy	2497	1487	
Poland	1386	1386	
Slovak Republic	1871	1339	
South Africa	1132	1162	
Denmark	2267	700	
Finland	534	408	
Austria	316	369	
Norway	721	347	
Switzerland	387	310	290
Luxembourg	410	213	282
Slovenia	180	174	160

Hereford

99,796 yearly weaning weights from 13 countries, thereof 57 % from USA:

Table 6: ICAR Inquiry 2003: Hereford

Country	Birth weight	Weaning weight	Linear scoring
United States	81529	57197	
Australia	6461	24500	
New Zealand	8329	10963	
Czech Republic	3279	2158	179
Denmark	3295	1145	
United Kingdom	3600	1100	
Germany	691	807	661
Finland	925	806	
Norway	1317	713	
Sweden	429	288	
Slovak Republic	131	53	
Ireland	651	46	27
Switzerland	26	20	20



Limousin

156,982 yearly weaning weights from 22 countries, thereof 74 % from France:

Table 7: ICAR Inquiry 2003: Limousin

Country	Birth weight	Weaning weight	Linear scoring
France	115903	85177	80894
United States	46289	32944	
Canada	12778	7352	
United Kingdom	16400	4600	
Poland	4263	4263	
Italy	5763	3685	
Germany	3405	2970	2441
Hungary	5153	2620	296
Ireland	439	2056	4789
Australia	2673	2008	
Denmark	5240	1710	
Slovak Republic	3035	1610	
Czech Republic	1480	1278	226
South Africa	1206	1277	
Sweden	1060	856	
New Zealand	764	852	
Switzerland	916	735	675
Austria	293	377	
Belgium		300	
Finland	317	157	
Slovenia	90	80	80
Norway	282	75	

Simmental

112,884 yearly weaning weights from 17 countries, thereof 58 % from USA

Table 8: ICAR Inquiry 2003: Simmental

Country	Birth weight	Weaning weight	Linear scoring
United States	66595	65191	
Canada	33292	26154	
South Africa	2363	3611	
New Zealand	3491	3300	
Germany	2222	2746	2005
Czech Republic	3605	2651	345
United Kingdom	6000	2580	
Sweden	2269	1680	
Australia	3001	1670	
Ireland	80	748	1238
Poland	699	699	
Slovak Republic	750	643	
Denmark	2325	525	
Austria	194	307	
Finland	232	186	
Norway	322	119	
Switzerland	103	74	69



There are 2 further breeds that could be seen as international, as beef recording is carried out in at least in 4 major European countries :

Piedmontese	22.500 weaning weights per year thereof 96 % in mother country (Italy)
Salers	19.200 weaning weights per year thereof 97 % in mother country (France)

However, those breeds predominantly exist in the countries of origin, i.e. the foreign populations are rather small. Nevertheless, as mentioned later, there should be the option to include small national populations as well.

Survey on demand for international evaluation of beef cattle

A survey addressing the feasibility and demand was carried out to assess the prerequisites and readiness of breeding organisations to participate in international genetic evaluation services provided by Interbull. The questionnaire (see Appendix 3) was sent to 154 national breed organisations/national umbrella organisations of the above mentioned breeds, and additionally to 4 international umbrellas (International Association of Belgian Blue Cattle Breeders, International Limousin Council, World Hereford Council, World Simmental Fleckvieh Federation). In the case of response from a national umbrella organisation, the results were assigned to each of the breeds involved.

Results

The most important results are shown in table 21 of Appendix 3. Apart from the World Hereford Council, unfortunately none of the breed umbrellas responded to the questionnaire. However, good response was received from individual national breeding organisations. In total 104 breed organisations from 24 countries (about 65 % throughout all breeds) indicated big interest in international evaluation. Most response (80 %) was received from European countries and South Africa, whereas only 40 %, 15 %, and 53 % came from North America (USA, Canada), South/Middle America and Oceania (Australia, New Zealand) respectively. Within Europe there was no response from Belgium, Spain, and Portugal and only poor response from Sweden.

