Appendix 7. EMR (inc Service ICAR) FTI Proposal 080316

Proposal template
(technical annex)

Fast Track to Innovation Pilot
Innovation actions

⚠ **The information to be captured in the proposal template on impact, excellence and quality and efficiency of implementation will together constitute the business plan, as referred to in the Work Programme. No separate business plan is to be submitted. As a result of this approach, the proposal template for the Fast Track to Innovation Pilot deviates substantially from the standard proposal template for other innovation actions.**

Proposals shall be business-driven and clearly demonstrate a realistic potential for quick deployment and market take-up of innovations.

Any proposal should contain a specification for the outcome of the action; it should capture similar type of information as a standard business plan does, which means that information on commercial viability, future development and strategy, finance and planning assumptions & projections should be covered as part of the proposal.

Please follow the structure of the template when preparing your proposal. It has been designed to ensure that the important aspects of your planned work are presented in a way that will enable the experts to make an effective assessment against the evaluation criteria. Sections 1, 2 and 3 each correspond to an evaluation criterion for a full proposal.

Please be aware that proposals will be evaluated as they were submitted, rather than on their potential if certain changes were to be made. This means that only proposals that successfully address all the required aspects will have a chance of being funded. There will be no possibility for significant changes to content, budget and consortium composition during grant preparation.

⚠ **Page limit:** For full proposals, the cover page, and sections 1, 2 and 3, together should not be longer than 30 pages. Sections 4 and 5, which allow applicants to elaborate on members of the consortium and ethics and security, have no page limit. All tables in these sections must be included within this limit. The minimum font size allowed is 11 points. The page size is A4, and all margins (top, bottom, left, right) should be at least 15 mm (not including any footers or headers).

If you attempt to upload a proposal longer than the specified limit, you will receive an automatic warning and will be advised to shorten and re-upload the proposal. Any excess pages will be overprinted with a 'watermark', indicating to evaluators that these pages must be disregarded.
Please do not consider the page limit as a target! It is in your interest to keep your text as concise as possible, since experts rarely view unnecessarily long proposals in a positive light.
First page with instructions should be deleted when the template is used.

COVER PAGE

Title of Proposal
List of participants (min. 3, max. 5)

Participant No *	Participant organisation name	Country	First Time Industry Applicant**
1 (Coordinator)	European Milk Recording E.E.I.G.	Belgium	Y
2	Institut für Milchuntersuchung GmbH & Co. KG	Germany	Y
3	SERVICE-ICAR S.R.L	Italy	N
4	Centre wallon de Recherches agronomiques	Belgium	N

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* Please use the same participant numbering as that used in the administrative proposal forms.
** In the context of the FTI pilot, a "first-time industry applicant" means a legal entity that is a private, for-profit organisation that has obtained a PIC (Participant Identification Code) for the first time, meaning that such legal entity is for the first time registered in the Beneficiary Register during the preparation of the proposal. *Please note that the correctness of your input is subject to cross-checks by European Commission services.*

1. Excellence

1.1 Objectives

- Describe the specific objectives for the action, which should be clear, measurable, realistic and achievable within the duration of the action. Objectives should be consistent with the expected exploitation and impact of the action (see section 2) and with the innovation strategy of the different partners of the consortium;
- Explain the industrial/economic/social challenge to address, and the market opportunity to be exploited, through your business-driven innovation action, and in what way this relates to specific objective(s) under Horizon 2020;
- Explain also how your solution meets the stated challenge or avails of the business opportunity, and describe (potential) other expected outcomes.

The final objective of this project is to deliver a marketable standardisation service to milk laboratories, milk recording organizations, farming extension services, milk industries and any other stakeholders of the dairy sector who uses Fourier transform mid-infrared (FT-MIR) spectrometry for milk analysis.

FT-MIR spectrometry has been used for many years to quantify common milk components such as fat and protein. Over the last decade, new applications of the FT-MIR technology have been developed. In this way, FT-MIR has been applied for the determination of a wide range of milk components such as protein composition (Bonfatti et al., 2011), minerals (Soyeurt et al., 2009), ketone bodies (Van Knegsel et al., 2010), lactoferrin (Soyeurt et al., 2007) and fatty acid profile (Rutten et al., 2009; Soyeurt et al., 2011). Then recent studies have been performed using these milk components obtained by FT-MIR in order to predict physiological indicators of the animal (Mohammed et al, 2011; Friggens et al, 2007).

In short, FT-MIR spectrometry is now the worldwide method of choice for composition and quality controls during routine liquid milk testing. It allows a fast, non-destructive quantification of milk chemical properties. These chemical properties are predicted from prediction equations applied to the spectrum generated by the FT-MIR spectrometer during the analysis of milk. This spectrum results from the interaction of the milk molecules with the MIR laser. However, because of differences of the instrumental responses between different FT-MIR spectrometers, spectra obtained on one instrument cannot readily be compared to a library acquired on a different instrument. Moreover, the use of prediction equation developed on one instrument with FT-MIR spectra obtained on another instrument will usually lead to an increased uncertainty of the prediction model.

For “classical” milk components like fat and protein used for milk payment, advisory services to farmers and genetic index, such uncertainty issues are overcome by calibration and harmonization procedures which are based on calibration solutions and slope and bias corrections and validated by ISO. One calibration solution is utilized to calibrate the apparatus according to one milk component. This calibration procedure guarantees that the results provided by the apparatus are accurate and stable over time. However for new milk components and physiological indicators described above, there is currently no option to standardize the spectra that generate the values.

This lack of standardisation methodology for new FT-MIR prediction equations is a real challenge for the dairy sector:

- Innovative approach of using FT-MIR spectrometry needs the support of important spectral databases associated to reference values for each of the properties to be studied. Because of

differences of the instrumental responses between different FT-MIR spectrometers, spectra obtained on one instrument cannot readily be compared to a library acquired on a different instrument.

- Moreover, the use of calibration models developed on an instrument with FT-MIR spectra obtained on another instrument will usually lead to an increased uncertainty of the prediction equation. This is a drawback when recalibrating an instrument or using a historical database.
- Due to physical use and perturbations occurring on each instrument there is deviation of spectral response of instruments in time leading to a deviation of the predicted values. Therefore a predictive equation is valid on an instrument only during a limited period of time.

Therefore spectral corrections adapted to each instrument (standardization procedures) are needed (Rodriguez et al., 2011) to enable the development of robust model which are compatible in time and transposable everywhere regardless the lab or the brand or model of spectrometer used. This is a clearly identified gap on the market.

From 2011 to 2015, a standardisation methodology for milk FT-MIR spectra was developed, tested and implemented as **prototype** in a network of 69 FT-MIR spectrometers from 3 manufacturers in 25 milk laboratories across North West Europe (OptiMIR project – INTERREG VB). The objective of the OptiMIR standardization procedure is to standardize spectra from different models and manufacturers of instruments, by reducing the inherent instrument to instrument variability, within the dairy network, so that the milk spectra from all spectrometers (the slaves) can be compared to the milk spectra of a standard instrument (the master). The standardization allows the collection of datasets from different sources and therefore the creation of common and more robust predictive equations and permits the use of these equations on all instruments. The method increases the reproducibility of the results of the FT-MIR analysis of milk within the network and enables the comparison of results from different instruments from different labs regardless the brand of the utilized spectrometers. The standardisation procedure also increases the stability of the FT-MIR analysis over time for a given apparatus. It thereby allows the building of innovative prediction equations and statistical tools based on comprehensive datasets to be used by all instruments of the network. The methodology has been published in a peer-reviewed journal (Grelet et al., 2015, J. Dairy Sci. 98:2150–2160) and therefore validated by the scientific community.

The specific objectives are:

- To strengthen the OptiMIR standardisation network, which is now handled by EMR EEIG, and comprises 69 FT-MIR spectrometers from 3 manufacturers in 25 labs in 6 countries.
- To optimise the different processes of the standardisation service such as the flow of data, the data processing, the mathematical procedures, the IT infrastructure, etc.
- To professionalise the standardization service: automated process and reduced costs, administrative and customers' relationship management, quality assurance system, etc.
- To achieve the international certifications and quality label of the methodology and processes of the standardisation service through International Committee for Animal Recording (ICAR) and ISO/IDF standing Committees (International Dairy Federation).
- To commercialise (market launch) and disseminate the standardisation service in milk recording companies, milk labs and industries to enable valid development and utilisation of accurate and compatible FT-MIR prediction equations everywhere.
- To ensure the continuous process improvement.

A measurable indicator for the project success after the implementation of the proposed service will be the increased number of institutions offering FT-MIR milk analysis using the standardisation service and thus taking part in the standardisation network. Thanks to the outcomes of a previous European R&D project (OptiMIR - INTERREG) the standardisation methodology and service is proven. Since 2012, the prototype of the standardisation service has been installed and provided in a European network consisting to date of 69 FT-MIR spectral instruments located in 27 milk analysis laboratories. In this regard a broad dissemination, the industrialisation and the commercial launch of a standardisation service based on this proven technology seems realistic and achievable within three years.

The industrial challenge directly addressed by this proposal is the facilitation of access to risk finance for investing in innovation. Hence, to maintain and strengthen the innovative standardisation service, major investments are required. However, the participants to the present proposal are all small and medium-sized enterprises (SMEs) which makes the required major investments especially high and risky for them. In this regard, this proposal targets the enhanced access to risk finance for investing in innovation ("Access to risk finance") and the increased innovation in SMEs ("Innovation in SMEs"), likewise (Work Program H2020; Article 3; Section 2).

