



**European Cooperation  
in the field of Scientific  
and Technical Research  
- COST -**

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**Brussels, 22 November 2013**

**COST 061/13**

**MEMORANDUM OF UNDERSTANDING**

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Subject :           Memorandum of Understanding for the implementation of a European Concerted  
                          Research Action designated as COST Action FA1308: DairyCare

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Delegations will find attached the Memorandum of Understanding for COST Action FA1308 as approved by the COST Committee of Senior Officials (CSO) at its 188th meeting on 14 November 2013.

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**MEMORANDUM OF UNDERSTANDING**  
**For the implementation of a European Concerted Research Action designated as**  
**COST Action FA1308**  
**DAIRYCARE**

The Parties to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 4114/13 “COST Action Management” and document COST 4112/13 “Rules for Participation in and Implementation of COST Activities”, or in any new document amending or replacing them, the contents of which the Parties are fully aware of.
2. The main objective of the Action is to assist in the development and application of novel technological solutions for improving the wellbeing of dairy animals across a range of dairy farming systems.
3. 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 96 million in 2013 prices.
4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.
5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of section 2. *Changes to a COST Action* in the document COST 4114/13.

## **A. ABSTRACT AND KEYWORDS**

*“Animal wellbeing is at the start of a chain that links to farmer profitability, product quality, consumer satisfaction and environmental sustainability”.*

This Action will focus the talents, skills and resources of researchers, industry partners and stakeholders in the dairy-foods chain onto the topic of dairy animal health and welfare. European dairy farms are getting larger. Dairy cows remain in focus, but there is growing interest in other dairy species. Milking technology is advancing, as is biotechnology relevant to animal wellbeing. European consumers prioritise animal wellbeing and product quality, whilst recognizing the importance of global food security and the need for increased milk production. Relevant research is happening across different disciplines (biological, ethological, technological) and in many different and diverse parts of Europe. The Action will maximise the value from this research by networking, coordination and avoiding duplication. The Action’s scientific focus will be on new and emerging developments in welfare biomarkers, activity-based welfare assessment and their combination and integration into “smart” husbandry support systems that will ensure optimum welfare for dairy animals. The Action will disseminate outputs widely to researchers, industry, dairy farmer end-users, consumers, policy makers and society generally. It will ensure that European dairy research remains world-leading, that European dairy animals are the best cared-for in the world, and that European consumers can take pride in European dairy industries that are competitive, responsible and sustainable.

**Keywords:** dairy animals, health, welfare, dairy technologies, health biomarkers

## **B. BACKGROUND**

### **B.1 General background**

The problem faced by modern animal production systems is to maintain the best possible standards of animal health and welfare (“wellbeing”) together with high productivity and a minimal environmental impact in an era of greatly increased demand for high-quality livestock products, larger livestock units and decreased contact between animals and husbandry staff. This requires better connection between two complementary but distinct “states-of-art” concerning the monitoring and managing of animal wellbeing. On the one hand, the technological approach, employing automated sensing and the power afforded by novel proteomics and metabolomics. On the other hand, the observational approach of combining a number of relevant behavioural measures

into a Welfare Index. Animal wellbeing is multifactorial, and achieving the best solutions will require inputs from animal scientists, ethologists, veterinarians and agricultural engineers working in partnership with SMEs and dairy equipment companies to create technologies that are then integrated into best practice blueprints that are then channelled through dairy consultancies to achieve better dairy animal welfare on the farm. By enabling networking, exchange of skills, capacity building through enhanced collaboration and targeted dissemination, this COST Action will do exactly what is required.

Whilst wellbeing is important in all production animals, dairy animals have some unique needs:

- Dairy animals live longer than most other production animals
- High yielding dairy animals are prone to metabolic problems
- Problems are concentrated at specific points in the lactation cycle
- Dairy animals are very sensitive to heat stress and hence global warming
- Nutritional manipulation to alter milk composition is common
- Regular milkings provide an opportunity for diagnostic observation..
- ..but manual milking is being replaced by automatic milking..
- ..so technological innovation in automated health diagnostics is more advanced
- Biotechnological innovation is more advanced
- There is renewed interest in “new” dairy species, including small ruminants, buffalo, camels and equidae, which are less well adapted to milking

An earlier COST Action “Measuring and Monitoring of Animal Welfare” considered welfare of all production animals and finished in 2006. The special needs identified here provide good reason for a new Action focused specifically on dairy animals. The fact that there have recently been major developments in the dairy industry, including new technologies that will enable larger herd sizes, coupled with growing recognition of the importance of animal-derived foods as part of the solution for global food security makes this current Action timely. Improved dairy animal welfare has recently been stressed by EFSA (European Food Safety Authority: “Scientific opinion of the use of animal-based measures to assess welfare of dairy cows”, Jan 2012), and FAO (Food and Agricultural Organisation) emphasized the importance of animal welfare and the need to prevent disease in its Sustainability Assessment of Food and Agricultural Systems (SAFA) Guidelines. COST funds networking and capacity-building activities rather than research, and that is exactly

what is needed at the present time. A number of national research projects concerned with animal welfare are underway, precision management technologies are being developed for a range of production animals and proteomics and automated diagnostics is advancing rapidly. Dairy management is evolving, with some farmers committing to intensive production, others to low-cost production and niche markets, others to alternative dairy species. Across Europe there is considerable diversity in dairy management systems and a broad knowledge base of expertise relevant to dairy animals, but considerable commonality in relation to wellbeing-supporting technologies such as electronic identification. COST represents an ideal vehicle for integrating the many relevant outcomes from different research projects, regional knowledge and cross-disciplinary skills. A number of concrete, tangible deliverables will arise out of the Action, which will provide benefit to dairy animals, farmers, members of the supply chain, consumers and society generally. The outcomes will address the societal and dairy industry need of improved animal welfare through scientific and technological advance in two significant areas:

- implementation of new and powerful innovative welfare management technologies on a range of modern dairy cow farms
- transfer of more traditional management skills that are well advanced in cattle to other dairy species

## **B.2 Current state of knowledge**

In the dairy sector the technological state of the art is centred on the individual animal. Capabilities in cow management include the ability to identify, traffic and milk individual cows fully automatically, feed concentrate rations fully automatically and obtain diagnostic data relating to several health and performance related criteria. Several systems are available that will sample milk automatically in-line and perform real-time analysis yielding quantitative data on biological parameters relevant to cow health and management of reproduction. Reproductive management technologies based on activity-recording of one sort or another are also available, for instance using tri-directional accelerometer recording in a collar. A number of visual imaging systems are also available or in development, such as 3D imaging technologies for body composition analysis, thermal imaging for mastitis detection and video gait analysis for lameness detection. All of these technologies are capable of identifying cows “at risk” or requiring attention and have potential for further development. These technologies operate in conventional (manual) milking parlours as well as in automated systems, and can be linked into national databases for breeding and health

recording purposes. Other technologies are available for automated recording of body weight and of food intake, but are not yet used commercially due to their high cost. Europe has led the way in research and application of these technologies. Most were developed in Europe and involve SMEs and larger enterprises from European countries and other COST countries (including Israel). They are supported by strong European biotechnological experts in proteomics and metabolomics. In contrast to these technological approaches, visual analysis and subjective scoring of multiple behavioural traits combined into a Welfare Index is the current gold standard for observational assessment of general welfare of dairy animals. Some Welfare Indices combine these behavioural measurements with biomarkers measured in plasma, requiring an invasive approach. This gold standard is based on the results from the EU-project Welfare Quality where key criteria were identified and agreed on by a broad group of European scientists. These include animal-based measures relating to good feeding, good housing (resting comfort, thermal comfort and freedom to move) and appropriate behaviour.

### **B.3 Reasons for the Action**

The Action has the objective of improved dairy animal welfare, and is mainly aimed at scientific and technological advance within the dairy production sector to achieve this. By enabling better welfare, the Action will create positive societal impact from added value throughout the dairy foods chain. Good welfare links directly to high quality and high productivity, hence longer term benefits will result from a positive contribution to the challenges posed by global food security. By involving SMEs in the development of new husbandry-support technologies that will have application around the world, the Action will contribute to European economic growth. Effective strategies for improving dairy animal welfare will require collaboration across a broad range of specialist and expert skills. All of the necessary expertise exist within Europe, but are dispersed across different countries in ways that are influenced by regional differences in dairy farming strategies and hence research emphasis. The first immediate benefit of the Action will be to bring together these disparate skillsets. Technological advance will be accelerated by knowledge exchange and synergism between disciplines, targeted towards a series of specific and achievable future outcomes. Animal scientists have knowledge of welfare physiology, veterinarians have knowledge of animal health and disease, biotechnologists have knowledge of proteomics and metabolomics. Together, these skills will enable the future development of novel welfare related biomarkers, the first outcome set. Ethologists have knowledge of animal behavior and the activities that are indicative of good or bad welfare, whilst electronic engineers have expertise in the

automatic capture of visual, auditory or locomotion data that relates to these activities. The combination of these skills will enable the future development of activity-based welfare measures, the second outcome set. To ensure application of these novel welfare technologies in practice the Action will include agricultural engineers with knowledge of milking and management systems and computer scientists with knowledge of the design of algorithms for data extraction, analysis and interpretation. Through the combination of these skills, the biomarker and activity data will be used to construct future decision support systems that will assist farmers to optimize the welfare of their dairy animals, the third outcome. To achieve the most productive outcomes, the Action will be organised into outcome-oriented Working Groups that are responsible for biomarker development, activity-monitoring and systems-level technologies, respectively. These scientific outcomes will mainly be targeted towards implementation on large dairy farms. However, the Action will also enable a fourth set of outcomes that will be targeted at smaller farms and especially non bovine dairy animals. Together, the different experts within the Action will provide unparalleled knowledge of best-practice within dairy cow management. Dissemination activities within the Action will be targeted not only at implementing the new technologies, but also at transferring this existing best practice knowledge into other species and other parts of the European dairy industries.

#### **B.4 Complementarity with other research programmes**

Co-operation benefits will happen through integration between this Action and other activities within EU FP7 and elsewhere. Two major European research initiatives concerned with farm animal welfare have commenced recently. DairyICT (funded through the ICTAgri era-net programme) will focus on technological approaches specifically in dairy cows, whilst EU-PLF, a new FP7 programme in Precision Livestock Farming will include research in dairy cows as well as poultry and pigs. A Nordic Dairy Cattle research coordination initiative is planned. There will be significant complementarity, since these projects are intended to *develop* new welfare technologies relevant to dairy animals, whilst this Action focuses on networking and ESR exchange to ensure *accelerated development, dissemination and application* of the technologies. Proteomics will be a theme within the biological objectives of the Action, and a close integration with the ongoing COST Action, Farm Animal Proteomics ([www.cost-faproteomics.org](http://www.cost-faproteomics.org)) will be sought. Our focus on health and welfare will be entirely complementary to their disease focus. The impact of nutrition on production animal health (including dairy animals) was one of the focuses within the recently completed COST Action Feed for Health ([www.feedforhealth.org](http://www.feedforhealth.org)) and this Action will build on the

outcomes from that programme. Interaction with educational programmes will include the Erasmus Mundus programme Food of Life ([www.emfoodoflife.eu](http://www.emfoodoflife.eu)), which includes dairy production and products as a main focus.

