EU-PLF

Deliverable 1.4

Protocols about farm assessments based on gold standards

Project acronym: *EU-PLF*
Project title: *Bright Farm by Precision Livestock Farming*
Grant Agreement number: *311825*
Coordinator: *Daniel Berckmans*
Funding Scheme: *FP7-KBBE.2012.1.1-02*

Due date of deliverable:	Month 36
Actual submission date	
Start date of the project:	November 1, 2012
Project duration:	4 years

Work package:	WP1
Task(s)	Task 1.3
Lead beneficiary for this deliverable:	Bristol
Editor:	
Authors :	
Quality reviewer:	

Project co-funded by the European Commission within the Seventh Framework programme (2012)		
Dissemination level		
PU	**Public**	
PP	**Restricted to other programme participants (including the Commission Services)**	
RE	**Restricted to a group specified by the consortium (including the Commission Services)**	
CO	**Confidential, only for members of the consortium (including the Commission Services)**	

INTRODUCTION

In Tasks 1.1 and 1.2 a set of Key Indicators (KIs) to capture the main aspects of the performance of a farm regarding animal welfare, animal health, production and environmental load were described for dairy cows and calves, broilers and fattening pigs (see Deliverables D1.1 and D1.2). Moreover, in relation to each defined KI in the different domains of animal welfare and health, production and
environmental load, a reference method, a so-called 'gold Standard' for determining the value of that indicator at farm level was defined. These Gold Standards are used during the project as reference to test and validate the performance of PLF techniques in measuring KIs at farm level.

Task 1.3 investigated the application of a number of PLF technologies to assess specified new Key Indicators (KIs) in dairy, broiler and calf husbandry. Specific gold standards related to these new KIs were applied by the scientist in the different institutions that conducted these studies.
In Task 1.4 regional people, trained to apply gold standards, assessed farms that were participating in field tests of PLF technology (WP2). This Deliverable describes the protocols that were applied for the different species.

DESCRIPTION OF PROTOCOLS APPLIED AS GOLD STANDARDS

Broilers

The Welfare Quality® protocols for Poultry were taught to assessors from Italy, The Netherlands, UK, and Spain. The assessors carried out both classroom and 'on farm' training activities to familiarize them with the scope, extent and procedures required by the assessment of the WQ protocols. The competency requirements were: practical capacity to effectively assess to the requirements of the Welfare Quality® protocol - determined by observing a practical assessment on a real farm. Assessment of measures against the use of reference test video and photographic material. The assessors were required to explain how they would go about assessing welfare in real farm situations, including practical issues, equipment required, correct sample size, level of engagement etc. The assessors were examined on their capacity to interact effectively with the producer (farmer) to gain the required information in a professional manner. The assessors were tested against a set of established gold standard reference material.
The 'on farm' assessment included; A requirement to explain how they would go about assessing the farm, practical issues, sample size, approach to the producer. The assessors demonstrated the use of measures reliant on practical assessment techniques with animals present – for example, the use of avoidance distance based tests where only use against live animals is possible. The assessors were assessed on 'professional assessment manner' and a careful, considerate approach to handling animals.
For pigs 8 assessors (local veterinarians) in France, The Netherlands, Spain and Hungary were trained to apply the relevant protocols.
To date, over 120 farm visits have been made (UK 62, IT 18, NL 30, ES 9). The birds have been assessed at week 3, 4 and 5 (and recently, for a number of farms, at weeks 1,2,3,4 & 5). The bird weight was taken from farmer weighings (birds were not picked

up for weighing), house dimensions were checked by the assessors who made the on-farm visits. The stocking density was calculated using bird weights from farmer records, bird numbers from farmer records (including cull and mortality records) and from house dimensions provided by the farm, and checked at the visit by the assessors. The farm was assessed using the protocols described in the Welfare Quality (WQ) assessment system. The full protocols can be found at http://www.welfarequalitynetwork.net/network/45848/7/0/40. In summary, the assessor carried out assessments against the WQ system for the following measures:

	Welfare Criteria		**Measures**
Good feeding	1	Absence of prolonged hunger	
	2	Absence of prolonged thirst	Drinker space
Good housing	3	Comfort around resting	Plumage cleanliness, litter quality, dust sheet test
	4	Thermal comfort	Panting, huddling
	5	Ease of movement	Stocking density
Good health	6	Absence of injuries	Lameness, hock burn, foot pad dermatitis
	7	Absence of disease	On farm mortality, culls on farm
	8	Absence of pain induced by management procedures	
Appropriate behaviour[1]	9	Expression of social behaviours	
	10	Expression of other behaviours	
	11	Good human-animal relationship	Avoidance distance test (ADT)
	12	Positive emotional state	Qualitative behavioural assessment (QBA)