Furthermore, the proposed service will contribute to the development of collaborative platforms combining harmonized phenotypes as the standardisation brings all MIR spectral data in one format and thus enables combination of these data in a global database (Work Programme H2020; Part II; Section 1.4.3.). This in turn will make possible fast data processing and analysis. Worldwide there are around 280 milk recording organisations and 170 milk analysis laboratories. Hence, the number of potential customers for the standardisation service is high. Moreover, there is no other comparable service than the proposed one currently available at the market. Therefore, the business opportunity is high.

Hence, the number of potential customers for the standardisation service is high. Moreover, there is no other comparable service than the proposed one currently available at the market. Therefore, the business opportunity is high.

Beside this economical challenge, another expected outcome will be a more sustainable and resource efficient milk production as the standardised phenotypes recorded will contribute to the enhancement of the health of the dairy cows, the improvement of their welfare and therefore the elongation of their life span. Therefore, this proposal contributes also to a social challenge, as health and welfare (Work Programme H2020; Part III; Section 3) of livestock is of increasing public concern and an important ethical issue.

1.2 Relation to the work programme

- Indicate in a concise manner the reason(s) why your proposal would fit under the section Fast Track to Innovation of the Work Programme. Please refer to the text of the Work Programme where appropriate.

The European Milk Recording, as a European Economic Interest Group, is a first-time industry applicant in Horizon 2020. The same applies for Service ICAR and the Institute of Milk Analysis. Thus this call will increase the participation of first-time industry applicants. As all three applicants are also SMEs, this call also achieves the increase of SMEs participation in Horizon 2020. In this regard, this

proposal refers strongly to the section Fast Track to Innovation of the Horizon 2020 Work Programme. The offered services of this proposal's applicants are different and a collaboration follows a transdisciplinary approach.

Beside, this call addresses the commercial take-up and wide deployment of the sustainable innovative standardization service as an expected impact in the Fast Track to Innovation Work Programme. The Fast Track to Innovation Work Programme also requests an initial market take up within three years after the beginning of the project. Due to the maturity level of the standardisation service this time frame seems realistic. The current level of maturity, when referring to the definitions of the Technology Readiness Levels (TRL; as described in the General Annex G Horizon 2020), of the innovative standardization service is between TRL 6 and 7 (more detailed description in Section 1.3). With the market introduction of the standardisation service, an enhanced competitiveness and growth of the industry applicants is expected. The newly established European Milk Recording EEIG as the single provider of the standardisation service will enhance its competitiveness and growth in terms of turnover and job creation. The European Milk Recording EEIG was funded as a platform for exchange among 11 European milk recording organisations and to maintain the standardisation service developed in OptiMIR (INTERREG).

The involved milk recording organisations are highly interested in expanding their activities by the implementation and the use of novel accurate and standardised phenotypes which requires further research. In mid- and long-term this proposal supports leveraging of private investment to further innovations and research, both built on the standardisation service.

The utilisation of the standardisation service enables an increase of the reproductibility of milk analysis by FT-MIR spectrometry which in turn will promote the phenotypes collected during milk recording. For the development of novel phenotypes obtained from mid-infrared analysis of milk, significant contributions by research will be required and purchased. Thus the standardization service is (indirectly) leveraging more private investment into research. At the other hand research can gain new finding through analysis of the 'Big Data' collected during milk recording. With the global distribution of the standardisation service the European Milk Recording EEIG will grow in terms of turnover and jobs.

1.3 Concept and approach

- Describe and explain the overall concept underpinning the action. Describe the main ideas, models or assumptions involved. Highlight any trans-disciplinary considerations; broaden on the methodology that you intend to follow, setting out, as appropriate, activities that you will implement during this action (e.g. demonstration, testing, advanced prototyping, pilot lines, miniaturisation, advanced design, performance verification, market replication encouraging the involvement of end users and potential clients, specialised research, validation processes etc.).
- Clearly specify the starting point and the level of maturity of the proposed solution by outlining the positioning of the action e.g. where it is situated in the spectrum from 'idea to application', or from 'lab to market'. Refer to Technology Readiness Levels (TRL) where possible. (See General Annex G of the Work Programme; note that under the Fast Track to Innovation scheme, proposed technological innovations will be expected to have a TRL of 6 or higher, and that non-technological innovations will expected to have a similar level of maturity).

- Explain how the concept and its planned development will lead to effective market take-up and what will be required to achieve that.
- In the context of the overall Horizon 2020 priorities, elaborate on the European dimension of your proposal and explain how your action will lead to innovation that will add value to Europe.
- Where relevant, describe how sex and/or gender analysis is taken into account in the action's content.

⚠ *Sex and gender refer to biological characteristics and social/cultural factors respectively. For guidance on methods of sex / gender analysis and the issues to be taken into account, please refer to http://ec.europa.eu/research/science-society/gendered-innovations/index_en.cfm*

The overall concept of this proposal follows the large accessibility of the developed standardisation service to global milk laboratories and milk recording organisations by supporting its dissemination and market launch. Our project wants to achieve the commercial delivering of a new standardisation service, which could be a general solution for the utilisation of new FT-MIR prediction equations coming on the market: to predict new molecules in the milk by avoiding multiplication of calibration procedures in the labs, and to predict dairy cows' physiology through animal prediction equations. Potential end users are thus: milk recording organisations, breeders' organisations, milk labs and industries.

It is worth noting that FT-MIR spectrometers are used worldwide for composition and quality controls during routine liquid milk testing especially in the frame of (1) milk payment to dairy farmers, (2) milk recording which provides the phenotypes required for the monitoring and genetic improvement of dairy cattle and (3) milk quality control or nutritional claims. The developed standardisation offers a solution for the main problem in the analysis of milk samples by FT-MIR spectrometers in a network: the differences of the instrumental responses between the different brands, models or locations of the FT-MIR spectrometers. Additionally, differences of the instrumental responses on one instrument occur over time. Consequently, the comparability of the results from FT-MIR analysis of milk from different instruments or from one instrument at different time points is not warranted. Because the utilisation of calibration solutions – one set of solutions per milk component to be analysed – is not possible for all the types of molecules, and is not relevant for physiological indicator like e.g. methane**, there is clearly a gap of standardisation methods for FT-MIR phenotypes in the milk sector**.
This approach will be a solution to calibrate the parameters that cannot be adjusted by slope and bias.

To overcome these problems, corrections adapted to each instrument (standardisation procedures) must be developed as explained under 1.1 (Objectives).

The main idea of the standardisation service from the monthly ring test samples to the created standardisation coefficients as well as the relationship between the creation of equations and the use in routine is displayed in Figure 1. The figure summarises the prototype of the standardisation service as established since 2012 among 69 Fourier transform mid-infrared (FT-MIR) spectrometers from 27 milk analyses laboratories located in six European countries. Following the main target of this call, this network of FT-MIR spectrometers should be globally extended.

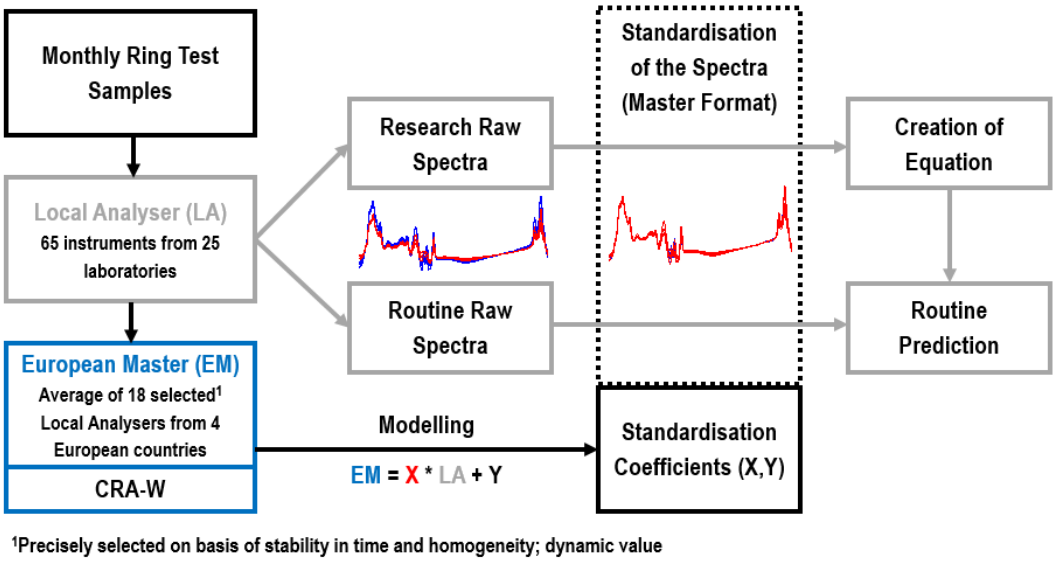

Figure 1. The main idea of the developed standardisation service from the monthly ring test samples to the created standardisation coefficients as well as the relationship between the creation of equations and the use in routine.

