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Standardisation of resource-based parameters to assess the welfare status of pigs

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Executive summary

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This paper identified resources for pigs, i.e. environment-based factors affecting pig welfare (but excluding management- and record-based parameters). Lists of resources have been described for both on-farm rearing conditions and for 'transport and slaughter conditions'. On-farm parameters include general information (such as breed of pigs, age, etc), density, flooring/bedding, ventilation system and dust and other resources such as environmental enrichment, feeding and water system, social conditions and provisions for health care. The 'transport and slaughter section' was discussed in an on-farm part (e.g. preparation for transport, holding areas, passageways, ramps and parameters related to the transport vehicle) and an abattoir part (slaughter facilities). Since the area covered was considerable, making it impossible to provide a detailed literature review, the validity, reliability and feasibility of the resource-based parameters have been subjectively assessed by the authors and a group of expert advisors. The document resulted from repeated upgrading of different versions of the paper based on comments received from expert advisors who independently worked on the text. It attempted to be complete (i.e. classify all relevant resources for pigs) and proposed solutions for the standard collection of the relevant environment-based on-site information to assess pig welfare. The document contains 2 deliverables, namely the report on resource-based measures in pigs (PRB-1) and the decision transparency report (PRB-1 T, which was specified in the methodology sections of this report).

Keywords: Farm animal welfare assessment, pigs, housing systems, standardisation, expert opinion.

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Chapter 1: Description of the measure and its usefulness

1. Proposal title

Standardisation of resource-based parameters in pigs.

*WQ 2.2. RBM, deliverable D2.17.1, part of Task 2.2.8

Principle investigator: Marc B.M. Bracke

Also involved were H. Spoolder, H. Vermeer, E. Lambooij (ASG, Lelystad, NL)

Partners (who commented on earlier versions of the paper): S. Edwards (UK), E. von Borell (DE), A. Velarde (ES), L. Keeling (SE), A. Butterworth (UK), and P. Barton Gade (DK)

2. Title of the measure

This document contains long lists of resource-based measures for pigs for application of welfare assessment on-farm and at the slaughterhouse (see Chapter 4 'Report of the work' for more details).

3. Sampling method.

See Chapter 4.

4. Taking the measurement

See Chapter 4.

5. Type of data

See Chapter 4 (mostly ordinal).

6. Validity of the measure

See Chapter 4.

7. Reliability of the measure

See Chapter 4.

8. Feasibility of the measure

See Chapter 4.

9. Rank of the measure (1=low to 4=high)

See Chapter 4.

10. Other relevant information on the measure

Not relevant.

11. Training material

General review documents on specified topics may be used for training (e.g. SVC, 1997, SVC, 2002, EFSA 2004, EFSA, 2005). Further, see Chapter 4/not applicable (at this stage).

Chapter 2: Summary of the work

See Chapter 4.

Chapter 3: Training material

General review documents on specified topics may be used for training (e.g. SVC, 1997, SVC, 2002, EFSA 2004, EFSA, 2005). Further, see Chapter 4/not further applicable (at this stage).

Chapter 4: Report of the work: Standardisation of resource-based parameters to assess the welfare status of pigs

Introduction

Within Welfare Quality sub-project 2 (WQ SP2) will develop monitoring systems for animal welfare based on both on animal parameters and design parameters of both the on-farm and transport & slaughter phases of the life of the pigs. By January 2007 WP 2.2 will have validated the measures to be included in the prototype systems for on-farm monitoring of animal welfare, and will have defined methods to integrate these measures into a system suited for comprehensive welfare assessment (as will be conducted in WQ 2.4). As part of this task (WQ 2.2), an activity was started to standardise resource-based measures for pigs, i.e. environment-based design criteria for overall welfare assessment.

Available resources include the housing system, floor space, ventilation system, feeding and watering, lighting, temperature control, foraging substrate, bedding and social conditions (group size, composition and stability) for the on-farm period, and e.g. (loading) facilities, vehicle design and stunning equipment for the transport and slaughter periods. Pig production systems vary widely and the influences of the environment in which the animals live are often key to the outcomes of the animal-based measures which will form the backbone of the Welfare Quality assessment scheme.

Existing 'records', farm records kept by producers and the immediate 'record' available by questioning stockmen on their management (use of resources), may provide useful data, but it is likely that more direct assessment of resource-based measures provides more reliable information. The animal-based measures have been proposed as key to Welfare Quality, but for proper welfare assessment resource-based measures (in a wide sense, including management-based measures) must be taken for several possible reasons: 1. Resource-based measures may be necessary for the proper interpretation of what animal-based measures mean for welfare; 2. Resource-based measures may fill in the gap where animal-based measures fail (because they are not valid, not reliable and/or not feasible within the constraints of the welfare assessment system). In such cases scientific information concerning how resources relate to welfare performance can be used to solve the problem.

Up to now a number of welfare assessment schemes (e.g. TGI and Freedom Foods) and most legal welfare regulations have been using (lists of) resource-based measures. For the purpose of overall welfare assessment at the European level, however, a standardised list remains to be formulated that can be used not only for (the research purposes of) Welfare Quality, but more widely for gathering the relevant environment-based information to assess the welfare status of pigs during housing, transport and slaughter for the purpose of both scientific study and for the purpose of ethical and political decision making. This information needs to be practicable/operational for on-farm use and reflect a substantial degree of consensus among welfare scientists.

Objectives

The objectives of this work were to determine

- a.** which resource-based measures should be proposed for inclusion in the monitoring scheme;
- b.** how valid, reliable and feasible participating experts believe these measures are;
- c.** how the most promising resource-based measures are to be operationalised, including the provision of work instructions regarding the collection of accurate and reliable resource availability and use.

Ad a. Since other projects are dealing with management-based parameters, these will not be considered in detail in this document.

Ad c. Objective c could not fully be met in this project, because it turned out to be inappropriate to make a required fundamental decision within the scope of this work. When conducting this work, it soon turned out that there were very many potentially relevant resource-based measures, and that it would be impossible to record them all in great detail within the total time available to conduct an audit. The choice therefore would be to record fewer parameters in more detail or more parameters with less detail. For example, when the parameter 'space per pen' is to be recorded in great detail (to the exact cm²), it requires much more time in the audit compared to recording the same parameter in to 2 levels (above/below a specified cut-off point, e.g. a legal requirement). This saves time because in most cases measures with few levels (separated by an inherently somewhat arbitrary cut-off point) can mostly be taken with 'clinical judgement' that does not require time-consuming detailed measurements. This trade-off between specificity and feasibility exists not only for resource-based measures, but also for animal-based measures. My (MB) personal preference would be to include many a-specific parameters rather than few specific parameters, but it was realised that this choice must be made within the separate subproject that is to decide upon on the ultimate protocol for pigs to be used in WP 2.4. Since the decision could not be made, the present work could not fully operationalise the most promising parameters (objective c). Instead, it characterised the whole spectrum of resource-based measures for pigs and suggested possible cut-off points that may (but do not necessarily have to be) used.

The report contains two deliverables:

- a) The factors described have been combined by a consensus of the work partners to provide a practical tool for assessing resource-based measures in pigs and a description of how these can be used, was the first deliverable of this work package (Pig Resource-Based, PRB 1).
- b) A short report outlining how the decisions on the method were derived has been produced to ensure transparency of the process. The decision transparency report, (PRB1 T) was the second deliverable of this work package. This second deliverable is described in the section 'Methodology', and esp. in its subsection 'Conducted activity'.

Methodology

Constraints and focuses of the work

The following focuses of the work applied:

The focus is on the formulation of a practicable list of resources for which there is (can be presumed to be) consensus among (welfare) scientists. Issues that raise points of (scientific) debate were avoided.

The areas covered by the work as stated in the original assignment included:

‘On farm’, which includes density, flooring/bedding, available resources, ventilation system, dust)

‘Loading/unloading’, which includes design of handling facilities, loading ramps, transport vehicle, transport time, time to slaughter

‘Slaughter facilities’, which includes equipment used for slaughter.

All these deliverables classify as D2.17.1 and are part of Task 2.2.8.

Management-related information, which includes the collection of information on stockmanship, farm records and handling, was excluded from this report on ‘resource-based measures in pigs’, as this was addressed in a separate WQ 2.2 subproject.

With these constraints in mind ‘*resource-based parameters*’ in this paper were (rather narrowly) defined as those welfare-relevant measures that pigs need for welfare, but (largely) excluding social conditions such as mixing (as these can be considered to be animal-based and management-based parameters), and excluding important aspects of management such as stockmanship, handling and health care. Note, however, that although while the animal-based and management based aspects were excluded (of e.g. handling and health care), the facilities for these practices (e.g. sick pens and handling facilities such as raceways and loading ramps) were included as ‘resources’ addressed in this document.

Conducted activity (RPB1 T)

This section contains the ‘methods’ of the work done to produce this report. In effect it also constitutes the ‘progress report, i.e. the decision transparency report of Pig Resource-Based, PRB1 T’ as was stated in the project plan.

