

Interbull Centre Activity Report



2016/2017

INTERBULL CENTRE

ACTIVITY REPORT 2016/2017¹

INTERBULL CENTRE

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The Interbull Centre is the operational unit of the ICAR permanent sub-committee Interbull.



The Interbull Centre holds the status of European Union Reference Laboratory (EURL) for Zootecnics (Bovine Breeding).



The Interbull Centre is ISO 9001:2008 certified.



¹ Presented at the 2017 Interbull Meeting, Tallinn, Estonia, August 2017



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Contents

INTRODUCTION.....	4
1. GOVERNANCE and ORGANISATIONAL STRUCTURE	5
2. QUALITY MANAGEMENT and ISO 9001 CERTIFICATION	7
3. The INTERBULL CENTRE'S COMPUTING INFRASTRUCTURE.....	8
4. PEOPLE	11
5. SERVICE and OPERATIONS – Interbull Centre	16
6. SERVICE and OPERATIONS – International Dairy Breed Evaluations (Interbull)	17
7. SERVICE and OPERATIONS – International Beef Breed Evaluations (Interbeef)	22
8. RESEARCH and DEVELOPMENT - Dairy.....	24
9. RESEARCH and DEVELOPMENT - Beef	26
10. RESEARCH and DEVELOPMENT - Infrastructure.....	28
11. RESEARCH and DEVELOPMENT - Funding.....	30
12. SERVICE CALENDARS.....	31
13. TASK FORCES and WORKING GROUPS	31
14. MEETINGS	33
15. COMMUNICATIONS and PUBLICATIONS	35
Appendix 1: Interbull Committees and Working Groups	36



inter  **genomics**

GEN  **EX**
International Genotype Exchange Platform



INTRODUCTION

The Interbull Centre is a section of the Department of Animal Breeding and Genetics (HGEN) of the Swedish University of Agricultural Sciences (SLU), and acts as the operational unit for Interbull and Interbeef, a permanent subcommittee and a working group of the International Committee for Animal Recording (ICAR), respectively. Additionally, the Interbull Centre holds the status of the European Union Reference Laboratory for Zootechnics (EURL-Z).

This Report describes the activities at the Interbull Centre between 1 September 2016 and 14 August 2017. During this period our routine activities for genetic and genomic evaluations have taken place as usual. In addition to our first Annual Meeting in South America (Puerto Varas, Chile) in October 2016, we organised a successful Technical Workshop in Ljubljana (Slovenia) in February 2017.

We have continued the developments of the International Platform for Genotype Exchange (GenoEx), and have started to develop a feasibility project on the application of International SNP evaluations.

Last but not least, in early August 2017 we furthermore learned that the European Commission designated the Interbull Centre as the new European Union Reference Centre from 1 November 2018.

Toine Roozen,

Interbull Centre Director

1. GOVERNANCE and ORGANISATIONAL STRUCTURE

The Interbull Centre is the operational unit of Interbull and provides genetic information services and applied research for improvement of livestock to a worldwide network.

1.1. Roles and Governance

The Interbull Centre is strongly related with three distinct institutions:

- 1- The Interbull Centre is a section of the Department of Animal Breeding and Genetics of the Swedish University of Agricultural Sciences (SLU).
- 2- The Interbull Centre has been contracted by ICAR to be the operational unit for ICAR's permanent subcommittee "Interbull" and the ICAR working group "Interbeef".
- 3- In 1996 the Interbull Centre was designated as the European Union's Reference Body "responsible for collaborating in rendering uniform the testing methods and the assessment of the results for pure-bred breeding animals of the bovine species" (EURL-Z). As such the Interbull Centre interacts with the EU member states through the international genetic evaluation services and also provides assistance to the European Commission in issues related to bovine breeding and genetics.

As such, the Interbull Centre is governed by SLU, ICAR and the EU, and has three roles:

- 1- *the Interbull Centre's role as the EURL-Z*
- 2- *the Interbull Centre's role as the operational unit of Interbull*
- 3- *the Interbull Centre's role as a research unit within a university*

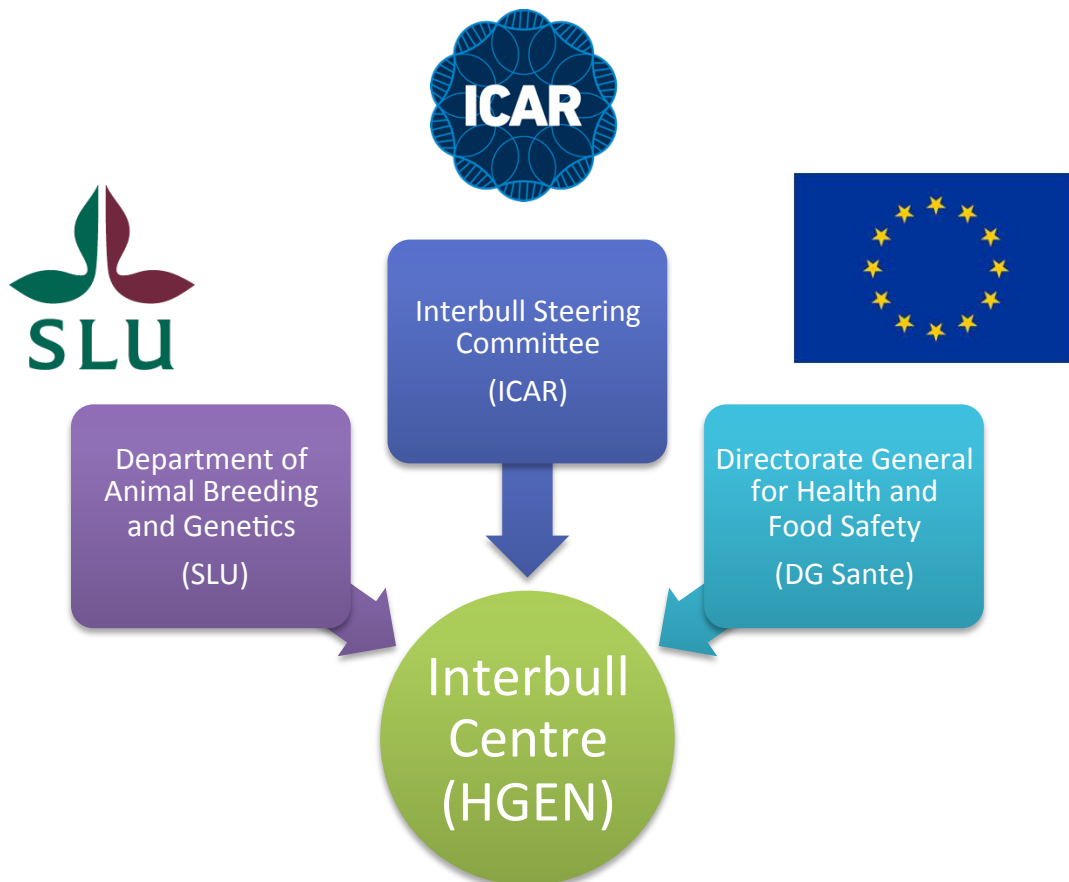


Figure 1.1: Governance and inter-institutional relationship of Interbull Centre

The International Bull Evaluation Service (“Interbull”) was formed by the European Federation of Animal Science (EAAP), the International Dairy Federation (IDF) and the International Committee for Animal Recording (ICAR), with support of the Food and Agriculture Organization of the United Nations (FAO) in 1983. Since 1988 Interbull is a permanent sub-committee of ICAR. Interbull is managed by an ICAR appointed **Steering Committee**, supported by two expert groups: the **Scientific Advisory Committee (SAC)** and the **Interbull Technical Committee (ITC)** (see Appendix 1).

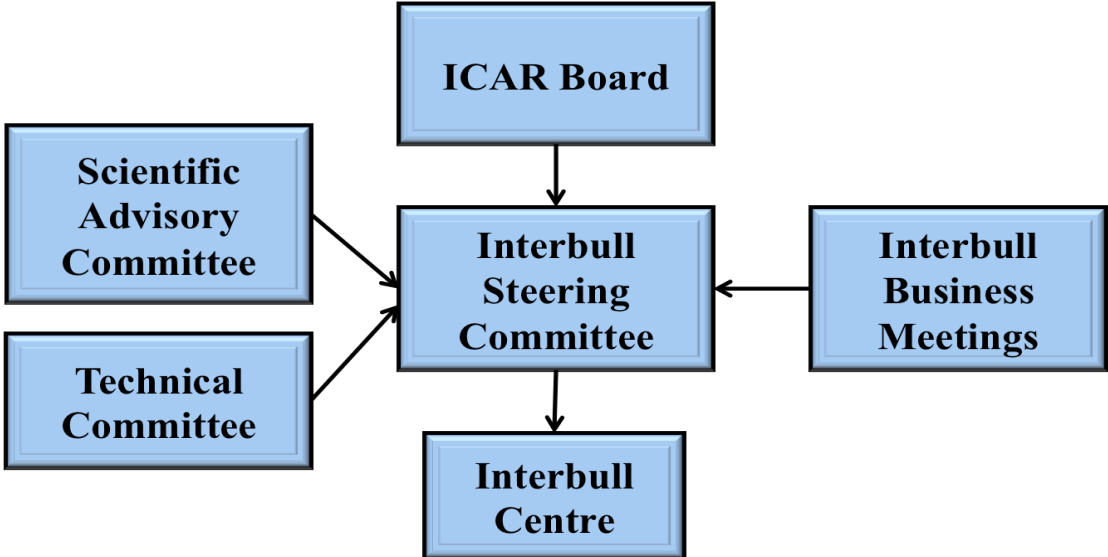


Figure 1.2: Interbull organisational structure.

The Interbull Committee structure is shown in Figure 1.2. The current composition of each of the Interbull Committees is provided in Appendix 1.