Title	**Drinker space (birds per drinker)**
Scope	Resource-based measure: Broiler chicken
Sample size	Animal unit
Method description	Calculate the total number drinkers in the house according to drinker type. **Nipples:**

[1] *At the slaughter house, no management procedures such as beak trimming, claw cutting etc are carried out. However, stunning and slaughter processes are carried out and these are assessed under the heading 'assessed at slaughter'

	Calculate nipples per meter and then multiply by total track length. **Cups:** Calculate number of cups per meter and then multiply by total track length. **Bell drinkers:** Estimate number of bells in the house. The total number of birds in the house must also be provided.
Classification	**Flock level:** **Number** of nipples **Number** of cups **Number** of drinkers **Number** of birds

Title	**Plumage cleanliness**
Scope	Animal-based measure: Broiler chicken
Sample size	Sample size according to protocol as described in the full WQ document at http://www.welfarequality.net/everyone/45630/9/0/22
Method description	Before measurement, increase the light intensity inside the house if necessary (as usually done by animal unit manager when inspecting the flock). Birds use their feathers to keep warm, to protect themselves from moisture dirt and skin infections. Clean and healthy birds spend a lot of time keeping their feathers 'preened' – and if their feathers become wet or soiled with litter (bedding), faeces or dirt, the feathers can lose their protective properties and so severe soiling with either dirt or faeces can have significant effects on bird welfare. Assess the cleanliness of the plumage. Walk slowly inside the house and catch birds one by one (10 in the same location). Examine the breast of the birds and score using a recording sheet. If birds are very mobile (for example in free range systems) it may be necessary to pen small groups of birds to catch them. Score using the classification portrayed in picture below, according to the scoring described below.
Classification	**Flock level:** **Percentage** of birds scoring '0' **Percentage** of birds scoring '1' **Percentage** of birds scoring '2'

	Percentage of birds scoring '3'

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Title	**Litter quality**
Scope	Resource- and management-based measure: Broiler chicken
Sample size	Sample size according to protocol as described in the full WQ document at http://www.welfarequality.net/everyone/45630/9/0/22
Method description	Assess the quality of the bedding in the house according to the parameters described below. Poor litter quality may reflect difficulties in managing the litter which may reflect in skin and foot lesions related to poor litter quality. <u>General comment on sampling and litter thickness:</u> Look at a number of locations in the house (minimum 4, maximum 6) (i.e. under drinkers and feeders, along the edges of the house and close to the doorways) to check whether there is a big variation in litter thickness across the house. If so, can you detect areas of litter which differ in appearance, or is the litter very uniform? If areas are different, then ensure that you sample using the method described from these areas of differing litter to reflect overall variability in the house.
Classification	**0** – Completely dry and flaky, i.e. moves easily with the foot. **1** – Dry but not easy to move with foot. **2** – Leaves imprint of foot and will form a ball if compacted, but ball does not stay together well. **3** – Sticks to boots and sticks readily in a ball if compacted. **4** – Sticks to boots once the cap or compacted crust is broken.

Title	**Dust sheet test**
Scope	Management-based measure: Broiler chicken
Sample size	Animal unit
Method description	The dust sheet test is conducted using a sheet of black A4 size paper. Put the paper onto a clip board and place it above bird height (i.e. to prevent pecking by birds) on a horizontal surface, preferably away from feed machinery. Position the paper while first entering the house. Then remove the sheet at the end of the assessment (which will take an approximately fixed time interval). Write with a finger on the paper to get an impression of the amount of dust on the paper. Classify the dust level found on the paper as follows: a. None b. Little c. Thin covering d. Lot of dust e. Paper colour not visible
Classification	**0** – No evidence of dust (score 'a') **1** – Minimal evidence of dust (score 'b' or 'c') **2** – Evidence of dust (score 'd' or 'e')

Title	**Panting**
Scope	Animal-based measure: Broiler chicken
Sample size	Sample size according to protocol as described in the full WQ document at http://www.welfarequality.net/everyone/45630/9/0/22
Method description	Panting is defined as breathing rapidly in short gasps. High temperatures will cause birds to pant – this is a natural response – however, persistent panting indicates that the thermal environment is not being maintained at a temperature which is comfortable for the birds in the long term. When a bird 'pants' it increases its respiratory rate to allow rapid exchange of air to prevent overheating. The visible signs of panting are that the birds often sit upright, open their beak and often make visible respiratory movements. Examine groups of birds at up to 5 well-distributed locations. If birds are panting, count out 100 birds (do not disturb them and leave them sitting where they are) and estimate how many of the 100 birds are panting.
Classification	**Group level:** **Percentage** of the sample showing panting