The spectral standardisation is a mathematical procedure used to bring all the spectra from different spectrometers into a common format. In infrared science, standardisation of spectra has been standard practice for a long time, but it was the first time that it was used for FT-MIR milk spectra and approached in such a big European network offered by EMR EEIG. It has been developed to use equations predicting new phenotypes based directly on the spectra (e.g., methane, ketosis status) that cannot be corrected by classical slope/bias correction.

It is generally known that spectra from various instruments are different and that the spectra from one single instrument can shift over the time. However, the standardisation allows merging of spectra from various instruments and the creation of equations which can be used on spectra from each instrument taking part to the standardisation process. Standardisation has 4 mains impacts:

- It brings possible to merge spectra from different instrument into a common database to create common equations;
- It allows the use of developed equations on all instruments of the network;
- It brings homogeneity in the predictions of the network;
- It ensures a stability in time with a monthly correction.

From a practical point of view, common physical milk samples (ring test sets) are monthly analysed on each local analyser in the participating organisations. Each instrument is mathematically corrected to match the format of a reference instrument, “the master”, which is a combination of several stable instruments. For each machine, standardisation coefficients are generated wavenumber by wavenumber via modelling of the European master (more details in Grelet et al., 2015).

The coefficients are applied on the raw spectra (no standardised spectra) to bring the spectra in the master format. Afterwards, the equations are developed in the master format and due to standardisation they can be applied on spectra of each local analyser. In practice the equations are developed with standardised spectra to be used for routine prediction with spectra coming from an analyser that is taking part in the ring test. In short, all spectra are transformed in a common format.

Equations are created in this common format and can be used in routine on all instruments due to the standardisation process done every month.

Figure 2 illustrates the reduction of spectral variability among the network after standardisation.

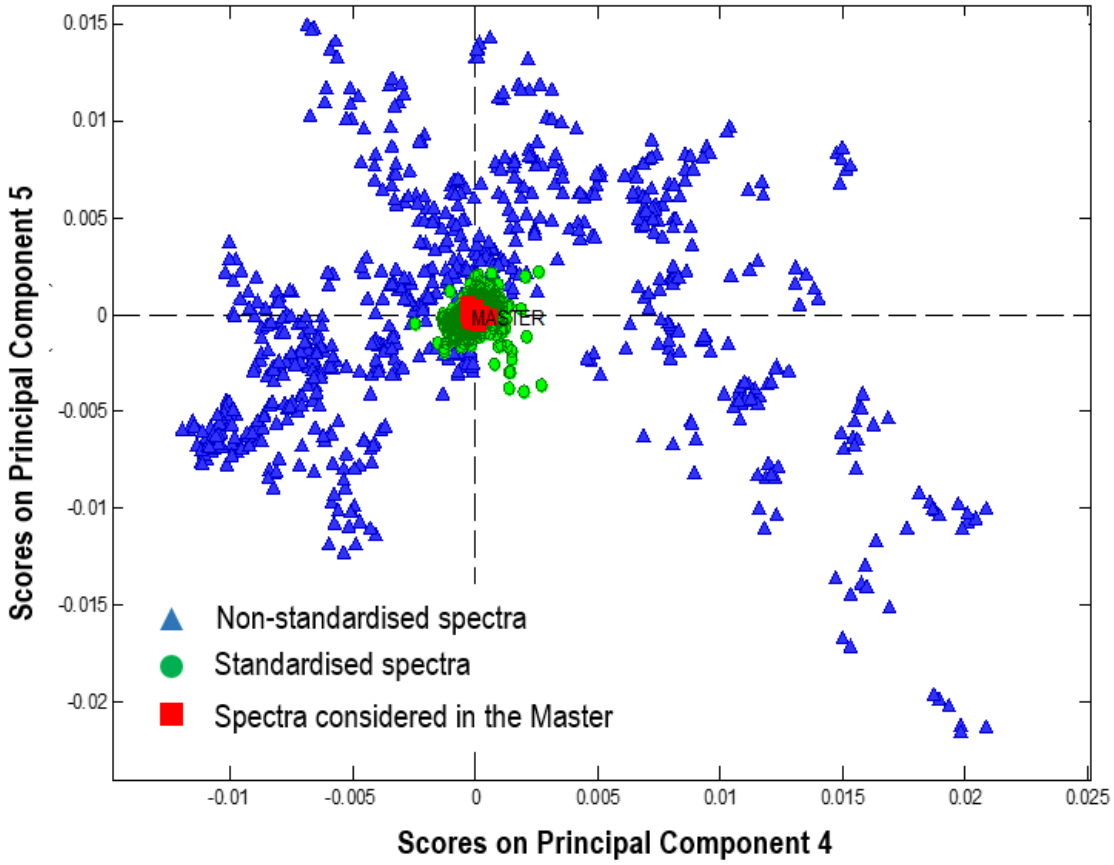

Figure 2. Principal Component Analysis results (Scores of the Principal Components 4 and 5) on informative wavenumbers for 15 common samples analysed on 45 instruments of the same brand. The blue triangle displays the Scores on PC 4 and 5 for the non-standardised spectra. The green circle displays the Scores on PC 4 and 5 for the standardised spectra and the red squares for the spectra of the European Master.

In short, all spectra are transformed in a common format by the standardisation service and the spectral variability between machines is reduced within the network. Thus the standardisation allows combining of spectra from various instruments and the creation of prediction equations which can be used on spectra from every instrument taking part to the standardisation process. Additionally, it allows stable predictions over time and a correction of deviations due to hardware perturbation or wear.

As the standardisation methodology itself is quite mature, the next activities will focus on market replication including advanced prototyping and advanced design by the Research Group at the Walloon Agricultural Research Centre, Belgium (CRA-W) as well as the verification of the performance by the Institute of Milk Analysis as a pilot laboratory/potential end user. In this regard, the transdisciplinary approach of this call is reflected by its applicants: the EMR EEIG as the manager and dealer of the standardization service, Service-ICAR as the validation and dissemination entity of

the standardization service, the Institute for Milk analysis as a pilot laboratory for process optimization and continuous improvement, and CRA-W as the R&D partner who developed the initial methodology in OptiMIR.

The activities that we will implement are:

- Maintenance of the ring-test procedure inside the EMR EEIG network (69 FT-MIR spectrometers from 3 manufacturers in 25 labs in 6 countries) to continue to standardise all the apparatus on a monthly basis.
- Development and installation of a web-service to support process optimisation and professionalisation of the standardisation service like e.g.:
  - ✓ Flow of data between milk labs and CRA-W, the technical operator of standardisation.
  - ✓ Data processing especially to constitute monthly master apparatus and calculate specific correction coefficients for every slave apparatus of the network.
  - ✓ Live monitoring of the spectrometers' stability
- Performance verification and continuous improvement of the web-service and ring-test procedures leaded by IfM, the pilot milk lab of the project.
- Validation process and involvement of end users and potential clients through International Committee for Animal Recording (ICAR) and ISOIDF working groups (International Dairy Federation).
- Specialised research at CRA-W to upgrade ring-tests procedure (frequency, type of samples used, etc.) and reduce costs, and to implement a technic to stabilize spectrometers between 2 ring-tests.
- Quality assurance system to ensure the standardisation is accurately done by the customers.
- Constitution of a transnational database with standardised milk spectral data and collaboration with Universities and research centres for the development of new FT-MIR based algorithms.

As already mentioned, the methodology of the standardisation service is quite mature. Based on the definitions of the different Technology Readiness Levels (TRL) as described in the General Annex G Horizon 2020 (2014-2015) the standardisation service is at least at TRL 6 (Table 1). Since 2012, the standardisation prototype has been implemented in a European network comprising 69 FT-MIR spectrometers that can be considered as operational environment. Some further developments are planned for the improvement of the standardisation service, e.g. to automatize the process, to strengthen the methodology and to reduce its costs. Due to this further plans the standardisation cannot be considered as completed system and in this regard TRL 8 has not been reached yet.

TRL	Definition	TRL reached by the standardisation service
1	Basic principles observed	✓
2	Technology concept formulated	✓
3	Experimental proof of concept	✓
4	Technology validated in lab	✓

5	Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)	✓
6	Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)	✓
7	System prototype demonstration in operational environment	(✓)
8	System complete and qualified	
9	Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)	

An important step in the successful market take-up of the standardisation service is its further evolution verified and closely monitored by one of the applicants of this call, the Institute for the Analysis of Milk, as a pilot laboratory. Another important, simultaneous step towards market take-up, is the dissemination and promotion of the standardisation service as described in the work plan. In brief, the standardisation service will be disseminated at local and global level. The current members of the European Milk Recording will disseminate the standardisation at local and umbrella organisations involved in animal recording e.g. ICAR at global level. The promotion of the standardisation will take part through cross-marketing, online-marketing and presentations at relevant fairs and congresses. In the past, the prototype standardisation service has already been leading to requests to join the network.

1.4 Ambition

- Describe your proposal's innovation potential / the advance it would provide beyond the state-of-the-art, and the extent the proposed work is ambitious. Your answer could refer to the ground-breaking nature of the objectives, concepts involved, issues and problems to be addressed, and approaches and methods to be used. Where relevant, refer to products and services already available on the market.
- Describe the expected key market application(s) extracted from the results already achieved, that differentiates your action and provides the highest value added to potential customers; explain the unique selling proposition of your envisaged solution (in comparison with other existing or emerging ones), including in terms of sustainability/life cycle, and when relevant, include expected improvement potential of the action output over time.