1.2. European Union Reference Centre

As a result of the new EU Animal Breeding Regulation (EU Regulation 2016/1012), the European Commission issued a call for the selection and designation of a European Union Reference Centre (EURC) responsible for the “scientific and technical contribution to the harmonisation and improvement of the methods of performance testing and genetic evaluation of purebred breeding animals of the bovine species” in January 2017.

Following an application, review and selection process, the Swedish proposal by the Swedish Board of Agriculture (“Jordbruksverket”) and the Interbull Centre was selected: The Interbull Centre shall assume its role as the EURC on 1 November 2018, at the same time as the new EU Animal Breeding Regulation shall come into force. Until that time, the Interbull Centre will continue its current role as “EU Reference Body for Zootechnics (Bovine Breeding)”.

The European Commission’s decision to designate the Interbull Centre as this European Union Reference Centre was published in the *Official Journal of the European Union* Issue L204/78, 5.8.2017.

2. QUALITY MANAGEMENT and ISO 9001 CERTIFICATION

The Interbull Centre's quality management system for international genetic and genomic evaluations of dairy cattle ("*Interbull MACE*" and "*Interbull GMACE*") have been SS-EN ISO 9001:2008 certified since January 2016 (Certificate no. SE004561-1). In line with continuous improvement practices, our quality management system for international beef genetic evaluations ("*InterBeef*") has since also been certified. Upgrading to the new ISO 9001:2015 standard (which includes additional focus on management practises and risk management) is also in progress.

Verification and validation of data, handling of non-conformities, planning for improvements and customer satisfaction are integral parts of all services carried out at the Interbull Centre and are hence included in the above mentioned accredited management system.

The ISO 9001 quality management standard was developed and published by the International Organization for Standardization (ISO). Important components of ISO 9001:2008 include customer satisfaction and establishing processes for continuous improvement.



Interbull Centre's ISO 9001 certification was obtained through the certification body Bureau Veritas. Created in 1828, Bureau Veritas is a global leader in Testing, Inspection and Certification (TIC), with offices in 140 countries.

The first surveillance audit by Bureau Veritas occurred in December 2016. Interbull Centre successfully passed the audit with a complete absence of non-conformities found.

The management standards help to increase the level of robustness of our systems and the already high quality of service offered to our customers. With independent certification of Interbull Centre by an outside auditor, more than ever the Interbull Centre can stand behind its quality policy of performing its services according to its Guiding Principles, as listed in the Interbull Centre's quality management manual.

Interbull Centre Guiding Principles

- Accurate predictions
- Independence
- Timely delivery
- Documented methods and practices publicly available
- Unbiased statistics
- Comprehensive communication

3. The INTERBULL CENTRE'S COMPUTING INFRASTRUCTURE

The Interbull Centre has an efficient, effective, versatile, scalable, and powerful computing infrastructure. It consists of customer facing software services and databases for data exchange (IDEA, GenoEx), a cluster system with attached clustered file storage that is used for high-performance data analysis as well as tools for system monitoring, operational system management, backups, communication and project management. Software costs have



Figure 3.1: Signs inside VHC for the Interbull Centre, In Silico Lab and HGEN.

been reduced to a minimum by use of well-vetted open source components, the performance and ease of maintenance of the system has been honed by years of experience doing large-scale data analysis at the Interbull Centre. By continuous investment in infrastructure improvement the Interbull Centre has been able to provide an increased number of traits and services within strict deadlines, as exemplified in the tables with statistics on each of the services.

3.1. Hosting

Interbull Centre hosts its infrastructure in two main locations. Production level and crucially important servers are kept at the University's dedicated server hall. The second location is a temperature controlled, secure and access-controlled computer hall in close vicinity to the Interbull Centre's offices. This location serves partly as a hosting facility for the data analysis infrastructure that needs occasional hands-on maintenance and partly as a laboratory for developing the future infrastructure of the Interbull Centre. There is also a third, smaller, separate location, which holds additional backup infrastructure for redundancy.

3.2. Hardware



Figure 3.2: Equipment inside the In Silico Lab.

The hardware consists of server-grade computers running the customer-facing services and databases as well as various internal systems (monitoring, communication etc.). The data analysis system currently consists of server-grade computers for administrative purposes — network boot,

clustered file storages and entry point— as well as a number of cost-effective, powerful, customised units for data analysis. These computers are connected in a high-performance, secured network to ensure the integrity and the exclusive usage of the system, as well as easy maintenance.

In addition, a dedicated file server is used for warm backups of data while an additional server and a tape machine is used for cold, long-term storage of backups.

3.3. Software Architecture

Interbull Centre bases its operations on custom in-house developed software, well-vetted open source components and a few industry-leading software packages from third parties. Software is adopted or developed to enable Interbull Centre staff and customers (from the academia and industry) to work efficiently solving their tasks and activities. The system is built with security and data integrity in mind.

The in-house software (IDEA and various data analysis packages) is based on decades of improvements in providing international dairy breed evaluations. The data analysis system is easily scaled up when demand for more processing power increases. It is constantly developed and refined to become an even better environment for data analysis.

As mentioned, Interbull Centre relies on the vast ecosystem of open source software to solve many of its tasks and activities. By using well-known community developed software, costs are reduced and recruitment of trained staff is simplified. Meanwhile the staff can focus on customising and developing solutions for the tasks that are specific for the Centre.

3.4. Information Security

Access to systems and data at the Interbull Centre is restricted. Customer facing systems are password protected and the network traffic is encrypted with HTTPS. Staff access to file storage and the data analysis system is through the encrypted secure shell protocol (SSH), Operational system management is also performed over SSH, but only by IT staff. Internally the systems (e.g. GenoEx and IDEA) connect to databases and sub-systems through encrypted connections (TLS, SSH).

Servers at the Interbull Centre run CentOS Linux (with a few specialised exceptions). Firewalls – with very restrictive settings – provide external security. To limit the risk and scope of intrusions the systems have the SELinux (Security Enhanced Linux) subsystem enabled for an extra layer of security.

The security aspects of the system are routinely discussed and improved. In addition, the system monitoring software detects problems and suspicious activity in an automated fashion.

To protect against information loss and reduced availability multiple layers of redundancy and backups are in place. Files are stored on a clustered file system, which keeps running even if a whole server becomes unresponsive or needs maintenance. In addition, file servers and database servers store their data redundantly on multiple hard disks using RAID. Databases, applications and file storage are backed up at regular intervals. The backups are placed on a file server that acts as a warm backup. Copies of the data are then made to cold (tape) storage. The most important data is kept in backups indefinitely, while working data are kept for months or years depending on the type and size of the data. Backups are restored and examined as a routine part of operations.

3.5. Applications

IDEA (Interbull Data Exchange Area)

Interbull Data Exchange Area (IDEA) is the main web service run by the Interbull Centre and facilitates the collection of data from all clients and customers, as well as the distribution of data. It is an exclusive area just for the allowed participants, protected by user logins and HTTPS (secure web traffic). Through the web site the users can retrieve, update and add pedigree information, breeding values, phenotype data and additional animal information which are used for Interbull Centre's evaluations. The Interbull Centre service staff can similarly monitor and manage the data flow by using the administration level tools and functionality in the web site, and to verify and ensure that the data is sound and correct.

AnimInfo (Animal Information)

Through the AnimInfo module in IDEA it is possible to store any kind of information about the animals in the system. The data is uploaded in a uniform fashion, through a flexible and extendable file format, which can be altered by the Interbull Centre staff through the IDEA admin web interface. Currently the system is used for various data, such as genetic traits, crossbreeding information and indicating whether an animal has been genotyped or not. It is anticipated that the type and volume of information stored in AnimInfo will be expanded significantly.

4. PEOPLE

4.1. Interbull Centre Personnel

Interbull Centre staff are employed by the Department of Animal Breeding and Genetics (HGEN) of the Swedish University of Agricultural Sciences (SLU), and consists of:

- Toine Roozen (MSc, MBA), Director
- Hossein Jorjani (DVM, PhD, Professor), Senior Genetic Data Analyst, Service Manager
- Haifa Benhajali (PhD), Genetic Data Analyst - Genetics
- Eva Hjerpe (MSc), Genetic Data Analyst - Genetics
- Valentina Palucci (MSc), Genetic Data Analyst - Genetics, Quality Manager
- Joanna Sendeka (PhD), Genetic Data Analyst - Genetics
- Marcus Pedersén, Genetic Data Analyst – IT; Systems Administrator
- Petri Pennanen (MSc), Genetic Data Analyst – IT; Programmer, Systems Administrator
- Carl Wasserman, Genetic Data Analyst – IT; Systems Developer, IT Coordinator
- Louise Simann (BA), Administrator

In addition, the following SLU members of staff have part-time responsibilities at Interbull Centre:

- Monica Jansson – Interbull Bulletin
- Cano Merkan – IT Coordinator / Systems Analyst
- Fernando Lopes Pinto (PhD), IT-hardware and bioinformatics

Louise Simann joined the Department of Animal Breeding and Genetics in September 2016 with a degree in Business Administration, and with the responsibility to support the Interbull Centre, and other HGEN sections. Louise works as an administrator, dealing with financial administration as well as HR administration. Louise has extensive experience in financial and HR administration from previous work places.

After three years as a member of the Interbull Centre staff, Petri Pennanen has resigned his position in July 2017 and is now working as programmer at Blocket, a Swedish online retail market for the whole country. We thank Petri for his dedication and wish him a fruitful career in his new company. A recruitment process to fill the open position is currently ongoing.

Fernando Lopes Pinto has been appointed as Director of Postgraduate Studies within the Department of Animal Breeding and Genetics (HGEN) and because of this his part-time position at the Centre has terminated. We thank Fernando for his contribution over the past years and wish him a successful career with his new position. We look forward for future possible opportunities of collaboration.

The organisational structure is provided in Figure 4.1.