Title	**Huddling**
Scope	Animal-based measure: Broiler chicken
Sample size	Sample size according to protocol as described in the full WQ document at http://www.welfarequality.net/everyone/45630/9/0/22
Method description	When birds are cool or cold, they will often group together into tight groups, sitting closely alongside each other, often in 'clumps' with areas of empty space in between. This huddling is usually distinct from the normal 'loose grouping' that birds will show when resting. Huddling can be a natural response to lower temperatures – however, long maintained or persistent huddling indicates that the thermal environment is not being maintained at a temperature which is comfortable for the birds in the long term. Huddling is less common than panting, as birds are usually kept adequately warm due to their stocking density and their production of metabolic heat. In free range unheated housing huddling may be more commonly seen. It is however possible for bird to get cold in cold weather or if the house temperature falls due to high ventilation rates. Examine groups of birds at up to 5 well-distributed locations. If birds are clearly huddled together, due to the difficulty in identifying groups of 100 birds, estimate what proportion of the flock is affected by huddling. In some houses where gas brooders or heaters are used, it may be seen that birds huddle in warmer spots in the house. Estimate the proportion of the whole flock engaged in this behaviour.
Classification	**Group level:** Estimated **percentage** of flock showing huddling behaviour

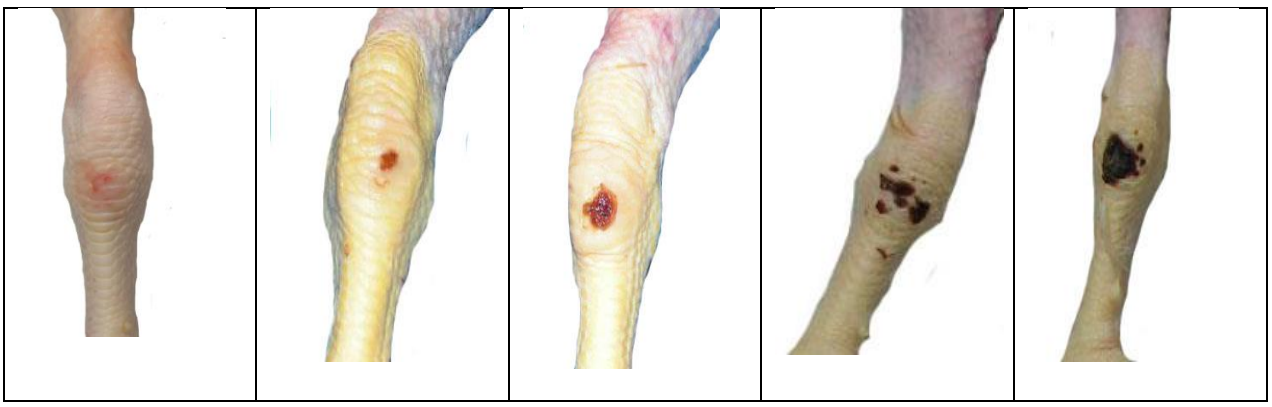
Title	**Stocking density**
Scope	Resource-based measure: Broiler chicken
Sample size	Animal unit
Method description	First calculate the total dimension of useable space in which birds are kept in m^2 and then divide it by the number of birds present, according to one of the two methods below (numbers or weight). **House area:** Measure internal dimensions of the house. If there is a farm statement for the house area – do a simple check by measuring house length by width to check that farm statement is correct. If the stated dimension of a house seems reliable (there has been a previous credible inspection which has measured available space) one may be able to use these measures instead of re-measuring the house. If the assessor solely relies on the stated estimate for space provided by the farm this can sometimes be incorrect.

