Brussels, 30 October 2015

COST 066/15

DECISION

Subject: **Memorandum of Understanding for the implementation of the COST Action "Synergy for preventing damaging behaviour in group housed pigs and chickens" (GroupHouseNet) CA15134**

The COST Member Countries and/or the COST Cooperating State will find attached the Memorandum of Understanding for the COST Action Synergy for preventing damaging behaviour in group housed pigs and chickens approved by the Committee of Senior Officials through written procedure on 30 October 2015.

MEMORANDUM OF UNDERSTANDING

For the implementation of a COST Action designated as

COST Action CA15134
SYNERGY FOR PREVENTING DAMAGING BEHAVIOUR IN GROUP HOUSED PIGS AND CHICKENS (GroupHouseNet)

The COST Member Countries and/or the COST Cooperating State, accepting the present Memorandum of Understanding (MoU) wish to undertake joint activities of mutual interest and declare their common intention to participate in the COST Action (the Action), referred to above and described in the Technical Annex of this MoU.

The Action will be carried out in accordance with the set of COST Implementation Rules approved by the Committee of Senior Officials (CSO), or any new document amending or replacing them:

a. "Rules for Participation in and Implementation of COST Activities" (COST 132/14);
b. "COST Action Proposal Submission, Evaluation, Selection and Approval" (COST 133/14);
c. "COST Action Management, Monitoring and Final Assessment" (COST 134/14);
d. "COST International Cooperation and Specific Organisations Participation" (COST 135/14).

The main aim and objective of the Action is to reduce the incidence of damaging behaviours in group-housed animals by refining methods of genetic selection and by developing husbandry innovations that improve early and later life conditions. This will be achieved through the specific objectives detailed in the Technical Annex.

The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 60 million in 2015.

The MoU will enter into force once at least five (5) COST Member Countries and/or COST Cooperating State have accepted it, and the corresponding Management Committee Members have been appointed, as described in the CSO Decision COST 134/14.

The COST Action will start from the date of the first Management Committee meeting and shall be implemented for a period of four (4) years, unless an extension is approved by the CSO following the procedure described in the CSO Decision COST 134/14.

COST is supported by the EU Framework Programme Horizon 2020

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OVERVIEW

Summary
The GroupHouseNet aim is to provide the European livestock industry with innovations in breeding and management for pigs and poultry that are needed for a successful transition to large group housing systems without necessitating painful tail docking and beak trimming. Allowing the animals greater opportunities to display their species-specific behaviour while avoiding the routine use of painful procedures, group housing of unmutilated animals sits at the core of the new animal welfare paradigm driven by consumer demand. Group housing is associated with increased risks of damaging behaviours among the animals, such as feather pecking, aggression and cannibalism in laying hens and tail biting, bellynosing, excessive aggression and cannibalism in pigs. Recent research suggests the key to reducing the incidence of these behaviours lies in refining and applying methods of genetic selection, and developing husbandry innovations that improve early and later life conditions - which is exactly what GroupHouseNet will use the COST Action framework and tools to do. GroupHouseNet brings together researchers and industrial partners dealing with animal breeding and genetics, animal nutrition, epidemiology, engineering, animal behaviour and welfare, epigenetics, immunology, (neuro)physiology, economics and ethics. To strengthen the scientific and technological basis in these areas the Action will facilitate knowledge sharing, creation and application in pigs and laying hens in both experimental and commercial environments. The activities will be conducted in an open, output-oriented transnational, multisectorial, and multidisciplinary research and development network emphasising COST Excellence and Inclusiveness Policy.

Areas of Expertise Relevant for the Action	Keywords
● Animal and dairy science: Agriculture related to animal husbandry, dairying, livestock raising, animal welfare ● Biological sciences: Epigenetics and gene regulation ● Veterinary science: Veterinary medicine (miscellaneous) ● Philosophy, Ethics and Religion: Ethics and morality, social ethics ● Biological sciences: Genomics, comparative genomics, functional genomics	● animal welfare ● damaging behaviour ● breeding ● health ● husbandry

Specific Objectives
To achieve the main objective described in this MoU, the following specific objectives shall be accomplished:

Research Coordination
● Review the role of genetics to enable selection for reduced expression of damaging behaviour and increased disease tolerance
● Review pre- and postnatal conditions that reduce damaging behaviour and favour health
● Review associations between damaging behaviour and health status of fattening pigs, sows and laying hens on commercial farms
● Review the effectiveness and disseminate the most promising possibilities for producing animals that are better adapted to the social, environmental, and health challenges met in commercial group-housing environments.

Capacity Building
● Provide researchers, engineers, advisors, policy makers and members of interest organizations with networking opportunities for first-hand access to innovative knowledge and tools for preventing damaging behaviour in group housed pigs and laying hens.

● Provide high quality training of Early Career Investigators (ECIs) through their inclusion in a strong European network focusing on reducing damaging behaviour in group-housed pigs and laying hens through interdisciplinary and intersectorial information-sharing and innovation with emphasis on capacity building in the COST Inclusiveness Target Countries.
● Provide state-of-the-art training in specialized theory, methodology and laboratory techniques based on workshops, courses, and Short-Term Training Missions involving active transfer between academia, industry and policy makers.
● Provide training with equal relevance for industry, academia and policy makers to give senior and ECIs complementary and industrial skills and stimulate further public-private sector collaboration.
● Provide ECIs and engineers with an exceptional training in relevant generic skills, such as networking, project management, personal development, career planning, communication, exploitation of innovations, research ethics, and IPR.
● Ensure participation by female scientists in line with the gender structure of the group originally proposing GroupHouseNet.