## **C. OBJECTIVES AND BENEFITS**

### **C.1 Aim**

The main objective of this Action is to improve the wellbeing of dairy animals through two mechanisms. Firstly, accelerated development and application of a range of relevant innovative technologies that assist and promote good husbandry, with focus on welfare-related biomarkers, activity-based welfare assessment and their combination and integration into "smart" husbandry support systems. Secondly, wider dissemination of established best-practice technologies, including from the dairy cow sector into niche sectors working with non-bovine and novel dairy animals

### **C.2 Objectives**

The Action will:

- Integrate experience and expertise from diverse dairy production systems in different parts of Europe and elsewhere to build awareness and knowledge of the welfare needs of dairy animals, and of the capabilities and limitations of current and developing welfare technologies
- Combine expert knowledge and expertise from the many relevant disciplines, including animal scientists, ethologists, veterinarians, technologists, computer scientists, veterinarians, systems scientists and social/socioeconomic scientists
- Identify gaps in current knowledge and technology, and encourage new and innovative scientific investigation in these areas
- Through this integration, innovation and combination, assist the development, validation and application of novel technologies for monitoring, managing and improving the health and welfare status of dairy animals
- Generate one or more cross-disciplinary, cross-regional, cross-species blueprints for action to improve dairy animal management based on these new technologies

- Disseminate this new knowledge and encourage the incorporation into different management practices of all relevant new scientific knowledge and technology as it arises during the next few years
- Through these various means, increase the competitiveness of the European dairy industries

### **C.3 How networking within the Action will yield the objectives?**

The COST Action will establish a cross-disciplinary network of scientists together with commercial technologists based in SMEs and large, multinational dairy equipment companies and extension workers based in dairy consultancy organisations, all of whom will have access to funding (national or international research funding, levy funding, seed corn funding, innovation funding, commercial income etc.) and all of whom will have a focus on management of dairy animals. This will create a critical mass of research, application and dissemination capability. The Action will focus on collaboration, dissemination of current knowledge, acquisition of new knowledge, mobility of researchers (especially ESR) and training. The collaborations will greatly enhance the scientific and technical capacity of the COST countries and ensure that Europe remains the world leader in the field. The objectives of the Action will be achieved by holding Networking Meetings, Best Practice Workshops and Educational Outreach Meetings, by arranging STSMs and by creating and maintaining a regularly up-dated Website which will highlight the research of the members of the Action. A Kick-Off meeting will review the current state of art, formulate the detailed structure of the Action and set the detailed Agenda. The diversity of expertise within the Action has already been highlighted, and this will be the first time that such a diverse group of people have gathered together to focus their attention on dairy animal wellbeing. The Networking Meetings will focus on the scientific interests of the three Working Groups (WGs), which deal with Biomarker-based Welfare Technologies, Activity-Based Welfare Technologies and System-level Welfare Technologies, respectively. These WGs will each be cross-disciplinary. For instance, the development of non-invasive automated biomarker sampling technologies will involve biologists, veterinarians, analytical biochemists and agricultural engineers. Having a cross-disciplinary WGs structure will be especially important for developing, integrating and internally disseminating the research output from the national research programmes of the participants, and will be a key element in the capacity building and acceleration of European technological development. The Best Practice Workshops have two objectives. Firstly, they will enable the transfer of established and

novel dairy-cow best-practice from region to region within Europe, from North to South and from East to West. Secondly, they will enable the transfer of established dairy cow technologies into other dairy species such as small ruminants, buffalo and camels. These meetings will be aimed primarily at extension services and dairy farmer end-users. These Workshops will incorporate a Technology in Practice study visit to a dairy unit and will involve significant input from the dairy technology industry participants within the Action. The Educational Outreach Meetings will target two sectors. Students will be targeted through the MSc programmes of partner Universities and through two Erasmus Mundus programmes. Farmers and other stakeholders in the dairy foods supply chain will be targeted through public meetings organized by the dairy consultancy partners that supplement the information available online through the website.

#### **C.4 Potential impact of the Action**

Benefits will happen within the scientific community (more collaboration and inter-disciplinary cross-fertilisation, more cost-effective use of skills and resources, improved knowledge of dairy animal welfare, increased research activity and new funding proposals), at the society level (wellbeing and productivity are interrelated, so food security will be enhanced), at the consumer level (wellbeing is important to consumers, so consumer satisfaction will be increased), at the level of EU industry (increased competitiveness of dairy technology companies and of EU dairy farmers) and at the level of the environment (healthy animals are more efficient and produce fewer emissions). Above all, benefits will happen at the level of the animal. Here are specific examples of key benefits:

***Improved use of existing and emerging novel technology for maximizing wellbeing of dairy cattle managed in large technological units:*** A number of individual stand-alone technologies for assisting dairy cow management have been developed in recent years, but uptake has been low because no single individual technology can ever provide a complete solution. The next phase of development is to combine different inputs from different technologies into smart systems that will provide complete management capability, and it is this collaborative process that the Action will facilitate.