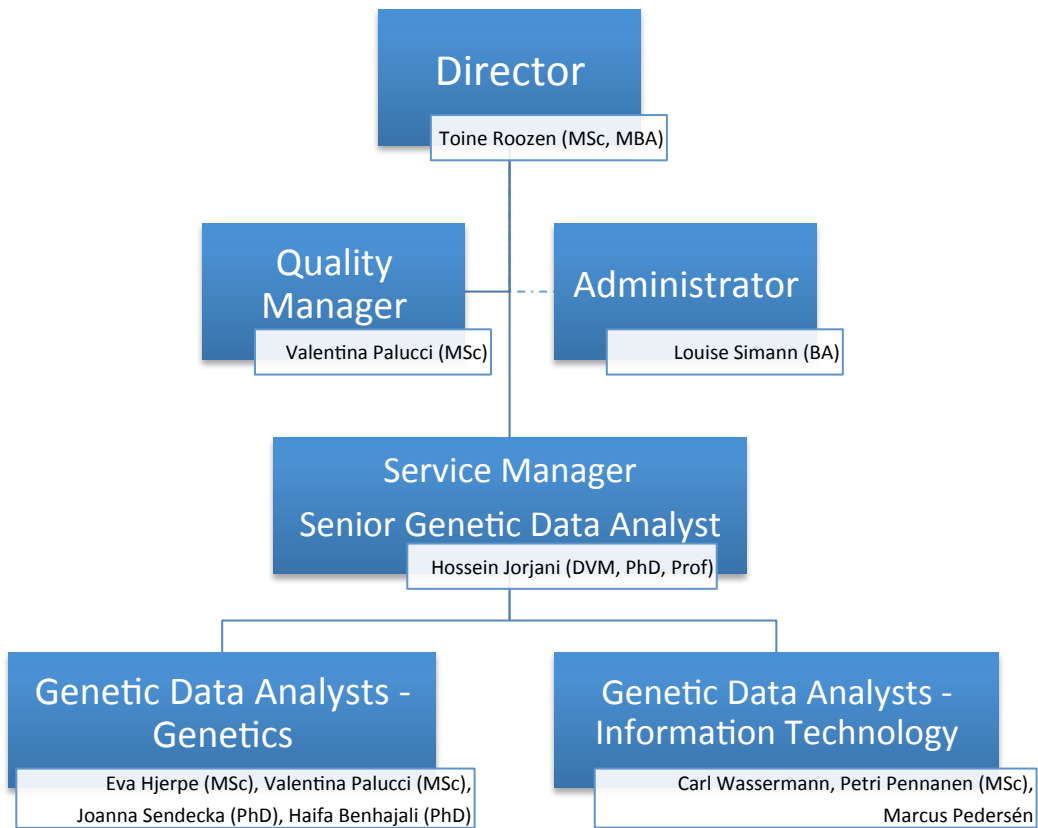


Figure 4.1: Organisational structure at Interbull Centre



Figure 4.2: Interbull Centre staff

4.2. Training, Courses, Meetings and Conferences

Staff was involved with the following courses, meetings and conferences during this period:

Training Courses provided:	Location	Dates	Speaker
Seminar in International breeding evaluation during course in Cattle production	Uppsala, Sweden	26 January 2017	Valentina Palucci
Seminar in the course "Husdjur i världen"	Uppsala, Sweden	26 January 2017	Valentina Palucci

Conferences/meetings attended	Location	Dates	Attendee
World Dairy Expo	Madison, USA	1-7 October 2016	Toine Roozen
Linux/Container Conference	Berlin, Germany	4-6 October 2016	Carl Wasserman
ICAR/Interbull Meeting	Puerto Varas, Chile	22-28 October 2016	Toine Roozen, Hossein Jorjani, Valentina Palucci, Haifa Benhajali, Joanna Sendeka, Eva Hjerpe Carl Wasserman
Swedish – US Scientific Symposium on :“The Future of Functional and Novel Traits for Dairy Cattle Breeding”	Uppsala, Sweden	15-16 November 2016	Toine Roozen, Hossein Jorjani
EuroTier	Hanover, Germany	17 November 2016	Toine Roozen
vit	Verden, Germany	18 November 2016	Toine Roozen
Meeting with Chinese delegation at Swedish Board of Agriculture	Jönköping, Sweden	19 January 2017	Toine Roozen
Gordon Conference	Houston, Texas, USA	26 Feb - 3 March 2017	Hossein Jorjani
Paris show and reception	Paris, France	27-28 February 2017	Haifa Benhajali
ISO surveillance Audit	Uppsala, Sweden	7 December 2016	Toine Roozen, Hossein Jorjani, Valentina Palucci, Haifa Benhajali, Joanna Sendeka, Eva Hjerpe Carl Wasserman Petri Pennanen Marcus Pedersén
Openshift Gathering (“Red Hat”, Berlin, 28 March 2017): Petri	Berlin, Germany	28 March 2017	Petri Pennanen
CloudNativeCon/KubeCon (“Linux”)	Berlin, Germany	29-30 March 2017	Petri Pennanen Carl Wasserman
Interbull Technical Workshop	Ljubljana, Slovenia	February 6-7, 2017	Toine Roozen, Hossein Jorjani, Valentina Palucci, Haifa Benhajali, Joanna Sendeka, Eva Hjerpe
Meeting with SC and ITC Chairs	Uppsala, Sweden	7 June 2017	Toine Roozen, Hossein Jorjani, Valentina Palucci, Haifa Benhajali, Joanna Sendeka, Eva Hjerpe Carl Wasserman Petri Pennanen Marcus Pedersén
ISO Internal Audit	Uppsala, Sweden	9 June 2017	Toine Roozen, Hossein Jorjani, Valentina Palucci, Haifa Benhajali, Joanna Sendeka, Eva Hjerpe Carl Wasserman Petri Pennanen Marcus Pedersén

4.3. Consultants and Suppliers

Through consultancy agreements with the Canadian Dairy Network (CDN) and the Irish Cattle Breeding Federation (ICBF), we have a good collaboration with:

- **Dr Pete Sullivan** (CDN, Canada): works as a part time consultant (25%), mainly on GMACE related issues.
- **Dr Thierry Pabiou** (ICBF, Ireland): supplies international genetic correlations for Adjusted Weaning Weight (AWW) for Interbeef evaluations to the Interbull Centre.

4.4. Visitors

We like to thank all our visitors for taking the time to visit us in Uppsala, which all contribute to productive collaboration.

Renzo Bonifazi is an Erasmus student from the *Università degli Studi di Perugia*, Italy, who worked at the Interbull Centre on genomics projects for a 4-month period (May-September 2016). The purpose of his study was to document and compare methods and results of calculating genomic reliabilities within national genomic evaluations of dairy cattle populations and suggest ways of harmonisation. In April 2017, Renzo completed his MSc at his University in Perugia with his thesis titled “Reliability in worldwide genomic evaluations of dairy cattle populations”.

Renzo returned to the Interbull Centre in May 2017 for a second training period (Erasmus post-degree Traineeship), during which he wrote a paper on the project done during his first training period in 2016 and worked on a multi-trait Animal Model for International Beef Evaluations (“AMIBE”), especially looking at Variance Components and genetic correlations using the package MiX99 (Luke, Finland). MiX99 has been tested using data from Interbeef member countries participating to the January 2017 routine evaluation. The optimal criteria to run the program has been defined through different scenarios and using data from 3 countries out of the 8 involved in the international evaluation. Genetic correlations for Adjusted Weaning Weight have been compared with those currently provided by ICBF (Ireland). In order to speed up the program as much as possible, different solutions have been tested.

On 14 and 15 November 2016, SLU’s Department of Animal Breeding and Genetics, Växjö Sweden and the Interbull Centre jointly organised the **Swedish – US Scientific Symposium on: “The Future of Functional and Novel Traits for Dairy Cattle Breeding”**. This symposium was initiated by a US group of dairy geneticists having a research coordination program called SCC-084 with the goal: “Genetic selection and mating strategies to improve the well-being and efficiency of dairy cattle.

During January 2017, **Lidia Chavinskaia** visited the Interbull Centre. Lidia is carrying out her PhD project on international issues of genomic selection. She is based in INRA and her project is supervised by Pierre-Benoît Joly, sociologist of innovation, and Vincent Ducrocq, geneticist.

The integration of genomics into the dairy cattle breeding is considered as an important breakthrough from technological as well as organisational point of view. This innovation has been implemented almost simultaneously in several developed countries and is viewed as an opportunity for emerging countries where the demand for animal productions is growing up. Lidia is investigating the forces driving the internationalisation of genomic selection in dairy cattle.

As Interbull is well-known as an important actor regulating international relations between different countries operating and using cattle breeding, Lidia used her time at the Interbull Centre to carry out a socio-historical analysis of Interbull's experience with the aim of providing a better understanding of on-going processes generated by the genomic era. Lidia also attended the 2017 Interbull Technical Workshop in Ljubljana as part of her visit to the Interbull Centre.

Erik Kutscher, an auditor within *Bureau Veritas Certification Sverige AB*, visited the Interbull Centre on 7 December 2016 to carry out the first surveillance audit with regards to Interbull Centre's SS-EN ISO 9001:2008 certification. Interbull Centre successfully passed the audit with a total absence of non-conformities found.

Reinhard Reents and **Gert Pedersen** visited the Centre on June 7, 2017. Aim of the visit was to discuss about expectations and responsibilities of the Interbull's Steering and Technical Committee's Chairmen towards the Interbull Centre staff and vice versa. The meeting was held in a positive and constructive atmosphere and helped clarifying roles and expectations, increasing the transparency level of all parties involved.

Friedrich (Fritz) Reinhard (VIT, Germany) visited the Centre on June 9, 2017 acting as internal auditor and auditing Interbull Centre's Quality Management System against the new ISO 9001:2015 standard.