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DESCRIPTION OF THE COST ACTION

1. S&T EXCELLENCE

1.1. Challenge

1.1.1. Description of the Challenge (Main Aim)

The main aim of the GroupHouseNet COST Action is to provide the European livestock industry with the innovations in breeding and management of early and later life conditions for pigs and poultry which it needs to achieve a successful transition to large group housing systems without necessitating the use of painful tail docking and beak trimming. Allowing the animals greater opportunities to display their species-specific behaviour while avoiding the routine use of painful procedures, group housing of unmutilated animals sits at the core of the new animal welfare paradigm driven by consumer demand. Group housing is unfortunately associated with increased risks of some damaging behaviours among the animals, such as feather pecking, aggression and cannibalism in laying hens and tail biting, bellynosing, excessive aggression and cannibalism in pigs. Recent research results suggest the key to reducing the incidence of these behaviours lies in refining and applying methods of genetic selection, and developing husbandry innovations that improve early and later life conditions - which is exactly what GroupHouseNet will use the COST Action framework and tools to do. GroupHouseNet will bring together researchers and industrial partners dealing with animal breeding and genetics, animal nutrition, epidemiology, engineering, animal behaviour and welfare, epigenetics, immunology, (neuro) physiology, economics, ethics and the philosophy of animal science and human-animal relations. The COST Action will thus combine more applied research on how to achieve good welfare and productivity in commercial group-housing production systems with fundamental basic science, such as understanding genotype x environment (GxE) interactions, the role of early life experiences, and immunological and neuroendocrine mechanisms underlying behaviour. Normative questions raised by the methods being developed will be explicitly considered. To strengthen the scientific and technological basis in these areas, the Action will facilitate knowledge sharing, creation and application in pigs and laying hens in both experimental and commercial environments. The activities will be conducted in an open, output-oriented transnational and multidisciplinary research and development network, with key players from both industry and academia working closely together. It will thus promote productivity and job opportunities in the European agricultural industry. The expertise of the partners initiating GroupHouseNet covers the whole area from fundamental approaches in epigenetics and immunology to applied approaches in animal breeding, engineering and animal behaviour science anchored in explicit ethical principles. Furthermore, commitment from industry partners ensures active participation at the highest possible level from industry and provides ample opportunities to translate promising scientific results to innovations in the European livestock industry.

Consumer demand for a high standard of animal welfare is changing European livestock practice, forcing farmers to introduce new husbandry systems. After the European ban on battery cages in 2012, laying hens have been moved mainly to large flocks in non-cage systems or flocks of 9 to 60 birds in furnished cage systems. In addition, raising entire male pigs that are more prone to fighting than castrated male pigs may be practised in most European countries by 2018. Similarly, sows are increasingly moved from individual stalls to large groups. With 150 billion pigs and 260 billion laying hens in the European Union, these transitions have resulted in large changes, particularly in the egg production industry. Although these new group-housing systems offer the animals greater opportunities to move around and display their species-specific behaviour, they also pose an increased risk for damaging behaviour compared with traditional systems. Malfunctioning social groups may display high levels of aggression and damaging behaviour such as feather- pecking in laying hens and tail biting and excessive aggression in pigs. The associated negative effects on health, welfare and mortality are significant. For instance, an outbreak of severe feather pecking

can easily result in an increase of 5% in mortality rates, which would translate to 13 billion laying hens dying prematurely due to feather pecking in the European Union every year, with vast economic and welfare implications. Older studies report mortalities due to cannibalism of up to 40% even in cage-housed birds when beak trimming is not used. Examples like this underpin the common view characteristic of the current paradigm that beak trimming is an absolute necessity, despite the fact that national average mortality for group-housed birds not subject to beak trimming may be as low as 4% in some countries.

1.1.2. Relevance and timeliness

To reduce problems caused by damaging behaviours in group housing, many European countries currently practice **beak trimming in laying hens and castration and tail docking in pigs**. Because these mutilations are painful for the animals, the pressure is increasing to prohibit them throughout Europe. For instance, bans on beak trimming are currently proposed in the United Kingdom (2016) and The Netherlands (2018). In addition, representatives of the pig chains in the European Union committed to stopping surgical castration of male pigs by 2018. **Thus, solutions for managing laying hen flocks with intact beaks, pigs with intact tails, and male pigs that are not castrated are urgently needed**. The evidence is accumulating that the tendency to develop such behaviours is strongly influenced by genetics and early life conditions. Moreover, recent studies suggest a link between poor health and damaging behaviour, although it remains unclear whether suboptimal health is a consequence or a potential cause of damaging behaviours. With the bans on beak trimming currently proposed in the United Kingdom and The Netherlands, the paradigm shift in animal welfare needs help with implementation. To date, new approaches such as genetic selection and husbandry innovations have not been adequately applied to the challenges described above, and their promise for improving the health, welfare and productivity of group-housed livestock throughout Europe remains unrealised.

1.2. Specific Objectives

1.2.1. Research Coordination Objectives

Four Research Coordination Objectives have been set up for the GroupHouseNet training network:

1. Review the role of genetics to enable selection for reduced expression of damaging behaviour and increased disease tolerance (WG1)
2. Review pre- and postnatal conditions that reduce damaging behaviour and favour health (WG2)
3. Review associations between damaging behaviour and health status of fattening pigs, sows and laying hens on commercial farms (WG3)
4. Review the effectiveness and disseminate the most promising possibilities for producing animals that are better adapted to the social, environmental, and health challenges met in commercial group-housing environments (WG1-3)

The main means to achieve these objectives will be the networking possibilities afforded by the COST framework. The Action will be organised in 3 Working Groups (WGs) with different tasks (see 1.3.2). These will be organised in a structure that offers a novel, unconventional combination and integration of cutting edge methodology.

1.2.2. Capacity-building Objectives

The specific Capacity-Building Objectives of the project are outlined in the following:

1. Provide researchers, engineers, advisors, policymakers and members of interest organisations with **networking opportunities for first-hand access to innovative**

knowledge and tools for preventing damaging behaviour in group-housed pigs and laying hens.