***Transfer of relevant technologies into other management systems, including smaller production units and non-bovine dairy species:*** As a specific example, the milking of camels is problematic because of milk ejection problems. Significant expertise has been gained in this precise area over several years of research and technological development in dairy cattle, and that expertise now

needs to be transferred.

***Recognition by farmers, consumers and other stakeholders in the dairy foods chain of the benefits of technology-based dairy animal wellbeing management:*** Technology is used in many different ways for monitoring and improving our own, *human*, wellbeing, and the benefits that this provides to society in, for example, improved disease diagnosis, improved security, improved mobility and generally in improved quality of life are well recognized and accepted. The principle of using appropriate technologies within animal production to improve *animal* wellbeing by focusing the valuable time of animal husbandry staff onto those animals that most require attention is undeniable and compelling, but is not yet commonly accepted. The Action will explore the reasons for this and identify ways of improving the perception of agricultural technology.

***Strengthening of the future research base, through ESR exchange and interaction with relevant teaching programmes:*** Future generations of animal researchers will require broader skillsets that include both traditional expertise (nutrition, genetics for instance) and futuristic approaches (computer based modelling, genomics for instance) as well as the ability to learn specific analytical techniques (in proteomics and metabolomics, for instance). These skills will be present within the Action and will be passed on to the next generation.

## **C.5 Target groups/end users**

The stakeholders involved in the Action itself includes a range of agricultural scientists, related SMEs, milking equipment manufacturers and dairy consultancies from 24 COST countries, Australia, Canada, New Zealand and United States.. The outcomes will target primarily dairy farmers, but with considerable additional impact on others within the dairy foods chain (milk buyers, processors, retailers) and ultimately the consumers of dairy products.

## **D. SCIENTIFIC PROGRAMME**

### **D.1 Scientific focus**

The scientific programme will focus on the health and welfare (wellbeing) of dairy animals. An integrated cross-disciplinary network of scientific experts will be established that will consider wellbeing from three focused perspectives:

- Biomarker-based Welfare Technologies (Working Group WG1)
- Activity-based Welfare Technologies (WG2)
- System-level Welfare Technologies, (WG3)

This three-pillar approach will provide a comprehensive means of assessing, managing and improving wellbeing whilst maintaining scientific focus and rigour. Research will have a strong focus on new and innovative approaches, and will be precisely allied to the requirements of the dairy industries and consumers.

Key tasks within the Biomarker theme will include the promotion and acceleration of research being conducted in the following areas:

- Development of non-invasive sampling methodologies for relevant body fluids and tissues (including saliva, sweat, milk, hair, urine and faeces)
- Validation of biomarkers measured in these samples in comparison to blood as gold standard
- Development of novel analytical methods and identification of novel welfare-related biomarkers including through the use of proteomic analysis
- Automation of sampling methodologies to allow for robotic collection
- Development of in-line analytical methods for use in milk, including the use of metabolomic analysis for detection of metabolic disorders

Key tasks within the Activity theme will include the promotion and acceleration of research being conducted in the following areas:

- Development of novel accelerometer-based methods for analyzing feeding behavior and locomotion, including lameness detection
- Development of visual imaging (video) methodologies for activity recording
- Development of specialized visual imaging systems for health and welfare monitoring, including infra-red, thermal and 3D imaging
- Movement logistics analysis and location analysis using global positioning system (GPS)
- Behavioral monitoring based on milking records and feed station record

- Validation of these various technologies by reference to the gold-standard of Welfare Index assessment

Key tasks within the System theme will include the promotion and acceleration of research being conducted in the following areas:

- Development of novel data acquisition, filtration and extraction tools including the use of “data-mining” for identifying welfare-related characteristics
- Integration and combination of outputs from the biomarker and activity themes to create bio-logic frameworks that enable the characterisation of health and energy balance and the detection of deviations from normality
- Linkage of relevant data through the production chain, from feed analysis through utilization by the animal to quality of the milk produced, and from the production industry to the support industries including national breeding programmes
- Identification of minimum data inputs required for optimizing management
- Integration of data streams into tailored (“smart”) husbandry support systems

The key tasks are designed to put in place advanced technologies for husbandry support that will improve health and welfare. A number of bioethical and socioeconomic issues will arise as a result. For instance, should robotic arms be used to collect samples of saliva, hair, sweat? Should health treatments be instigated based on subclinical problems diagnosed by technological means? What is the likely cost- benefit analysis of these technologies? The Action will include experts in the areas of bioethics and socioeconomics, and these issues will be considered as secondary tasks where ongoing research allows.

The research structure will be flexible, and the cross-disciplinary nature of each WG will encourage cross-fertilisation between WG and incorporation of new and unforeseen areas of research as they emerge during the course of the Action. To achieve the objectives identified in Part C the Action will involve scientists from all different parts of the EU (North, South, East and West) and from other areas of the world where dairy systems and dairy research can provide additional unique inputs (including Israel, New Zealand, United States and Canada). Technical researcher skills will include biological expertise, analytical expertise, engineering expertise and data computation expertise within both basic and applied research. These researchers will have access to sophisticated animal science facilities, state of the art laboratories for analytical and investigative research and