Table 9: Inquiry on International evaluation of beef cattle

Breed	Contacted	Replying	Stating Usefulness	Confirming high connectedness	Confirming regular exchange	Original IDs available	Expecting benefits
Angus	24	17	17	10	15	16	15
Belgian Blue	13	9	8	8	9	8	8
Blonde d'Aquitaine	19	11	9	8	10	9	9
Charolais	27	19	18	13	18	18	18
Hereford	22	14	10	8	10	11	10
Limousin	30	19	18	9	17	18	17
Simmental	23	15	12	6	12	12	11
All breeds	158	103	91	61	90	91	87

More than 85 % of responders saw international genetic evaluation as useful and expected additional benefits by doing so. Although regular exchange was confirmed by almost the same proportion, only 60 % of the responders appraised their population being highly connected with foreign populations. Regarding the identification of common sires, the original animal ID mostly could be retrieved from the animal information (this does not necessarily mean that the animal keeps the original ID).

In principle 80 % of responders wish to participate in evaluation services provided by Interbull. Another 10 % would not exclude participation, however there was no clear affirmation to do so right now.



Table 10: Inquiry on International evaluation of beef cattle – Participation and cost share: All breeds

Participation	Cost share	Frequency	Yearly weaning weights	Smallest	Biggest
Yes	Yes	39	371,625	10	200,000
Yes	Depends	17	167,680	100	72,490
Yes	No	25	19,832	10	4920
Depends	Depends	4	44,963	1,000	30,000
Depends	No	8	37,900	130	25,000
No	No	10	350,930	10	294,431

In total, 39 organisations affirmed to contribute to the costs. Another 21 organisations stated that financial involvement would depend upon the magnitude of costs arising from that service (due to the fact that the service fees largely will depend on the number and size of participants, it was not possible to indicate the expected amount in the questionnaire).

It was surprising that 25 organisations wished to participate in international evaluation without being willing to contribute to the costs. This reconfirms, at least, strong demand for that service. However, due to the lack of alternatives it might be expected that some of those respondents eventually will be prepared to contribute to the relevant service fees.

Table 11: Inquiry on International evaluation of beef cattle – Participation and cost share: Angus

Participation	Cost share	Frequency	Yearly weaning weights	Smallest	Biggest
Yes	yes	7	7,470	130	4,000
Yes	depends	3	10,850	650	8,000
Yes	no	4	2,172	80	1,400
Depends	depends	1	3,000	3,000	3,000
Depends	no	1	2,740	2,740	2,740
No	no	1	294,431	294,431	294,431

Table 12: Inquiry on International evaluation of beef cattle – Participation and cost share: Belgian Blue

Participation	Cost share	Frequency	Yearly weaning weights	Smallest	Biggest
Yes	yes	3	160	10	100
Yes	depends	2	420	100	320
Yes	no	2	30	10	20
depends	no	1	1,000	1,000	1,000
no	no	1	10	10	10

Table 13: Inquiry on International evaluation of beef cattle – Participation and cost share: Blonde d'Aquitaine

Participation	Cost share	Frequency	Yearly weaning weights	Smallest	Biggest
yes	yes	5	32,845	60	32,000
yes	depends	1	470	470	470
yes	no	3	1220	90	1,000
depends	no	1	130	130	130
no	no	1	75	75	75



Table 14: Inquiry on International evaluation of beef cattle – Participation and cost share: Charolais

Participation	Cost share	Frequency	Yearly weaning weights	Smallest	Biggest
yes	yes	8	210,660	150	200,000
yes	depends	4	66,970	1,100	60,000
yes	no	4	2,730	180	1,300
depends	depends	2	31,000	1,000	30,000
depends	no	1	2,770	2,770	2,770

Table 15: Inquiry on International evaluation of beef cattle – Participation and cost share: Hereford

Participation	Cost share	Frequency	Yearly weaning weights	Smallest	Biggest
yes	yes	3	2,690	500	1,440
yes	depends	1	2,180	2,180	2,180
yes	no	3	3,330	80	2,400
depends	depends	2	1,000	1,000	1,000
depends	no	1	660	660	660
no	no	4	19,000	660	11,000

Table 16: Inquiry on International evaluation of beef cattle – Participation and cost share: Limousin

Participation	Cost share	Frequency	Yearly weaning weights	Smallest	Biggest
yes	yes	9	115,410	900	90,000
yes	depends	3	8,270	870	4,500
yes	no	5	7,770	350	4,920
depends	no	1	2,620	2,620	2,620
no	no	1	20,000	20,000	20,000