2. Provide high-quality **training of Early Career Investigators (ECIs)** through their inclusion in a strong European network focusing on reducing damaging behaviour in group-housed pigs and laying hens through interdisciplinary and intersectoral information-sharing and innovation with an emphasis on **capacity building in the COST Inclusiveness Target Countries**.
3. Provide state-of-the-art training in specialised theory, methodology and laboratory techniques based on workshops, courses, and Short-Term Training Missions involving an active transfer between academia, industry and policymakers.
4. Provide training with equal relevance for industry, academia and policymakers to give senior and ECIs complementary and industrial skills and stimulate further public-private sector collaboration.
5. Provide ECIs and engineers with an exceptional training in relevant generic skills, such as networking, project management, personal development, career planning, communication, exploitation of innovations, research ethics, and IPR.
6. **Ensure participation by female scientists** in line with the gender structure of the group originally proposing GroupHouseNet.

1.3. Progress beyond the state-of-the-art and Innovation Potential

1.3.1. Description of the state-of-the-art

Previous work on these injurious behaviours has focussed mainly on the removal of parts of the beak or tail. Recent studies point at genetic and early environmental factors as central to the aetiology of these behaviours, thus providing a direction for their prevention. Both in pigs and in laying hens, it is shown that new methods of genetic selection are needed to breed animals for group housing systems, and that selection for reduced levels of mortality in group-housed laying hens results in a decreased stress sensitivity and a reduced expression of damaging behaviour. In pigs, it is found that selection for increased indirect (social) genetic effects on growth leads to a lower expression of damaging behaviour and changes in stress responsiveness and immune status. Furthermore, it is shown that animals with specific genotypes may be more at risk of showing damaging behaviour. A mutation in the pigmentation-related gene PMEL17 protects against feather pecking, but at the same time causes animals to be more active and aggressive, underlining the complexity of damaging behaviour and the need for further research. Recent studies also indicate that phenotypic variability also affects the incidence of damaging behaviours, immune status and hen performance. It is shown that pigs have stable personality characteristics that influence their adaptive capacity and that tail biting is under genetic control. However, apart from the animal's genetic background, the experience of its parents also strongly influences social behaviour and adaptive capacity. In laying hens, it is shown that stress in the parent stock affects the behavioural development of the offspring through epigenetic effects. It was recently reported that stress during early life stages is translated to subsequent generations through the interplay between stress hormones and epigenetic mechanisms, suggesting non-genetic inheritance of stress responses. **To make real steps towards practical solutions, however, these individual research approaches have to be brought together.** Further, to ensure uptake in the European livestock industry, new tools are needed for phenotyping individual animals and for evaluating epigenetic effects.

In pigs, it is found that an enriched and stimulating rearing environment results in pigs that show more explorative and less damaging behaviour than pigs from a barren environment. They also play more, suggesting positive effects on their welfare. Also, the social environment plays an important role: there are indications that social experiences of gilts during rearing can predict their later

aggressive behaviour as adults in a group of sows. Increased opportunities for interaction with the mother also positively affects behaviour in pigs, as indicated by increased play behaviour and reduced expression of damaging behaviour such as bellynosing. In poultry, incubation conditions seem to influence adaptive capacity later in life. In broilers, it has been shown that 16 hours' light per day during incubation, and early environmental enrichment, improves adaptive capacity and reduces aggression, respectively, offering a promising route to explore further in laying hens. Post-hatch supplementation with suitable litter material for foraging and exploratory behaviour has been demonstrated to reduce damaging behaviour later in life, although the conditions in the production environment also remain important. In layer chicks, maternal care has been shown to have positive effects on behavioural development, resulting in reduced fearfulness and feather pecking and increased foraging behaviour. Although full maternal care is challenging to implement in current poultry production systems, one can simulate certain aspects of maternal care. Dark brooders, for example, provide the opportunity for chicks to rest together in a warm and dark environment, partially mimicking the conditions provided by a broody hen. The use of dark brooders during early life has been found to reduce feather pecking under experimental circumstances and recently also in commercial flocks. **Although these research results are promising by themselves, to date they have not been brought together in one coherent research programme, nor have they been translated to innovations in the European livestock industry.**

Furthermore, recent studies suggest a link between poor health and damaging behaviour, with suboptimal health being both a consequence and potential cause of damaging behaviours. Improvements in genetic selection and the early life environment should, therefore, result in animals showing less damaging behaviour and having better health status.

Based on this presentation of the state-of-the-art, it can be hypothesised that damaging behaviours can be prevented by a combination of innovative breeding strategies with a more optimal early life environment combined with small adjustments to the production environment of adult animals. Further, it can be hypothesised that a strong reduction of damaging behaviour will be linked to an improved health status.

1.3.2. Progress beyond the state-of-the-art

To prevent the development of damaging behaviours, the GroupHouseNet will progress beyond the current State-of-the-art through a work programme moving from WG1) the role of genetics, epigenetics, and GxE interactions, through WG2) the role of early life experiences and their match with the production environment, to WG3) the relationship between damaging behaviour, health status and the welfare of commercial production animals.

The first objective of **WG1** is to coordinate research and share knowledge aimed at **developing novel methods for phenotyping and genotyping for damaging behaviour and health traits**. For pigs, this will involve the coordination and sharing of knowledge related to the following ongoing research efforts: to develop genetic methods to select for increased disease resistance and reduced aggression and tail biting by identifying molecular and phenotypic markers. It will also do the same for research aimed at developing behavioural, physiological and/or molecular tools to identify tail biters or pigs that are predisposed to be bitten, for use in new commercial breeding programmes and on-farm prevention programmes. In addition, WG1 will coordinate ongoing research aimed at investigating the potential of novel breeding strategies targeting indirect, or social, genetic effects to reduce aggression and tail biting, and thereby improve group performance. A second objective of WG1 is to coordinate, share and apply research aimed at **mapping transgenerational epigenetic consequences of early life experiences with a focus on improving social behaviour and adaptive capacity**. Relevant ongoing research efforts involve

evaluating transgenerational epigenetic effects in laying hens. Positive social interactions and exposure to a complex environment appear to have a stress buffering effect. This is accompanied by corresponding epigenetic changes in tissue from pigs and poultry, and in nucleated red blood cells from laying hens. The identification of less invasive blood-based epigenetic markers of stress has potential uses in monitoring welfare status and as molecular markers of robustness.