computing facilities capable of handling large datasets. They will be undertaking pioneering and innovative research in topics relevant to welfare, many of which have been identified above. These researcher skills will be complemented by specialist knowledge of the dairy industries from industry participants, including for example feed manufacturers, veterinary pharmaceutical companies, agricultural equipment companies, dairy advisory services, breeding companies. Involvement of SMEs will be particularly encouraged. As a specific example of how integration across different countries could provide considerable added value, there will be opportunity to compare Scandinavian systems with southern European, large dairy farms in UK with small in Switzerland and advanced farms in Holland with rapidly-advancing farms in Estonia (all “for instance”). Comparisons could also include specialist regional systems such as Parmigiano-Reggiano and genetically closed herds in the Channel Islands. As a specific example of solving knowledge gaps and encouraging innovation, let us consider our inability to ask dairy animals the question that a medical doctor would ask, "how are you today?" The Action includes a new approach to wellbeing-related biomarkers by combining analysis of saliva, milk, sweat and hair to obtain data that relates to different windows of biomarker accumulation, from minutes to weeks, and which could be applied not only in cows but also in sheep, goats and others. None of these collections will require an invasive approach, all are potentially capable of automation in a robotic milking system and in addition to reflecting systemic levels, some of these will also reflect local production and thereby have additional diagnostic power, for instance in relation to lameness. The scientific programme is directed towards the achievement of the first main objective identified in part C, the accelerated development and application of novel welfare technologies. The second main objective, wider dissemination of best practice to niche sectors, will be the focus of targeted Best Practice Workshops, described later in Section H. Achievement of the secondary objectives relating to cross-regional blueprints and dissemination will also be addressed in that section.

## **D.2 Scientific work plan methods and means**

The scientific work plan comprises an overall coordination effort that will run continuously during the Action and which will include a dedicated Website, a Kick-Off Meeting whose main purpose will be to set the detailed scientific Agenda, a series of Networking Meetings incorporating coordinated meetings of the three WG, opportunity for independent WG meetings, Early Stage Researcher (ESR) sessions within networking meetings, Short Term Scientific Missions (STSMs) and a Final Conference. The timetable is shown in Section F.

**Coordination Effort and Dedicated Website:** A database of contacts and interests that comprises of more than 50 parties interested in participating to the Action, and another similar sized group who are aware of the Action and wish to be kept informed, exist. The database will be updated throughout the duration of the Action and will be available for all to parties to use. A dedicated website will be created which will have a members-only section for internal communication and coordination (the public access section will be described later in section H, Dissemination). This will incorporate, amongst other things, a literature awareness section where the results of literature searches will be made available, an event awareness section where Action members will be able to post news of relevant meetings, symposia etc., a careers section for posting of relevant vacancies and opportunities, and an expertise exchange where members in need of specific skills can advertise for help. There will be links to other relevant COST Actions and to member's institutional websites, including both academic and relevant commercial sites. There will be dedicated pages for the Conference Proceedings, ESR Forum and STSM reporting.

**Kick-Off Meeting:** The Kick-Off Meeting will launch the Action. A major objective for this meeting will be to review and refine the Objectives for the Action by discussion with all relevant stakeholders, in order to create the final Implementation Plan which will ensure that the purposes of the Action are achieved. In particular this meeting will ensure that the research is focused firmly on the requirements of the dairy industry (in its broadest sense, including all stakeholders in the production and supply chain) and consumers of dairy products. The formulation of the WG and Organisational Structures will also be done at this meeting. Keynote speakers will be invited to present current state of the art on the three scientific themes, Biomarker Technologies, Activity Technologies and Systems Level Technologies. An ESR Forum will be established at this meeting and will run throughout the Action, with dedicated sessions at 4 of the Networking Meetings and a dedicated ESR page on the Action website.

**Networking Conferences:** These will be the main Action-level research activity. A total of 5 will be held, the last of these being the Final Conference. Each Conference will take place in a different part of Europe and each will feature a different dairy welfare theme that is chosen for its cross-cutting relevance to integrate the activities of the WG. Individual WG will be asked to organise scientific sessions within the Conferences, sometimes as an individual WG and sometimes as a joint session of two groups. There will be no parallel sessions so members will all be able to benefit from the entire Conference. Submitted scientific presentations by WG members will be complemented by keynote presentations from invited speakers. A hardcopy Conference

Proceedings will be produced and an online Conference Report will be posted on the Action website, and a condition of being asked to contribute will be that the abstract will be included in the Proceedings and the presentation made available on the website.

***Working Group Sessions and Meetings:*** The 3 WG and their key scientific tasks have been described. Membership of individual WG will be open to all Action members without restriction, meaning that an individual can take an active role in more than one WG. In addition to the individual and joint scientific sessions at Networking Conferences described above, and subject to funding being available, WG will be free to organize one or more independent meetings when appropriate opportunities arise (for instance as a satellite to a relevant scientific meeting). These will be reported on the website as for the Networking Conferences and a short report will also be presented to all members attending the next Conference. In general, the WG will each have the following responsibilities:

- To establish an efficient research network of researchers and industry representatives needed to achieve the identified key tasks
- To coordinate, encourage collaboration and discourage repetition in research activities
- To encourage joint publication of research findings
- To obtain added value by effective interaction with other WG

WG3, Systems-Level Welfare Technologies will take the lead in cross-WG interaction, since part of their scientific remit is to integrate the biomarker and activity outputs. WG2, Activity-Based Welfare Technologies, will have expertise in Welfare Index criteria, and a further task for this WG will be to review and as far as possible harmonize different criteria used in different countries.

***ESR Forum and ESR Sessions.*** Membership of the ESR Forum will be open to all ESR and will be independent of the WG structure. The ESR Forum will organise a scientific session at three of the Networking Conferences and the Final Conference on a relevant topic of their choosing. This will be the main venue for presenting the outputs from STSM. The usual reporting procedures will apply. In addition the ESR will be involved in the selection and approval of STSM, in the selection of subjects for the two Research Training Workshops to be held at Action midpoint and year 4, and in the delivery of Educational Outreach. These latter two Activities will be described under Section

## H Dissemination.

**STSMs.** STSMs will be used to promote mobility, exchange techniques, establish collaborations and enable research to proceed where specialist facilities are only available in the host Institution. Participation of industry as well as academia will be actively encouraged, and STSM will be targeted towards ESR as a valuable contribution to career development.