A first draft of text was prepared by the first author (MB) and this text was submitted to the experts from which we received replies: H. Vermeer (NL), E. Lambooij (NL), E. von Borell (DE), S. Edwards (UK), L. Keeling (SE, WP 2 subproject leader), H. Spoolder (NL), A. Velarde (ES), P. Barton Gade (DK). The text was upgraded based on the comments of the first expert and then sent to the second expert, and so on. As a result the final paper is the product of input from all contributors. However, it should be noted that in later stages changes have been made based on received comments, while these changes may not have been evaluated by earlier reviewers, even though the final draft was made available to all contributors.

In the course of the project different issues received more close attention. One aspect was to attempt uniformity across species. This issue was addressed by requesting (and receiving) information from the other groups (working on poultry and cattle) and by sending early drafts of our work to those groups. Another issue concerned specifying cut-off points. It was realised that cut-off points are inherently somewhat arbitrary and problematic from a scientific point of view. Since the starting document for the transport and slaughter section contained specified cut-off points, the experts involved in that phase of work were asked for their opinion on the issue of whether cut-off points should be listed or whether the description ought to be kept more objective (as was done for the original on-farm section). It was decided that both approaches were valuable, as it relates to the fundamental decision (addressed above) on the trade-off between specificity and feasibility of the parameters. This issue, too, was raised as a topic to the participating advisors. The discussions resulted in a mixed approach, where this paper attempted to address main issues and left decisions for the subsequent group deciding on the final protocol for pigs.

For the first draft and later upgrading we used as primary sources of information the EU legislation on pigs, existing EU reports (SVC, 1997, SVC, 2002, EFSA 2004, EFSA, 2005), a report on transport and slaughter (Lambooij, 2004) and a book draft of COST 846 (Measuring and monitoring of farm animal welfare), Subworking Group Pigs, Velarde et al., 2006, in prep.)). In the sections below the different resource-based measures are first identified (and listed hierarchically) for the farm, loading/unloading and slaughter phase respectively. For each phase the measures are specified/defined and they are evaluated in more detail under the headings ‘validity’ (V), ‘reliability’ (R)

and 'feasibility' (F). Each heading is scored on a 5 point scale ranging from least to most. So when the item 'floor area' contains the code 'V 5', this means that the validity (V) is scored subjectively (on average) by the experts participating in this project as '5', i.e. best validity relative to most other resource-based measures. Under the heading 'validity' we describe in what way the measure contributes to welfare, i.e. what are the costs (risks) and benefits for welfare. This also includes a specification of the age groups for which the measure is/is not relevant and so-called critical windows (i.e. specific moments/times in which the measure should be taken). Under 'reliability' we describe the degree to which assessors can determine in a 'reliable' way (including both inter- and intra-observer reliability). Under 'feasibility' we describe the extent to which the measure requires time, expertise or money (e.g. specialised equipment) to determine, and how a problematic measure may be made more feasible (e.g. by specifying cut-off points for welfare). The main references are specified per section.

The section on 'transport and slaughter' covers two deliverables: 'Loading/unloading' (i.e. Deliverable 2.2.2.34, which was originally formulated to include 'design of transport vehicle, transport time, time to slaughter') and 'slaughter facilities' (i.e. Deliverable 2.2.2.35, which included 'equipment used for slaughter').

The lists in the section 'Transport and slaughter' were initially taken from Lambooij (2004), and supplemented with other information. The lists were subsequently integrated with the format used for the on-farm section (esp. with respect to the objectivity of the description and the specification of cut-off points). Many elements listed in the transport and slaughter section have correlates in the on-farm section (e.g. ventilation system, environmental temperature, space, etc). It was decided to discuss in later sections, e.g. in the 'Transport and slaughter' section only issues specific to this phase of the animal's life, and it was assumed that the principles described in the earlier (on-farm) section also apply for transport and slaughter, unless specified otherwise.

Resource-based measures in pigs (PRB 1)

This chapter describes a proposal for a practical tool for assessing resource-based measures in pigs (Pig Resource-Base, PRB1) as described in the project plan. It contains 2 main sections: 'on-farm' and 'transport and slaughter', each of which contain lists of (further subdivided) resource-based parameters for pigs.

On-farm

See e.g. EFSA 2005, Hoy et al. (2004) and Von Borell et al. (2001).

Resource-based measures to be collected 'on farm' included (using the specific wording in the task description) 'density, flooring/bedding, available resources, ventilation system and dust'. From this wording it was decided to construct sections for the main resources (including space (m² and m³), flooring/bedding and air quality (ventilation system/dust)) and for 'other resources' (which include other enrichment materials/toys, feeding and watering systems, sick pens, and resources for managing social conditions such as pens for mixing groups of pigs). Excluded resources were social conditions per se and the provision of food, water and health care, in as far as these are either 'animal-based', 'records-based' or 'management-based', as these aspects are covered in separate subprojects. Before discussing welfare-relevant resource-based parameters, however, a short section addressed 'general information' to be collected from the farm. The on-farm section ends with a brief section on how to deal with variability (which provides a starting point for a discussion, which could not be solved in this project).

General information

Type of pig (dry sows, lactating sows, weaners, growers, fatteners, etc.)

Breed

Age/body weights/start date of the pigs (in the pen/unit) This information may not always be available on farms, except in general terms.

Layout of the buildings, units, pens on the farm. Of particular importance with respect to resources of pigs is to specify the animal's environments, i.e. their enclosure/pen. A drawing and/or picture of a pen could sometimes say more than 1000 words. Included in the pen layout could be pen dimensions, partitions types of floor and position of the feeder, watering points and other pen fittings

(e.g. toys, straw rack, scratch post, etc). This information may be collected on the first visit to the farm, while subsequent visits only need to take note of any changes.

Group size (the number of pigs per pen/enclosure). (Note that 'group size' is also a resource-based welfare parameter in the category 'social conditions'.)

This general information may not be 'resource-based' per se, but provides the context for the interpretation (and sometime derivation) of the other resource-based measures. For example, pen dimensions and floor-type dimensions are used to calculate the available space and dimensions of functional areas.

Density

See EFSA report 2005, COST chapter B. Horning and EU legislation.

Floor area per pen
Floor area per pig
Scaling factor (k)
Moving pigs

Floor area per pen This is the total space or surface per pen, where a 'pen' is defined as the enclosure in which the animals live and have permanent access to (e.g. an outdoor area would be included under 'pen-area' if the animals have free access to it). Additional spaces (to which animals have access only part of the time) may have to be listed separately.

V 4 Space is a necessary, but not sufficient condition for (different elements of) behaviour and welfare. As a general rule, the more space the better for welfare, as more space tends to imply (but not necessarily implies) less behavioural restrictions and better space quality.

R 5

F 5 Taking pen dimensions may be done at the first farm visit, even perhaps by the farmer, and then kept in the farm record file, so it doesn't have to be repeated every farm visit.

Floor area per pig This measure is calculated from floor area per pen and group size.

V 4 Space is a necessary, but not sufficient condition for (different elements of) behaviour and welfare. As a general rule, the more space the better for welfare, as more space tends to imply (but not necessarily implies) less behavioural restrictions and better space quality. Since the pigs in a pen share the available space per pen, in larger groups of pigs lower amounts of space per pig may suffice. As a minimum norm space allowances should be in accordance with legal requirements/SHVO (Hoy et al. 2004).

R 5

F 5

Scaling factor (k) The scaling factor is calculated from the floor area per pig (A) and body weight (W), with the formula $A = kW^{2/3}$ (EFSA, 2005, p 17).

V 5 Space requirements for different behaviours (including resting in a recumbent position when it is hot, resting sternally, stretching, turning around and performing agonistic behaviours) depend on the size of the pigs. According to the EFSA (2005) report on space allowances for pigs the scaling factor is the more appropriate expression of space provided to pigs, and it proposes that future research should use the scaling factor as an expression of space provision for pigs.

R 3 On most farms the weight of the pigs will not be known. Perhaps, a rough estimate could be made from average weight gain figures (if age were known) or by 'clinical' judgement in relation to specified cut-off points (e.g. whether the available space allows simultaneous recumbent resting, i.e. all animals lying flat on their sides). This would also improve feasibility.

F 3

Moving pigs Moving pigs from one pen to another (within one farm). This is a management-based parameter that is dealt with below (in the transport and slaughter section). It may also affect other parameters (e.g. floor area per pen). Suggestions for such 'variability of information' is given in a separate section below (called 'how to deal with variability within farms').

Flooring/bedding

See EFSA report 2005, COST chapter B. Horning and EU legislation.

Floor type qualities
Floor types and bedding

Roughness
Edges
Pen soiling
(Insulation: see thermoregulation)

Floor type quantities

Areas of floor types
Functional areas (e.g. space of the resting area, space of dunging area)
Slat dimensions
Bedding dimensions
Slopes

Pen divisions

Walls
Divisions within the pen
Corridors/fences for moving pigs and holding pens (see Transport)

Floor type qualities

Floor types and bedding Floor types refer to the types of material of which the floor is made and whether it is solid/slatted and/or sloped, e.g. solid concave concrete floor, (expanded) metal slats, (coated) plastic slats, etc. The different floor types (and their properties, e.g. dimensions and proportions) need to be registered. Areas of outdoor access should also be identified (including its quality, e.g. pasture, bare soil, mud, etc). The term 'bedding' refers to layers provided on top of the floor. Examples of types of bedding are straw, sawdust and compost. Within specific floor types or bedding materials a further distinction can be made with respect to 'quality' (e.g. good versus poor quality slats). Such qualifications are classified elsewhere (e.g. edges, roughness, 'food quality').