	If no farm statement is available, measure house (length x width) and (subtract) accommodate for house 'furniture' (feeders, drinkers, structural elements of the building etc.) which reduce the space available to the animals. It may also be possible to use ultrasound or laser measurers to increase the speed of measurement (not good in dusty environments or bright light). Furthermore, a practical approach to measuring large houses is to measure a bay (i.e. section) and multiply by the number of bays, or measure one cage or nest module and multiply by the total number. **Number of animals:** Ask for mortality figures to calculate the number of actual birds. Look for paper evidence of delivery numbers of birds, and, after slaughter, the number of birds slaughtered should be quite accurate (as long as traceability of batches is good). **Weight loading:** Animal weights at a given age are often calculated by the animal unit manager by trial weighing a small number of birds. Some farms have step on automatic weighers, which can give average weights for the birds (however, small birds, sick birds, lame birds do not use the weighers).
Classification	House area **m^2** and Average bird weight **kg** and **Number** of birds

Title	**Lameness (gait score)**
Scope	Animal-based measure: Broiler chicken
Sample size	Sample size according to protocol as described in the full WQ document at http://www.welfarequality.net/everyone/45630/9/0/22
Method description	Lameness is the inability to use one or both limbs in a normal manner. It can vary in severity from reduced ability or inability to bear weight, to total immobility. For all farm visits, which are made close to slaughter age, 150 birds approximately will be caught using a catching pen at random locations generated by computer. For very flighty birds (for example some free range birds) it may be necessary to catch small pens of birds. Each bird is individually encouraged to walk out of the pen and is scored as it does so. For each bird caught, the gait score is recorded. The flock average gait score can be calculated by multiplying the number of birds in each gait score category, then dividing the total by the total number of birds scored. Birds are classified according to these criteria:

	0. Normal, dextrous and agile. 1. Slight abnormality, but difficult to define. 2. Definite and identifiable abnormality. 3. Obvious abnormality, affects ability to move. 4. Severe abnormality, only takes a few steps. 5. Incapable of walking.
Classification	**Individual level:** **Number** of animals in each scoring class (0,1,2,3,4,5) and **Percentage** of animals in each scoring class (0,1,2,3,4,5).

Title	**Hock burn**
Scope	Animal-based measure: Broiler chicken
Sample size	Sample size according to protocol as described in the full WQ document at http://www.welfarequality.net/everyone/45630/9/0/22
Method description	Hock burn is a contact dermatitis found on the skin of the caudal (back) part of the hock joint. The skin is turned dark by contact with litter and consequently skin lesions can result. The scoring scale allows assessment of the severity of these lesions (see photographic reference). Assess the presence of hock burns with regard to the severity scale. Scoring categories 0/1/2/3/4 as photographic illustration. Assess the number of animals in each scoring category and combine the categories for classification.
Classification	**Individual level:** **a** – No evidence of hock burn (score '0') **b** – Minimal evidence of hock burn (score '1' and '2') **c** – Evidence of hock burn (score '3' and '4')



0	1	2	3	4

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Title	**Foot pad dermatitis**
Scope	Animal-based measure: Broiler chicken
Sample size	Sample size according to protocol as described in the full WQ document at http://www.welfarequality.net/everyone/45630/9/0/22
Method description	Foot pad dermatitis is a contact dermatitis found on the skin of the foot, most commonly on the central pad, but sometimes also on the toes. The skin is turned dark by contact with litter and consequently deep skin lesions can result. The scoring scale allows an assessment of the severity of these lesions (see photographic reference). Assess the presence of hock burns with regard to the severity scale, scoring categories 0/1/2/3/4 as photographic illustration. Assess the number of animals in each scoring category and combine the categories for classification.
Classification	**Individual level:** **a** – No evidence of foot pad dermatitis (score '0') **b** – Minimal evidence of foot pad dermatitis (score '1' and '2') **c** – Evidence of foot pad dermatitis (score '3' and '4')

				
0	**1**	**2**	**3**	**4**

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Title	**On farm mortality**
Scope	Management-based measure: Broiler chicken
Sample size	Animal unit
Method description	Mortality is defined as the 'uncontrolled' death of animals (as distinct from culling/euthanasia). The animals may die from, for example- septicaemia, respiratory disease, acute infection or dehydration. Any animal which is 'found dead' on the floor in the house, or out on the field is considered a mortality.