The objective of **WG2** is to coordinate, share, and disseminate results from efforts aimed at **characterising pre- and postnatal conditions that reduce damaging behaviour** and assessing whether this also improves health status. Ongoing experimental research in laying hens suggests that avoiding parental stress, providing light during incubation, access to dark brooders post-hatching, as well as the provision of a stimulating and complex multidimensional rearing environment, will reduce the risk of aggression and feather pecking and improve health in adult birds. In pigs, ongoing experimental research aims at characterising postnatal early life experiences that contribute to improving social behaviour, preventing tail biting and bellynosing, reducing aggression, and increasing play behaviour, exploratory behaviour, and health. The effects of the social experience of pigs during rearing on their later success as breeding sows adapting to different social groups is also an area of focus. **For both species, GroupHouseNet will thus produce a comprehensive overview of research characterising maternal and early life environments that minimise the risk of damaging behaviours and improve the health status of the group-housed animals.**

The objectives of **WG3** are to map and summarise current knowledge about the relationship between damaging behaviour and health status under commercial conditions, to develop new ideas for further research, and to disseminate scientific knowledge to effect real change on farms. The focus of **WG3** is distinct from the previous WGs in having less focus on genetic selection, epigenetic mechanisms, GxE interactions, and developmental processes, and more focus on links between environment, health, and damaging behaviour in adult animals. For both pigs and laying hens, members of **WG3** will work with Early Career Investigators to develop credible research agendas to fill identified gaps in knowledge. In pigs, there will be a focus on exploring the **relationship between symptoms of poor health and their behavioural correlates, with a focus on tail biting and aggression-related behaviour**. **WG3** will also share best practice and standardise methodologies for assessing health status and disease tolerance in pigs, focussing on immunological (cytokine signalling), genetic (Single Nucleotide Polymorphism) and behavioural (sickness behaviour) indicators so that these can be better linked to tail biting, aggression and/or disease tolerance. In laying hens, there will be a focus on studying and optimising environmental effects on **feather pecking, aggressive behaviour, cannibalism and health in adult birds**. For both pigs and laying hens, **WG3** will also assess the cost-effectiveness of ethically justified practical strategies to reduce damaging behaviour and favour health that can be implemented at the farm level, and then publicise and disseminate the most cost-effective ethically responsible solutions to stakeholders including end users, interest organisations, policymakers and the general public (WP5).

1.3.3. Innovation in tackling the challenge

Ultimately, fulfilment of the Action objectives should lead to innovative methods for breeding and rearing non-tail docked, non-castrated, non-beak trimmed animals that are better suited for a life in group housing systems. It should also result in the reduction of damaging behaviours in all production systems, and improve animal welfare and health. Some of the initiating partners may have made considerable contributions to the current state-of-the-art in this field, but their approaches have never been brought together in one coherent research network. By sharing knowledge, it is expected that GroupHouseNet will make considerable progress beyond the current state-of-the-art, both regarding

the use of cutting-edge scientific approaches and in the joint application of these novel ideas in the European livestock industry. This approach is enabled by cross-fertilisation between top-quality science and leading industry partners. By bringing these top players together, GroupHouseNet is forged into a very strong and unique, multi-disciplinary research network, that also remains open to new ideas and partners.

1.4. Added value of networking

1.4.1. In relation to the Challenge

To achieve the main aim, the Action will actively exploit pluralities of different European animal production systems and policy regimes: whereas in some member states beak-trimmed hens are still kept in furnished cages, other member states have prohibited beak trimming and very successfully keep most hens in non-cage systems. Tail docking of pigs is still standard practice in some countries but is prohibited in others. Thus, **Europe's challenges in livestock welfare and productivity can only be addressed by a coordinated transnational network linking industry and academia**. The academic proposers initiated GroupHouseNet based on their long-term experience and collaboration in research, development and training in this field, both nationally and internationally. The international industry proposers, many of which are SMEs, have contributed significantly to defining the research coordination objectives according to their needs, and will be actively involved in the Working Groups. The academic proposers already have excellent contact with local industry partners, recruited to the Action based on past and on-going research collaborations.

Experts from over 17 institutions in 15 widely-distributed COST countries, including six countries in South Eastern Europe, have already responded positively to joining this Action. Among these, a range of disciplines and expertise is represented, as is essential for a One Health perspective. In addition, among the participants, important stakeholder groups are also represented (poultry rearers, feed producers, breeding companies, producers), while other stakeholders have registered interest and would be interested in participation should GroupHouseNet be awarded funding. Further experts from COST countries have been contacted and expressed interest but have been unavailable to participate in the proposal, while international experts outside of Europe have also been informed of GroupHouseNet. Since the current information-base regarding the prevention of damaging behaviour is fragmented and discipline and species-specific, there is a clear need for efficient networking and collaboration among experts in different fields and sectors as well as pooling of existing knowledge and resources to produce the GroupHouseNet outcomes listed below. The specific tasks in GroupHouseNet can only be undertaken through cooperative multi-disciplinary networking, as planned in the Action's Working Groups. Typical COST activities will be constructive in achieving this, including the planning/kick-off meeting, annual meetings, Working Group (WG) meetings, STSM (Short-Term Scientific Missions mainly for Early Career Investigator (ECI) training through international and academia-industry exchange), and workshops and symposia. The latter will be associated, wherever possible, with relevant general scientific meetings (Table 3.3.1). Workshops will be used for optimisation and harmonisation of methodology. Skills and knowledge will be transferred between laboratories and between researchers, with an emphasis on ECIs and nurturing future networking. Policy-makers are already involved in GroupHouseNet and will be invited to selected meetings.