The new standard presents some major changes especially affecting the management section with, for example, more focus towards the organisation and its context, the needs and expectations of relevant parties and risk assessments, than it was given in the past.

During the internal auditing particular attention was given to the parts of the quality management system mostly affected by such changes and in doing so Fritz was able to provide us with some useful recommendations regarding, for example, the inclusion of legislation and regulations within the description of Interbull Centre's context or planning a yearly review of the IT's resource's assessment.

All recommendations obtained during the internal audit will be addressed and incorporated in the Interbull Centre's quality management system in time for the external auditing scheduled for the 28 and 29 of November 2017 when Interbull Centre's external auditor, Erik Kutscher, will visit the Centre in order to upgrade its certification to the ISO 9001:2015 standard.

Two Swedish high school students, Axel Vikander and Ludwig Svensson, spent, as part of their computer studies, two days a week for a total of 10 weeks at the Interbull Centre and were involved mainly in Linux development and administration, i.e. learning and testing how to install, configure and administer Linux systems and specific Linux applications/services like MediaWiki and Gitlab, converting mercurial repositories to git repositories. They had also the opportunity to try some programming in Python.

5. SERVICE and OPERATIONS – Interbull Centre

Since the start of international evaluations in 1995, the service portfolio and output at the Interbull Centre has increased significantly; both through expansion of the international genetic evaluations to include new populations and new traits, and through the addition of new items.

On the following pages details on the full range of services and activities at the Interbull Centre are reported for 2016/2017.

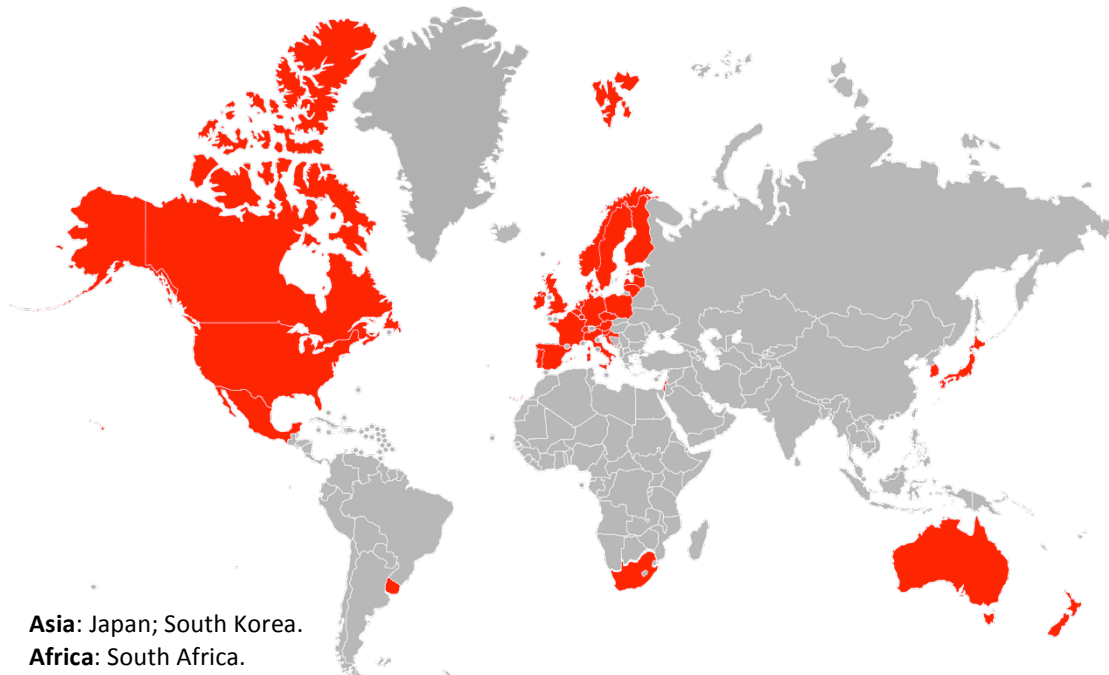
	Multiple Across Country Evaluations (MACE) for progeny tested bulls							Genomic Services			Beef
1995	PROD										
1999	PROD	CONF									
2001	PROD	CONF	UDDER								
2004	PROD	CONF	UDDER	LONG							
2005	PROD	CONF	UDDER	LONG	CALV						
2007	PROD	CONF	UDDER	LONG	CALV	FERT					
2008	PROD	CONF	UDDER	LONG	CALV	FERT	WORK				
2010	PROD	CONF	UDDER	LONG	CALV	FERT	WORK	GEBV test			
2011	PROD	CONF	UDDER	LONG	CALV	FERT	WORK	GEBV test	IG		
2014	PROD	CONF	UDDER	LONG	CALV	FERT	WORK	GEBV test	IG	GMACE	
2015	PROD	CONF	UDDER	LONG	CALV	FERT	WORK	GEBV test	IG	GMACE	AWW

PRODUCTION, CONFORMATION, UDDER Health, LONGevity, CALVing Trait, FERTility, WORKability, IG=InterGenomics, GMACE, AWW = InterBeef (AWW=Adjusted Weaning Weight)

Figure 5.1: Development of Interbull Portfolio

The Interbull Centre provides international genetic evaluation services for dairy and beef cattle in 35 countries from 5 continents; Europe: 26 countries; America's: 4; Oceania and Asia 2 each; Africa: 1.

Figure 5.2: Interbull's Global Reach



Asia: Japan; South Korea.

Africa: South Africa.

America's: Canada; Mexico; Uruguay, USA

Europe: Austria; Belgium; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Germany; Hungary; Ireland; Israel; Italy; Latvia; Lithuania; Luxemburg; The Netherlands; Norway; Poland; Portugal; Slovak Republic; Slovenia; Spain; Sweden; Switzerland; United Kingdom.

Oceania: Australia; New Zealand.

6. SERVICE and OPERATIONS – International Dairy Breed Evaluations (Interbull)

6.1. Validation of National EBVs and GEBVs



One of the most important roles played by Interbull is to test the national genetic evaluation results for consistency before using them as input for the international genetic evaluations. This is part of the Interbull evaluations quality control measures, but also serves as a public recognition that the national data supplied by Interbull Service Users is reliable. The Interbull Centre offered the validation services regularly during the period and Service Users are required to perform validation when:

services regularly during the period and Service Users are required to perform validation when:

- the national evaluation model or the genetic parameters change causing the REML sire standard deviation to change more than 5% between previous and current data,
- a population participates for the first time in a specific Interbull evaluation, or
- it has been more than 2 years since the last validation results were submitted to Interbull.

Results of validation tests are confidentially kept between the Interbull Centre and the service user. The fact that a given population participates in the Interbull evaluation for a given trait implies that it has passed validation. The only exception are the results from the GEBV test for production traits, which are made public to comply with determination of the Directorate of Animal Health and Welfare of the European Commission, who has accepted Interbull Centre recommendation to consider genomic evaluations validated by the GEBV test as valid procedures within EU states (official communication).

Methods I, II and III for validation of classic EBVs (based on performance data) follow the official test evaluations calendar. Validation results are submitted over a period of the three weeks after the commencing of the test evaluation and are processed before the end of the test run. The GEBV test results can be submitted by Service Users to the Interbull Centre at any time. Results will be processed as received.

6.2. MACE Evaluations

Interbull Centre test evaluation runs were performed in September-October 2016 and January-February 2017. Many changes in national and international evaluations have been introduced during this period, and are all described in the service reports published on the Interbull Centre website at http://www.interbull.org/ib/maceev_archive after each subsequent routine evaluation. Table 6.2 shows statistics on Interbull MACE evaluations.

Routine international genetic evaluations for Brown Swiss, Guernsey, Holstein, Jersey, Red Dairy Cattle and Simmental production traits were computed as scheduled in December 2016, April 2017 and August 2017. In April 2017 Mexico joined the HOL evaluation for the first time; France merged data from the Red Holstein population into the Black and White Holstein population; ZAF stopped participating to the GUE evaluation due to the reduction in size of their population.

Routine International genetic evaluations for Brown Swiss, Guernsey, Holstein, Jersey and Red Dairy cattle conformation traits were computed according to the same schedule as for production traits. In April 2017, data for GBR HOL have been provided by SRUC; SVN participated for the first time with data for HOL BCS; France merged data from the Red Holstein population into the Black and White Holstein population.

6.3. Additional conformation traits for BSW

Following the decision from the Steering Committee, during the month of May 2016 Interbull Centre conducted a pilot study to analyse additional BSW conformation traits. Of the nine countries currently participating in the Interbull BSW conformation evaluation, six (CAN, CHE, ITA, USA, DEA and SVN) provided data for the new traits at that time.

After reviewing the pilot run results, a large number of small issues were raised, including some concerns about low to medium correlations attributed to different trait definition among participating countries. It was decided to conduct a test run for such traits during September 2016. Results of the test run were reviewed by the Interbull Technical Committee during its meeting in Puerto Varas, Chile in October 2016. After reviewing the results, the Technical Committee made a positive recommendation to the Steering Committee with the advice to exclude the new traits “Pin Width” as considered as the same trait as the already estimated “Rump width”. The Steering Committee accepted their recommendation and advice and approved the introduction of the remaining 10 new traits in the December 2016 official evaluation.

Table 6.1: List of new conformation traits for BSW and summary of what participating countries have provided.