FT-MIR spectrometry is the worldwide method of choice for composition and quality controls during routine liquid milk testing. It allows a fast, non-destructive quantification of milk chemical properties.

In addition of classical milk components like fat and protein, this technology is more and more used to develop new equations for the detection of specific milk components and the prediction of complex phenotypes related to animals' physiology. Dairy farmers, extension workers or vets have thus new opportunities for decision making tools in farm management (animal health, feeding, breeding, ecological footprint…), and the milk industry has new opportunities for specifications, labelling, etc.

Hence, new milk components, or new physiological phenotypes (e.g. methane emissions) can be obtained from FT-MIR analysis of milk. However for new milk components, it is often difficult and sometimes impossible to use specific calibration solutions, **especially because the multiplication of calibration solutions is not a sustainable solution in the lab**. **Moreover it is impossible to use such calibration solution for the new physiological indicators of the animal**: for example there is no possibility to calibrate a solution based on the methane emission of the animal. This means that an FT-MIR prediction equation built on a specific FT-MIR spectrometer cannot be transposed on another apparatus. Without standardisation new FT-MIR algorithms are thus specific to each single FT-MIR apparatus.

CRA-W and EMR EEIG developed an innovative prototype service to standardize the spectra overtime, across models of machine, and across brands of machine, and based on a transnational approach (Grelet et al., 2015). This standardisation operates monthly across a network of some 25 labs and enables to obtain similar results (spectra) over time, across models of machine and across brands of machine. This is a world premiere.

This innovation reaches TRL6 through the implementation of the OptiMIR project (INTERREG NWE) which came to an end in 2015, and allows to develop transposable prediction equations and obtain accurate phenotypes regardless the brand or model of the spectrometer. The ambition of this proposal is to achieve the delivering of a marketable standardisation service to milk laboratories, Milk Recording Organizations, dairy industries and other stakeholders who use MIR technology for milk analysis.

The project will optimize the different processes of the standardization service, to professionalize it and to reduce its overall costs. It will achieve the international standardization of the methodology and process (ISO/IDF and ICAR certification). It will finally disseminate the standardization service for milk MIR spectra with 3 commercial arguments:
(1) Comparable results over time and across labs, brands and models of spectrometers
(2) Development of algorithms which are accurate everywhere
(3) Potential utilisation of the same prediction equations everywhere

In the future and according to recent developments, the FT-MIR analysis of milk will thus provide a wide range of new information such as the milk characteristics (e.g. technological properties) or the characteristics of the animal that has produced the milk (e.g. health status). This means in effect that the offered standardisation service is an essential requirement to access accurate information. If the condition of standardizing milk FT-MIR spectra is reached then it opens the door for:

- New extension services and advisory tools delivered to dairy farmers for farm management (e.g., animal health, feeding and breeding).
- Milk quality information used by milk industries and retail sector for specifications, label, etc. (fatty acids profile, methane emissions of the animals, etc.)

At the moment 69 instruments from 27 laboratories located in 6 different European countries are taking part in the prototype standardisation service. Consequently, the comparability of spectra and the highest attainable precision for the determination of spectra from different instruments is met in the prototype network. An increased uncertainty of innovative prediction equations to predict the state of cows developed and used on different instruments must convince stakeholders to develop

and implement a global solution of standardisation. The spectral corrections adapted to each instrument (standardisation procedures) have been developed and technology demonstrated in relevant environment.

The expected key market application will be licences for the standardisation service per local instrument that guarantees:
1. The provision of ring test samples;
2. The calculation of the Master (average of the most stable local instruments with a licence);
3. The modelling of the standardisation coefficients and provision of these coefficients to standardise the spectra of each local instrument with a licence for the standardisation service;
4. Technical support; and
5. The opportunity to receive access to different models for the prediction of the status of a cow (just the opportunity, additional service offering).

In this regard, the first three points will contribute to the global precision improvement of FT-MIR spectral instruments if the standardisation service reaches the global market. The fifth point will add value to the activities of milk recording and evaluation of dairy livestock farming. A potential suspected outcome will be further models for the prediction of the animal status. For the potential customers, milk laboratories and milk recording organisation, the standardisation service itself will improve the quality of their measurements by improving the precision of their FT-MIR instruments. As milk laboratories and milk recording organisation are service providers, the standardisation ensure a certain data quality for reporting to their customers, dairy farmers or others. Additionally, with the access to different prediction equations of the status of a cow they can expand their current services by the expeditious and cost-effective implementation of further developed equation for the prediction of the cow status. The European Milk Recording EEIG has a unique selling proposition, because the organisation and contribution of such a big global standardisation service is innovative and currently no comparable service is available.

2. Impact

2.1 Expected impacts

⚠ *Please be specific, and provide only information that applies to the proposal and its objectives. Wherever possible, use quantified indicators and targets.*

- Describe how your action will contribute to:
  - the expected impacts set out in the work programme;

    Fast development, commercial take-up and/or wide deployment of sustainable innovative solutions (products, processes, services, business models etc.) in enabling and industrial technologies and/or for tackling societal challenges.

    Time to initial market take-up no later than 3 years after the beginning of the FTI project. In very well-justified cases linked to the specific characteristics of a particular innovation field or industry sector, the time to initial market take-up could be longer.
    Enhanced competitiveness and growth of business partners in the consortium, measured in terms of turnover and job creation.
    Increased industry participation, including SMEs, and more industry first-time applicants to Horizon 2020.
    Leveraging more private investment into research and/or innovation.
    Where appropriate, addressing transnational value-chains and/or EU-wide or global markets.

- developing innovation meeting the needs of European and global markets;
- improving the innovation capacity and the integration of new knowledge strengthening the competitiveness and growth of the industrial legal entities in the consortium;
- any other environmental and socially important impacts (if not already covered above).

- Elaborate on which user needs have been identified and will be met upon completion of the action, and on the way in which the proposed innovation will outcompete current state-of-the-art solutions in the same sector of activity. Compare your solution with solutions offered by competitors (if any), using a cost-benefit analysis.
- Describe the type of market targeted (e.g. niche or high volume). What is the estimation of total available market size and growth rate? What are the market trends? What are you planning to use as main selling points? Describe the most relevant market segments for initial introduction of the new solution, and its potential early adopters / users (both in terms of profile and geographical location).

The main impact of our project will be a general solution for the transposable utilisation of new prediction equations coming on the market: to predict new molecules in the milk by avoiding multiplication of calibrating solutions in the labs, and to predict new dairy cows' phenotypes. The fact to standardise directly the MIR spectra beforehand is completely innovative and brings a solution to the following assessment: **there is thus a gap on the market between the opportunity of predicting a wide range of new phenotypes and the possibility to implement them on a routine basis in the labs**. End users are: milk recording organisations, breeders' organisations, milk labs and industries.

Without our standardisation service a research centre had only the opportunity to develop algorithms by using non-standardized MIR spectra. This algorithm would be thus accurate only on the machine(s) used for the building, and as long as no disturbances occur. Research output are in this case not adaptable on the field at large scale nor transposable. Moreover, without our standardisation service no large database including spectral data are possible to collate, meaning poor variability and robustness based on a local population.

With our standardisation service, a research centre has now the possibility to build a model by using standardised spectra. This model is thus accurate on all the machine of the standardisation network, which includes currently 69 spectrometers in 27 labs, whatever the brand or model of the machine. Research output can in fact be now adaptable on the field at large scale and transposable in the whole network. Within the frame of the OptiMIR project, we collated the first large database including spectral data with high variability and robust prediction equations based on a NWE population.

EMR EEIG will continue to promote and disseminate the standardisation of FT-MIR spectrometers in milk labs by (1) advocating this methodology in the different working groups in ICAR (International Committee for Animal Recording) and ISO/IDF (International Organization for Standardization / International Dairy Federation), and (2) by spreading the network of labs and instruments in Europe and wider.

As a direct consequence of our standardisation service, the Milk Recording Organisations, milk industries and dairy farmers get the opportunity to develop or use common innovative indicators and tools in terms of farm management and value-creation to sustain their business. Milk analysis get the

potential to produce complex information on individual dairy cows. At farmers' level, this opens the door for alert and monitoring on animal health, feeding, and environmental impact, but also for new breeding strategies based on a genetic evaluation of new traits, for example in term of methane emissions. At milk industries' level, this opens the door for developing new quality labels, and health and nutritional claims. The finalized service of standardization will in fact interest all laboratories carrying out FT-MIR analysis on milk: in one hand for farm management tools and in the other hand for the process on the stability of the spectrum.

In term of potential market for the dissemination of the standardisation service we can consider the following number of laboratories which are specialized in milk analysis:

- More than 160 laboratories for milk recording organizations for a total of around 240 analysers.
- More than 200 laboratories for milk industry with **at least** one analyser per laboratory

This market is stable and will remain stable in the future. Our goal is to implement the standardization service on 304 analyzers during the next 5 years. The cost of the standardization service for EMR member is 1,700€ per machine per year (cost price). The cost of the standardization service for external companies is 2,950€ per machine and per year. The potential revenues are thus 1,250€ per machine and per year while selling the service to external companies.