1.4.2. In relation to existing efforts at European and/or international level

Although there has been quite extensive research regarding putative methods for reducing the incidence of tail biting and feather pecking in adult animals, research projects focusing on integrated

genetic, health-related and developmental perspectives communicated to stakeholders, interest groups and policymakers after sound ethical evaluation are significantly fewer. Although international research projects that study genetic and/or early environmental factors contributing to the development of damaging behaviour do exist or have recently been completed none of them consider the full complexity of these issues, being either too focused on specific subject areas or being isolated from potential users. For breeding, genetics is rapidly becoming the norm, but the regular use of such technologies for the problems arising from group housing has not been implemented, hampered by the lack of initiatives to create rapid bioinformatics pipelines for such purposes. In most research projects concerned with preventing damaging behaviour and improving health by improving disease tolerance, these approaches have had a minor role.

Ongoing research projects will be of great value for this COST Action – and vice versa – but will not duplicate efforts. By coordinating recent and existing research in the subject areas of GroupHouseNet this COST Action will provide the scientific basis for the implementation of innovative methods as sought by the agricultural industry to satisfy a growing consumer demand for improved animal welfare and the changing requirements from regulatory bodies.

2. IMPACT

2.1. Expected Impact

2.1.1. Short-term and long-term scientific, technological, and/or socioeconomic impacts

In scientific terms, the most significant short-term impact will result from the coordination of research and development of the multidisciplinary skills required to improve the welfare, health and productivity of group-housed laying hens and pigs. In the long-term, this will contribute to creating career opportunities for the Early Career Investigators (ECIs), and will produce highly competent workers for the European agricultural industry. The most effective training of ECIs is through participation in large research networks, as a learning member of a vibrant research team under the supervision of well-qualified supervisors.

The short-term technological impact will be realised through the cross-fertilisation between academic partners and breeding companies actively developing new genetic markers, methods and breeding programmes focussing on the improvement of animal behaviour and health. The long-term technological impact will be in the implementation of innovative breeding markers and methods, and recommendations for practically-oriented husbandry practices that will both significantly reduce problems related to damaging behaviour, and improve animal health. Multidisciplinary approaches to the resolution of practical problems are key to the development of technological innovations to produce animals better adapted to current commercial environments and consumer demands. In addition, a joint international effort will provide the industry with clear, unified, science-based guidelines to prevent or better manage injurious behaviours in pigs and laying hens, allowing improvements in animal performance, welfare and the sustainability of production.

The long-term socioeconomic impact lies partly in the added value of improved ethical standards of animal products not associated with mutilation and the suffering caused by damaging behaviour. The further socioeconomic impact lies in the harmonisation of legislation with an innovative food production industry. It also lies in the reduction of economic losses caused by damaging behaviour and associated poor health. The European Union provides leadership in creating high standards of welfare for livestock, from which external nations often follow. Examples of similar trends in North America are the industry-driven transitions away from battery cages and gestation crates. European facilitation of solutions to problems connected with aggression in group-housed animals is

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responsive to developing ethical concerns and the expectations of consumers and thereby strengthens opportunities for industry participants to market their products worldwide.

2.2. Measures to Maximise Impact

2.2.1. Plan for involving the most relevant stakeholders

To ensure maximum use and long-term impact of the GroupHouseNet results, the outreach activities will be targeted towards specific stakeholders and end-users of the GroupHouseNet results, including animal health personnel, animal production advisors, scientists in public and private sectors, animal breeders, animal housing and feed producers, policymakers at national and international levels, and the general public. While the bulk of the proposal has been prepared by an international group of scientists (universities and research institutes) and people working in the veterinary fields, the proposal has also been reviewed by industry partners in the areas of animal breeding, rearing, housing and production. Some of these are already committed participants in this application and others will join, dependent on funding. To ensure maximum outreach to the end-users and stakeholders, all dissemination activities will be adjusted and directed at these in conjunction with activities aimed at dissemination for scientific audiences. As sustainable production of ethically acceptable food is a long-term necessity for the future health of life on earth, everyone is a stakeholder and beneficiary to the outcomes of GroupHouseNet.

2.2.2. Dissemination and/or Exploitation Plan

Review and opinion articles likely to result from GroupHouseNet will preferentially be published in open-access journals. To reach relevant stakeholders and end-users successfully through targeted dissemination of the GroupHouseNet outcomes, organised symposiums, workshops and meetings will be held in connection with both national and international animal production meetings for industry representatives, veterinarians and advisors, as well as the scientific community. Examples of relevant international congresses are listed in Table 3.3.1, whereas the choice of national congresses will depend on future partners. The objective for the GroupHouseNet dissemination plan is outlined below. Representatives of the identified stakeholders will be invited to join the GroupHouseNet Stakeholder and End-User Forum; representatives from industry and from policymakers have already contributed to initiating GroupHouseNet. The GroupHouseNet Stakeholder and End-User Forum will be led and organised by itself, with researchers participating as observers. Furthermore, where there is complementarity between GroupHouseNet and other research (or similar) frameworks, these will be among the target audiences. Some members of GroupHouseNet may be both audience and members (i.e. are members of other research frameworks or members of panels in policy bodies). GroupHouseNet has already been reviewed by international and national policy organs, and industrial partners and some of these have already expressed eagerness to participate in GroupHouseNet. Intra-Action communication channels will be established to ensure that all members of GroupHouseNet are kept aware of results and outcomes.