V 4 Different floor types and bedding provide different levels of comfort for resting (cushioning, thermal insulation), grip on the floor for walking (and other activities), and substrate for exploration (recreation).

R 4

F 4 There may be many different kinds of bedding material, and recognising each of them accurately, may have its limits to what an auditor can cope with. A classification system may be used instead (i.e. scoring the extent to which floor provides resting comfort, thermal comfort, grip and recreation, where for recreation, for example, material properties like rootability, destructibility, hygiene, novelty and accessibility could be formulated as relevant dimensions).

Roughness Roughness is to be specified for each floor type and is to be determined for the floor as a whole including bedding, slopes and openings. It can be expressed in different ways (subjectively, but also more quantitatively, e.g. as a Leroux number). For example, newly built concrete slatted floors may be required to have a Leroux number of at least 65.

V 4 The floor should provide sufficient grip to perform the different behaviours (e.g. stand up/ly down, elimination behaviour, play). Falling may lead to injuries. Conversely, excess roughness may also cause lesions. As minimum norms the pigs should be able to walk normally without the risk of slipping/falling and the floor should not be so abrasive as to cause evident skin lesions.

R 3 It is difficult to quantify the level of roughness of the floor, and it may vary over time (e.g. due to soiling of the floor).

F 3 A subjective assessment on a scale with a very limited number of points (e.g. 3 points) could be feasible for trained assessors.

Edges Edges and defects in the floor, presence of broken slats.

V 5 Sharp edges pose a risk for injuries.

R 4 Edges may be masked by manure, poor lighting and/or a high stocking density.

F 5

Pen soiling Pen soiling refers to the degree to which the different parts of the pen (esp. the different floor types, bedding, walls, feeders, drinkers and the pigs themselves) have been soiled (with excreta). Pen soiling is closely related to behaviour (and may be assessed there), but it is classified here as resource-based

parameter by analogy to e.g. environmental temperature (which may also depend on animals being present). Soiling with excreta is to be distinguished from soiling with earth/mud (from wallowing).

V 4 In terms of animal welfare pen soiling (with excreta) is not only a hygiene problem (a risk factor for health) but also an aversive stimulus to the pigs (e.g. pigs avoid soiled objects and places for manipulation and resting).

R 4 A simple classification system needs to be constructed (e.g. expressing pen soiling on a 3 point scale (none, some, considerable soiling)).

F 4

Insulation: see below under thermoregulation

Floor type quantities

Areas of floor types

Functional areas Dimensions (m²) of the resting area, the dunging area, corridors and areas for general activity. and/or their presence/absence (e.g. in fully slatted and deep litter systems). (Visibly) Separate areas for elimination, resting and feeding are preferred (Von Borell et al., 2001). For resting a solid and insulated surface is preferred with visual protection towards neighbouring groups and (total available) space according to legal requirements (Von Borell et al., 2001), which, for WQ, would perhaps best be interpreted as EU (rather than national) regulations.

V 4 Sufficient space in the various functional areas is necessary for the full performance of the required behaviours and for meeting the respective needs of the pigs. However, pigs may not choose to use the functional areas as designed (so this measure should ideally be supplemented with additional performance measures of the use of the functional areas).

R 3 Boundaries between what does and what does not belong to a functional area may sometimes be difficult to draw, and may depend on other factors (e.g. what is suitable resting area may vary depending on the environmental temperature).

F 3 Feasibility may be improved by applying (perhaps simplifying) rules of thumb. E.g. the perhaps most important aspect of 'functional areas' may be to require a dry and comfortable lying area, while it may be presumed that if this is adequate, then the other functional areas (feeding and dunging) may be adequate too.

Slat dimensions Dimensions (cm) of slat width and slot width, presence of a dung gap. Slat- and slot widths should be in accordance with legal requirements/SHVO (Hoy et al. 2004, see also EFSA, 2005, p. 38-42). For example, Council Directive 2001/88/EC (EC, 2001) states, that when concrete slatted floors are used, the maximum width of the openings must be 14 mm and 18 mm for weaners and rearing pigs respectively. Furthermore, separate drainage of liquid manure in most bedded systems is preferred (except deep bedded systems).

V 5 Inadequate slat dimensions increase the risk for injuries. Insufficient slot widths can result in soiled and slippery floors, while too wide slots can result in toes getting caught in the slots.

R 4-5

F 3 Some farrowing and weaner perforated floor types can be quite complex. (Simplifying) Cut-off points could be formulated, e.g. legal requirements.

Bedding dimensions This refers to the amount of bedding provided (grams/day), the layer dimensions (cm depth) and particle dimensions (cm).

V 3 Even small amounts may give considerable benefit (see e.g. Day et al. 2002a).

R 3 Bedding dimensions can be quite diverse within a pen.

F 4 Bedding dimensions could only be described at a gross level, and may, to some extent, require information from the stockperson. Simplifying cut-off points may be formulated to increase feasibility of recording (e.g. more/less than 5 gr/day, a layer that suffices to cover the entire floor of the activity area, destructible particles that are at least the width of the snout of a pig, or similar).

Slopes The slope of the floor, esp. of the solid floor, is related to other variables such as pen soiling, movement- and lying comfort. It would seem sensible to use legal requirements as starting point for welfare auditing.

V 4

R 4

F 4

Pen divisions

Walls Pen walls (front, back, sides) can be described in terms of the degree to which they allow contact between pigs (open/closed).

V 3 Open pen divisions allow pigs to see what is going on in their environment (providing some predictability, which is esp. important for the reduction of fear) and this may provide some additional stimulation (which is esp. important for individually housed pigs). However, open pen divisions may also pose an injury risk (limbs or heads get caught if the pen divisions have been incorrectly designed and sized) and may reduce biosecurity (increased disease transmission). If put in the wrong place, they may also increase pen fouling and thus reduce hygiene.

R 5

F 3 The welfare benefits of making this measure fully operational may be considered to be limited. However, the gross distinction 'open/solid partitions' should be feasible and could be used to examine relationships with animal-based health (injury/disease status) and welfare (behavioural) measures. Another argument to include the measure may be that whereas injuries and disease levels may be presumed to be adequately covered by the (animal-based measures in) WQ scheme, the presumed welfare benefits of enhanced stimulation may not be.

Divisions within the pen

V 3 Pen divisions may reduce agonism (by providing an opportunity for escape), may improve the separation of functional areas and may somewhat improve stimulation (more exploration). Pen divisions may also restrict movements (esp. when provided in small pens) and then affect welfare negatively.

R 5

F 4 The interpretation of how the pen divisions contribute to welfare (positively or negatively, and how much) may require too much expertise in relation to the gain of incorporating the measure in the index.

Corridors/fences for moving pigs and holding pens (see Transport)

Ventilation system and dust

See SVC 1997, COST chapters R. Geers and EU legislation.

Climatic system

- Ventilation system
- Alarms and failsafe systems
- Insulation
- Heating system
- Cooling system
- Air space
- Outdoor access
- Climatic zones
- Slurry pit

Climatic variables

- Environmental temperature
- Chill factor/humidex
- Air flow
- Relative humidity
- Light
- Ammonia
- Dust
- Other gasses
- Noise

Climatic system The recording of 'climatic system' may be problematic/unworkable. Suggestions are made to address this problem.

Ventilation system The ventilation system is described by its facilities for providing air flow (natural/artificial ventilation, capacity of ventilators, position of ventilator, air inlets and conditioning (heating/cooling) of incoming air). The whole system may be quite complex. For

example, Von Borell et al (2001) prefer fans with a max. speed of 900 revolutions/min, i.e. low-speed fans, controlled exhaust air discharge over fans, exhaust air blown outside 1,5 m above the middle of the ridge, air supply via drop down channels or via the feeding alley, air exhaust under the floor with a min. distance of 0,5 m between the manure and the slatted floor.

V 4 Pigs need fresh air, but draughts are to be avoided. Increased air flow can be used for cooling pigs, while reduced air flow can conserve heat.

R 2 Assessing the ventilation system could be difficult, unless we may rely on the farmer's description of building materials and textbook values.

F 2 There are many types of ventilation system and many variations on the themes. The main classes (natural/artificial ventilation, etc) can easily be classified. At some point a substantial degree of expertise is required to determine what exactly the relevant properties of the ventilation system are and whether and to what degree it affects welfare. It may be considered to leave this area to climate specialists (as it may be advised to leave an assessment of the health status to veterinarians and an assessment of the diet to feed specialists). As a very general screening it may be appropriate to measure the environmental temperature, relative humidity, air speed and ammonia levels, in order to detect gross deviations from the norms (e.g. temperature within the thermal comfort zone, depending on the size of the pigs and floor type, RH 40-60%, air speed < 0.2m/s; NH₃ < 15 pp, or similar). Another 'solution' may be to make recordings (e.g. pictures, video) of unfamiliar systems and have an expert backup panel assisting the auditors in their evaluation of whether this system is adequate.

Alarms and failsafe systems These are a legal requirement.