	The animal unit manager is asked about mortality management on the farm based on data collected from farm records. Using house records of animal numbers placed, minus number died (but not including those actively culled, which are included in the measure 'culls on farm'): Number of animals placed in house from the hatchery (A) Total number of animals found dead in the last flock cycle (M). Calculate the percentage mortality using the following equation: Percentage of mortality = (M/A) x 100
Classification	**Farm level:** **Percentage** of mortality on farm during the last flock cycle

Title	**Culls on farm**
Scope	Management-based measure: Broiler chicken
Sample size	Animal unit
Method description	Culling is defined as birds which are actively and humanely killed by the animal unit manager for disease control purposes, or for lameness, sickness or disease. These are known as 'culls'. The animal unit manager is asked about mortality management on the farm based on data collected from farm records. Using house records of bird numbers placed, minus those actively culled (but not including those found dead, which are included in the measure 'on farm mortality '): Number of birds placed in house from hatchery (A) Total number of birds which were actively culled (but not including those which died without being culled) during the flock cycle (C) Calculate the percentage culled using the following equation. Percentage of culling = (C/A) x100
Classification	**Percentage** culling
Title	**Avoidance Distance Test (ADT)**
Scope	Animal-based measure: Broiler chicken
Sample size	Sample size according to protocol as described in the full WQ document at http://www.welfarequality.net/everyone/45630/9/0/22
Method description	The theoretical number of birds that should be within arm reach of the observer (within 1 m) if the birds were evenly spread in the barn is calculated from stocking density. The assessor approaches a group of birds in the litter area, squats for 10 seconds and then counts the number of birds at arms length. The assessor then attempts to touch the birds one by one. Every attempt

	to approach a group of birds is considered as a trial, even if all birds from the group withdraw from the approaching or squatting assessor. Repeat the trial 21 times. Record the number of birds at arms length at each trial, and then the number of birds actually touched. If no birds have been touched after 12 trials – stop the test at 12 trials.
Classification	**Individual level:** Total **number** of birds within touching range (1 m around the observer).

Title	**Qualitative Behaviour Assessment (QBA)**
Scope	Animal-based measure: Broiler chicken
Sample size	Animal unit (depending on number of observation points, see *method description*)
Method description	Qualitative Behaviour Assessment (QBA) considers the expressive quality of how animals behave and interact with each other and the environment i.e. their 'body language'. Select between one and eight observation points (depending on the size and structure of the farm) that together cover the different areas of the farm. Decide the order in which to visit these observation points, and wait a few minutes to allow the animals to return to undisturbed behaviour. Watch the animals that can be seen well from that point and observe the expressive quality of their activity at group level. It is likely that the animals will initially be disturbed, but their response to this can be included in the assessment. Total observation time should not exceed 20 minutes, and so the time taken at each observation point depends on the number of points selected for a farm:

Number of observation points	1	2	3	4	5	6	7	8
Duration of observation per observation point in minutes	10	10	6.5	5	4	3.5	3	2.5

When observation at all selected points has been completed, find a quiet spot and score the 20 descriptors using the visual analogue scale (VAS). Please note that scoring is not done during observation, and that only one integrative assessment is made per farm.

Each VAS is defined by its left 'minimum' and right 'maximum' point. 'Minimum' means that at this point, the expressive quality indicated by the term is entirely absent in any of the animals you have seen. 'Maximum' means that at this point this expressive quality is dominant across all observed animals. Note that it is possible to give more than one term a maximum score; animals could for example be both entirely calm and content.
To score each term, draw a line across the 125 mm scale at the appropriate point. The measure for that term is the distance in millimetres from the minimum point to the point where the line crosses the scale. Do not skip any term.
Please be aware when scoring terms that start with a negative pre-fix, such as unsure or uncomfortable, that as the score gets higher, the meaning of the score gets more negative, not more positive.
The terms used for the QBA broiler assessment are:

	• Active • Calm • Friendly • Relaxed • Content • Positively occupied • Helpless • Tense • Scared • Comfortable • Inquisitive • Drowsy • Fearful • Unsure • Playful • Agitated • Energetic • Nervous • Confident • Frustrated • Distressed • Depressed • Bored
Classification	**Flock level:** **Continuous scales** for all body language parameters from minimum to maximum.
Optional additional information	QBA rating scales and parameters (see Annex C RS)

Human-animal relationship

Data collected regarding the Avoidance Distance Test (ADT) described above were related to data that automatically recorded by the eYeNamic system during a short period when the assessor 'walked through' the flock. No disturbance was allowed in the broiler flock during a 10 minutes period. After 10 minutes the assessor entered the stable, walked along the long side of the stable (close to the outside wall), turned at the short side of the stable and walked in a straight line through the middle of the stable below the camera (see fig.1). After the walking through procedure, the flock was left alone without any disturbance for 15 minutes.

Automatic recordings from the eYeNamic system were collected during 10 minutes before the start of the experimental procedure until 15 minutes after the assessor left the stable (see below). The system delivered data on activity and distribution of the animals with a frequency of 3 recordings per minute.