What will be disseminated? To ensure maximum outreach to the end-users and stakeholders, a wide range of adjusted informative dissemination materials will be produced (e.g. not just scientific papers and white papers, but also, for example, short articles, blogs and videos, distributed in the local language using a dedicated website as well as other channels suitable to industry and public, such as press releases, etc.). These materials can only be produced through the collaboration facilitated by the proposed network and use of such means as those available in the COST framework. The materials will contain basic information related to the ‘‘top twelve’’ major achievement milestones in regards to estimating the cost of damaging behaviour, overviews of national academic and private sector competence centres for prevention of damaging behaviour,

standards for recording and analysis standardisation, advertisement and dissemination connected with Training Schools (TS), symposia and stakeholder-approved research agendas.

General comments:

- Scientific publications will be based on concrete results; authorship will be based on Vancouver regulations.
- Articles of a more general nature (not in peer-reviewed scientific journals) will be published as appropriate and translated into local languages.
- Seminars attached to larger conferences (see Table 3.3.1) will be arranged as appropriate.
- All members will be encouraged to include mention of the GroupHouseNet homepage on their own institute homepage (article, link etc.).
- A dedicated website will enable the spread of knowledge to different interest groups. It will be linked to stakeholder web pages such as international egg commissions and national associations of egg producers in each country. The site will include tools for electronic dissemination and teaching.

How will GroupHouseNet disseminate? The dissemination plan will be finalised by the Executive Committee at the kickoff of GroupHouseNet, with approval before acceptance by a quorum of members of the Managing Committee. The plan provides a clear pathway for knowledge exchange within and outside the Action and is designed on the basis of guidelines relating to COST. Dissemination, communication and transfer activities will start from the beginning of the Action. The policy of the dissemination plan is that all members will:

- be active in dissemination activities;
- define their key messages from the Action;
- establish appropriate target audiences and match their dissemination approach and genre to these audiences by selecting appropriate levels and modes of communication;
- seek feedback on the success of the experience and knowledge transfer and use this to inform further activities.

GroupHouseNet members will give presentations and demonstrations of the Action's results in sessions, workshops, panels and other national and international events. Members will also participate in mass media (television, radio or web-based media) with scientific and relevant content, when appropriate.

The Editorial Board will provide assistance in all forms of dissemination, particularly for articles to be attached to the homepage, other similar documents, and reports on the success of STSMs (Short-Term Scientific Missions), TS (Training Schools) etc. The public area of the website will contain an electronic document repository and be continuously updated with a wide range of informative materials produced in the form of links to publications, reports, videos, lectures, etc. This will be openly available and will also include a section for posting of questions or suggestions; these will be answered openly (public forum) and the Webmaster will have the task of checking for further questions or comments on a regular basis (at least weekly). Closed (members only) areas of the website will be used for working documents and for arranging of internal (GroupHouseNet members only) meetings and workshops, and a calendar encompassing all these and more to be kept updated by the Webmaster. Works in progress that require e-communication will also be conducted through the "members only" section of the website where possible. The Webmaster will also be responsible for a dedicated LinkedIn group (for discussion-based communication) and a YouTube channel (showing short videos explaining and demonstrating GroupHouseNet results).

To ensure successful dissemination, the planned outreach activities are included as a standard item at the agenda of every Executive Committee meeting, allowing for amendments to the plan. Also, close communication with end-users (largely scientific, including clinical and laboratory, regulatory, and commercial) will ensure that the Action does not lose focus on the main objective.

Innovation management, IPR-management: No intellectual property in need of protection is foreseen to arise from the Action, but will otherwise be taken care of properly by the Executive Committee.

2.3. Potential for Innovation versus Risk Level

2.3.1. Potential for scientific, technological and/or socioeconomic innovation breakthroughs

Wide dissemination of specific innovations related to rearing and housing of pigs and laying hens will facilitate the ability to produce pig meat and eggs using animals that are not subject to the mutilation currently viewed in many countries as the only viable method for preventing damaging behaviour. The networking activities are also envisioned to facilitate the implementation of new breeding programmes that specifically target genetic markers of damaging behaviour and disease tolerance that will further improve the welfare of animals and the ethical acceptability of pork and egg products. The identification of non-invasive epigenetic, behavioural and molecular markers of stress exposure and disease tolerance have groundbreaking potential in monitoring animal production systems.

3. IMPLEMENTATION

3.1. Description of the Work Plan

3.1.1. Description of Working Groups

In order to fill the identified knowledge gaps and establish recommendations, the scientific work plan for GroupHouseNet involves the division of each of the three WGs (see 1.2.1) into subtasks (see 1.3.2) that will deliver a subset of relevant outcomes (listed below as achievement milestones) contributing to knowledge about practical methods for the prevention of damaging behaviour. The work in each WG will be guided by the Capacity-Building Objectives (see 1.2.2) and follow GroupHouseNet dissemination and exploitation plans and policy as outlined in section 2.2.2. A brief description of the means by which training objectives will be achieved is included in Table 3.3.1 (Training Schools, STSMs, and meetings, workshops and symposia associated with national and international congresses) and section 1.2.2. Briefly, dissemination will be a priority for each of the WGs. Furthermore, the Action will deliver advanced training (as Training Schools and Short-Term Scientific Missions) in various targeted skills, and in the conversion of the obtained knowledge into accessible and commercial tools and services for the public or private livestock sector. Actual scientific and technical equipment (production facilities, health databases, testing stations, rearing facilities, research labs) required to conduct these tasks are already available in the participant institutions, and the availability and maintenance of such equipment is already met.