**Final Conference and Blueprint Release.** The Final Conference will be specifically designed to round-off the Action and draw together the various research activities that have taken place. The first half-day of the two-and-a-half-day Conference will be given over to discussion and amendment of pre-circulated drafts of blueprints for action to improve dairy animal management based on the new technologies developed during the course of the Action. The second day will comprise the usual WG-organised research sessions. The final day will be open to stakeholders from the agricultural industries, supply chain and consumers and will start with the ESR session, giving an opportunity for the younger scientists to interact with industry. This will be followed by the presentation of the Blueprints, described under Section H, dissemination.

## E. ORGANISATION

### E.1 Coordination and organisation

Coordination of the Action will be the responsibility of the Management Committee which will comprise participating country representatives and be led by a Chair and Vice-Chair. The Research Programme and its Dissemination will be undertaken by the three WGs defined in section D, together with the ESR Forum. Each of these will be led by a Chair and Vice-Chair. In addition an STSM Coordinator will be appointed from amongst academic participants, and a Dissemination Coordinator will be appointed from amongst the commercial partners. At its first meeting (Kick Off Meeting) the MC will appoint the Action Chair and Vice Chair, WG Chairs and Vice-Chairs and the STSM and Dissemination Coordinators. Together these individuals will comprise the Action Steering Group (ASG) which will be responsible for the detailed organisation of the Networking Conferences and other activities, including dissemination. The appointment of the Chair and Vice-Chair of the ESR Forum will be made at the first Networking Conference (end of year 1) and these individuals will join the ASG. The ASG will answer to the MC.

After the initial Kick-Off Meeting, the MC will meet once a year, each meeting being held immediately following a full Networking Conference. The responsibilities of the MC are defined in

COST 4159/10 and the mechanisms to be put in place to enable the MC to fulfill those responsibilities are described below. The ASG will meet twice a year, once immediately preceding the Networking Conference and once approximately three months before the next Networking Conference. In addition to these face to face meetings the MC and ASG will maintain effective communication by use of modern electronic communication.

The responsibilities of the ASG will be:

- To coordinate and plan the Networking Conferences, Best Practice Workshops, and Educational Outreach Meetings, including the appointment from the MC of local organisers where necessary for individual activities
- To receive reports from WG Chairs and Vice Chairs to ensure WG objectives are met
- To receive requests for and approve STSMs
- To receive reports from STSMs to ensure approved objectives are met
- To report to the MC on the functioning of the WG, the progress of STSMs, and plans for future activities
- To ensure the establishment and maintenance of the Action website for communication between partners and for dissemination of knowledge on dairy animal welfare to the external community
- To execute the Dissemination plan described in section H
- To ensure close liaison with the Dairy Industries

***Monitoring and Evaluation Plan*** The Action website will be established by the coordinating institution, where dedicated IT support is available to assist with site preparation and maintenance. Individual members of the ASG will have the necessary access to update the sections of the site for which they have responsibility. Feedback from the public access section of the Website will be monitored by the IT support and this will help to inform the monitoring and evaluation activities. The coordinating institution also has a mechanism in place for extracting media coverage, and the Action will be included as a routine part of this on-going exercise. In addition, on an annual basis the ASG will contact a randomly selected subset of Action participants seeking their confidential assessment of the Action's performance. Finally, the MC will ensure satisfactory performance of the Action through achievement of a series of predetermined Milestones. These will include:

- Publication of Proceedings from Kick-Off Meeting (Action start)

- Establishment of ASG (Action start)
- Establishment of website (3 months)
- First tranche of STSM established (6 months)
- Publication of Proceedings from Networking Conferences (scheduled in section F)
- ESR representatives join ASG (12 months)
- Educational outreaches take place (12, 24, 36, 48 months)
- Social Media dissemination established (15 months)
- Best Practice Workshops take place (20, 30 months)
- Research Training Workshops take place (23, 44 months)
- Publication of Proceedings and Blueprints from Final Conference (Action end)

Together, these four measures will constitute the Monitoring and Evaluation Plan, which will be communicated in Annual Reports from the MC.

## **E.2 Working Groups**

The Research Plan and in particular the Networking Conferences will be organised around the three previously defined WG together with the ESR Forum. The responsibilities of each WG will be:

- To organize specific scientific sessions within each Networking Conference
- To encourage WG members to prepare common publications including reviews and educational material
- To contribute WG-specific inputs to Best Practice Workshops, Educational Outreach Meetings and other common activities
- To establish joint research activities with other WG

Cross fertilization between WG will happen naturally as part of the Research Plan, since the outputs from WG1 (Biomarkers) and WG2 (Activity) will inform the activities in WG3 (systems). In addition, the ESR will operate outside the WG structure and will incorporate elements from each part of the research into their scientific sessions.

## **E.3 Liaison and interaction with other research programmes**

The Action will establish efficient interaction with other relevant COST Actions including FA1002 Farm Animal Proteomics, FA1005 Improving health properties of food (INFOGEST) and FA0805 Goat-parasite interactions (CAPARA). MC members from each Action will be encouraged to participate in relevant activities of both Actions. The Action will establish a close interaction with two specific EU research programmes, FP7 Precision Livestock Farming and ERA-NET ICT-Agri Dairy-ICT. In addition the Action will maintain a database of national and regional research activities, maintain close contact with these activities and encourage their participation in Action activities, especially Networking Conferences.