		Year X	**Year X + 1**	**Year X + 2**	**Year X + 3**	**Year X + 4**
EMR members	No of machines	69	76	76	76	76
	Expenses/machine without WP1 & WP2 funding	€ 1,700	€ 1,700	€ 1,700	€ 1,700	€ 1,700
	Expenses/machine with WP1 & WP2 funding	€ 0	€ 0	€ 1,615	€ 1,534	€ 1,458
Ongoing contacts	No of machines	0	7	30	30	30
	Revenues/machine without WP2 funding	€ 1,250	€ 1,250	€ 1,250	€ 1,250	€ 1,250
	Revenues/machine with WP2 funding	€ 1,250	€ 1,250	€ 1,335	€ 1,416	€ 1,492
	Revenues without WP2 funding	€ 0	€ 8,750	€ 37,500	€ 37,500	€ 37,500
	Revenues with WP2 funding	€ 0	€ 8,750	€ 40,050	€ 42,473	€ 44,774
Results of ICAR-IDF certification and promotion (WP4 & WP5)	No of machines	0	0	66	132	198
	Revenues/machine without WP2 funding	€ 1,250	€ 1,250	€ 1,250	€ 1,250	€ 1,250
	Revenues/machine with WP2 funding	€ 1,250	€ 1,250	€ 1,335	€ 1,416	€ 1,492
	Revenues without WP2 funding	€ 0	€ 0	€ 82,500	€ 165,000	€ 247,500
	Revenues with WP2 funding	€ 0	€ 0	€ 88,110	€ 186,879	€ 295,508
TOTAL	Total expenses without WP1 & WP2 funding	€ 117,300	€ 129,200	€ 129,200	€ 129,200	€ 129,200
	Total expenses with WP1 &	€ 0	€ 0	€ 122,740	€ 116,603	€ 110,773

	WP2 funding					
	Total revenues without WP2 funding	€ 0	€ 8,750	€ 120,000	€ 202,500	€ 285,000
	Total revenues with WP2 funding	€ 0	€ 8,750	€ 128,160	€ 229,352	€ 340,281
	Balance without WP1 & WP2 funding	**-€ 117,300**	**-€ 120,450**	**-€ 9,200**	**€ 73,300**	**€ 155,800**
	Balance with WP1 & WP2 funding	**€ 0**	**€ 8,750**	**€ 5,420**	**€ 112,749**	**€ 229,509**

1. First step - From Year X to Year X+1 : EMR EEIG's network (= captive market)
   - Milk Recording Organizations involved in EMR EEIG network have developed new tools based on phenotypes predicted from FT-MIR analysis of milk samples from cows of their farmers (= OptiMIR tools). These tools related to milk composition, risk of ketosis and acidosis, methane emissions, etc. can work only with spectra standardized by the EMR service. For 2016, this captive market represents 27 laboratories and 69 analyzers.
   - In parallel, EMR will incorporate a new member. The plan is to incorporate 7 machines from Austria in EMR membership according to previous preliminary contacts. This will bring the network from 69 to 76 machines.

2. Second step – From Year X+1
   EMR will disseminate the standardisation service (through OptiMIR tools, or not) in others countries as a commercial service. The plan is to include some 30 additional analyzers joining the standardization network: contact have started with Switzerland, Poland and Netherlands. We can expect 5 machines from Switzerland, plus 2 (1 for Poland and 1 for Netherlands) for Year X+1, and then a complete involvement from Year X+2, meaning 30 analyzers (5+10+15).

3. Third step 2018: **ICAR service and International Dairy Federation** to increase the network
   The goal of ICAR is to promote the development and the improvement of the activities of performance recording (especially milk recording and milk analysis) and the evaluation of farm livestock. ICAR has a worldwide membership network in 57 different countries (all countries where milk production is important). ICAR service will promote the standardization service to increase the network of users. **International Dairy Federation** (IDF) is a non-profit private sector organization representing the interests of various stakeholders in dairying at the international level. IDF Methods Standard Steering Group works in parallel with ISO TC/34/SC 5 Milk and Milk Products. IDF is working on the spectrum standardization with the aim to produce publication and revise the nowadays ISO/IDF guidelines if it is necessary. ISO/IDF guidelines and standards are respected worldwide by the laboratories working for milk industry.

   IDF and ICAR will promote the standardization service to the laboratories around the world. If we consider a total of 440 potential analysers (240 + 200 as described above), we can expect that **15% of new analyzers will join the network each year (=66), from 2018 to 2020.**

- Describe the expected impact of your innovation/solution in terms of scientific, technological or other (for instance social or environmental) progress.

The main impact of the innovation is the global harmonisation of all MIR instruments participating to the process. Without this harmonisation all the different instruments are producing a specific spectral response which make difficult any common use of spectral data. The standardisation will leads to many potential collaborations between laboratories/research teams/industrial partners/international organisations. Exchange of data will be possible to collate common databases; and common tools based on FT-MIR prediction equations could be build and used by all organisations. This should permit economies of scales as specific prediction equation will not be created in each area but data could be combined in order to develop global and shared prediction equations. A side effect is also the strengthening of the robustness of the prediction equation as combining more variability from data of several areas.

Then the standardisation process is above all a quality insurance system for labs using FT-MIR prediction equations to provide predicted values and phenotypes to farmers and industry whereas there is currently no such existing quality insurance systems for FT-MIR prediction equation that cannot be corrected by slope and bias calibration. Bringing all MIR instruments into a common format and using models developed in this format will improve accuracy of predicted values. Another objective of the innovation is to improve stability in time of the predictions by using a daily check system. Globally it should bring better quality to the data provided from FT-MIR analysis of milk.

Finally, it is should strengthen the network of labs using FT-MIR calibrations and encourage exchanges of knowledge and global collaboration.

- Elaborate on economic relevance of your solution, in particular with respect to growth of the industry partner(s) in the consortium (turnover, market share, employment creation, longer-term sales expectations, return on investment and profit). In addition, describe the expected economic return on investment of your action for the economy at large, with particular attention for the possible creation of growth and jobs, and possible changes in the main sector of economic activity of the industry partners of the consortium.

  An engineer will be appointed at CRA-W to conduct R&D steps of WP3 (process optimization) and WP6 (continuous improvement). The project will contribute to this employment creation by funding the engineer during 3 years. Then EMR EEIG will have the financial ability to maintain the job out of their own resources.

- In the context of the action, elaborate on your capital investment policy for the next three years of operation and indicate the estimated funding requirements to reach go-to-market, making reference to the parties that will/should be involved. Envisaged financial mix: percentage or relevance of own funds, FTI funding, other external funding (loans, venture capital…)…

- Describe any barriers/obstacles, and any framework conditions (such as regulation and standards), that may determine whether and to what extent the expected impacts will be achieved, especially in relation to market acceptance and wide take-up. (This should not include any risk factors concerning implementation, as covered in section 3.2.)

The first barrier to the dissemination of the innovation is the fact that development of FT-MIR prediction equations for new phenotypes and the use of these tools are relatively recent. For the moment, only a part of the labs using FT-MIR technology is able to extract spectra from the instruments and to work with. However, the interest on these technology as well as the use and the scientific researches on this field are increasing exponentially.

The second barrier is linked to the need of analyzing a common milk on all instruments to perform the standardization. A common set of raw milk need to be send to each lab and this can be an issue in some countries where the custom regulation is really strict in order to avoid the spreading of new diseases (e.g. Australia).

2.2 Measures to maximise impact

a) Dissemination and exploitation of results

- Provide a draft 'plan for the dissemination and exploitation of the action's results'. Describe a credible path to deliver the innovations to the market. The plan, which should be proportionate to the scale of the action, should contain measures to be implemented both during and after the action.

  ⚠ *Dissemination and exploitation measures should address the full range of potential users and uses including research, commercial, investment, social, environmental, policy making, setting standards, skills and educational training.*
  ⚠ *The approach to innovation should be as comprehensive as possible, and must be tailored to the specific technical, market and organisational issues to be addressed.*

- Explain which stakeholders that should be involved in the last stretch towards a successful commercial exploitation of your innovation, in addition to those already present in the consortium and/or in the validation process of the proposed innovation/solution.
- Explain how your action will benefit the competitiveness and the innovation capacity of the individual partners of the consortium; make a link, where possible, to the corporate strategies of the industry partners in the consortium. Describe briefly the final steps needed to be taken before the innovation is ready to be taken to the market and give an indication on expected time to market/deployment.
- Elaborate on how you intend to position yourself in the market over time; in other words, explain your further commercial strategy, and planned implementation, via partners in the consortium, or through cooperation with third parties. Provide a timeline detailing planned marketing & sales efforts (including in terms of distribution).
- On the basis of your expected result, elaborate on the possible further development strategy for your innovation, bound to ensure your future competitiveness.
- Add any other factors of relevance related to dissemination and exploitation of results that could increase impact and explain how.

WP2 is to fund the original EMR EEIG network during the 2 first years of the project to avoid losing instruments which would increase the cost per instrument, and create a snowball effect which would

jeopardize the existence of the prototype network. The 2 first year are critical for EMR EEIG to sustain the standardization for its members (see table above).

Moreover, as soon as a couple of process optimization steps are not achieved by WP3, the delivering of the standardization by EMR will be at risk. The professionalization of the service we want to deliver is needed to enable a smooth commercialization and dissemination. WP3 will also lead to cost reducing at EMR level, the revenues will then increase of 5% per year from Year X+2 to Year X+4.