The competencies needed to deliver the outcomes in GroupHouseNet are wide and encompass a range of expertise in the GroupHouseNet framework. Necessary competencies range from diagnostic expertise in the different health challenges, to epidemiological, modelling and laboratory expertise for physiological, epigenetic and immunological studies, to expert knowledge on production methods and monitoring production, and health and welfare under production

conditions. Different experts within these various fields are already participating in this application and include researchers with proven/documented expertise in health, production, animal monitoring, molecular biology, breeding, nutrition, animal behaviour, animal welfare, and animal production economics, as well as ethics and normative questions pertaining to human-animal relations.

GroupHouseNet will enable scientists to compare methods for investigating different risk factors for damaging behaviour, standardise methods for diagnosis, detection and typing, including implementation of novel molecular technologies for the assessment of occurrence (analysis and diagnosis). Tailor-made guidelines for recording, diagnostics, and standardisation of methods are needed to enable timely collection and exchange of information. This will provide a basis not only for future research, but also for developing guidelines, and will enable stakeholders and policymakers to implement appropriate preventive measures.

The “top twelve” major achievement milestones include:

1. Establishment and expansion of the network ensuring that all fields and sectors relevant for preventing damaging behaviour in pigs and laying hens are covered.
2. Creation of GroupHouseNet WGs composed according to Capacity-Building Objectives (see 1.2.2), large geographical distribution, and the inclusion of participants that have not previously worked together.
3. Creation of the first map of research groups and private sector parties with competence in analysis and prevention of damaging behaviour in pigs and laying hens and uploading this to the web page.
4. Completion of the first STSMs (Short-Term Scientific Missions) for Early Career Investigator (ECI) training under the GroupHouseNet umbrella.
5. Organisation of the first TS (Training School) aimed at ECIs and applications by industry.
6. Production of the first Europe-wide estimate of the cost of damaging behaviour in terms of producers economy and animal welfare.
7. Completion of the first workshop on the prevention of damaging behaviour organised in connection with a national or international congress and co-organised by ECIs.
8. Development of a prioritised short-term/long-term research agenda that reflects important knowledge gaps, is stakeholder-approved, and includes plans for training-through-research and/or international exchange projects for ECIs.
9. Consensus on method validation and standardisation issues, both for recording and analysis of damaging behaviour in pigs and laying hens.
10. Consensus on method validation and standardisation issues, both for recording and analysis of genetic markers of damaging behaviour and disease tolerance in pigs and laying hens.
11. Completion of the first international symposium on the prevention of damaging behaviour co-organised by ECIs.
12. Finishing the Action with the knowledge that the network has produced real results and the ECIs involved will continue forward from the basis achieved.

3.1.2. GANTT Diagram

The following GANTT diagram gives an estimate of the timing of major achievement milestones and iterative use of networking tools. Final decisions regarding timing will depend on participants.

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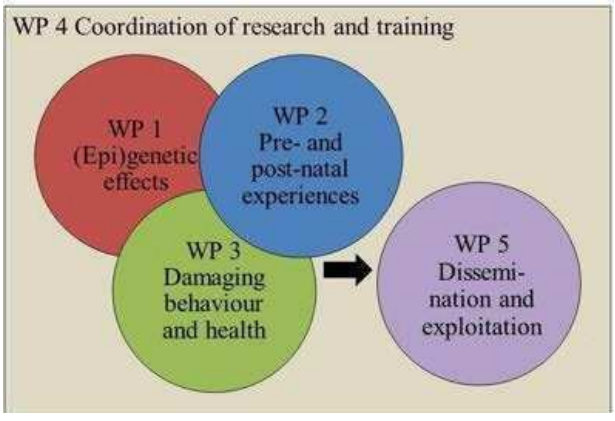
Quarter: / Main activities:	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Achievement milestones																
1	■	■	■	■												
2	■	■	■	■												
3			■	■												
4			■	■												
5			■	■												
6				■	■	■										
7				■	■	■										
8					■	■	■									
9						■	■	■	■							
10									■	■	■	■				
11											■	■	■	■		
12														■	■	■
COST networking tools																
Regular dissemination	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
STMS			■	■	■	■	■	■	■	■	■	■	■	■	■	■
Training Schools			■				■				■				■	
Meetings	■			■				■				■				■
Workshops				■				■				■				■
Review/opinion articles												■				■

3.1.3. PERT Chart

To achieve the objectives outlined above, the project is structured into five highly interactive work packages. WPs 1, 2 and 3 encompass novel research exchange and training projects. The first two work packages aim at understanding the role of genetics and epigenetics (WP1) and of pre- and postnatal experiences (WP2) in damaging behaviour and health in laying hens and pigs. WP3 focuses on the relationship between damaging behaviour and health and publicises the innovative strategies developed in the project to reduce damaging behaviour and improve health. WP4 and WP5 comprise, respectively, the coordination of research facilitation and training, and the dissemination and exploitation of results and findings.



3.1.4. Risk and Contingency Plans

The greatest risk in GroupHouseNet may be that the Research Coordination Objectives and milestones are linked to, and therefore partly contingent on the success of funded research projects

drawing their respective fields beyond the state-of-the-art. This risk is mitigated by the variety of research groups and private sector parties addressing related questions in different European countries. Another risk is that academic partners depend on the resources and networks provided by industry partners and policymakers for implementation of innovations and policy, respectively. The potential impact of this risk is greatly reduced by having partners from the pig and poultry industries and in groups defining public policy in nearly every participating country, allowing implementation of effective corrective measures should problems with one partner arise. Another risk is a lack of real collaboration between the different academic consortium partners across different disciplines. This risk is well-controlled by comprising working groups with multiple partners and ensuring that all primary topics are areas of focus in multiple research groups in most of the participating countries. It will be further reduced by ensuring joint responsibility for individual STSMs, and joint supervision of ECIs trained within these, thus producing synergy and interdependence between the partners. If unforeseen challenges arise, a response will be formulated and approved by the Executive Committee through e-mail and the effectiveness of the response will be monitored and used for further decision-making.