#### **E.4 Gender balance and involvement of early-stage researchers**

This COST Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its MC agendas. The Action will also be committed to considerably involve early-stage researchers. This item will also be placed as a standard item on all MC agendas.

Gender balance within the sciences covered by the Action is good, with considerable numbers of female scientists engaged in animal wellbeing research. Almost 40% of the interested parties in this Action are female. The Action will take positive measures to encourage gender balance. At the organizational level, by requiring that Chair and Vice Chair of each WG and ESR are of different gender a balanced ASG will be achieved. At the research level, equal numbers of male and female researchers will be invited to participate at Networking Meetings as Invited Speakers.

Early Stage Researchers will be actively involved from the outset, through the creation of the ESR Forum. They will play an active role in Action Management through participation in the ASG. STSMs will be targeted towards ESRs. Participation of ESR at Networking Conferences will be strongly encouraged, and from the midpoint of the Action timetable onwards there will be a dedicated ESR session within each meeting, where ESR will be able to report on the outcomes of their STSM. This will have the additional benefit of creating an additional conduit between different WG. ESR will also be encouraged and supported to participate strongly in those Educational Outreach Meetings that target students. Finally, the Training Schools described in section H will be a further activity targeted towards ESR.

#### **F. TIMETABLE**

The Action will last for four years. The timetable is shown below:

Activity	Year 1				Year 2				Year 3				Year 4			
<b>Research Activities</b>																
Coordination Effort	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Kick-Off Meeting	X															
Website: member pages		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Networking Conference				X			X			X			X			
WG sessions: Coordinated				X			X			X			X			X
WG meetings: Independent										X						
ESR Session							X			X			X			X
STSM			X	X	X	X	X	X	X	X	X	X	X	X	X	
Final Conference, Blueprint Release																X
<b>Organisational Activities</b>																
MC Meeting	X			X			X			X			X			X
ASG Meeting		X		X		X	X		X	X		X	X		X	X
<b>Dissemination Activities</b>																
Website: open access pages		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Research Training Workshop								X							X	
Best Practice Workshops							X			X						X
Educational Outreach				X				X				X				X
Social Media and Video Reports					X				X				X			X
<b>Monitoring, Evaluation and Reporting Activities</b>																
Website: feedback		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Media Coverage		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Internal Survey				X				X				X				X
Annual Report				X				X				X				X

ASG report to MC				X			X			X			X			X
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## G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: AT, BE, CH, DE, DK, EE, EL, ES, FI, FR, HR, HU, IE, IL, IT, MK, NL, NO, PL, PT, RO, SE, SI, UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 96 Million € for the total duration of the Action. This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

## H. DISSEMINATION PLAN

### H.1 Who?

The Action will place great emphasis on dissemination to a wide range of participants, end users, stakeholders in the dairy foods chain, consumers, policy makers and society generally. Indeed, one of the stated key objectives of the Action is: *wider dissemination of established best-practice technologies, including from the dairy cow sector into niche sectors working with non-bovine and novel dairy animals*. This specific objective will be achieved through the holding of three Best Practice Workshops, each of which will target producers specialising in a range of dairy species in addition to dairy cattle (described in detail below). In addition to this cross-species component, knowledge transfer will also target all parts of Europe, with particular emphasis on North:South and East:West transfer. Within the categories of participants are animal scientists, ethologists, veterinarians, agricultural engineers and social scientists. A number of SMEs engaged in development of agricultural technologies are also actively involved as participants, as are four major multinational dairy equipment companies, a major multinational dairy animal feeds company and a number of dairy consultancy firms who provide advice to dairy farmers. The research outcomes will be highly relevant to other researchers in the general area of lactation science, and dissemination will include close cooperation with the on-going NordForsk Researcher Network in Comparative Lactation Biology, CoLact, which comes to an end later this year. Scientific presentations will be made at the Annual Meetings of the European Association for Animal Production (EAAP) and at other relevant national and international conferences. The primary end

users of the research will be dairy farmers, as well as other relevant agricultural technology SMEs and large enterprises, others in the agricultural extension sector and agricultural education institutions. All will be actively involved with the Action throughout, and in particular the initial establishment of the detailed Objectives will be done in close collaboration with the dairy industries and consumers. Within education, there will be direct involvement with two on-going Erasmus Mundus MSc programmes, Food of Life and Sustainable Animal Nutrition and Feeding. Within the dairy foods chain the outputs will also be disseminated to milk buyers, milk processors and retailers. Consumers will be actively involved in the Action and will be a primary target of non-technical dissemination, through Consumer Organisations and the general press. Policy makers will be kept fully informed at national, EU and global levels, including DG for Agriculture & Rural Development, DG for Research and DG for Health and Consumers of the European Commission. The outcomes will also be relevant to the animal health industry, and information will be channelled to this sector through the International Federation for Animal Health Europe and European Technology Platform for Global Animal Health.