V 4-5 The welfare impact of power and equipment failures may be considerable, but the actual welfare benefit depends on the degree to which the housing system depends on electrical power and equipment, and it also depends on the degree to which the systems actually become operative.

R 4-5

F 4-5 When taken as a legal requirement, it may not be worthwhile to check alarms and failsafe systems for the welfare audit (namely when compliance with minimum legal requirements can be assumed to be present).

Insulation Included under 'insulation' are the insulation properties of the floor, building walls and roof. In the simplest version it could be registered whether the floor, walls and roof are, or are not insulated.

V 3 Insulation co-determines thermal comfort. It depends on other variables such as outside temperatures (climate, season), pig size, heating, feeding level, etc.

R 3

F 3 Interpretation of the measure may require quite some expertise.

Heating system, e.g. air heated outside the unit (in corridor, under roof), heating in the unit (heaters, floor heating), degree of control of heating system (i.e. degree to which the temperature can be controlled automatically and in what range).

V 5 Heating can reduce cold stress (and overheating can induce heat stress).

R 3

F 3 Heater capacity can be quantified but expert input may be needed to calculate its sufficiency.

Cooling system, e.g. wallowing pool, showers, ground tube ventilation

V 5 The provision of cooling is esp. important in Southern European summer conditions.

Wallowing is also important for outdoor animals to avoid sunburn.

R 5

F 5 If scored as presence/absence. Assessing efficacy, however, may be much less feasible without expert input (e.g. F 2).

Air space The term 'air space' refers to the volume of unit. It is to be related to the number of pigs in the unit and their size. Air space is commonly expressed as m³/kg. Pigs with outdoor access have 2 values for 'air space' (one of the indoor volume and one set at 'high').

V 3 A norm could be ≥ 3 m³/pig of 100 kg, but too high air space with inadequate heating/thermoregulatory opportunities (no deep straw) may also be problematic.

R 4

F 3 It may be rather difficult to exactly measure the volume in some building types. When the objective is to identify the most serious 'outlier' farms, a rough estimate could suffice (certainly in the start-up phase of the WQ scheme and when the farmer can provide more accurate details when he/she believes the estimate is unfavourable).

Outdoor access

V 3 Outdoor access provides opportunities for pigs to move around (space) and to breathe fresh air. It provides a different climatic zone (sunshine). Provisions of shade in large outdoor areas are also relevant as pigs may suffer from sunburn. Even though not all experts may agree that outdoor access per se is beneficial to pig welfare, it may be important to record it to address consumer concerns.

R 4-5 There could be problems in defining “outdoors”, e.g. access to roofed and/or concrete floored but otherwise open areas may have to be classified separately and some open front buildings may have some outdoor properties (fresh air) but lack others (e.g. more space).

F 5

Climatic zones Different climatic zones in a pen may be present when there are e.g. different air flow patterns, floor types (slatted/solid floors), outdoor access and localised heat/cooling sources (shower/heat lamp, kennel systems with enclosed lying boxes).

V 5 The presence of different climatic zones within the pen allows pigs to regulate their body temperature (cooling when hot and heating when cold). This is important as pigs cannot sweat and as within a (large) group there may be considerable variation in thermal comfort. This item partly, but not entirely relates to the need to have different functional areas, because in part thermal requirements may differ between activity and resting periods.

R 3 Measurement of airflow patterns can be very variable in natural ventilation systems.

F 5

Slurry pit This includes slurry pit depth/capacity, the potential for slurry pit ventilation and the presence of separate slurry channels.

V 3 The construction of the slurry pit may affect air quality (ammonia levels).

R 3

F 3

Climatic variables Note that climatic variables may not be considered to be fully resource-based criteria (i.e. they are not fully environment-based design criteria), because they are ‘performance of design criteria’, i.e. environment-based parameters (e.g. temperature) that are the consequence/output of evident resources (e.g. ventilation system), but that also of animal-based performance criteria (e.g. body temperature, weights and numbers of animals in the unit).

Environmental temperature

V 4-5 The environmental temperature is an important factor affecting thermal comfort. The importance of the environmental temperature varies between animal categories, e.g. a very high ambient temperature is critical for the survival of the newborn piglet, e.g. the temperature in the piglet nest should be > 30 degrees C for the first 10 days of life (Hoy et al., 2004).

R 3 Point measurement of the environmental temperature may not be a very reliable indicator for long term thermal comfort (it may be a hot/cold day today) and should be interpreted in relation to other climatic variables (including the management of the farmer and the behaviour and health status of the animals). We could perhaps ask for a max-min thermometer record in at least some units.

F 3 It may be difficult to measure a ‘representative’ value in many buildings because of stratification and airflow patterns. On the other hand, of all climatic variables (including ventilation system, etc), perhaps the main focus should be on air temperature (and air speed and ammonia concentrations) in the lying area.

Chill factor/Humidex The ‘chill factor’ is derived from air temperature and air velocity; humidex is derived from air temperature and relative humidity. These measures are designed to indicate more closely how the temperature feels.

R 2 It may be difficult to determine these factors (esp. chill factor) in a representative way.

Air flow This includes air velocity and air flow patterns.

V 5 High air velocity (> 0.2 m/s unless under hot conditions) may lead to cold stress and increased respiratory disease. Air flow patterns can be determined by producing smoke. Air flow patterns may be difficult to describe and interpret. The lying area is probably the most appropriate area to measure.

R 3 Air flow patterns can vary widely over time, especially in natural ventilation or as fan speeds change to maintain the set temperature.

F 3-4 Air speed monitors and smoke can be used to do the measurements. Feasibility may be lower for air flow patterns; very low (perhaps F 1) for natural ventilation.

Relative humidity

V 3 Relative humidity rarely comes in the range of values (very high) where it considerably affects welfare. Under high environmental temperatures it could do so when the relative

humidity is very high. Very low RH can exacerbate respiratory disease but does not commonly occur. Condensation can be an issue if insulation is inadequate.

R 4

F 3 RH should only be recorded if there is an indication of problems.

Light The type of light can be natural or artificial. Access to natural light can be direct exposure to sunlight or indirect (via windows). The light level/intensity can be determined using a Lux meter and should be measured at pig height and at several places in the unit. Other measures of light intensity could be the number of bulbs and window size (as % of floor area). Also relevant is the duration of light (e.g. times the lights go on and off and whether this is controlled manually or automatically).

V 3 The importance of light for pigs, over and above the level required by law (40 Lux) is not known. There is also some evidence that pigs may prefer less than 40 lux under certain conditions (S. Edwards, pers. comm.). The light regime is important as Zeit Geber (i.e. indicator of time), controlling the synchronisation of behaviour.

R 3 Considerable spatial variation may be present. The range and average values may be used of several measurements taken in a specified protocol (as operational e.g. in poultry research).

F 3 Feasibility is relatively low due to high variability between meters

Ammonia

V 3 Within most commonly found ammonia levels there appears to be limited effect on pig welfare. However, in chronically elevated conditions, e.g. when ammonia and dust levels are both high and in combination with suboptimal temperature and humidity the variable would be more important (e.g. V 5).

R 3 Considerable spatial variation may be present.

F 3-4 Ammonia levels can be measured using Dräger-tubes. Digital measures also exist.

Dust

V 3 Dust levels may affect respiratory disorders, but there is only limited information on how dust levels directly affect pig welfare.

R 3 It is difficult to adequately determine dust levels.

F 3 A kit does exist, but is very expensive

Other gasses, e.g. H₂S, CO, CO₂.

V 3 Under most commonly encountered conditions these other gasses have limited welfare impact (unless stored slurry is agitated).

R 4

F 3 Dräger-tubes can be used to do the measurements.

Noise The sound level can be determined in decibels.

V 3 Knowledge about the degree to which noise affects pig welfare is limited, but high noise levels may affect communication, e.g. between piglets and sow.

R 3 Considerable minute to minute variation can occur, e.g. during feeding and agonistic behaviour.

F 3 Feasibility depends not only on the specification of how to measure (as it would not be feasible to measure during a whole day) and on how portable and costly the equipment would be.

Other resources

Other resources (than space, flooring/bedding and air quality) include: other enrichment materials/toys, body-care facilities, feeding system and the provision of water, social conditions and health care (including e.g. the provision of hospital pens).

Enrichment materials

Type of material

Amount

Material dimensions

Provision frequency

Accessibility to the pigs

Body care facilities

Other pen fittings

Feeding system

Food

Watering system

Water
Social conditions
Health care

Enrichment materials A model was constructed (called RICHPIG) to assess the welfare impact of enrichment materials for weaned and growing pigs. The model scores for a wide range of different materials and the weighting factors of a range of assessment criteria (welfare relevant material properties such as rootability, novelty and destructibility) have been compared with expert opinion (Bracke et al., In press-a; In press-b). The model and the lists of scores can be used in the WQ assessment scheme. (Note, the same is true for expert and model (SOWEL) scores being available for a range of different housing systems for pregnant sows and the weighting factors for a range of welfare attributes of housing systems, Bracke et al., 2002a and 2002b; and there is a model for scoring risk factors for tail biting (PIGTAIL, Bracke et al., 2004a).

Type of material, e.g. wood, metal, substrate, roughage and plastic/rubber.