Name of Trait	Trait Code	Participating Countries								
		CAN	CHE	FRA	ITA	NLD	USA	DEA	SVN	GBR
Overall Frame	Ofr	X	X	X	X	NP	X	X	X	NP
Top Line	Tpl	X	X	X	X	NP	✘	X	X	NP
Overall Rump	oru	X	X	X	X	NP	X	X	X	NP
Rump Length	Rle	--	X	X	X	NP	X	X	X	NP
Pin Width	pwi	✘	—	NP	✘	NP	✘	✘	✘	NP
Thurl Position	Thp	X	X	X	X	NP	X	X	X	NP
Hock Quality	hoq	X	X	X	X	NP	✘	X	X	NP
Fore Udder Length	Ful	--	X	X	X	NP	✘	X	X	NP
Udder Balance	udb	--	X	X	X	NP	✘	X	X	NP
Teat Direction	Tdi	--	X	X	X	NP	✘	X	X	NP
Teat Thickness	Tth	--	X	X	X	NP	✘	X	X	NP

NP: Not Participating

✘: Initially submitted but later on rejected due to low raw correlations with other countries

--: Not submitted

Udder health traits evaluations for Brown Swiss, Guernsey, Holstein, Jersey, Red Dairy Cattle and Simmental were also computed according to the same schedule as production traits. In April 2017, France merged data from the Red Holstein population into the Black and White Holstein population; ZAF stopped participating to the GUE evaluation due to the reduction in size of their population.

Direct Longevity trait evaluations for Brown Swiss, Guernsey, Holstein, Jersey, Red Dairy Cattle and Simmental were computed according to the same schedule as for production traits. In April 2017,

Norway joined the evaluation for RDC for the first time; ZAF stopped participating to the GUE evaluation due to the reduction in size of their population.

Calving traits evaluations for Brown Swiss, Holstein and Red Dairy cattle were computed according to the same schedule as for production traits.

Female fertility traits evaluations for Brown Swiss, Guernsey, Jersey, Holstein, and Red Dairy Cattle were computed according to the same schedule as for production traits. In April 2017, France merged data from the Red Holstein population into the Black and White Holstein population; ZAF stopped participating to the GUE evaluation due to the reduction in size of their population. In August 2017.

International genetic evaluations for workability traits for Brown Swiss, Holstein, Jersey and Red Dairy Cattle were computed according to the same schedule as for production traits. In April 2017, data for GBR HOL have been provided by SRUC.

Table 6.2: Total number of populations per breed-trait group combination in the April 2017 routine Interbull genetic evaluation service.

Breed Group	Production (3)	Conformation (23; BSW 33)	Udder Health (2)	Longevity (1)	Calving (4)	Female Fertility (5)	Workability (2)	TOTAL (40)	Increment in the period	Number of publishable proofs (production)
Brown Swiss	11	9	10	10	6	9	7	62	0	10 615
Guernsey	5	4	5	5	0	5	0	24	-4 [†]	1 092
Holstein	30	23	28	20	16	19	11	147	-1 ^Δ	146 925
Jersey	11	9	8	9	0	9	5	51	0	12 404
Red Dairy Cattle	14	9	13	11	7	11	6	71	+1 [*]	15 631
Simmental	13	0	12	6	0	0	0	31	0	31 388
TOTAL	84	54	76	61	29	53	29	386	-4	218 055
Increment	-1	-1	-2	+1	0	-2	+1	-4		5 609

The number of traits by trait group is given in parenthesis.

Number of bulls with published MACE EBVs for production traits is shown in the last column.

[†] Reduction due to absence of ZAF data

^Δ: Reduction due to inclusion of FRR in FRA population

^{*}NOR joined the longevity evaluation for the first time

Table 6.3: Size of Interbull Centre operations for MACE.

Multiple Across Country Evaluation (MACE)	Dec 2014	Dec 2015	Dec 2016
Countries	34	33	34
Evaluation breeds	6	6	6
Country-breed-trait combinations ¹	1,833	1,825	1,899
Breed-trait evaluations	171	171	181
Animals in the pedigree database	23,084,236	24,981,462	27,896,152
Submitted national estimated breeding values	11,030,135	11,573,393	12,182,435
Qualified national estimated breeding values	6,086,142	6,348,587	6,654,381
Calculated international estimated breeding values	265,634,220	270,221,873	282,411,323
Distributed international estimated breeding values	102,965,388	103,108,350	106,979,713
Multiple Across Country Evaluation (MACE)	Sep 2014	Sep 2015	Sep 2016
Estimated across country genetic correlations ^{1a}	13,168	12,548	12,303
Validation tests ²	183	132	167

¹ Merging of 2 populations in one country during 2015

^{1a} Merging of 2 populations in one country during 2015 and 2016

² Subject to natural fluctuations

6.4. International Genomic Evaluation of Young Bulls (GMACE)

International genomic evaluation of young bulls (GMACE) is conducted for the time being only for Holstein breed, with 11 countries submitting nationally genomic breeding value estimates (GEBV) for up to 38 traits. Statistics on GMACE evaluations are presented in the table below.

Table 6.4: Size of the Interbull Centre operations for GMACE.

Genomic Multiple Across Country Evaluation (GMACE)	Dec 2014	Dec 2015	Dec 2016
Countries	32	31	31
Evaluation breeds	1	1	1
Country-breed-trait combinations	326	339	340
Breed-trait evaluations	38	38	38
Animals in the pedigree database	23,084,236	24,981,462	27,896,152
Submitted national estimated breeding values	12,398,617	17,324,351	19,428,147
Qualified national estimated breeding values	9,823,735	14,135,403	14,851,282
Calculated international estimated breeding values	129,211,446	153,062,674	155,263,850
Distributed international estimated breeding values ¹	363,705	322,431	536,340

¹ Change of publication rules during 2015 and 2016

Routine international genomic evaluations for Holstein were computed as scheduled in December 2016 and April 2017. Test evaluation runs were performed in September- October 2016 and January-February 2017. Beside EBVs used as input for MACE, also used as input for GMACE, GEBVs from the following countries and traits were used in the latest April routine run. Since January 2017, the Parameter-space approach proposed by Peter Sullivan (CDN) has been adopted. [Note: More details about the Parameter-space approach are available in the *GMACE reliabilities* for MAS update reported in chapter 8 of the present document, "Research and Development for dairy"].

Table 6.5: Number of traits and the number of countries submitting GEBVs in the April 2017 GMACE routine run, per trait group.

Breed	PROD (3)	CONF (21)	UDER (2)	LONG (1)	CALV (4)	FERT (5)	WORK (2)
HOL	11	10	10	9	7	10	7

6.5. Interbull genomic evaluation of BSW populations (InterGenomics)

Interbull Centre conducts genomic evaluation of the BSW population on behalf of seven (7) out of eleven (11) populations participating to the Brown Swiss international evaluation (“InterGenomics”). Statistics on InterGenomics evaluations are presented in the following table.



Table 6.6: Size of the Interbull Centre operations for InterGenomics.

InterGenomics (Genomic evaluation of BSW populations)	Dec 2014	Dec 2015	Dec 2016
Number of countries	8	8	8
Number of country-trait combinations	212	219	279
Number of unique submitted genotypes	16,599	20,561	26013
Number of genotypes entering imputation & genomic evaluation	15,808	19,500	23571
Number of distributed international GEBVs	Not previously reported		6,385,844

7 populations, 8 countries: CAN, CHE, DEU/AUT, FRA, ITA, SVN, USA

6.6. Interbull Code of Practice

The Interbull Code of Practice has been updated, on the basis of decisions by the Steering Committee, notably: **Chapter 5, Methods of international evaluation** including a specific paragraph describing the methodology applied for InterGenomics.

6.7. Changes in Interbull Service Users

Responsibility for submission of **Conformation and Workability data for GBR HOL** was officially transferred from CDN to SRUC as from the April 2017 routine evaluation. As a result, all GBR data is now provided by SRUC, while CDN continues to provide all Canadian data to Interbull.

We welcome Asociación Holstein de México as the latest Interbull Service User and thank Adriana Garcia Ruiz who worked hard to prepare data and validation tests so that Mexico could join the test run in January 2017. With the inclusion of the production traits of Holstein cattle from Mexico, the Interbull Centre now runs international genetic MACE evaluations for 30 Holstein populations.

7. SERVICE and OPERATIONS – International Beef Breed Evaluations (Interbeef)



Interbeef is ICAR’s Working Group responsible for international standards in beef cattle improvement (www.icar.org/pages/working_groups/wg_interbeef.htm). The Interbeef Working Group is also responsible for providing services of international genetic evaluations of beef traits and breeds, which it completes in collaboration with the Interbull Centre.

The Interbeef international test and routine evaluations are performed by the Interbull Centre for 10 European countries, 3 breeds (Charolais, Limousin and Simmental) and 2 traits (direct and maternal weaning weight). The analysis is based on genetic evaluations of raw phenotypes (as opposed to EBV’s) with over 61m EBV’s generated at the most recent proof run.

According to an agreement between the Interbull Centre and Interbeef WG the variance components are estimated by ICBF. For Interbeef research projects not performed by Interbull Centre, data from participating organisations are sent to Interbull Centre for renumbering of animal identification number, extraction of pedigree from IDEA and creation of the pedigree file needed in the project. All files are then sent to the research partner.

Performance data used in test and routine evaluations is carefully checked for consistencies between previous and current evaluations. For research projects, where no previous data is available, the files are checked for the correctness regarding file format and file content. Interbeef breeding values are estimated using MiX99, while reliabilities are calculated using MTEDC5 software. Variance components are estimated by ICBF using the DMU package.

Statistics on the latest Interbeef evaluation of the beef breeds Charolais, Limousin and Simmental are presented in the following table:

Table 7.1: Size of the Interbull Centre operations for international beef breed evaluations: Charolais, Limousin, Simmental beef to date.

Interbeef	Jan 2015	Jan 2016	Jan 2017
Countries	10	10	10
Evaluation breeds	2	2	3
Country-breed-trait combinations	18	18	22
Animals in the pedigree database	23,927,437	25,389,096	28,256,603
Submitted national estimated breeding values	7,210,100	7,472,166	7,977,376
International estimated breeding values ¹	69,569,165	57,996,544	61,142,008
Distributed international estimated breeding values	938,179	1,108,658	1,344,841

¹ Change of rules during 2015

7.1. Interbeef Code of Practice

The first Interbeef Code of Practice presented during the Interbeef working group meeting in Salzburg in March 2016 was revised and presented again at the Interbeef working group meeting in Chile in October 2016. A new version was presented and discussed at the working group meeting in Edinburgh in June 2017. The purpose of the document is to clearly clarify rules, roles and responsibilities of interested parties for the Interbeef evaluations and projects. The document will be made available on the ICAR webpage when approved.