3.2. Management structures and procedures

In addition to being coordinated by a Management Committee (MC) according to COST regulations, GroupHouseNet will make use of the following organisational elements: Executive Committee, Working Groups, Expert Groups, a Stakeholder and End-user Forum, an Editorial Board, an Early Career Investigator Think-Tank, a Gender-Equality Group and an appointed Webmaster. The Executive Committee will consist of the Action Chair and Action Vice-Chair of the MC, the WG Leaders, the Dissemination Coordinator and the STSM/TS Coordinator.

The responsibilities of the Executive Committee will include:

- Coordination of WP4 (facilitation and training) and WP5 (dissemination and exploitation)
- Assessment and approval of outcomes prior to delivery
- Coordination of dissemination and initiation of dissemination initiatives (WP5)
- Planning of meetings, workshops and symposia with ECIs
- Establishment and continuous updating of the website
- Ensuring that capacity building is optimised (WP4)
- Financial and administrative duties
- Development of a Monitoring and Evaluation Plan (MEP) that will be used to ensure that objectives are being achieved according to the initial WG lists.

Since knowledge regarding applicable and economic methods for preventing damaging behaviour is fragmented over disciplines and sectors, each specific WG will be developed on the principle that it should be multidisciplinary and multisectoral. Each WG will involve at least one member of each Expert Group to ensure multidisciplinary and multisectoral integration and satisfactory sharing of knowledge and experience. By emphasising inclusion of Early Career Investigators (particularly for STSMs), the achievements of GroupHouseNet will be carried forward into the future. Those participants representing end-users or stakeholders (exemplified by industry and by policymakers) will be encouraged to form a separate Stakeholder and End-User Forum that will be able to have input into the decision-making but will not be able to steer the results obtained or influence the outcomes. Early career investigators will be encouraged to form a distinct, but not separate, Early Career Investigator Think-Tank to ensure that their needs are being met; in particular they will be encouraged to be pro-active in dissemination. These positions need not be exclusive to each other. The Webmaster will manage the website and keep it updated, usually on a weekly basis.

3.3. Network as a whole

GroupHouseNet will unite academic research groups and industry partners specialised in genetic, epigenetic, nutritional, immunological, and developmental aspects of health and behaviour with the common goal of improving the welfare and productivity of group-housed pigs and poultry in the social housing systems that will be more common in Europe in the near future. The Action proposers have complementary expertise in different specialised techniques that will make the group as a whole uniquely qualified. Due to close collaboration the team as a whole can offer a variety of local and collaborative Action-Wide Training Workshops (Table 3.3.1) that are not available today, in addition to pre-existing courses offered by the participating institutions. These workshops will also be open to other European researchers, not working within the Action. The network also provides unique opportunities for taking advantage of team leaders' specific scientific competences and broad expertise in mentoring and science education, and in the organisation of congresses and workshops.

Table 3.3.1 Possible Action-Wide Training Schools, Short-Term Scientific Missions, and Conferences at which workshops and meetings may be organised:

Main Training Events & Conferences	ECTS (if any)
Training Schools in Specialised Skills (mainly for ICIs):	
(Epi)genetics: Genetic selection, gene x environment interactions, and epigenetics: 3-day workshop on how genetics and GxE interactions influence the behaviour and welfare of group- housed animals.	1
Early life experiences: early life environments, rearing and behavioural development: 3-day workshop on optimal rearing of poultry and pigs for modern social housing	1
Welfare-friendly systems: Injurious pecking in hens, tail biting in pigs, innovative farming systems, and outreach: 3-day workshop on innovative housing systems, assessment, preventive strategies and communication with farmers in connection with advisory and outreach activities	1
Training Schools in Complementary Skills (mainly for ICIs):	
Personal development: learning to develop personal development plans – 2-day workshop	1
Communication: communication with industry and outreach activities – 2-day workshop	1
Career development: 2-day workshop	1
Dissemination: project management, dissemination, exploitation, commercialisation and intellectual property rights (IPR): 2-day workshop	1
Short-term scientific missions (academic-industry exchange visits mainly for ICIs):	
Behavioural analysis: Behavioural observation and phenotyping methodology	
Production animal laboratory training: dissection and brain tissue collection, xMAP bead array analysis, ELISA, HPLC, immunohistochemistry, cell culture	1
Welfare assessment: Methods for assessing welfare	
Laboratory methods for gene expression: PCR and microarrays	1
Practical quantitative genetic analysis using large data sets	
Antibody production methods using chickens	
Future egg production using non-beak trimmed birds in furnished cages	
Introduction to National Pig Health Services and Pig Health and Production Recording Systems	
Small business entrepreneurship and small business management	

Hatching, rearing and production for future non-cage systems using non-beak trimmed laying hens	
Incubation conditions and early life experiences: Effects on behavioural development and welfare in laying hens	1
Pig breeding and genetics from a practical perspective	
Practically oriented courses covering several topics like introduction to pig breeding, pig health and management, piglet mortality/survival, and production of slaughter pigs	
Training in off-test recording at nucleus breeding herds	
Training at a boar testing station including CT-scanning and image analysis	
Potential conferences at which symposia, workshops and meetings will be arranged	
Annual meetings of the European Federation of Animal Science	
International Congress of the International Society for Applied Ethology (ISAE)	
Regional ISAE meetings	
UFAW Yearly International Animal Welfare Science Symposium	
UFAW Yearly Animal Welfare Student Scholars' Meetings	
Meetings of the World's Poultry Science Association (WPSA) and associated groups	
Workshop on Fundamental Physiology and Perinatal Development in Poultry	
International Workshop on the Assessment of Animal Welfare at Farm and Group Level (WAFL)	
Annual Meeting of the European Federation of Animal Science (EAAP)	
Annual meeting of Association for the Study of Animal Behaviour (ASAB)	

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