Finally the WP4 and WP5 will contribute to the increase of clients accessing the service by providing a international exposure to the methodology through the network of milk recording organizations (ICAR) and milk labs and industries (IDF). CRAW will also promote the standardization service to research laboratories to increase the research network. Laboratories from China, Brazil and Denmark have already expressed their interest.

The main commercial argument of the standardisation is that the end users of the service (milk recording organisations, milk industries and labs) get the opportunity to use common and transposable algorithms. The offered standardisation service is a general solution for the utilisation of new FT-MIR prediction equations coming on the market: to predict new molecules in the milk by avoiding multiplication of calibration procedures in the labs, and to predict dairy cows' physiology through animal prediction equations.

Some molecules or animal traits predicted from standardized spectra already exist like e.g. fatty acids, or methane emissions. In order to promote efficiently the standardisation service, EMR EEIG wants to be able to propose the access to a new animal health indicator of high interest.

There is a big opportunity with Lactoferrin. Lactoferrin is an iron-binding glycoprotein present in milk. It is considered as an important host defence molecule (antimicrobial/antiviral activities, immunomodulatory activities, antioxidant activities). It seems to play a key role in the defence mechanisms in the mammary gland of dairy cows. The Lactoferrin concentration was shown to be higher in milk of subclinical and clinical mastitis. Lactoferrin level is much higher in the first colostrum than in the mature milk. Hence it has been suggested that the high Lactoferrin concentration in the initial days of lactation could be necessary for the establishment and selection of the new-born intestinal flora and that Lactoferrin could be also essential in the control of iron absorption during the neonatal period. Bovine Lactoferrin can also be interesting for humans, as a biologically active food component. Finally, bovine Lactoferrin is genetically variable and heritable.

Through a collaboration between EMR EEIG and the University of Liège - Gembloux Agro Bio-Tech (ULg-GxABT) that will be considered as third party, an existing mid-infrared equation for Lactoferrin can be upgraded rather quickly. In fact, the original equation has been developed by ULg-GxABT in 2012 (Animal, 6:1830-1838) by using unstandardized spectra and can be upgraded by providing ULg-GxABT with new reference data and standardized spectra. This will be done in the WP5 and will constitute a focal point and an incentive for subscribing to the standardisation service.

b) Intellectual Property, knowledge protection and regulatory issues

- Industrial Property Rights assets: describe the key knowledge (IPR) items and who owns them; patents (filed and/or granted) or other ways of protection; ownership;
- Describe the measures to ensure the possibility of commercial exploitation;

- Outline the strategy for knowledge management and protection as well as current IP status;
- Explain the regulatory and/or standard requirements to be fulfilled for the exploitation of the technology/product/solution or concept: how they are to be met; (if not already covered in point 2.1)
- **Where relevant** include information on how the participants will manage the research data generated and/or collected during the action, in particular addressing the following issues[1]
    - What types of data will the action generate/collect?
    - What standards will be used?
    - How will this data be exploited and/or shared/made accessible for verification and re-use? If data cannot be made available, explain why.
    - How will this data be curated and preserved?

    ⚠ *You will need an appropriate consortium agreement to manage (amongst other things) the ownership and access to key knowledge (IPR, data etc.). Where relevant, these will allow you, collectively and individually, to pursue market opportunities arising from the action's results.*

    ⚠ The appropriate structure of the consortium to support exploitation is addressed in section 3.3.

- **Where relevant** include measures to provide open access (free on-line access, such as the 'green' or 'gold' model) to peer-reviewed scientific publications which might result from the action[2].

    ⚠ *Open access publishing (also called 'gold' open access) means that an article is immediately provided in open access mode by the scientific publisher. The associated costs are usually shifted away from readers, and instead (for example) to the university or research institute to which the researcher is affiliated, or to the funding agency supporting the research.*

    ⚠ *Self-archiving (also called 'green' open access) means that the published article or the final peer-reviewed manuscript is archived by the researcher - or a representative - in an online repository before, after or alongside its publication. Access to this article is often - but not necessarily - delayed ('embargo period'), as some scientific publishers may wish to recoup their investment by selling subscriptions and charging pay-per-download/view fees during an exclusivity period.*

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1 For further guidance on research data management, please refer to the H2020 Online Manual on the Participant Portal.

2 Open access must be granted to all scientific publications resulting from Horizon 2020 actions. Further guidance on open access is available in the H2020 Online Manual on the Participant Portal.

c) Communication

The WP5 includes the communication action that will be conducted during the project – and after – to ensure the smooth dissemination of the standardization service across the market.

- Describe the proposed communication measures for promoting the action and its findings during the period of the grant. Measures should be proportionate to the scale of the action, with clear objectives. They should be tailored to the needs of various audiences, including groups beyond the action's own community. Where relevant, include measures for public/societal engagement on issues related to the action.

3. Implementation

3.1 Work plan — Work packages, deliverables and milestones

Please provide the following:

- brief presentation of the overall structure of the work plan;
- timing of the different work packages and their components (Gantt chart or similar);
- detailed work description, i.e.:
  - a description of each work package (table 3.1a);
  - a list of work packages (table 3.1b);
  - a list of major deliverables (table 3.1c);
- graphical presentation of the components showing how they inter-relate (Pert chart or similar).

⚠ *Give full details. Base your account on the logical structure of the action and the stages in which it is to be carried out. Include details of the resources to be allocated to each work package. The number of work packages should be proportionate to the scale and complexity of the action.*

⚠ *You should give enough detail in each work package to justify the proposed resources to be allocated and also quantified information so that progress can be monitored, including by the Commission.*

⚠ *You are advised to include a distinct work package on 'management' (see section 3.2) and to give due visibility in the work plan to 'dissemination and exploitation' and 'communication activities', either with distinct tasks or distinct work packages.*

⚠ *You will be required to include an updated (or confirmed) 'plan for the dissemination and exploitation of results' in both the periodic and final reports. (This does not apply to topics where a draft plan was not required.) This should include a record of activities related to dissemination and exploitation that have been undertaken and those still planned. A report of completed and planned communication activities will also be required.*

⚠ *If your action is taking part in the Pilot on Open Research Data[3], you must include a 'data management plan' as a distinct deliverable within the first 6 months of the action. A template for such a plan is given in the guidelines on data management in the H2020 Online Manual.*

[3] Certain actions under Horizon 2020 participate in the 'Pilot on Open Research Data in Horizon 2020'. All other actions can participate on a voluntary basis to this pilot. Further guidance is available in the H2020 Online Manual on the Participant Portal.

This deliverable will evolve during the lifetime of the action in order to present the status of the action's reflections on data management.

Definitions:

'Work package' means a major sub-division of the proposed action.

'Deliverable' means a distinct output of the action, meaningful in terms of the action's overall objectives and constituted by a report, a document, a technical diagram, a software etc.

'Milestones' means control points in the action that help to chart progress. Milestones may correspond to the completion of a key deliverable, allowing the next phase of the work to begin. They may also be needed at intermediary points so that, if problems have arisen, corrective measures can be taken. A milestone may be a critical decision point in the action where, for example, the consortium must decide which of several technologies to adopt for further development.

The work plan will achieve the further development, the dissemination and the market-launch of a standardisation service for FT-MIR spectrometers. The standardisation process of FT-MIR spectrometers has been developed, tested and implemented as a prototype in a network of 69 FT-MIR spectrometers in 27 milk laboratories across North West Europe throughout the OptiMIR project (INTERREG VB) and then through EMR EEIG. The methodology and technology built within OptiMIR has been validated and demonstrated in relevant environment (TRL6).

The proposed programme of work is organized into 6 work packages (**WP**) including a project management WP (WP1). WP1 ensures efficient scientific and administrative management, and effective internal and external cooperation for the partnership. Five actions will be covered by WP2 to 6: the strengthening of the existing network of standardisation (WP2), the optimization of the standardisation process (WP3), the accreditation of the process (WP4), the market launch and the promotion of the service (WP5) and the continuous improvement of the process (WP6). Figure 1 indicates dependencies between WP and work flow from WP1 through to WP6.

The first step (WP2) to achieve the market launch of the standardisation service is to strengthen the existing prototype of standardisation network of EMR. This WP aims to (1) maintain and support the current standardisation prototype, launching ramp for the standardisation service we want to disseminate, and (2) provide the necessary materials and outputs to further develop and optimize the standardisation process in WP3. WP3 is concomitant with WP2 and achieves the optimisation of the process to reduce the costs and facilitate the commercialisation of the process. New optimised processes will be developed by CRA-W and then tested and validated by IfM. EMR will be in charge of the IT developments. WP4 relates to the standardisation process that will be done through the active participation to ISO/IDF and ICAR working groups who deals with international standards for labs and milk recording. ICAR and Service ICAR will develop a certification scheme to follow in the final certification of the product.

WP5 includes the actions related to the exploitation, the dissemination and the promotion of the standardisation service. In collaboration with EMR, Service-ICAR SRL will organise technical and scientific meetings, describe and present the opportunities in related to the standardisation process and disseminate the standardisation service through ICAR and ISO/IDF network. The new standardisation service will be advertised to all potential customers including milk recording organisations, breeders' associations, milk laboratories and milk industry stakeholders. WP4 and WP5 are undertaken after one year of project when the standardisation service has reached a certain level of maturity. Finally, over the whole duration of the project, WP6 completes the continuous improvement of the process and the service through the review of feedbacks from current users of

the standardisation prototype and from new clients of the service. WP6 will feed WP2 for the further optimisation of the standardisation process and service. Figure 2 shows the timeline associated with the achievement of each WP.