Table 17: Inquiry on International evaluation of beef cattle – Participation and cost share: Simmental

Participation	Cost share	Frequency	Yearly weaning weights	Smallest	Biggest
yes	yes	4	2,390	190	1,000
yes	depends	3	78,520	2,030	72,490
yes	no	4	2,580	300	1,200
depends	no	2	27,980	2,980	25,000
no	no	2	3,560	1,000	2,560

In principle, there were only small differences among breeds. Only Hereford shows somewhat less acceptance, as many national Hereford organisations have approached the Animal Genetics and Breeding Unit in Australia, which is the research and development team behind BREEDPLAN tasked with developing an across country evaluation for this breed. Most key Hereford breed societies are using ABRI BREEDPLAN services. (AUS,NZ, USA, ARG, URU). It was also observed that other breed organisations utilising the BREEDPAN recording and evaluation scheme were reluctant to participate in the inquiry, by arguing that international evaluation would be covered by BREEDPLAN.

A huge variety of traits to be preferably included, additionally to birth and weaning weight, were proposed by the breed organisations. If the traits were ordered according to groups, the most important category seemed to be calving ease followed by carcass, growth and conformation traits.



Trait group	Trait	Frequency
Calving ease	Birth conditions/Calving ability/Calving difficulty/Calving ease	24
Carcass traits	Carcass grade/Carcass yield/	19
Growth	Net gain	16
Conformation	Body conformation/Conformation	14
Reproduction	Gestation length	9
Conformation	Muscularity	8
Feed conversion	Dry Matter intake/Feed intake	8
Maternal traits	Milk	8
Calving	Calf Mortality	7
Calving	Calf quality	7
Carcass traits	Eye Muscle Area/Muscle Depth	7
Carcass traits	Dressing percentage	6
Carcass traits	Rib-/Rumpfat depth	5
Growth	400 d weight	5
Conformation	Skeletal development	4
Growth	600 d weight	4
Behaviour	Docility/Temperament	3
Meat quality	Marbling	3
Meat quality	MAS (marbling/taste/tenderness)	3
Reproduction	Scrotal circumference	3
Growth	Yearling Weight	3
Meat quality	IMF	2
Reproduction	Fertility	2
Reproduction	Heifer Pregnancy	2
Conformation	Functional ability	1
Conformation	Height at withers	1
Feed conversion	Retention	1
Meat quality	Meat quality	1
Meat quality	Tenderness	1
Reproduction	Reproductive Traits	1
Reproduction	Stayability	1
Growth	200 d weight	1
Growth	Mature cow weight	1

Most respondents wished the evaluation to be carried out once (32 %) or twice (39 %) a year. Twelve percent (12 %) and 15 % preferred to have three or four evaluations per year and only one respondent wished six evaluations. The preferred evaluation month largely depends upon the breeding season of the relevant breed/region. A huge variety of preferred evaluation months was observed. Apart from some accumulation in winter (December, January), there was no clear preference for any month. No difference across breeds that were ready to participate, and those not supporting Interbull services, could be observed in this respect.



Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
44	3	18	17	23	16	15	3	17	15	6	22
0,22	0,02	0,09	0,09	0,12	0,08	0,08	0,02	0,09	0,08	0,03	0,11

Conclusions

In principle the survey evidenced much interest in and strong demand and support for international evaluation. However, most affirmation was received from European countries whereas (apart from some limited exceptions) American, Oceanian, and South African breed organisations still hesitate to become involved with Interbull. Apart from birth and weaning weight, a large variety of traits of interest can be observed. The preferred frequency of evaluations usually does not exceed four evaluations per year. However, there is no clear preference regarding a specific evaluation month.

Proposed Methodology

The methods to be used for International Beef Evaluations will be those appropriate where pedigree and performance data is supplied by multiple countries for multiple traits and multiple breeds. It is expected that the methods will evolve over time under the control of the relevant Interbull Structures .