V 4 Some materials appear to be more suitable for providing enrichment for pigs (e.g. straw, mushroom compost, soft wood) than other materials (metal, hardwood, plastic/rubber).

R 4

F 4 Compound materials consisting of different types of material may be difficult to classify (or define a separate class).

Amount This includes both the amount provided and the 'amount' still present in the pen at the time of recording. Both the total amount and the amount per pig may be relevant (in larger groups lower amounts per pig may be adequate; this is similar to floor area per pen and floor area per pig).

V 4

R 3-4 Farmer statements as to how much a material is provided may not be reliable.

Assessing amount of particulate materials could be difficult, but as a starting point gross classifications should suffice for WQ.

F 4

Material dimensions, e.g. particle size

V 4 Materials need to be either rootable or biteable for it to have any functional significance.

However, there is no uniform relationship with welfare (adequate particle size may depend on the type of behaviour elicited and the type of material involved).

R 4 (at a gross level of description)

F 3-4 (at a gross level of description) A problem with feasibility is that at present there are no really good definitions available.

Provision frequency

V 5 Pigs are curious animals and novelty is an important factor for maintaining interest in a material.

R 3 Farmer statements as to how often materials are provided may not be reliable.

F 4

Accessibility to the pigs, e.g. on the floor or hanging

V 4 Pigs have a tendency to show synchronised behaviour, including synchronised exploration. Although it is not known to what extent time sharing is possible, a somewhat lower level of physical accessibility may be adequate in large groups.

R 3 The degree to which material is accessible simultaneously by all pigs has fuzzy borders and may vary across the day.

F 4

Note: the performance of the design criterion 'enrichment material' may also be recorded, i.e. the state (of destruction) the material is in, e.g. whether materials shows indications of being bitten and whether the material is soiled.

Body care facilities, e.g. (vertical/oblique) scratching posts, body brushes (esp. for sows), wallowing pool, mud.

V 3-4 Body care facilities allow natural behaviours like scratching and wallowing, provided they are suited to the size of the pigs in the pen. To some extent pigs may also use pen divisions and feeders.

R 5

F 5

Other pen fittings

V 5 Protruding or damaged pen fittings may cause injury.

R 5

F 5

Feeding system Aspects of the feeding system include feeder type, no of pigs per feeding space, dividers; automatic/by hand, trough length; trough shape, sequential/simultaneous feeding and predictability of food provisioning. The impact of the feeding system on animal welfare may take various forms. Feeding systems differ in the extent to which animals can eat ad lib (reach satiety), in the extent to which they expose pigs to aggression from conspecifics (e.g. floor feeding systems have been regarded as problematic) and in the extent to which pigs can synchronise their feeding behaviour (which is something they 'want to', e.g. electronic sow feeder systems force sows to eat sequentially, rather than simultaneously). The feeding system may also interact with the environmental enrichment, in that some feeding systems (e.g. using high fibre diets) may also provide occupation for the pigs. Because of these diverse impacts of the feeding system on animal welfare, it may be difficult to specify which systems are better and which systems are worse for welfare. (See also note above: leave evaluation of the diet to a feed specialist.) One aspect, available feeding space, could be assessed, provided this is done in relation to both restricted and ad lib systems (see existing guidelines for feeding space per pig in different circumstances).

Food Aspects to be recorded here may be brand name, meal/pellets/fluid, amount/day, provision frequency, contents (ingredients and nutritional properties) and food 'quality' (but again, this appears to be a specialist area).

Watering system Included here are the type of drinker (e.g. nipple or water bowl), flow rate, flow rate (should be 2-3 l/min for a sow, 0,5-0,8 l/min for piglets, > 0,8 l/min for growing pigs (Hoy et al. 2004)) and drinking points should be adjusted/adjustable to the size of the pigs (Hoy et al. 2004).

Water Aspects to be recorded here include the type of water (quality, e.g. from tap/soil), provision frequency, amount/day, litres/min and the number of pigs/drinker (e.g. ≥ 12 fattening pigs/drinker, Von Borell et al., 2001).

Social conditions This includes aspects related to group size and to mixing and separation of pigs (e.g. stable/dynamic groups, family groups, presence of a boar).

Mixing Stable groups are preferred (for welfare) over dynamic groups as mixing leads to agonism (fighting) and stress. Mixing is a management-based parameter that is dealt with elsewhere. Facilities used for mixing (if any) are dealt with here.

Facilities used for mixing pigs Facilities for mixing of pigs may include specific areas used for mixing of unfamiliar groups of pigs.

V 4 When pigs are mixed, the temporary penning in areas with ample space, adequate grip on the floor and opportunities to escape from other pigs is preferred for welfare over the direct penning (mostly at high stocking densities in regular pens).

R 3-4 Main distinctions can be made (good facilities present/completely absent), but there are all kinds of intermediate forms related to mixing management, that may make the interpretation and classification difficult.

F 4

Group size The number of animals in the pen

V 3-4 Individual housing (group size = 1) deprives the pig of social contact and is likely to be a deprivation of an important welfare need because pigs (with the possible exception of adult boars) are social animals. Under (semi-)natural conditions pigs organise themselves in small family groups (a few, genetically related sows and their offspring). Larger groups may have both welfare costs and benefits (e.g. more risk of aggression (e.g. due to mixing) and more space per pen respectively). In very large groups aggression may be reduced relative to smaller groups, but these also give problems of identifying sick pigs. In addition to being a welfare parameter, information about group size is required to calculate other welfare parameters such as density-related measures (space per pig) and is an important variable in the assessment of risk factors for animal-based welfare measures.

R 4-5 Large groups in complex systems may be somewhat difficult to count exactly, but adequate estimates can be made (e.g. by taking the average of several counts).

F 5

Health care Health care is a specialised and multifaceted area, which is relevant for welfare assessment but not its main focus. For norms see e.g. Hoy et al. (2004). Relevant items include not only hygiene provisions, disease pens and equipment used for treatments of animals (which are discussed below), but also other items related to hygiene status e.g. rodent control, equipment used for keeping farm records (computers, recording devices, etc), emergency power supplies, alarm system, monitoring systems (feed intake, body temperatures, etc). These latter items are not discussed in further detail, but could perhaps be included at a general level (present/absent) in the welfare scheme (as a starting point; see also under ventilation equipment).

Hygiene provisions Clean equipment and protective clothes are provided for all personnel and visitors. Suitable equipment for cleaning and disinfecting (of people, buildings, equipment and vehicles) are present. The farm-house is built from materials that can easily be cleaned and disinfected properly. A hygiene 'barrier' (i.e. hygiene sluice, for vehicles and personnel) is present.

V 3

R 3

F 3

Disease pen A special pen for injured and sick animals is present. When there are (chronically) ill animals on the farm, there is evidence that the disease pen is actively used. There is a sufficient capacity of disease pens (i.e. a capacity of > 1% of the herd; e.g. Hoy et al., 2004). Individual pens for seriously ill animals are preferred, as is a management protocol for re-introduction into the group). Conditions in the pen are adjusted to the needs of the diseased animals (resting comfort, food and water of good quality, in sufficient amounts, within reach of the animals), appropriate environmental temperature, light conditions, pen size, floor type, etc (all characteristics were also described for regular pens above). Provision of straw or other material providing extra resting comfort and thermal comfort is preferred.

V 5

R 3-4

F 4 Legal requirements could be used as easy cut-off points to determine whether 'disease pens' are suitable (as a starting point for monitoring).

Equipment Equipment used for the (medical) treatment of animals, such as snares for taking blood samples, injection-equipment, castration and tail-docking equipment and equipment for the identification of pigs (e.g. ear tags) should be suited to its purpose (in good working order). V 3-4 The fact that the equipment is used implies welfare relevance (pain), but equipment use falls outside the scope of this work (is more management-related).

R 3

F 3

How to deal with variability within farms?

A farm may have different types of pen and/or different types of units for one type of pig. Furthermore, over time the conditions under which pigs are kept may change (e.g. organic pigs may have access to pasture, except during the winter months). It may be an issue how to deal with the variability of available resources within farms, as this may affect the final welfare judgement.

Since this problem does not only concern resource-based measures, it must be addressed in the research group constructing the final protocol in collaboration with the group taking the protocol to the farms (WQ 2.4), perhaps also of the integration group (WQ 2.3). In the short description below some possible strategies to deal with this problem are suggested.

Several different strategies could be applied. One extreme example would be to make as many different assessments as there are particular different cases on the farm. Another example would be to select one case (e.g. selected randomly or selecting the most prevalent case) as being representative of the farm.

Alternatively, a heuristic strategy may be adopted that is based on general principles and common sense. Here is the proposal for the outline of this strategy.

When a farm operates entirely different systems (e.g. both organic and conventional pigs), the welfare assessment body may consider allowing one farm to qualify for more than one welfare label. This would involve operating different audits on the same farm, and tight control of Identification and Registration of individual animals.