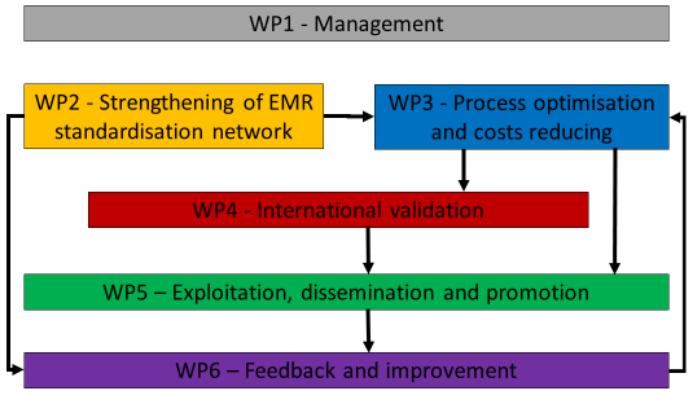

Figure 1 - PERT Chart indicating dependencies and work flow among WP1 to 6

		Year 1				Year 2				Year 3			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5	Quarter 6	Quarter 7	Quarter 8	Quarter 9	Quarter 10	Quarter 11	Quarter 12
WP1	Management												
WP2	Strengthening of EMR standardisation network												
WP3	Process optimisation and costs reducing												
WP4	International validation												
WP5	Exploitation, dissemination and promotion												
WP6	Feedback and improvement												

Figure 2 - Gantt chart indicating the timelines associated with each WP

Table 3.1a: Work package description

Work package number	WP1	**Start Date or Starting Event**		M1
Work package title	**Management**			
Participant number	1	2	3	4
Short name of participant	EMR EEIG (WP leader)	IfM	Service-ICAR	CRA-W
Person/months per participant:	XX	XX	XX	XX

Objectives
WP1 ensures efficient coordination and administrative management as well as effective internal and external cooperation for the partnership.

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

Project management includes overall coordination of the project team in terms of internal communication and realisation of the work plan (Task 1.1), financial management (Task 1.2) and reporting (Task 1.3). Overall project management will be performed in EMR by the project manager. Also, a project management board including representatives from the 4 partners will be established.

Task 1.1. Coordinating work flow (Leader: EMR; Participants: all)
EMR will be responsible for the overall implementation and maintenance of the proposed work plan. The specific work plan within each of the 6 WP will be coordinated and overseen by the respective WP leader. EMR will ensure that all project activities comply with the consortium agreement and the project technical annex. Efficient communication processes will be facilitated among the partners. Conference calls and meetings will be organised regularly. The project management board will meet every 6 months for reporting and coordination. EMR will be in charge of preparing, organising and implementing meeting.

Task 1.2. Financial management (Leader: EMR; Participants: all)
EMR will be in charge of all financial issues; with all partners solely responsible for providing their own financial reports to EMR in a timely manner. EMR will oversee and verify the proper deployment of resources (staff, equipment, etc.). The project manager in EMR will advise and assist all partners on financial issues.

Task 1.3. Reporting (Leader: EMR; Participants: all)
EMR will oversee the achievement of the deliverables and the milestones according to defined deadlines in order to ensure that the major objectives of the project are met. EMR will compile partners' inputs into final reports.

Deliverables (brief description and month of delivery)

- Consortium agreement signed (M1)
- Mid-term report, including risk assessment report (M18)
- 7 management board meetings including the kick-off meeting (M1) and the final meeting (M36) as well as intermediate meeting (M6, M12, M18, M24, M30) – agenda/minutes available
- Final report (M36)

Work package number	WP2	Start Date or Starting Event		M1
Work package title	**Strengthening of EMR standardisation network**			
Participant number	4	1		
Short name of participant	CRA-W (WP leader)	EMR EEIG		
Person/months per participant:	XX	XX		

Objectives

WP2 strengthens the existing prototype for standardisation of FT-MIR spectrometers. The prototype, currently deployed throughout the EMR network, will be maintain and support through the monthly standardisation of FT-MIR spectrometers and the realisation of daily check analysis for the whole network. WP2 will provide necessary materials and outputs for WP3.

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

The existing prototype for standardisation of FT-MIR spectrometers is the launching ramp for the standardisation service. Currently, the EMR network for standardisation comprised 69 FT-MIR spectrometers in 27 milk laboratories. Maintaining and supporting this prototype is vital for the achievement of the project. Since the end of the OptiMIR project (September 2015), the maintenance of the standardisation prototype has been financially supported by EMR members. However, the overall cost is rather high because some process optimisations have still to be realised and the number of instruments in the network is still limited. Therefore, the risk of losing labs in the network due to the current high cost of standardisation could jeopardize the existence of the prototype network. WP1 aims to maintain and support the current standardisation prototype until the cost of standardisation is reduced thanks to the optimisation of the process (WP2) and to the inclusion of new FT-MIR spectrometers in the network (WP5). Currently, the prototype service is managed by EMR EEIG for the administrative and operational aspects while CRA-W is the technical and scientific operator.

Task 2.1. Monthly realisation of standardisation in EMR network (Leader: EMR EEIG; Participants: CRA-W, IfM)

CRA-W will be in charge of organising every month the routine standardisation of the FT-MIR spectrometers in the EMR network including IfM. The protocol implies monthly ring tests and is organised as following:

(1) The first step consists into the monthly creation of the ring test milk samples (milk samples with known concentrations in fat and proteins) at CRA-W. Then the ring test milk samples are sent by CRA-W to every milk lab of the network for analysis. They have to be transported by refrigerated freight. A set a 5 samples is needed by instrument. The spectral responses of these milk samples obtained for each FT-MIR spectrometers are sent back to CRA-W.

Then. The lab that has 4 MIR spectrometers has thus to receive 4 sets comprised with 5 raw milk samples every month. All the 65 instruments participate to the ring tests, one set of sample has to be analysed by apparatus. Following the analysis the corresponding 5 spectra are generated, extracted from the instrument and have to be sent to the reference lab (CRA-W). When all spectra from all machines are

received by CRA-W, a virtual Master is generated. It is an average of the most stable machines in the network enabling to bring stability to the reference of the network. Then CRA-W can create mathematical coefficients which enables to match all the 69 apparatus of the 27 labs into the Master format. These coefficients are transferred to each concerned instruments in order to standardize locally the spectra. It was observed that FT-MIR instruments suffer from perturbations (maintenance operation, physical use…) that lead to instability in time of predictions, then the standardisation is done every month to cope with this issue. The Master is re-generated every month after every ring-tests. The standardisation module which enables the correction and where standardisation coefficients are applied is already implemented in the different lab or datacentres of the EMR EEIG network. The global output of this task is enabling the comparisons, building and use of transposable algorithms across the network.

Task 2.2. Daily check analysis

An objective of the WP2 is to optimize the daily check tool, enabling the monitoring of the stability in time of the instruments and a potential correction of the spectra following the perturbations. Currently a prototype of tool is existing and available for labs. The goal of this task is the supplying of daily check data coming from daily analysis of the daily check milk from all the instruments of the network, in order to provide research material for the WP2.2. Moreover this will allow to maintain the current existing prototype of the daily check tool.

Task 2.3. Providing data for optimization

Development is still ongoing in the frame of the WP2 to automate the transfer and calculation and in order to optimize the method, especially regarding stability in time. In order to do this data are needed from real ring test and daily check analysis. The goal of this task will be to provide data from all the instruments of the network to the WP2.

Deliverables (brief description and month of delivery)

The EMR EEIG network is maintained and strengthen to enable R&D finalization, process optimization and costs reducing.

1. Network of 65 MIR instruments maintained during 2 years (EMR & CRA-W)
2. Standardization coefficients produced monthly during 2 years (CRA-W)
3. Merging of data from different spectrometers possible (CRA-W)Transfer of calibration possible between instruments (CRA-W)
4. Daily check milk analyzed daily on each instrument (EMR)
5. Ring test data provided for WP2 researches (EMR & CRA-W)
6. Daily check data provided for WP2 researches (EMR)

Work package number	WP3	Start Date or Starting Event		01/07/2016
Work package title	Process optimizations of the standardisation service			
Participant number	4	1	2	
Short name of participant	CRA-W	EMR EEIG	IfM	
Person/months per participant:				

Objectives
To optimize the different processes of the standardisation service, to professionalize its different steps and to reduce its overall costs.

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

WP3 is concomitant with WP2 and achieves the optimisation of the process to reduce the costs and facilitate the commercialisation of the process. New optimised processes will be developed by CRA-W and tested and validated by IfM. EMR will be in charge of the IT developments. Different areas of actions are planned.

- A web-service to automate the flows of all type of data between CRA-W and labs.
- A quality assurance system which includes monitoring and stabilization of machines between 2 ring-tests.
- Tests on type of samples and frequency to reduce costs of ring-tests.

In this work package, the following actions will be undertaken to optimize and automate the current standardization processes in order to reduce the costs and facilitate the transposition of the prototype in an operational and sustainable environment :

1. Development and roll-out of a web-service

Each partner will connect to the web-service with a login and a password. The web-service will be protected by HTTPS. A batch software will be created in addition to web service platform. A database will be associated. IfM is the pilot lab that will test, criticize and validate the implementation of new procedures, protocols, applications, etc.