In the first instance the methods will be those identified as most appropriate in the EUBEEVAL Project¹. That is:

- a) Data in the form of: a shared "501" identification cross-reference file, a shared "502" pedigree file and nationally supplied files of phenotypic performance data for the relevant traits. Details of these files can be found in the Guidelines established by the EUBEEVAL project. The traits to be considered, in order of priority are: growth & carcase, calving & calf mortality, fertility & survival, and other functional traits. It is very clear that the responsibility for providing clean data in the appropriate file formats must rest with the participating country.
- b) An international genetic evaluation model that includes fixed effects, random effects and covariances established through collaborative research based on the data available from each participating country. The reports to the EUBEEVAL project from the INRA and AGBU teams describe the results of a first attempt at an international genetic evaluation of beef breeds in Europe. Both research groups concluded that the approach of fitting a comprehensive model to phenotypic data is preferred over the MACE method currently used for international dairy cattle evaluations. Responsibility for in particular defining the fixed effects for each country must rest to a large extent with the country concerned.
- c) The publication of national evaluations will be the responsibility of the participating organisations from each country. These organisations will determine how national evaluations make use of the International Evaluations in the results published by them. They will have the choice of two options:
 - i. Use the International Evaluations without modification. This is the path that a country with a small population of performance recorded beef animals would likely find most attractive.
 - ii. Compute National Evaluations and combine them with a "reduced set" of the International Evaluations. The "reduced set" being the result of fitting the full International Evaluation model to all data except the phenotypes used in the National Evaluation for the country. In this way "double counting" is avoided and the relevant international information incorporated in the national evaluation. Further, this approach supports national evaluations being at a greater frequency and possibly using more complex models (across breeds and or multi-trait for example) than the International Evaluations.



Operational model

Based on Interbull experience expansion of the service of international evaluations consists of several stages, which can be arranged by a combination of performing activities internally or outsourcing certain activities. During the first phase the feasibility of new evaluations is determined, and this phase is typically followed by pilot studies with the aim to finalize the details of the system for international evaluation. In most cases these activities have been carried out by partner organizations of Interbull. The last phase considers documenting the code of practice and performing a full-scale test evaluation as preparation for a first routine evaluation, and is always done by the Interbull Centre, the operational unit of Interbull. Once the system has been designed and upon successful completion of the full-scale test evaluation and review of the results, it is put into routine. Thus, the operational model will be discussed from two perspectives: development of a new international genetic evaluation system and routine production of international genetic evaluations. An important pre-requisite for embarking upon an expansion to international beef evaluations is the existence of a demand for the service, such that it is economically feasible to conduct, and to continuously improve the quality of the service.

Establishing a system for routine evaluations of beef breeds / traits

The service of international evaluations consists of research, development, design, computations, delivery, follow-up and promotion. It is of strategic importance that Interbull undertakes core activities like the design of the new international evaluation service, capitalizing on the progress in research and development achieved by the EUBEEVAL Project² and the fifteen years of experience with international comparisons of dairy cattle.

To the extent that more research and development is needed (see below) to complete the design of the new services, there are two alternatives: subcontracting these activities or conducting those in-house. The benefits of subcontracting relate to flexibility, promptness and efficiency of operations. It would make use of the internationally available scientific expertise and builds on the existence of an already existing network of contacts. Furthermore, close cooperation between Interbull and its subcontracted partners will facilitate a smooth transfer of knowledge needed for an optimal establishment of the service.

Careful consideration should be given to choice of activities to outsource and partners to subcontract. To take advantage of the strength of incorporating the service of international evaluations into an independent, non-profit organization, Interbull needs to have full control over such activities. The integrity of Interbull and the perception of independence among its members would be compromised if the subcontracted organization has a commercial interest in the product or has close connections with competing service providers.

Previous experiences with Interbull partners performing some of the research and development needed for service expansion have been positive. It should be noted though, that these cases concerned addition of new traits according to a previously established framework (international evaluations using national evaluation results of dairy bulls as input). The present case, on the other hand, involves the development of an entirely new product (international evaluations of beef breeds / traits based on performance data).

Regarding beef international evaluations, development in the areas of validation of expansion to more populations, breeds and traits as well as validation of changes of data, models and methods of already participating populations, is required. Experience with international evaluations of dairy bulls learned that both these aspects are important for the quality of the international evaluation services. Such verification and validation of input data proved to be necessary to assure fairness and stability of international comparisons. When the various components of the international genetic evaluation system have been specified, these need to be documented in a code of practice for beef international evaluations.