The camera used for this experiment was hanging on the ceiling close to the entrance.

The procedure was performed three times during the production period of each flock, at the age of 3, 4 and 5 weeks.

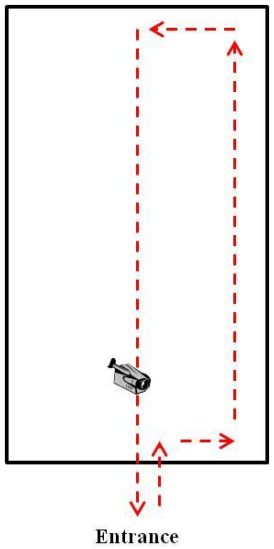


Figure 1: The procedure of walking through the broiler flock.

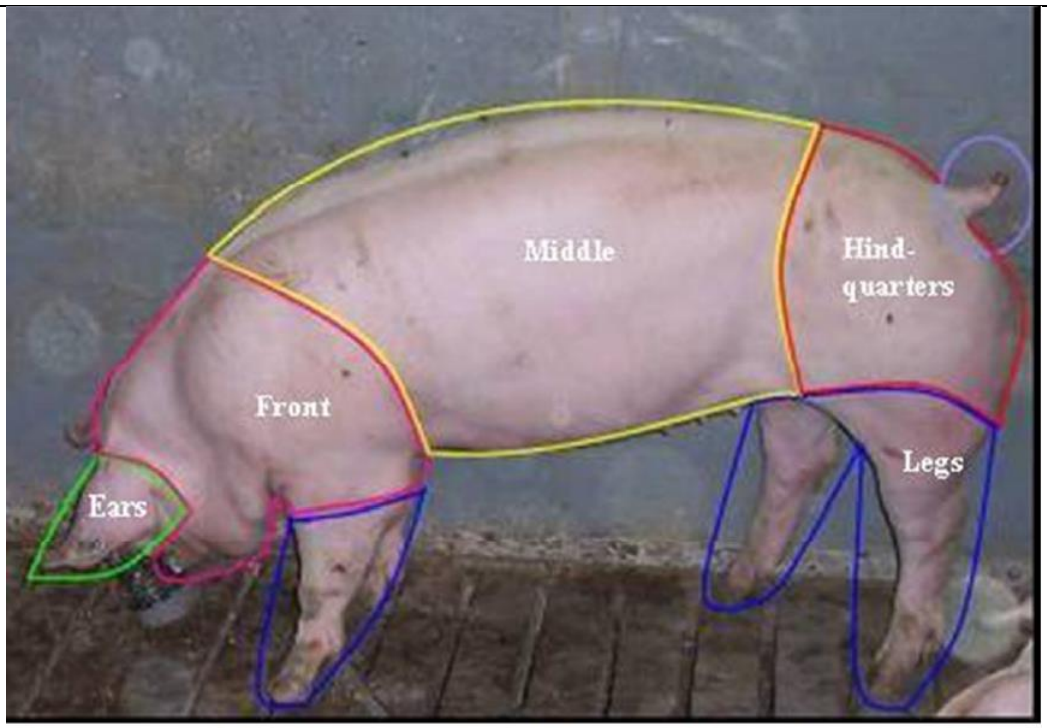
Environmental Monitoring

Environmental monitoring of ammonia and (bio)-aerosol concentration as well as ventilation rate was carried out at one farm (UK, Pershore) by the Royal Veterinary College (RVC). Monitoring was continuous, apart from short breaks for calibration and equipment management procedures. Ammonia concentration was measured at 6 minute intervals using a Chemiluminesence NO_x analyser (model 42i, Thermo Electron Inc., USA) following catalytic conversion of Ammonia to Nitric Oxide at 775 C in bespoke converters (Mattheus Milieutechniek bv, Netherlands). Aerosol concentrations were measured at two locations below the fan shaft using DustTrac DRX analysers (TSI Ltd) fitted with a PM10 inlet, at 2 minute intervals. The bio-aerosol particle size distribution was measured using an aerodynamic particle sizer, size fraction from 0.7 to 20 µm (APS 3321, TSI Ltd) at 2 minute intervals. Due to the variable fan speed, some non-isokinetic sampling is to be expected. Ventilation rate was measured using three full size measuring fans (FANCOM bv) fitted below selected fans of ventilation stage 1, 2 and 3 (out of 6 ventilation stages), as well as the duration each fan/stage was operational at any one time.
Data collection from each instrument was managed with Labview (NI UK Ltd) virtual instrument routines and stored locally on the PC. Data collected were regularly uploaded to the RVC server for further analysis.