## **H.2 What?**

The results of the Action will be disseminated to Target Groups by:

- Action activities
  - Networking Conferences (research dissemination)
  - Best Practice Workshops (cross-species, cross-region dissemination)
  - Research Training Workshops (dissemination to ESR)
  - Educational Outreach Meetings (dissemination to the next generation of researchers)
  - Short-Term Scientific Missions (research technology dissemination)
- Press Releases
- Public access website
- Social networking internet site
- Professional networking internet site (password protected)
- Video networking internet site

- Research Publications
- Non-technical publications
- Participation at relevant related activities organised at national or global level
- End user contact through dairy consultancy partners
- Release of Blueprint for Action to Improve Dairy Animal Welfare

### H.3 How?

Dissemination will be achieved through a variety of mechanisms targeted to different audiences. The principal Activities will all be part of dissemination, and in addition specific dissemination measures will be taken during the lifetime of the Action.

**Best Practice Workshops.** Best Practice Workshops will be held in years 2, 3 and 4. These will each be organized as a satellite to a Networking Conference and will target a different audience, comprising industry, dairy consultancies and dairy farmers themselves. The first two Workshops will primarily target the transfer of established best practice into new and developing regions of the EU dairy industry, and especially the transfer of dairy cow best practice into other species, including small ruminants, buffalo and camels. For this reason, these Workshops will be held in regions of the EU where these species are of commercial importance. Topics to be covered in these Workshops that have cross-species importance will include milking technique and milk ejection, welfare-friendly housing and management and technologies for identification and recording in addition to the welfare-related technologies being developed in the Action. The third Workshop will primarily target dissemination of the novel technological outcomes of the Action to the dairy cow sector, and especially the technologically advanced sector and those who are looking to expand. All three Workshops will showcase new and innovative best-practice technologies in the setting of an actual dairy unit, and will include presentations from key experts from the Action as well as Technology in Practice demonstrations. The Workshops will be supplemented by on-going contact between dairy consultancies who are participants within the Action and their dairy farmer clients.

**Research Training Workshops.** Research Training Workshops (RTW) will be held in years 2 and 4. These will be intended for ESR from the Action and elsewhere who wish to be trained intensively and in a short time (RTW will each last for 3 - 5 days) in the most advanced analytical, sensing, automated sampling or other techniques that are in place within the Action consortium. The choice of specific topics to be covered will be made by the ASG advised by the ESR Forum at least 6

months in advance.

**Networking Conferences.** These will be the primary on-going means of research dissemination to scientific participants and others actively involved in the different WGs. WGs will be encouraged to organize scientific sessions that have relevance beyond the immediate members, to invite European and international experts to participate as keynote speakers and to involve relevant industry representatives and stakeholders whenever appropriate. The Proceedings of each Conference will be made available on the dedicated Action website and a report published in the Annual Action newsletter. Presentations made at Networking Conferences will be available on the website as PDF files, subject to the agreement of the author. The Action will coordinate with other relevant national and international research groupings and explore joint scientific meetings when appropriate.

**Website.** A dedicated website will be created that has a full public access section and a subscription-only section that will be available without cost to all. Since animal welfare is an evocative issue, it is felt that having a fully restricted access portion would create the wrong impression: the Action does not want to appear secretive, even if some of the content will be technically difficult for lay people to understand. The website will contain information about the Action, its *raison d'être*, its structural organisation, its Working Groups and participants. It will be used to publicize, organize and report on Action activities, will include publications from participants and links to other relevant organisations and activities outside the Action. It will be updated regularly, and a news section will keep participants and subscribers fully informed.

**Other Networking.** To promote easy communication and exchange of files between participants the Action will establish a password-protected Sharepoint or Dropbox internet exchange facility. To promote widespread public and end-user awareness on a global scale, the Action will establish groups within Twitter (social networking) and Linked In (professional networking: password protected) and will interact with other relevant groups, such as the Linked In groups “Hi-Tech Dairy Farming” and “Global Dairy Innovation Network”. Short lay-person oriented videos promoting the Action and describing specific areas of research (especially STSMs) will be produced and made available on YouTube.

**Publications and Reports.** Scientific publications by participants will be publicized on the webpage and the Action will strongly encourage joint publications (original research and review articles) in international peer reviewed Journals, especially those that are public access. Publications that arise from STSM or other activities supported by the Action will carry acknowledgement of COST. Position papers, briefing papers and non-technical publications will be prepared by the Action when appropriate and made available on the webpage. Formal Reports will be produced annually and at Project End, or at other times as required by COST, and will be available on the Action website.

***Educational Outreach Meetings.*** To promote improved knowledge of dairy animal wellbeing within key student populations and to encourage the next generation of dairy scientists, Action participants will contribute with a dedicated Dairy Welfare Technology short course within the Erasmus Mundus (EM) MSc double degree programme, Food of Life, which attracts high calibre students from around the world. This course will run annually. The same course or a modified version of it will also be made available to students from other EM courses and relevant Higher Education Institutions.

***Participation in Related Activities.*** On an individual basis, Action participants will be encouraged to promote the Action at relevant scientific meetings, such as the Annual Meeting of the European Association of Animal Production. The Action will seek to collaborate with other relevant COST Actions such as Farm Animal Proteomics in the holding of joint sessions, and with other national or international meetings and events, such as the biannual Lactation conference organised by the Centre for Reproductive Biology in Uppsala.

***Short Term Scientific Missions.*** Early Stage Researchers and others participating in STSMs will be encouraged to act as Ambassadors for the Action, promoting its objectives during their mobility periods. The short video mechanism will be especially encouraged in this context.

***Blueprint for Action to Improve Dairy Animal Welfare.*** A major feature of the Final Networking Conference will be the approval and release of one or more Blueprints that will incorporate established best practice together with the novel monitoring and management technologies developed during the course of the Action to provide guidance on how best to manage dairy animals under different circumstances prevailing in different parts of the EU.