² Research conducted by INRA and AGBU under sponsorship of ICBF, Institute de l'Elevage, MLC and ICAR



Routine international beef evaluations

At present two approaches for production of international evaluations of dairy bulls are practiced: in-house production (e.g. milk production traits, udder health traits), and outsourcing of certain activities (conformation traits). Outsourced activities include research and computations, but core activities like delivery, follow-up and promotion are performed by Interbull. The Interbull Centre has strict control as regards delivery and editing of data to be used, software for parameter estimation and evaluations, validations made and results obtained in order to maintain credibility of the service. This is of strategic importance, to maintain the perception that international evaluations are under the auspices of an independent organization. Crucial for the acceptance of subcontracting as an alternative for performing certain components of the service of international evaluations for conformation traits, was the establishment of a technical committee with the task to oversee the subcontract.

Outsourcing of activities needed for the design of the new service of international beef evaluations appears to be a cost-effective alternative, and one which facilitates prompt availability of the new service. However, Interbull will have the opportunity to put the necessary structure for routine international beef evaluations in place during the period of finalizing the design of the new service, which makes in-house production a viable alternative.

Subcontracting certain components of a routine international beef evaluation has similar advantages as described previously. Outsourced activities should include research and development activities in addition to computation of routine evaluations, in order to make efficient use of the experiences gained at the subcontracted sites. This may also increase the sense of responsibility and participation among the partner organizations. In the case of subcontracting activities to multiple sites, efficient and close coordination of the activities is an important prerequisite, or Interbull could risk losing control.

Computation of international evaluations for dairy and beef breeds at the same site certainly has synergistic advantages. The integrity of Interbull and its products benefit from running the services internally. In addition, in-house experience with all components of a new service contributes to the critical mass at the Interbull Centre, which is a prerequisite for efficient communication with subcontractors and customers, prompt reactions to developments in the sector and growing demands for expansion of the new service, as well as continuity of the organization. On the other hand, there are no actual links between the type of data for international evaluations of beef and dairy breeds. Thus, the advantages of in-house expansion of evaluations when new traits are added for dairy breeds might not be realized in the case of beef evaluations.

Evaluation of both options, in-house or outsourcing activities related to a new service of international beef evaluations, needs to consider the intentions of Interbull regarding long-term development of the Interbull Centre.

Cost estimation

During the pilot project carried out by INRA, data on the Charolais breed from three countries were considered. A genetic evaluation of weaning weight treated as separate traits in these three countries was carried out successfully. However, several issues were identified that need to be addressed before such international evaluations can be put into routine. These issues will need to be addressed during the development stage, and determine the amount of resources and time needed before a first routine evaluation can be scheduled.

The single most important issue is quality of identification and establishment and maintenance of a cross-reference list. Experiences from dairy cattle and also from other species showed that this task is very time consuming, yet crucial for the usefulness of international evaluations. This part alone is estimated to take around four person months per new country that is added, based on experience from the pilot project, and falls under the responsibility of the country wishing to participate.

Procedures for routinely screening and monitoring the quality of input data need to be developed in addition to improving unique international identifications, since the quality of international genetic evaluation results will depend on the quality of input data received from member organizations participating in an international evaluation. Existence of international beef evaluations does not affect the responsibility of member organizations for accurate data recording and storage, but some member organizations may choose to discontinue national evaluations. In such cases feedback channels need



to exist to ensure that national data collection routines are at par with the requirements on data quality for input in international evaluations.

Experience with the international comparison involving three countries led to the conclusion that the model for genetic evaluation adopted needed further considerations. In short, definition of contemporary groups, heterogeneity of residual variances, interactions between maternal genetic effects among countries and estimation of genetic correlations were identified as the main areas of concern.

Fairness of international comparisons is essential for the credibility of an international genetic evaluation service. Member organizations regularly monitor and report on (Interbull meetings) the fairness of international comparisons for dairy bulls. Experience with dairy cattle has shown that validation of national evaluations is an important tool in this respect, and development of equivalent tools for international comparisons for beef traits/breeds is critical for the credibility of this new service.

Of the 102 organizations that responded to the questionnaire 80 indicated an interest in participating in an international beef evaluation service by Interbull, but only 38 organizations were prepared to contribute to the funding of a such a service on a cost-sharing basis. These organizations covered ten countries and seven breeds. The majority of these countries and breeds did not participate in the pilot project, which will clearly affect the time needed to prepare for a first routine evaluation.