Fattening pigs

For pigs 8 assessors (local veterinarians) were trained under the management of SLU. The assessments are carried out on eight farms spread over different countries in Europe (The Netherlands, Spain, Italy, UK, France, Hungary) by trained veterinarians and focus on tail biting, wounds on the body, lameness and coughing/sneezing (see protocol below). To date, over 129 farm visits have been made (UK 11, IT 16, NL 33, FR 28, ES 16, HU 25).

Title	**Wounds on the body**
Method description	The assessor must maintain a distance of approximately 0.5 m from the animal at all times. Wounds on the body should be visually assessed by inspecting one side of the pig's body. Choose the side with the optimal view for observation. The tail zone is not considered here. Wounds on the body can present as either surface penetration of the epidermis or penetration of the muscle tissue. At the same time, it can be defined as scratches or wounds, respectively. The pig's body is considered according to five separate regions: 1. Ears 2. Front (head to back of shoulder) 3. Middle (back of shoulder to hind–quarters) 4. Hind–quarters 5. Legs (from the accessory digit upwards).

	 ©2007, INRA, IFIP and Newcastle University Each zone will be considered separately according to this standardization: • A scratch longer than 2 cm will be considered as 1 lesion, 2 parallel scratches with up to 0.5 cm space between them will be considered as 1 lesion, • A small wound (less than 2 cm) will be considered as 1 lesion, • A bleeding wound between 2 and 5 cm, or a healed wound more than 5 cm will be considered as 5 lesions. • A deep and open wound of more than 5 cm will be considered as 16 lesions. The assessor must assess each sow's region according to the following scale: a – No visible skin injuries, or up to 4 lesions visible b – 5 to 10 lesions visible c – 11 to 15 lesions visible
Classification	Individual level: 0 – All body regions with an individual score 'a' 1 – Any body region with an individual score 'b' and/or maximum of one body region with an individual score 'c' 2 – Two or more body regions with an individual score 'c', or at least one body region that has more than 15 lesions. Herd level: Number of pigs with wounds scored as 0 Number of pigs with wounds scored as 1 Number of pigs with wounds scored as 2

Title	**Tail biting**
Method description	All animals to be scored should be standing up. The assessor should have a clear and unobstructed view of the pig's tail. Tail biting is a parameter related to damage of the tail, ranging from superficial bites along the length of the tail to absence of the tail. The assessor should assess according to the following scale:

	0 – No evidence of tail biting or Indication of superficial biting along the length of the tail, but no evidence of fresh blood or of any swelling (red areas on the tail are not considered as wounds unless associated with fresh blood); **2** – Fresh blood is visible on the tail; there is evidence of some swelling and infection; part of the tail tissue is missing and a crust has formed
Classification	Number of pigs with a score 2

Title	**Coughing and sneezing (respiratory disorders)**
Method description	Directly after entering the compartment coughing and sneezing can be assessed. All pigs in the compartment are assessed. Coughing and sneezing will be assessed for 5 minutes per compartment. The number of coughs occurring during five minutes is recorded.
Classification	Total number of coughs and sneezing during 5 minutes in each compartment

A full Welfare Quality® assessment is carried out on two additional farms in Spain by skilled assessors with a lot of experience in performing the Welfare Quality® assessment.
Assessments are performed since January 2014.
Data are submitted by SLU to the Emdesk web tool and used by other partners to compare with the PLF data collected using the automated camera and microphone systems.

Dairy cows

Comfort around resting

The gold standard for comfort around resting is an assessment according to the Welfare Quality® protocol by a trained assessor (Welfare Quality®, 2009) and is described as follows:

Title	Time needed to lie down
Scope	Animal-based measure: Dairy cows
Sample size	Sample size: All cows that lie down during the observation in each segment
Method description	This measure applies to lactating cows as well as to dry cows and pregnant heifers if they are kept with lactating animals. It considers all observable lying down movements (minimum sample size of 6 is required). Time recording of a lying down sequence starts when one carpal joint of the animal is bent and lowered (before touching the ground). The whole lying down movement ends when the hind quarter of the animal has fallen down and the animal has pulled the front leg out from underneath the body. Time needed to lie down is recorded in seconds, continuously in the focus segment. The duration of a lying down movement is only taken when undisturbed by other animals or human interaction and – in case of cubicles and littered systems – if it takes place on the supposed lying area. Observations take place in segments of the barn (→ 6.1.4.1). Individual level: Time in seconds
Classification	Herd level: Mean time to lie down (in **seconds**)
Title	Animals colliding with housing equipment during lying down
Scope	Animal-based measure: Dairy cows
Sample size	Sample size: All cows that lie down during the observation in each segment
Method description	This measure applies to lactating cows as well as to dry cows and pregnant heifers if kept with lactating animals. It considers all lying down movements for which time needed to lie down has been recorded (minimum sample size of 6 is required). A collision is defined as occurring when, during lying down, the cow collides with or contacts housing equipment with any part of the body (usually hind quarter or side). The collision is obviously seen or heard. Collisions with housing equipment are recorded continuously in the focus segment. The duration of a lying down movement is only taken when undisturbed by other animals or human interaction and – in case of cubicles and littered systems – if it takes place on the supposed lying area. Observations take place in segments of the barn. Individual level: **0** – No collision - **2** – Collision
Classification	Herd level: **Percentage** of animals colliding with housing equipment (i.e. score 2)

Title	Animals lying partly or completely outside the lying area
Scope	Animal-based measure: Dairy cows
Sample size	Sample size: All cows in the observed segment
Method description	This measure applies to lactating cows as well as to dry cows and pregnant heifers if they are kept with lactating animals. Assess the number of animals which are lying and how many of them are lying with their hind quarter on the edge of the cubicle or the deep littered area (edge markedly pressing into the hind leg of the animal), lying with hind quarter (both hind legs) or completely outside the supposed lying area (cubicles, deep littered area). Observations take place in segments of the barn. Animals lying partly/completely outside the lying area are recorded at the start and at the end of each segment observation (see 6.1.4.1). Group level: **Number** of animals lying ; **Number** of animals lying partly/completely outside lying area
Classification	Herd level: Percentage of animals lying partly/completely outside lying area out of all lying animals
Title	Animals lying partly or completely outside the lying area
Scope	Animal-based measure: Dairy cows
Sample size	Sample size: All cows in the observed segment
Method description	This measure applies to lactating cows as well as to dry cows and pregnant heifers if they are kept with lactating animals. Assess the number of animals which are lying and how many of them are lying with their hind quarter on the edge of the cubicle or the deep littered area (edge markedly pressing into the hind leg of the animal), lying with hind quarter (both hind legs) or completely outside the supposed lying area (cubicles, deep littered area). Observations take place in segments of the barn. Animals lying partly/completely outside the lying area are recorded at the start and at the end of each segment observation (see 6.1.4.1). Group level: **Number** of animals lying ; **Number** of animals lying partly/completely outside lying area
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Calves

For calves the scoring systems of McGuirk 2008 (McGuirk S.M. 2008. Disease management of dairy calves and heifers. Vet Clin North Am Food Anim Pract 24:139-153) for calf health and calf respiratory scoring were applied as gold standards to relate to information generated by the SoundTalk system. These are described below.

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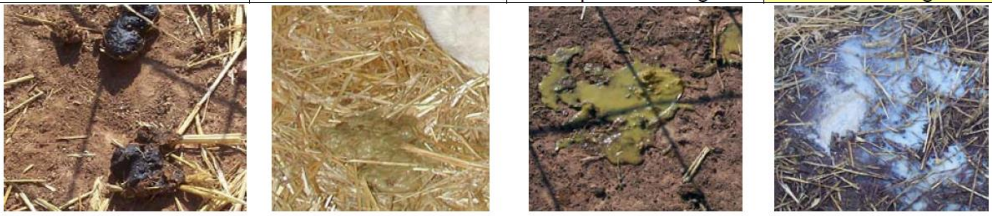
Calf Health Scoring Criteria			
0	**1**	**2**	**3**
Rectal temperature			
100-100.9	101-101.9	102-102.9	≥103
Cough			
None	Induce single cough	Induced repeated coughs or occasional spontaneous cough	Repeated spontaneous coughs
Nasal discharge			
Normal serous discharge	Small amount of unilateral cloudy discharge	Bilateral, cloudy or excessive mucus discharge	Copious bilateral mucopurulent discharge
			
Eye scores			
Normal	Small amount of ocular discharge	Moderate amount of bilateral discharge	Heavy ocular discharge
			
Ear scores			
Normal	Ear flick or head shake	Slight unilateral droop	Head tilt or bilateral droop
			
Fecal scores			
Normal	Semi-formed, pasty	Loose, but stays on top of bedding	Watery, sifts through bedding
			

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The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 311825.

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