7.2. Status of bull and type of proofs for beef

During the meeting in Salzburg in March 2016, a working group was appointed in order to provide suggestions for inclusion of codes for “status of bull” and “type of proofs” for beef data. The working group included representatives from VIT, INRA, ICBF and Interbull Centre.

During the Interbeef Technical Meeting in Chile in October 2016, the working group presented their recommendation on the subject: The recommendation for “Status of bull” was to use the same codes as for dairy with one additional code (05 = natural service bull, i.e. stock bull). The Technical committee approved the suggestion provided for Status of bull but decided not to introduce any “type of proofs” codes for beef. It was also decided to include the “status of bull” in the incoming 605 file (official file) and in the distributed publication file produced after each beef evaluation. File format was presented and approved for both files (605 and publication file). The status of bull was introduced in the beef evaluation starting from the January 2017 routine run.

7.3. Validation reports

The validation report was distributed according to plan together with the results from the beef routine evaluation in October 2016. The report was also discussed in the Technical Committee in Chile 2016 where it was decided to add some additional information to it. The revised report was introduced and distributed together with the results for the January 2017 routine run. The purpose of the report is to help participating organisations to get a first overview of the results from the evaluation. It will still be the member organisations’ responsibility to perform a final validation of the distributed results.

7.4. Adjusted weaning weight (‘AWW’)

Routine and test evaluations CHA, LIM and BSM

The working method and routines for the beef international evaluations are working well. The evaluations for beef have expanded to also include Simmental beef animals (BSM). The first routine run for Simmental beef was performed in January 2017. The participating countries were DEU, DFS, CHE and IRL. The number of participating countries for the international genetic evaluation for CHA, LIM and BSM for Adjusted Weaning Weight (‘AWW’) can be found in Table 7.2.

Table 7.2: Breeds, participating populations and number of publishable records in the international evaluation for 'adjusted weaning weight' (aww).

Breed	Populations	Number of publishable records in distribution file	
		1601r	1701r
CHA	6 (IRL, CZE, DFS, FRA, DEU, CHE)	531 364	561 820
LIM	8 (CZE, DFS, ESP, GBR, IRL, FRA, DEU, CHE)	577 294	584 446
BSM	4(DEU DFS CHE IRL)	-	198 575

8. RESEARCH and DEVELOPMENT - Dairy

The following is a brief summary of research and development activities conducted at the Interbull Centre or with the involvement of the Interbull Centre staff since September 2016.

8.1. Expanding InterGenomics

InterGenomics- Brown Swiss (2.0)

Since “InterGenomics 2.0” was adopted in April 2014, InterGenomics partners have shared information on young bulls and advertised national computation on InterGenomics genotype pools as “InterGenomics”. The final step in completing “InterGenomics 2.0” has now been set in motion (and is expected to be completed in 2017) with the implementation and validation of a quality protocol for national computations on InterGenomics genotype pools in order to assure the overall quality of the computations done at national level.

InterGenomics-Holstein

Many of Interbull’s current customers from Holstein populations involved in MACE asked for an investigation on how the InterGenomics model could be used by Interbull Centre to provide services required for genomic selection to these countries. Following the considerable interest expressed for such service during a workshop in Ljubljana, the Steering Committee approved an InterGenomics-Holstein Research Run to be conducted in order to investigate the practical implementation of such service. Ireland, Slovenia, Croatia, South Africa, Portugal and Uruguay participated in this Research Run, which was conducted during the period May - August 2017. Results from the research run will be presented and discussed in Tallinn on 29 August 2017 in a follow up workshop to the Interbull Annual Meeting.

8.2. Mendelian sampling trend validation

The working group has continued investigating the results from the pilot study held in February 2014 in order to find plausible explanations for the country-breed-traits combinations failing the Mendelian test validation (about 26% of the data collected in 2014). As the final step of investigation, 4 countries were contacted for further information about their data. Responses from these countries confirmed that the software had correctly identified a problem, which has consequently been corrected by those countries.

In light of this, during the Chile meeting the Interbull Technical Committee made the following recommendations to the Steering Committee, which subsequently approved them:

- 1) To introduce the test as mandatory for production traits during September 2017 test run and for other traits from January 2018 test run;
- 2) The results of the MS-validation test alone will not be used to reject the data. They will be used in conjunction with the other validation tests to create a more clear picture of the validity of the national genetic evaluation model;
- 3) Interbull Centre will summarise the results and report them to the Interbull Technical Committee as soon as they become available.

The Interbull Centre thanks the members of the MS-validation working group for their good work. The MS-validation test software has been made available to countries under the IDEA/Software page.

8.3. MACE robust to bias in trends; 'Robust MACE'

Since 2013, research collaboration between INRA, Institute de l'Elevage and Interbull Centre has been studying the impact on international breeding values of using a MACE model robust to bias in trends of national genetic evaluations. In December 2015, the Interbull Centre took over the responsibility of carrying out the necessary runs and summarising the results. A working group has been formed in order to oversee the general design of the studies and results, including the type of models to be compared, and the parameters to be considered for comparison of models. Recent results showed that Robust Mace is over correcting the bias for some traits and not for others. Discussion inside the working group has led to the decision to change the de-regression model in MACE where a simple country year effect was still used. Modifying the de-regression program by including a country*birth year effect instead of a country effect solved the problem of over-correction. The working group has now one main question that still needs to be answered: how can we assess which model is better? Discussion about the method that should be used in order to answer this question is now on-going inside the working group and with SAC members.

8.4. GMACE reliabilities for MAS

Following enquiries after the December 2015 GMACE run, Pete Sullivan (CDN, Canada) has been investigating a potential upward bias in GMACE reliabilities for MAS. The parameter-space GMACE approach was suggested to the Interbull Technical Committee. In this approach, new residual correlations are derived to account for different heritabilities among country-traits. Parameter space restrictions were used to bound GMACE results on the scale of each country. The use of Predicted National Reliabilities (the MP.5 approach) is no longer used for the GMACE genetic evaluations. For reliability approximations, MP.5 is no longer used for reliabilities that have a defined parameter space, but MP.5 continues to be used to improve reliability predictions in countries where a bull does not have a national GEBV (i.e. where a parameter space is not defined). Following approval by ITC, the parameter-space GMACE was implemented during the January 2017 GMACE test run.

8.5. WHFF – Genetic Traits

Following a request from WHFF to assist with the **international exchange of information on these genetic traits**, the Interbull Centre's database for the collection of animal trait information ('AnimInfo') has been developed for the collection of the WHFF genetic trait information. Subsequently, tests have been carried out with Interbull Centre's customers in Germany, The Netherlands and Great Britain to upload this information. During the reporting period, these three countries uploaded the information on more than 160 000 genetic tests for 100 000 Holstein cows and bulls to the Interbull Centre's Database.

Currently 31 National Genetic Evaluations Centres (see www.interbull.org/ib/users_map) are involved in International Bull Evaluations for Holstein cattle. All 31 NGEC's will have the opportunity to join the exchange of information on genetic traits once the service will be introduced.

9. RESEARCH and DEVELOPMENT - Beef

9.1. Pilot run crossbred animals

Two pilot runs with the inclusion of crossbred animals in the AWW evaluation for CHA and LIM were performed at the Interbull Centre during 2016 and 2017. The second pilot run tested a new approach of including crossbred animals in the international evaluations compared to the approach used in 2016. With the new approach, pedigree information for the crossbred animals was uploaded in IDEA/pedigree while the breed composition was uploaded in IDEA/AnimInfo. The breed composition was then used to create phantom groups. New data with the inclusion of crossbred animals was provided by Ireland, while data from the January routine run 2017 with no crossbred animals were used for the other member organisations participating in the routine evaluation. The result from the new pilot run was presented and discussed during the Beef Technical meeting in June 2017 where it was decided to investigate the effect of using phantom groups in the beef evaluation further.

9.2. Maternal publication rules

During 2016, Interbull Centre and INRA have been working on defining and testing maternal publication rules for the beef evaluation. During the Technical Committee meeting in Chile 2016, the results from this cooperation were presented. A decision was then taken to apply the proposed rules on the spring test evaluation in 2017 and test the relative impact on the results. Combined maternal publication rules were presented at the Edinburg meeting in June and new files with the combined rules have been distributed to INRA for further investigation.

9.3. Calving traits

The latest results from the calving trait research project were presented in Chile in 2016. During spring 2017, a small working group with representatives from Interbull Centre, CMBC, ICBF and INRA held several follow up meetings. During the Beef Technical Committee meeting in June 2017, the first breeding values and reliabilities for calving traits were discussed. Given the promising results it was decided to hold a parallel test evaluation at CMBC and the Interbull Centre during the autumn of 2017 for LIM and CHA. The plan is to have the first routine evaluation for calving traits for LIM and CHA in January 2018 and a test run for Beef Simmental during March test run 2018. A data call for the test evaluation scheduled during the fall will be sent out to member organisations in August/September. The file format for calving traits will be adjusted so it will be better harmonised with the file format for animal weaning weight. The harmonisation of the file formats should lead to small or no changes to the existing workflow for estimating beef breeding values and reliabilities at the Interbull Centre.

Table 9.1: Breeds and populations participating in the research project for the calving traits 'birth weight' (bwt), 'calving ease' (cae) and 'stillbirth' (stb).