According to experiences from the EUBEEVAL project, adding new countries to the system is resource intensive. The aspect that requires most resources is to develop a statistical model (fixed and random effects) to describe the data from each country, which was estimated that to be around 3-4 person months for each new country*breed combination. Assuming that a start is made with the two breeds considered in the EUBEEVAL project, Charolais and Limousin, and the five new countries which indicated an interest to participate in the development of international beef evaluation service, about 3 person-years are needed for this part alone. If countries are given the responsibility of developing the statistical model according to criteria set by the international beef evaluation centre, the amount of resources can be somewhat reduced. This would also have the advantage that local specialists are more involved in the development of the statistical model, thus making better use of the knowledge about local production systems.

Today, the international genetic evaluations for dairy cattle include data from 26 countries and six breeds, and cover five trait groups. Four routine and two test evaluation runs are done annually. Operational activities are performed at the Interbull Centre, which currently counts six full-time employees, and its subcontractor (North American Consortium). The annual budget of the Interbull Centre amounts to approximately 600 thousand Euros. Being the EU community reference laboratory, Interbull receives an annual contribution from the EU, equal to 65 thousand Euros in 2005. An increase in this contribution is expected in the event of expansion to beef international genetic evaluations and can be used to support part of the development of the new services.

To sum up, assuming that countries take full responsibility for providing complete and accurate pedigree information and developing a statistical model (fixed and random effects) for their data according to objective criteria, and considering that developments are needed for input data checks, the international genetic evaluation model, and validation of international beef evaluation results, it is estimated that about 3 person-years are needed to prepare for a first routine evaluation of the two breeds previously studied (Charolais and Limousin) and five new countries for both breeds. Today, the cost for one full-time employee at the Interbull Center amounts to approximately 100 thousand Euros per year. Thus, funds needed for 3 person-years are approximately 300 thousand Euros.

Re-evaluation of Interbull structures

Interbull is a permanent sub committee of ICAR. Therefore Interbull follows the legal ICAR structure for a nongovernmental organisation. The legal status of Interbull is important in respect of the commercial impact of international genetics evaluations. As international genetics evaluations may have a large commercial impact, the risk on claims may be higher. The Interbull organisation is a professional body where the processes of international genetic evaluation are repeatable and this could allay any claims.



Interbull is governed by a steering committee, consisting of 9 members, representing different parts of the world. These are: Oceania, North America (2*), Europe (6*) and Eastern Europe (1*). One of the steering committee members is appointed as chairman. In addition, the Interbull Secretary is an ex-officio member of the steering committee

The steering committee discusses and approves measures with impact on short term and medium-long term. Measures on a high strategic level are discussed and approved by the ICAR board.

The Steering Committee meets, on average, once a year. All Interbull members are invited to the Interbull business meeting. The main purpose of the business meeting is to hear opinions and to discuss intended decisions by the Steering committee.

The responsibility for international evaluations is high. All changes in the procedures should result in better quality services or results. Changes and improvements are discussed in the Interbull Technical Committee. This committee consists of seven members, the chairman and six highly qualified scientists in the field of genetic evaluations. The Chairman is a member of the Interbull Steering Committee. The Interbull Technical committee deals with all types of issues related to international evaluation for all breeds and all traits. The Technical committee meets one to two times a year and reports to the Steering Committee.

Finally a four person Scientific Advisory Committee advises the steering committee and the technical committee on strategic or scientifically complicated matters.

Interbull as a sub committee of ICAR has an ideal structure for international evaluations. A cross reference file is set up; procedures to come to routine international genetic evaluation are set for implementing changes; research is ongoing for finding improvements and international evaluations is already in place for a wide number of traits. Although the initial set up was for dairy and dual-purpose breeds, the structure, knowledge and infrastructure is ready to be used for international beef evaluations. Thus, to use the Interbull structure for international beef evaluations is by far the most efficient option.