When this is not an option and when the variation is relatively small (e.g. < 5%) we propose to ignore the fact that there is variability and prescribe to select the most typical case. When the variation is larger (which may mean that a larger proportion of the pens are involved, or that the discrepancy in ultimate welfare score is more substantial), then, a very limited number of cases may be identified, taking some kind of 'average'. This could be a simple arithmetic average, but better would be to take an average that is proportional to the number of different cases involved and that is proportional to the principle that overall welfare is affected relatively more by the worst cases, in which case a higher weight would be given to the welfare status of the worst-off pigs. Under this rule we partly adopt the view that a chain is as strong as its weakest link. This rule is only adopted partially as otherwise overall welfare should always be equal to the welfare status of the worst off pig in the herd (which would be an unacceptable outcome for farmers, consumers and scientists).

This rule would still leave considerable room for (subjective) interpretation. When in doubt, it may be advised to register both the average/typical case as well as the main outliers (esp. the one deviating downwards with respect to welfare).

A tentative conclusion is that dealing with variability will inevitably involve subjectivity in assessment judgement. General guidelines may be formulated as a starting point for developing the assessment protocol.

Note.

Another aspect of 'variability' concerns the problem that in pig husbandry there are many different systems (housing systems, feeding systems, ventilation systems) and types of material using in those systems. In addition, there may be unforeseen developments in the use of systems and materials. The auditing scheme may have to be equipped with a facility for upgrading of its classifications. For example, it could be helpful that an auditor who encounters a 'novel'/unknown type of systems/material, he/she makes more detailed recordings (e.g. taking pictures, provided the farmer can agree to these procedures). A committee of experts could then periodically adjust the classification system as required.

Transport and slaughter

For references on 'loading/unloading' see Lambooij (2004), SVC 2002 (parts on pigs), Von Borell and Schäffer (2005) and Schäffer and von Borell (2002a, 2002b).

For requirements on slaughter, see e.g. EFSA (2004), Von Borell and Schäffer (2005), Schäffer and von Borell (2002c; 2003, 2004a, 2004b).

Practical sources on these subjects also include Temple Grandin's work (e.g. Grandin 2000, 2003) and Barton Gade (1997).

On-farm part of 'transport'

Preparation for transport (on-farm)

- Pig identification
- (Time off feed)

Passageways

- Width
- Floor of passageways
- Slopes and angles
- Walls
- Light/shadows/colours
- Driving equipment
- Group size used for driving
- Humans

Holding area

- Floors
- Walls
- Light/shadows/colours
- Ventilation system of holding yards
- Temperature
- Cooling system
- Temperature
- (Waiting times)
- Density
- Social conditions
- (Food)
- Water

Ramps

Vehicle

- Deck access
- Deck height
- Compartments
 - Density
 - Groupings

Hazards
Maintenance and hygiene
Flooring
Ventilation
Insulation
Temperature
Food
Water
Light
Vehicle driving
Pig driving equipment
Signs
Emergency treatment
Emergency killing

Preparation for transport (on-farm)

Pig identification (if any) Identification of pigs such as slap marking is a management-based parameter. Equipment used for pig identification that is considered unethical, should not be present on the farm.

(Time off feed) Time off feed is a management-based parameter that is (to be) dealt with elsewhere. Animals have been properly prepared before transport, which includes that regular feed is withheld for 5 h (as the stomach gets empty within 5 h; max 12 to 16 hours) but a light food is provided. Recommendations for fasting before loading are about 12 hours off feed but this needs further documentation.

Passageways Passageways allow movements from the pen to the holding area, and from the holding area to the ramp (leading onto the vehicle) on the farm. The objective is to avoid adverse effects (e.g. animals refusing to move), stress from driving (PSE), (skin and leg) injuries and death by providing conditions allowing and facilitating quiet moving of animals.

Width Passageways should have a sufficient width, holding 4 ± 1 pigs such that the pigs can move together, as they are gregarious animals.

V 3-4

R 4

F 4

Floor of passageways Floors are solid and without (steel) projections. Floors are not slippery and have a good drainage.

V 4

R 4

F 4

Slopes and angles Slopes are absent, or $< 15\text{-}20^\circ$. If the race has curves, there should be no sharp corners to facilitate the movement of the animals, i.e. turns are more than 90° .

V 4

R 4

F 4

Walls Walls are solid and without (steel) projections. There are no protrusions or sharp edges of the fences or gateways in areas with pigs, and hinges and latches do not project into the pathway.

V 4

R 4

F 4

Light/shadows/colours Passageways (floor, walls) have neutral colours and no shadows. Animals are moved from areas with reduced light levels to better-illuminated areas.

V 3-4

R 3-4

F 3-4

Driving equipment Pigs are driven (quietly (which is a management-based variable)) using sound cues and driving boards. Wood/plastic 'sticks' should preferably not be used. Electric goads are not used and are not present.

V 3-4

R 3-4

F 3-4

Group size used for driving Pigs are moved in small groups of approx. 15 animals. Smaller groups of 5-6 pigs are even more preferred as this gives the handler more opportunities to reach any animal that stops.

V 3-4

R 3-4

F 3 Recording group size would require asking the farmer and/or being present during driving. Humans Personnel can return after driving the pigs without disturbing them (i.e. the previously driven batch or the next one coming, if any).

V 3-4

R 3-4

F 3

Holding area (on-farm, both for sending pigs off to other farms/slaughter and for receiving pigs from other farms) The facilities provided during holding at the farm before loading will depend on the time that the pigs remain there. If the time is short then access to water may be not be necessary, irrespective of live weight. The absence of holding pens/yards may not be negative for welfare (unless it means e.g. that moving of animals is less quiet). It may be even positive for welfare as it e.g. reduces the animals' exposure to unfamiliar pens and may reduce mixing of unfamiliar animals thus limiting aggression (and improve meat quality).

Floors

V 5 Inadequate flooring may increase discomfort, fear and injuries. A norm could be that floors must be clean, dry (e.g. with sufficient slope/bulging of the floor) and sufficiently rough (comparable to an epoxy-layer of 1 to 2 mm Al_2O_3 or 10 mm rubber). (And floors should not have steep slopes.)

R 3

F 3-4

Walls The walls are smooth to prevent injuries such as skin damages.

V 4

R 4

F 4

Light/shadows/colours Floors and walls have a neutral colour and no (sharp) colour contrasts to avoid fear of pigs. There should be no dim and uneven lighting.

V 3

R 3

F 3

Ventilation system of holding yards

V 4 The ventilation system is important to maintain the environmental temperature at a level that is comfortable for the pigs. A norm could be that holding yards (preferably) have forced ventilation. At a more elementary level holding yards should be sheltered, i.e. holding yards have protection from influences from outside weather conditions (heat, cold, wind and rain) to avoid heat stress, cold stress and disease.

R 4

F 3

Temperature

V 4-5 The temperature in holding yards is preferably maintained within the thermal comfort zones of the pigs, but at least always between 0 and 32°C. Short term exposures to relatively high or low temperatures in the holding yards are less problematic for animal welfare (which is already reduced because of being in the unfamiliar environment) than more long-term exposures to less severe temperatures in the on-farm stage (also because the consequences in terms of respiratory disease cannot take effect in animals that are to be slaughtered). The air velocity ≤ 0.2 m/s (unless there is a hot climate, in which case an airspeed of up to 0.5 m/s may be appropriate (Whittemore, 1993).

R 3-4

F 3-4

Cooling system Equipment used for misting or showering is present for arrived pigs to make the animals quiet and reduce aggression.

V 3-4

R 4

F 4

(Waiting times) Time in the holding area (or in loaded vehicles).

V 4 A resting period is provided after assembly and before loading to avoid exhaustion and porcine stress syndrome (PSS). Animals in waiting areas (in holding areas and in loaded vehicles) may, however, suffer from reduced thermal comfort (too cold; too hot) and may become restless (fighting). A norm could be that the waiting area and parking duration of loaded vehicles is logistically adjusted such that temperature increase in the compartments is limited.

V 3-4

R 2

F 2 Only major deficits can be detected (but this may suffice for the time being). Waiting times are management-based measures that fall outside the scope of the resource-based listing in this document.

Density Danish industry recommendations for space requirements for holding pens for slaughter pigs up to 110 kg are: 0.45 m² per pig for holding periods below half an hour, 0.55 m² per pig up to 3 hours and 0.65 m² per pig for longer holding periods, where 0.65 m² corresponds to the space allowance for pigs of 85-110 kg in pig housing, as described in Directive 91/630/EEC of 19 November 1991, and where the other values are arbitrary figures that allow a progressively smaller space allowance for shorter holding times (see SVC, 2002, pp. 32). [text suggestion made by A Velarde] For welfare reasons, it could also be considered beneficial when additional space were provided for exploration and agonistic encounters (the need for which may be elevated in holding areas, esp. when unfamiliar pigs are mixed).

V 4

R 3-4

F 3-4 Feasibility may depend on the presence of pigs in the holding area during an audit.

Social conditions Boars and sows are penned separately to prevent mounting and injuries.

Groups of pigs are preferably not mixed.

V 4-5

R 3-4

F 3-4

Food See 'time off feed'

Water Water is provided via nipples.

V 3-4

R 4

F 4

Ramps Loading (and unloading) on ramps is often psychologically disturbing for pigs and therefore loading ramps must have an angle of < 15-20°. Descending ramps must have an angle of < 20°. All efforts should be made to eliminate the need for slopes. A much better alternative, therefore, is the presence of a deck lift (tail gate lift or mobile deck on the transport vehicle). This avoids fear, PSS and stress due to driving. Ramps should also have safe side-walls. At the change over from ramp to floor straw can be used.