Breed	Trait	Populations
CHA	bwt	5 (CHE, CZE, DFS, FRA, IRL)
	cae	5 (CHE, CZE, DFS, FRA, IRL)
	stb	3 (CHE, IRL, DFS)
LIM	bwt	6 (CHE, CZE, DFS, FRA, GBR, IRL)
	cae	6 (CHE, CZE, DFS, FRA, GBR, IRL)
	stb	3 (CHE, IRL, DFS)

9.4. Female fertility

The research project for CHA and LIM fertility traits is performed by vit in Germany. Following presentation of the latest results at the Interbeef Technical Committee in June 2017, it has been decided to issue a new data call in August/September 2017 and to change the file format. The Interbull Centre will provide access to Interbull Centre's servers for vit to perform the next research run during fall 2017; the results will be presented in Auckland in February 2018.

Table 9.2: Breeds and populations participating in the research project for the female fertility traits 'age at first calving' (afc), 'calving interval' (cai) and 'number of calvings' (nca).

Breed	Trait	Populations
CHA	afc	4 (DFS, IRL, DEU, CHE)
	cai	4 (DFS, IRL, DEU, CHE)
	nca	3 (FRA, DEU, CHE)
LIM	afc	5 (DFS, GBR, IRL, DEU, CHE)
	cai	5 (DFS, GBR, IRL, DEU, CHE)
	nca	4 (GBR, FRA, DEU, CHE)

9.5. Carcass traits

During the Interbeef Technical meeting in June 2017, a research project for carcass traits was discussed. SRUC, in the UK, was appointed to work on defining the traits to be included in a carcass research project. A proposal on traits and file format will be presented to the Technical Committee in Auckland in February 2018, which is expected to be followed by a data call for carcass traits during spring or summer 2018.

9.6. AnimInfo for beef

The Interbeef Working Group has expressed its interest in using AnimInfo to exchange additional information for beef cattle: There is an ongoing project to investigate how AnimInfo can be used to exchange information if an animal is genotyped or not. There are also ongoing discussions on exchanging information on recessive traits via AnimInfo.

10. RESEARCH and DEVELOPMENT - Infrastructure

10.1. GenoEx

The implementation of the International Genotype Exchange Platform “GenoEx” has proven to be even more complicated than originally envisaged.



The services to be provided through this platform are differentiated into three categories: Parentage SNP Exchange (GenoEx-PSE), Genotype Data Exchange (GenoEx-GDE) and Customised Genotype Repository (GenoEx-CGR).

Although some of the principles and permission at the start-up of GenoEx-PSE may seem simple, nonetheless more complex principles and permission need to be taken into account for future services. In addition, the system purchased, which requires a professional working with it interactively, has been built for human trial data with unique data (SNP) per subject, whereas within GenoEx-PSE multiple and duplicate records need to be dealt with for each animal.

During the reporting period, much effort has gone into creating such flexibility and scalability into GenoEx, and the platform is designed to:

- Store SNP data on several database nodes (servers);
- Handle lots of concurrent input/output;
- Interoperate between different database engines and tables (e.g. with BC|SNPmax),

While it also allows for:

- Custom user interface;
- Faster/cheaper changes;
- Full control of integrations with other data at the Interbull Centre.

10.2. IDEA: AnimInfo

AnimInfo was introduced in the January 2016 routine run. AnimInfo is a module in the Interbull Centre Data Exchange Area (IDEA) website which allows member organisations to report additional information connected to existing animals in the pedigree module and to use IDEA as an exchange area for information.

The system was developed to allow different security levels for the information, which means that for some of the information only the authorised organisation may view and upload, for other information it is possible for some or all organisations to view and/or upload. The first type of additional information in AnimInfo was “CROSSBREED” information: percentage red Holstein genes in Simmental dairy.

“Exchange of Genetic Traits” through AnimInfo

During the reporting period, the module was updated to accommodate data for the **international exchange of information on genetic traits**, as reported in paragraph 8.6 under “WHFF – Genetic Traits”. AnimInfo now holds information on genetic traits for Holstein only. The Interbull Centre is receptive to requests for similar activities for other breeds, as long as the coding and nomenclature have been harmonised (at least) within breeds.

“Additional GMACE info” in AnimInfo

The two GMACE input files, file formats 733 and 734, were previously handled as flat files and were directly used in the GMACE evaluation process.

In order to increase (and automate) the quality control, and improve the integration of the information in the GMACE evaluation process, a new database module has been created in IDEA’s AnimInfo for storage of the information content of these two files.

A conversion programme was written and made available to all national genetic evaluation centres to facilitate uploading the data to the AnimInfo database. The new module was successfully tested in the January 2017 test run and implemented in the April 2017 routine run.

Additional information in AnimInfo

Genetic Evaluation Centres and Service Users are invited to propose new types of information; the use of XML file format allows easy future development of the AnimInfo.

The following pages provide basic information on XML: <https://en.wikipedia.org/wiki/XML> and <https://wiki.interbull.org/public/XMLdigest>, while a manual on how to use the module is available on: (https://wiki.interbull.org/public/IDEA_animinfo_manual)

11. RESEARCH and DEVELOPMENT - Funding

In addition to funds raised from service fees, research and development activities at the Interbull Centre are financed by grants from the Swedish University of Agricultural Sciences (SLU) and the European Union, Co-funding for the development of GenoEx-PSE services has also been granted by ICAR. Contributions of the above organisations to the development of Interbull Centre services are gratefully acknowledged. Contributions made to R&D activities from participating organisations leading to improved or expanded Interbull Centre services are also much acknowledged.

11.1. International Consortia

Interbull Centre's involvement in the following international consortia is focused on providing services to the project (enabling international exchange of data; quality control), and on developing services to the Interbull Community (several of whom are involved in the projects), in line with Interbull's Strategic plans:

"GenTore"

Project title: *Genomic management tools to optimise resilience and efficiency*

Project Period: 1 June 2017 – 31 May 2022 (60 months);

Funding source: European Commission; Horizon2020, Research and Innovation action;

Website: www.GenTORE.eu (or www.interbull.org/ib/gentore)

Twitter: [@GenTORE_2020](https://twitter.com/GenTORE_2020)



"ReDiverse"

Project title: Biodiversity Within and Between European Red Dairy Breeds - Conservation through Utilization

Project Period: 1 September 2017 – 31 August 2020 (36 months);

Funding source: European Commission; Era-Net SUSAN (ID 29)

Website: www.interbull.org/ib/rediverse

"MethaBreed"

Project title: *Implementation of comprehensive phenotyping and breeding strategies across North-West Europe for the reduction of enteric methane emissions from dairy cattle.*

Project Duration: 42 Months.

Funding source: European Union; European Regional Development Fund; Interreg North-West Europe

Funding status: MethaBreed was submitted in June 2017 for the 2nd and Final Stage of application. A decision on funding is expected in September 2017.

11.2. International SNP Evaluation

The Steering Committee has approved funding for an 18-month feasibility project on International SNP Evaluations as presented and discussed by Mike Goddard during the 2017 Interbull Technical Workshop in Ljubljana in February 2017. We are currently developing plans and agreements (including the division of work between Australia and Uppsala, access and sharing of data and results). The latest available details will be provided during the Interbull Meeting in Tallinn.

12. SERVICE CALENDARS

Schedules for International dairy and beef evaluations at the Interbull Centre are released upon approval by the Interbull Steering Committee and the Interbeef Working Group respectively.

12.1. Service Calendar – Interbull (Dairy)

During the period comprehended by this report, routine evaluations for production, conformation, udder health, longevity, calving, female fertility and workability traits were scheduled with the following release dates:

2016	December 06	2017	April 04	August 08
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Test evaluation runs for production, conformation, udder health, longevity, calving, female fertility and workability traits took place as follows:

2016	September	2017	January
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Future Routine and Test evaluations for production, conformation, udder health, longevity, calving, female fertility and workability traits have been scheduled, and are on the Interbull website:

www.interbull.org/ib/servicecalendar.

12.2. Service Calendar – Interbeef (Beef)

During the period comprehended by this report, routine evaluations for animal weaning weight were carried out for CHA and LIM with the following release dates:

2016	November 7	2017	March 22
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Test evaluation runs for animal weaning weight (aww) took place as follows:

2016	September	2017	June
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Future Routine and Test evaluations for Interbeef have been scheduled, and are on the ICAR website:

www.icar.org/index.php/technical-bodies/working-groups/interbeef-working-group/

13. TASK FORCES and WORKING GROUPS

During the reporting period, Interbull Centre staff was involved in the following Task Forces and Working Groups.

Interbull-ICAR Operations Task Force (IB-ICAR TF)

Toine Roozen is the secretary of the Interbull-ICAR Operations Task Force. The Task Force provided an interim reports on Interbull-ICAR operational issues during the ICAR meetings in Puertoa Varas (October 2016) and Edinburgh (June 2017), and is expected to provide its final report during the ICAR meeting in Auckland in February 2018.

GenoEx-PSE Implementation Task Force (GenoEx-PSE ITF)

The GenoEx-PSE ITF, chaired by Toine Roozen, was established to implement GenoEx-PSE.

GenoEx-PSE Expert Group (GenoEx-PSE EG)

Hossein Jorjani is the secretary of the GenoEx-PSE EG, which provides expert advice to the GenoEx-PSE ITF.

The functions of the GenoEx-PSE ITF and GenoEx-PSE EG have been assumed by the DNA Working Group which was founded in October 2016 and is chaired by Brian Van Doormaal

Interbeef Working Group

Eva Hjerpe has monthly conference calls with members of ICAR's Interbeef Working Group. Other members of staff have attended these calls as and when required. Interbull Centre was represented at the Interbeef meetings in Edinburgh on 12 and 13 June 2017 by Eva Hjerpe and Toine Roozen.

Parentage Recording Working Group

Hossein Jorjani is a member of ICAR's Parentage Recording Working Group.