The representation on the Interbull steering committee aims to be a fair representation of the countries of the world and of the different breeds. For Europe the representation covers most of the breeds, while for Oceania and America is primarily dairy breeds. Moreover, beef production is a very important part of cattle production. When international beef evaluations are carried out by Interbull, beef should be fairly represented on the Interbull committees in order to ensure the best quality services are provided. We recommend therefore two extra representatives be appointed to the Steering Committee of Interbull from the beef world to achieve a fair representation among breeds and countries. In addition beef should be fairly represented on a technical level. There is more and more overlap in technical solutions for dairy and beef evaluation. Therefore extension of the current technical committee with genetic experts in beef evaluation would be advisable. On the other hand it may be worthwhile to have two technical committees, one for dairy and one for beef, in order to keep the discussion more specific and to ensure maximum attention for beef and for dairy, providing a strong link between the two technical committees is retained.

Opportunities and Risks

Undertaking international genetic evaluations for beef has a number of risks for Interbull. Table 18 below lists these, and shows that due to the pilot project, Interbull's experience with dairy evaluations and the questionnaire, most risks are controlled.



Table 18. Risks and Controls for Interbull in developing international genetic evaluations for beef cattle

Risk	Controls
The service is too expensive	Funding is being sought from other organisations (especially EC). The costs of the service will be based on experience from Interbull and the EUBEEVAL project, so that a realistic budget will be available before any major investments are made.
Not providing the important EBVs	More EBVs will be developed in the future and the questionnaire has identified those considered most important. Participating countries will have the possibility to calculate extra EBV's for traits correlated to those included in the international evaluations.
Not delivering in time	Interbull has experience in delivering these types of evaluations on time and the beef evaluations will use their expertise.
Poor perceived quality of EBVs because expectations are too high	The national organisations will be in charge of disseminating the international EBVs. These organisations will be supported with scientific knowledge from Interbull and the EUBEEVAL partners and be able to make sure breeders have realistic expectations.
Poor perceived quality of EBVs because of problems with data quality or connectedness	The EUBEEVAL project has established clear rules for minimal connectedness. Interbull will put in place systems to check data quality.
Confusion over various EBVs (national and an international for each country)	The national organisations will be in charge of disseminating the international EBVs. These organisations are best placed to interact with breeders. There will be the option to include the international EBV in the national figures, rather than presenting them separately.
Absence in the evaluation of important countries	The questionnaire has shown which breeds and countries are interested, so that potential partners have realistic expectations. It will be in the interest of the important countries to participate if there is a market.
Problems with timely and quality data provision by participating countries	Interbull has experience with obtaining data and checking quality. Special routines for checking of phenotypic data will be put in place.
IDs not retrievable	Documentation of genetic links between countries, through the correct identification of animals used in several countries is essential. The EUBEVAL project has gained important experience and a report on the procedure used to link Irish and French Limousin and Charolais animals is freely available.
Inclusion of new countries proves to be difficult	The questionnaire has shown that there are many genetic links among countries.
Competition of other providers	Currently, there is only a very limited amount of genetic evaluation in beef breeds. The Interbull service would be the first to provide evaluations for a wide variety of breeds and countries, and be ahead of any potential competition.
Interbull gets overwhelmed by data if many more countries than the anticipated 5 new countries per breed want to join. Especially, countries may "just send data" when the activities are externally funded.	Priorities will be assigned based on past involvement, breed (preferring fewer breeds from more countries) and data quality. In case of overwhelming demand, a financial contribution will be requested to either discourage participation or fund extra resources at Interbull.



Table 19 shows that there are indeed important opportunities for Interbull to establish itself as a centre of excellence in the field of international genetic evaluations for beef and that this would provide a valuable service to the beef industry.

Table 19. Opportunities for Interbull to develop international genetic evaluations for beef cattle

Opportunity	Detail
Market demand	The questionnaire has shown that there is wide interest in genetic evaluations for beef and that many organisations are willing to contribute financially.
Pilot project completed	The EUBEEVAL project has shown that good links exist for some breeds and countries and established rules for data sharing and the requirements for genetic links. Statistical models were investigated and clear recommendations made.
Ahead of competition	Although a few examples exist of beef genetic evaluations across borders, these are limited to a few countries and breeds. An Interbull service in this respect would establish Interbull as the global centre of excellence for beef and provide an important service to the beef industry.

Many risks were covered by doing the research project and by involving Interbull with its experience. The key issue is to balance the need to include more countries, traits and breeds with maintaining quality.