V 4

R 3-4

F 4-5

Vehicles

Deck access Vehicles with a single deck (solid top or tarp) are ok. Multi-tiered vehicles must have mobile or floating decks. If not, it is preferable that the vehicle has an elevator for (un)loading at the docking ramp.

V 4-5

R 4

F 5

Deck height Deck heights should not cause discomfort while standing and not cause pain and/or injury when the vehicle accidentally encounters an uneven road deck. In any case the height between decks should be according to law (recommendations: piglets (around 25 kg) and feeder pigs (around 60 kg) > 60 cm; slaughter pigs (around 100 kg) >= 90 cm; adult pigs > 120 cm; Lambooij, 2004). The roof is well above the heads of all animals. A 100 kg pig is on average 77 cm tall at the highest point and most research into deck heights shows that 90 cm is sufficient (P. Barton Gade, pers. comm.). Optimal deck heights also depend on the ventilation system used and with effective air movement 90 cm seems to be OK (P. Barton Gade, pers. comm.). Signs on the vehicle should indicate area and height.

V 4

R 5

F 5

Compartments

Density Animals are able to stand (with their heads up) and move in a natural way, and all can lie down at the same time to avoid exhaustion and injuries.

The loading density should be according to legal requirements. Recommendations (Lambooi, 2004, unless stated otherwise) are:

- piglets (20-25 kg): 0.15 m²/animal
- feeder pigs (around 60 kg): 0.35 m²/animal
- slaughter pigs (100-120 kg) 0.42 m²/animal (Lambooi, 2004) – 0,6 m²/animal (Schäffer and von Borell 2002a)
- slaughter pigs (120-140 kg) 0.45 m²/animal (and up)
- heavy pigs (>140 kg) 0.71 m²/animal

Additional space is provided if the temperature rises above 25 degrees Celcius.

Signs on the vehicle should indicate area (and height).

V 5

R 5

F 5

Groupings Groups of pigs (that have been reared together in the same pen) are preferably not mixed to avoid fighting, exhaustion, stress and PSS (but this may be difficult to realise in practice). Partitions between individual pens would be preferred, but moveable internal compartment gates are not always considered to be an option (P. Barton Gade, pers. comm.). Danish recommendations are for pigs from different farms to be kept separately until loading and the mixed groups, so formed, are not to be mixed any more at the abattoir. Adult boars and sows are kept separately.

V 4-5

R 4 It may be difficult to determine that groups of animals have been mixed.

F 3-4

Hazards Vehicle compartments are smooth, free from obstructions, projecting objects and hazards that could cause skin damages. The vehicle is sound and free from any rot or rust. Vehicle is escape proof and does not cause injury.

V 4

R 3-4

F 4

Maintenance and hygiene The vehicle can be (and has been) cleaned and disinfected effectively to avoid/eliminate contamination, and the vehicle is sound and free from any rot or rust.

V 3-4

R 4

F 4

Flooring The floor is made of non-slip material with a roughness comparable to an epoxy layer with 1 to 2 mm Al₂O₃ or 10 mm rubber, and contains a layer of straw or straw dust of 2 cm or an equivalent. This material is sufficiently absorbent (and provides isolation, esp. in winter (e.g. straw)). These measures should avoid discomfort and injuries (and heat stress and cold stress).

V 4

R 4

F 4

Ventilation In order to avoid cold stress and heat stress, the vehicle has artificial/mechanical ventilation (which preferably can be controlled from the drivers cab), and, if not, air inlets are opened or closed depending on the weather conditions. Ventilating compartments and containers have vents positioned at the upper part of the left and right sides. The vents can be opened according legal prescriptions.

V 3-4

R 3-4

F 3-4

Insulation The floor contains a layer of straw or straw dust of 2 cm or an equivalent, that provides sufficient isolation, esp. in winter (e.g. straw). The walls and roof of vehicles must be insulated. If not, vehicles have provisions to protect the pigs from freezing to the wall, esp. when the walls are made of aluminium.

V 4

R 4

F 4

Temperature The temperature is preferably held within the thermal comfort zone, and certainly between 5 and 25-32°C. Measures are (present and are) taken when the inside temperature drops below 5°C or rises above 25, respectively 32°C to avoid dehydration and exhaustion. The optimal air velocity is < 0.2 m/s and the optimal environmental temperature is 16°C (for a 100 kg slaughter pig or adult pig).

Additional space is provided if the temperature rises above 25 degrees C. Regulation of the compartment temperature includes the time between loading and departure, depending on the weather conditions.

V 4

R 3

F 3

Food On longer journeys, food and water are available at appropriate times (in accordance with legal requirements and in accordance with the biological needs of the animals). Light food is preferred as pigs can suffer from travel sickness if their stomachs are full. If the transport is over 24 hrs, when feeding will be mandatory, then a light meal should be given at the start of a longer (e.g. 9 hr) stop, so that feed has been digested when the transport starts again. The provision of food is a management-based parameter, but it could be possible to check feeders and availability of food. The vehicle should carry sufficient food (and water) for the whole journey.

V 3-4

R 2-3

F 2-3

Water On longer journeys, and esp. during stops, water is provided via nipples. Drinking nipples are available for journeys over 8 hours, and have a low level signal system.

The vehicle carries sufficient (food and) water for the whole journey.

Per 15 pigs 1 nipple drinker is provided (Lambooi, 2004), an alternative recommendation could be e.g. 2 nipples per compartment. Problems with water availability may occur when the outside temperatures drop (much) below 0°C, and measures are taken to prevent such problems.

V 4

R 3-4

F 3-4

Light Inside light is present for loading and control.

V 4

R 4

F 4

Vehicle driving There is a definite delivery appointment, a complete transport declaration (origin, owner, dispatch location and place of destination, day and time of loading), route planning (road surface, curves, jams, traffic lights), esp. in longer transports), professional competence and knowledge of the driver, and a tachometer is present and in use. Highways and main roads are preferred to urban traffic. Domestic transport has a duration < 8 h, including loading and unloading.

V 3-4

R 3

F 3

Pig driving equipment There are no electric goads on the vehicle or in possession of the driver

V 3

R 3

F 3

Signs Symbol and note 'Live Animals' on the vehicle. Signs on the vehicle should indicate area and height.

V 2-3

R 5

F 5

Emergency treatment Legislation states that it should be possible to access all compartments on the vehicle for emergency treatment (but this may run into practical problems with e.g. safety of the driver and welfare concerns, e.g. stress of unaffected animals when they must be

off-loaded at a suitable place to make emergency treatment possible). It is preferable that manual unloading is possible in case of an emergency.

V 3-4 Its actual incidence is probably relatively rare incidence.

R 4

F 4

Emergency killing Penetrating captive bolt stunner (or other suitable equipment) is available in case of emergency euthanasia.

V 3

R 4

F 5

Abattoir part of 'transport and slaughter'

Slaughter facilities

Vehicles

Unloading

Passageways at the slaughter house

Holding in abattoir lairage

Disease pen

Emergency killing

Hygiene provisions

Fixation, stunning and killing

Slaughter facilities This section is kept relatively short, because general points applying to on-farm conditions, also apply here.

Vehicles (see above)

Unloading (see above)

Passageways at slaughter (see above)

Holding in abattoir lairage (see above)

Disease pen (see above) A special reception centre for injured and sick animals is present.

Emergency killing A facility to kill animals in case of emergency is available in the form of either penetrating captive bolt or electrical stunning equipment (with 240 V / 1.3 A / > 3s on the head (eye-ear) and > on the heart to induce cardiac arrest).

V 3

R 4

F 4-5

Hygiene provisions (See above)

Clean equipment and protective clothes are provided for all personnel and visitors. Suitable equipment for cleaning and disinfecting (of people, buildings, equipment and vehicles) are present. Building, yards, passageways and equipment are built from materials that can easily be cleaned and disinfected properly.

Fixation, stunning and killing For this specific item, reference is (again) made to the EFSA 2004 report for further details. Equipment used for fixation, stunning and killing (sticking) is a rather specialist field that is not easily incorporated into an assessment system (low reliability and feasibility), while also validity of the resource-based item may be questionable (as the welfare problem concerns only a very short period (seconds or minutes) of the animal's life). For this reason, too, this section has not been fully elaborated. Only relevant items have been listed, and a general assessment of validity, reliability and feasibility is given here:

V 3-4

R 2-3

F 2

Electrical stunning

Restraining system

Equipment

Electrode application Proper electrodes must be used, which are appropriate for the size of the animals.

Maintenance of the electrodes.

Current flow Minimum current of 1.3 A for at least 1 s to induce immediate loss of consciousness. A minimum of 1.0 A, 50Hz sine wave AC to induce cardiac ventricular fibrillation.

Appropriate and calibrated voltage and current measuring devices should be used to set stunners.

Sticking If stunning head only, sticking should be performed within 15s after stun.

Proper maintenance of the equipment.

CO2 stunning

Minimum CO2 concentration of 90% at the bottom of the pit (EFSA 2004 recommendation). Pigs should be exposed to a minimum of 80% with 10s from leaving atmospheric air.