14. MEETINGS

14.1. Annual Meetings

The SC agreed to organise the Interbull Annual Meetings jointly with ICAR in even years (2018, 2020, etc.), while alternating the odd years between EAAP (2017, 2021, etc.) and ADSA (2019, 2023, etc.). The Interbull Annual Meetings are scheduled to take place as follows:

2018 (February): The Joint ICAR-Interbull Meeting will precede WCGALP in Auckland, New Zealand;

2019 (June): The 2019 Interbull Annual Meeting will be organised in collaboration with ADSA in Cincinnati, Ohio;

2020 (June): The Joint ICAR-Interbull Meeting will be held in Leeuwarden, The Netherlands;

2021 (August): The 2021 Interbull Annual Meeting will precede the EAAP meeting in Davos, Switzerland.

Updated information on future Annual Meetings and other meetings that may be of interest to the Interbull Community can be found on: http://www.interbull.org/ib/ibc_future_events.

14.2. 2016 Interbull Annual Meeting

The 2016 Interbull Annual Meeting was held in conjunction with the ICAR Biannual meeting in Chile.

During the Interbull Open Meetings the following topics were discussed:

- Methods and practical experiences for parentage analysis
- New developments in genomic methodologies and evaluations
- Genetic evaluation of new phenotypes

PowerPoint presentations of the open meetings are available through the Interbull Centre website: http://www.interbull.org/ib/puerto_varas_presentations.

The Interbull Centre Activity Report was presented to the approximately 150 attendees of the business meetings, and can be downloaded for details on personnel, finances, budgets, activities and plans from www.interbull.org/ib/itbcreports.

In addition to the Interbull Open Meeting and Business Meetings on 24 and 25 October, the Interbull Technical Committee and Steering Committee held meetings on 23, 24 and 26 October.

14.3. 2017 Interbull Technical Workshop

More than 70 people participated in the 2017 Interbull Technical Workshop and satellite meetings in Ljubljana, Slovenia (6-8 February 2017), and discussed, through an interesting exchange of international and national experiences of the single step evaluation methodology, how MACE could handle this genomic information and also how countries should deal with MACE when they are using 'single step'. We also explored how conventional validation methods could be adapted in order to deal with the effects introduced by genomic selection.

For the development of a potentially new Interbull service, a possible Interbull feasibility project on international meta-analysis of SNP effects was presented; through international collaboration participating countries could estimate more accurate SNP effects and therefore more accurate genomic EBVs. In order to implement such a service, an idea on how to make optimal use of the Interbull community's knowledge and expertise was presented.

Satellite meetings were organised for Interbull Steering and Technical Committees and InterGenomics Brown Swiss and Holstein.

Follow up of these topics, have resulted in these same topics being addressed in the Interbull Annual Meetings in Tallinn and Auckland

Presentations are available on: www.interbull.org/ib/2017_technical_workshop.



Figure 8.3: Activities during the 2017 Interbull Workshop.

14.4. Interbeef Meeting

Interbull Centre staff attended and presented at the Interbeef meeting in Edinburgh in June 2017: Toine Roozen and Eva Hjerpe.

15. COMMUNICATIONS and PUBLICATIONS

15.1. Interbull Bulletin

The Interbull Bulletin contains the state-of-the-art in genetic evaluation methods, as well as the most recent information on national and international implementations. During the period comprehended by this report the 50th issues of the Interbull Bulletin has been published: the proceedings of the 2016 Interbull Annual Meetings in Puerto Varas, Chile.

<https://journal.interbull.org/index.php/ib/issue/archive>

15.2. Interbull Web Site



Further developments to the Interbull home page (www.interbull.org) have been done during the period covered by this report based on the outcome of the usability test performed last year. In particular, the structure of the page has been changed so that the content of submenus is displayed simply by hovering over the main menu link. This simple change should help visitors localising the information they are seeking more easily.

15.3. LinkedIn

The Interbull Centre company page is available on LinkedIn: Interbull Centre staff members have linked their individual profiles to the company profile.

15.4. Publications of Interbull Centre staff as authors or co-authors

Rozen, A.W.M., Jorjani, H. & Van Doormaal, B.J. 2017. GenoEx-PSE: International Genotype Exchange Platform - Parentage SNP Exchange. In: ICAR Technical Series no 21: Proceedings of the 40th ICAR Biennial Session held in Puerto Varas, Chile, 24-28 October 2016 (ISSN: 1563-2504; ISBN: 92-95014-17-0). pp. 71-78.

Sánchez-Molano, E., Tsiokos, D., Chatziplis, D., **Jorjani, H.**, Degano, L., Diaz, C., Rossoni, A., Schwarzenbacher, H., Seefried, F., Varona, L., Vicario, D., Nicolazzi, E.L., Banos, G. 2016. A practical approach to detect ancestral haplotypes in livestock populations. BMC genetics 2016; 17: 91. doi: 10.1186/s12863-016-0405-2

Appendix 1: Interbull Committees and Working Groups

Interbull is managed by an ICAR-appointed **Steering Committee**, consisting of 9 members from different countries. The objectives for the Steering Committee are to set strategy, priorities, work plans and budget for Interbull Centre. Since 2003 the Steering Committee is supported by two expert groups: the **Scientific Advisory Committee** (SAC) and the **Interbull Technical Committee** (ITC).

Interbull Steering Committee

During the Reporting Period, the following Interbull Steering Committee members have been proposed (and subsequently approved by the ICAR Board meeting on 29 November 2016):

- New term of four years for Enrico Santus as representative of Italy, Spain and Portugal;
- Matthew Shaffer to replace Daniel Abernethy for the remainder of his term (1 year) as the representative of Oceania.

Daniel Abernethy has been a valued SC member since 2013, being a proponent of strong Interbull governance, but recently left his role in charge of the genetic evaluations in Australia. We like to thank Daniel for his contributions and welcome Matthew Shaffer - Chief Executive Officer of DataGene, Australia - who took over Daniel Abernethy's SC membership as the representative for Oceania until the end of the current term (2017).

Interbull Steering Committee Composition and term times.

Name	Representing	Member since	End of term
Reinhard Reents, PhD VIT, Germany	Germany, Austria and Switzerland. Chairperson Interbull Steering Committee	2000 Chair since 2006	2019
Brian Van Doormaal, MSc CDN, Canada	America's	1996	2017
Marj Faust, PhD ABS Global, Inc., USA	America's	2009	2017
Marija Klopčič, PhD, Associate Professor University of Ljubljana, Slovenia	Eastern Europe	2013	2017
Matthew Shafer, PhD DataGene, Australia	Oceania	2016	2017
Sophie Mattalia, MSc INRA-SGQA, France	France and Wallonia	2006	2018
Gert Pedersen Aamand, PhD NAV, Denmark	Nordic Countries Chairperson Interbull Technical Committee	2004	2019
Marco Winters, PhD AHDB Dairy, Great Britain	UK, Ireland and The Netherlands	2015	2019
Enrico Santus, PhD ANARB, Italy	Italy, Spain and Portugal	1996	2020
<i>Daniel Abernethy, BSc, MBA ADHIS PTY, Australia</i>	<i>Oceania</i>	<i>2013</i>	<i>2016</i>

For contact details see www.interbull.org/ib/steeringcommittee.

Interbull Technical Committee

The objective of the Interbull Technical Committee (ITC) is to identify and review technical issues that may be essential for providing a high quality service to countries participating in the international genetic evaluations. This objective is achieved via the consideration of new or improved methods that increase the efficiency and accuracy of the evaluation service, while safeguarding the transparency of the services and its acceptability by Interbull Centre Service Users and additional stakeholders. The ITC comprises of genetic evaluation specialists who:

- Test questions posed by the Interbull Community
- Test new proposal, identifying and solving issues the Interbull Centre and/or Interbull Service Users may run into when implementing new protocols.

Members of the Interbull Technical Committee

- Gert Pedersen Aamand, PhD, Chairperson of ITC, NAV, Denmark
- Gerben de Jong, PhD, CRV BV, The Netherlands
- Hossein Jorjani, DVM, PhD, Professor, SLU, Sweden
- Gerrit Kistemaker, PhD, CDN, Canada
- Tom Lawlor, PhD, Holstein USA, USA
- Zengting Liu, PhD, VIT, Germany
- Raphael Mrode, PhD, SRUC, Great Britain
- Esa Mäntysaari, PhD, professor, LUKE, Finland
- Peter Sullivan, PhD, CDN, Canada
- Paul VanRaden, PhD, USDA, USA

For contact details see www.interbull.org/ib/technicalcommittee

Scientific Advisory Committee

The objective of the scientific advisory committee is to propose methodological developments that are needed to ensure the strategic direction, scientific soundness, and long-term progress of the Interbull Centre services, and to act as a resource body to the Interbull technical committee and steering committee on scientific issues.

Members of the Interbull Scientific Advisory Committee

- Vincent Ducrocq, PhD, senior scientist, Chairperson of SAC, INRA, France
- Daniel Gianola, PhD, Professor, University of Wisconsin, USA
- Mike Goddard, DVM, PhD, Professor, University of Melbourne, Australia
- Ignacy Misztal, PhD, Professor, University of Georgia, USA

For contact details see www.interbull.org/ib/scientificadvisorycommittee

Interbeef Working Group

Interbeef is ICAR's Working Group responsible for international standards in beef cattle improvement. The Interbeef Working Group is also responsible for providing services of international genetic evaluations of beef traits and breeds, which it completes in collaboration with the Interbull Centre. For further details see: <http://www.icar.org/index.php/technical-bodies/working-groups/interbeef-working-group/>

Members of the Interbeef Working Group

- | | |
|------------------------------------|---|
| • Andrew Cromie, Ireland, Chairman | • Emma Carlén, Sweden |
| • Robert Banks, Australia | • Laurent Griffon, France |
| • Pavel Bucek, Czech Republic | • Friedrich Reinhardt, Germany |
| • Kirsty Moore, United Kingdom | • Japie Van de Westhuizen, South Africa |
| • Mauro Fioretti, Italy | |