Exposure time (minimum of 100s). (EFSA recommendation)

Captive bolt

Used as back-up stunning method

Restraining system

Appropriate cartridge selection, storage and gun maintenance.

Discussion

Evaluation of the ‘tool’

This study was conducted as part of a European research project aimed at developing a welfare assessment tool. The paper described resource-based parameters for welfare assessment of pigs on-farm and with respect to ‘transport and slaughter’. Other partners have been (and/or still are) working on animal-based parameters, record-based parameters and management-based parameters (which have, accordingly, been excluded from incorporation in this work).

A systematic decomposition of all aspects potentially relevant from a ‘resource-based’ perspective has been made. This has resulted in a long, hierarchically composed list of items, each of which has been subjectively evaluated with respect to its validity, reliability and feasibility for incorporation into the welfare assessment tool.

This document provides the input for the next phase of the European research project (WP 2.3 and WP 2.4) to integrate information and construct standardised and practicable welfare assessment lists across species (pigs, cattle and poultry). For that phase of the work, a fundamental choice is left between selecting relatively few resources for detailed measurement, or selecting a larger number of resources which are recorded only on a scale with a few (2 or 3) levels, depending on the time (and money) available to do the audit.

Another issue to be addressed there is to further integrate the groups of parameters (resource-, management-, record-, animal-based), for in the end these parameters have to be integrated into the assessment. For example, in order to assess climate and ventilation the management of these resources must be taken into account. Another problem relates to genetics. Pigs are obviously different in their abilities to adapt to certain conditions. Breeds or certain genotypes might be more or less suited or adapted to certain housing conditions, and this paper has not been able to reach that level of detailed discussion (if it were known). This points to a general ‘shortcoming’ and that is that the animal’s environment, its ‘resources’, cover such a wide range of aspects that the level of description necessarily had to be kept very general, even without detailed references being included. Instead a reference is made to overview-documents (mainly EC reports), because the scope of this work did not allow going into that level of detail. Despite this, the work should provide a good starting point for the further development of the welfare assessment tool with respect to resource-based measures for pigs (and to a lesser extent also for other species such as cattle and poultry).

Evaluation of the process

Because of the limited budget, a decision was made to progressively upgrade the paper instead of organising one or two workshops. The impression was that this has worked reasonably well, as this has channelled the process from ‘talking together’ into ‘writing together’. A number of relevant authors were prepared to comment on earlier versions of the document in a most constructive way. Their contributions are much acknowledged.

The document has also been sent to other partners working in WQ subproject to, esp. to groups working on resource-based measures in the other species and groups working on management- and records-based parameters. It is hoped that this will have contributed to the harmonisation of the work.

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Literature

- Anonymous, 2001. Scientists' assessment of the impact of housing and management on animal welfare. *J. of Appl. Anim. Welfare Sci.* 4, 3-52.
- Barton Gade, P., 1997. The effect of pre-slaughter handling on meat quality in pigs. *Proc. 6th Biennial Conf. Of the Australasian Pig Science Association*. Editor: P.D.Cranwell, Werribee, Australia, pp. 100-115.
- Blokhuis, H.J., Jones, R.B., Geers, R., Miele, M., Veissier, I., 2003. Measuring and monitoring animal welfare: transparency in the food product quality chain. *Animal Welfare* 12, 445-455.
- Bracke, M.B.M., Spruijt, B.M., Metz, J.H.M., Schouten, W.G.P., 2002a. Decision support system for overall welfare assessment in pregnant sows A: Model structure and weighting procedure. *J. Anim. Sci.* 8, 1819-1834.
- Bracke, M.B.M., Metz, J.H.M., Spruijt, B.M., Schouten, W.G.P., 2002b. Decision support system for overall welfare assessment in pregnant sows B: Validation by expert opinion. *J. of Anim. Sci.* 8, 1835-1845.
- Bracke, M.B.M., Hulsegge, B., Keeling, L., Blokhuis H.J., 2004a. Decision support system with semantic model to assess the risk of tail biting in pigs: 1. Modelling. *Appl. Anim. Behav. Sci.* 87, 31-44.
- Bracke, M.B.M., Zonderland, J. J., Bleumer, E.J.B., In press-a. Expert judgement on enrichment materials for pigs validates preliminary RICHPIG Model. *Appl. Anim. Behav. Sci.*
- Bracke, M. B. M., Zonderland, J. J., Bleumer, E.J.B., In press-b. Expert consultation on weighting factors of criteria for assessing environmental enrichment materials for pigs. *Appl. Anim. Behav. Sci.*
- Butterworth, A. (Ed). 2005. Science and society improving animal welfare. *Welfare Quality conference proceedings*, 17-18 November 2005, Brussels, Belgium. ASG, Lelystad, 146 pp.
- Day, J.E.L., Burfoot, A., Docking, C.M., Whittaker, X., Spoolder, H.A.M., Edwards, S.A., 2002a. The effects of prior experience of straw and the level of straw provision on the behaviour of growing pigs. *Appl. Anim. Behaviour Sci.* 76, 189-202.
- EC, 2001. Council Directive 2001/88/EC of 23 October 2001 amending Directive 91/630/EEC laying down minimum standards for the protection of pigs (OJ. L 316, 1.12.2001. p. 1)
- EFSA, 2004. Welfare aspects of animal stunning and killing methods. EFSA-Q-2003-093, EFSA-AHAW/04-027 panel, 241 pp.
- EFSA, 2005. The welfare of weaners and rearing pigs: Effects of different space allowances and floor types. EFSA-Q-2004-077, EFSA-AHAW panel, 129 pp.
- Grandin, T., 2000. *Livestock Handling and Transport*, 2nd ed. Wallingford: CAB International.
- Grandin, T., 2003. Transferring results of behavioural research to industry to improve animal welfare on the farm, ranch and the slaughter plant. *Appl. Anim. Behav. Sci.* 81, 215-228.
- Hoy, S., Von Borell, E., Richter, T., Sundrum, A., 2004. Das HACCP-Programm in der Schweinehaltung – Kritische Kontrollpunkte (CCP) aus der Sicht der Tiergesundheit. *Züchtungskunde*, 76
- Lambooij, E., 2004 Welfare and hygiene code for pigs during transport; Implementation of a security scheme. ASG, Lelystad, Report 04/0010107.
- Schäffer, D., von Borell, E., 2002a. Tiergerechtes Handling. 1. Kontrollpunkte für den Transport von Schlachtschweinen. *Fleischwirtsch.* 82, 41-46.
- Schäffer, D., von Borell, E., 2002b. Tiergerechtes Handling von Schlachtschweinen. 2. Kontrollpunkte für das Entladen von Transportfahrzeugen. *Fleischwirtsch.* 82, 22-26.

- Schäffer, D., von Borell, E., 2002c. Handling von Schlachtschweinen. 3. Kontrollpunkte für den Ruhestall im Schlachthof. *Fleischwirtsch.* 82, 51-56.
- Schäffer, D., von Borell, E., 2003. Handling von Schlachtschweinen. 4. Kontrollpunkte für den Zutrieb zur Betäubung. *Fleischwirtsch.* 83, 17-24.
- Schäffer, D., von Borell, E., 2004a. Tiergerechtes Handling von Schlachtschweinen. 5. Kontrollpunkte für die CO₂-Betäubung. *Fleischwirtsch.* 84, 22-29.
- Schäffer, D., von Borell, E., 2004b. Treiber treffen häufig nicht richtig - Treibhilfeneinsatz beim Eintritt der Schweine in Elektrobetäubungsanlagen. *Fleischwirtsch.* 84, 21-24.
- S.V.C. (Scientific Veterinary Committee), 1997. The welfare of intensively kept pigs. Doc. XXIV/ScVc/0005/97, Scientific Veterinary Committee, Animal Welfare Section, Brussels, 199 pp.
- S.V.C., 1999. Standards for the microclimate inside animal transport road vehicles (www), European Commission, Brussels, 32 pp.
- S.V.C., 2002. The welfare of animals during transport (details for horses, pigs, sheep and cattle), European Commission, Brussels, 130 pp.
- Whittemore, C., 1993. *The Science and Practice of Pig Production*. Longman, Burnt Mill, Harlow.
- Velarde A, Hörning, B, Wemelsfelder, F., Tuytens, F., Spoolder, H.A.M., Boe, K., Bracke, M.B.M., Courboulay, V. and Geers, R., 2006. On-farm pig welfare monitoring: a literature review (abstract). In: Blokhuis H.J., Jones, R.B., Veissier, I. and Geers, R. Cost Action 846 "Measuring and Monitoring Farm Animal Welfare", K.U. Leuven R&D, Lovenjoel, Belgium, p. 24.
- Von Borell, E., Bockisch F.-J., Büscher, W., Hoy, S., Krieter, J., Müller, C., Parvizi, N., Richter, T., Rudovsky, A., Sundrum, A., Van den Weghe, H., 2001. Critical control points for on-farm assessment of pig housing. *Livest. Prod. Sci.* 72, 177-184.
- Von Borell, E., Schäffer, D., 2005. Legal requirements and assessment of stress and welfare during transportation and pre-slaughter handling of pigs. *Livest. Prod. Sci.* 97, 81-87.

Colophon



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