1.1. Flow of data

With the aim to optimize processes, lead times and costs, a web service will be created to automate the flow of data in link with different steps of the standardization, and permit direct exchanges between EMR members and customers, and the CRA-W. Therefore the process will be faster to produce correction coefficients to be applied in the labs. The new coefficients will be posted on SFTP accounts partners according to the rhythm of the transmission of monthly ring test spectra.

1.2. Automation of the creation of master apparatus

Through every monthly ring-tests, each instrument is mathematically corrected to match the format of a reference instrument, “the master”, which is a combination of several stable instruments. The calculation of the Master is done when all ring-tests samples have been analysed by the labs and sent to CRA-W. In fact today MatLab procedures are performed at CRA-W by an engineer. The web-service will then enables the automation of the creation of the Master based on the ring-tests samples sent through the web-service.

1.3. Automation of the calculation of coefficients for slave apparatus

Today the standardization coefficients to correct every slave apparatus according to the Master are also generated through MatLab procedures which are performed at CRA-W by an engineer, for each instrument, wavenumber by wavenumber. The web-service will then enables the automation of the creation of these coefficients.

1.4. Monitoring of the stability of apparatus between 2 ring-tests by using daily check sample

The standardization is performed with a monthly frequency. However the FT-MIR instruments are known to suffer from deviation in time due to physical use and from perturbation due to maintenance operation, piece replacement. These perturbations can strongly impact the spectra and can lead to bias in the final prediction. The daily check is a complementary step that allows monitoring daily the stability of instruments, to detect if perturbations occur between 2 ring tests.

The daily check is a tool based on the daily analysis of an UHT milk from a common batch during a period of 3 month. It will be possible to daily update the spectra on the web service in order to follow instantaneously the stability of the instrument. The perturbations will be detected by the deviation in time of the result obtained from a fat equation model applied on raw spectra. Deviation in fat content reflects deviation of raw spectra. For each daily check spectra uploaded on the web service a picture will be generated and send by mail to the lab allowing the monitoring of the instrument.

1.5. Correction of apparatus' deviations between 2 ring-tests by using daily check sample

When the possibility to assess the stability of instruments between two ring tests is establish, the next step is to allow a direct and online correction of the spectra. Without this direct correction and if perturbations occurs predictions are biased until the next ring test. The daily check sample will be utilized both for detection and correction of the stability of the apparatus.

2. Quality Assurance

The project will establish a complete Quality Assurance system:

- To ensure that a spectrum can be used for standardisation.
- To ensure that an apparatus did not deviate between 2 ring-test (see above – stability via daily check)

3. Ring-tests

There are 2 ways of optimization: frequency of ring-tests which are currently done every month, and the type of ring-test samples. For the moment the samples are constituted of raw milk conserved at 4°C. These samples are not stable in time and they have to be analyzed quickly and constituted every month, which lead to a different set of samples every month. The objective is to find a way of conserving samples in time in order to be able using them on a period of several months. The conservation of samples should be compatible with the physical properties needed for the standardization process (homogeneity of samples, conservation of fat globules structure…). This should bring more stability in time to the instruments as a unique sample set is used and transport cost will be reduced as a common set of samples will be sent once for several month.

Also and according to the efficacy of the correction of apparatus' deviations between 2 ring-tests by using daily check sample, it would be possible to reduce the frequency of the ring-tests.

Deliverables (brief description and month of delivery)

1. Secured web-service
2. Data flow and transfer automated (EMR & CRA-W)

3. Master computed semi-automatically (EMR & CRA-W)
4. Standardization coefficients computed automatically (EMR & CRA-W)
5. Feed-back report automatically provided to the end-users (EMR & CRA-W)
6. Quality Assurance system: guidelines and practice code. Monitoring of daily stability available through the web service (EMR & CRA-W)
7. Correction of perturbations available through the web service (EMR & CRA-W)
8. Possibility to use “long term” samples for ring test evaluated (CRA-W)
9. Possibility to reduce number of ring test evaluated (CRA-W)

Work package number	WP4	Start Date or Starting Event					
Work package title	Standardization through international committees and product certification						
Participant number	3	4	1				
Short name of participant	Service-ICAR	CRA-W	EMR EEIG				
Person/months per participant:							

Objectives
International certifications and quality label of the methodology and the process of the standardisation service for MIR spectrometers in milk labs

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

Milk Recording Organizations (MROs) have to be certified by ICAR for the quality assurance of their animal data. However, this kind of certification is still to be defined for phenotypes derived from milk analysis and thus from FT-MIR spectra. EMR model is the most advanced candidate to tackle this international problem of standards on this field. And that's the reason why Service-ICAR is interested to be part of the project to certify EMR standardisation and disseminate the technology as a new standard to produce animal data from milk analysis and FT-MIR technology.

ICAR's roles is to harmonize milk recording methods, calculation procedures and formulation of results. Through the work of Sub-Committees, Working Groups and Task Forces, ICAR is the only truly independent organization to deliver certifications and standardized practical guidelines for the development of the animal recording, production and breeding sector at a global level.

To follow the standardization process in the ISO/IDF/ To participate in the ISO/IDF working group and Standing Committees for IR new parametersk item to revise the nowadays guidelines

To develop an ICAR conformity assessment scheme (certification) for this new service

To allocate resources to:

- develop guidelines/procedures necessary to follow the certification scheme
- develop in the Milk Analyses Sub Committees the design and organize the certification scheme
- document of the certification scheme
- describe the purposes, requirements of the certification analyse and to established the requirements
- describe the methods for determining the fulfilment of the requirements

Service –ICAR will consider the requirements obtained in the certification process:

- to contract outsourcing for the technical aspect
- to produce the certification documentation

Deliverables (brief description and month of delivery)

1. **To follow the standardization process in the ISO/IDF**
2. Participation in the ISO/IDf working group and Standing Committees
3. **To develop a conformity assessment scheme for this new product (algorithm)**
4. To certification scheme
5. To develop, in the ICAR MA Sub Committees the design and organize the certification scheme
6. To document the validation of the certification scheme
7. To contract outsourcing for the technical aspects

Work package number	WP5	Start Date or Starting Event					
Work package title	Exploitation, dissemination and promotion						
Participant number	1	3	4				
Short name of participant	EMR EEIG	Service-ICAR	CRA-W				
Person/months per participant:							

Objectives

Commercialisation and dissemination of the standardisation service for FT-MIR spectrometers in milk labs to enable valid comparisons and utilisations of same prediction equations everywhere

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

The EMR network will be opened to external companies that are not members of the EEIG. As a first step the already interested companies will be contacted and informed of the market launch of the service. In our planned framework EMR EEIG will be the provider of the standardisation service to both its members and to external customers. EMR will thus manage the administrative part, the relationship with clients, and the IT part (database, web-service, web-applications, etc.). CRA-W is the technical operator of the standardisation and will especially ensure the ring-tests between all participants. Service-ICAR SRL will organise technical and scientific meetings, describe and present the results of the measurement of animal production and disseminate the standardisation service through ICAR and ISO/IDF network.

A communication plan will be set up and will underline new possibilities that the standardisation service of MIR spectrometers in milk lab brings:

- Possibility to create common database with spectral data from different sources.
- Possibility to develop transposable prediction equations able to be applied on every machines of the network. Example: A lab develops an equation to predict some key elements in link with the fertility of cows. If the equation is built by using non-standardized spectra then it is accurate only on the machine utilized for its building, and as long as there are no disturbances. If the algorithm is built by using standardized spectra then it is accurate on all the machines of the standardisation network, and it can be thus shared or sold within the network.
- Possibility to obtain the right predictions from a transposable algorithm on every machine of the network whatever the brand or model of spectrometers. A non-standardized spectra inputted into an algorithm built with standardized spectra lead to wrong predicted values, and wrong indicators.
- Following WP3 results, possibility to obtain stable prediction over time for every models on all instruments
- Possibility to replace several quality assurance protocols for MIR spectrometers built for several milk components by the Quality Assurance protocol built directly for the MIR spectra

Service-ICAR will open the door of the worldwide ICAR network and promote our standardisation service organizing conference, workshops and on site visits of Dairy Herd Improvement Laboratories facilitating the dissemination of this project. In fact, ICAR is composed of 117 Members from 59 countries. Its Members are involved in different areas of the animal production sector ranging from breed associations to herd management organizations, milk and genetic laboratories, industry service providers, public research centers and competent authorities. ICAR is a platform for sharing information and best practices between members. ICAR shares and learns from each others' experiences exchanging ideas and technologies. Through the ICAR International Annual Conferences and ICAR Guideline updates, ICAR disseminates best practices in the field of animal identification, recording systems, data analysis and genetic evaluation.

Scientific publication by CRAW

The main commercial argument of the standardisation is that the end users of the service (milk recording organisations, milk industries and labs) get the opportunity to use common and transposable algorithms. Some molecules or animal traits predicted from standardized spectra already exist like e.g. fatty acids, or methane emissions. In order to promote efficiently the standardisation service, EMR EEIG wants to be able to propose the access to a new animal health indicator of high interest. There is a big opportunity with Lactoferrin (see description in 2.2 - Measures to maximise impact). Through a collaboration between EMR EEIG and the University of Liège - Gembloux Agro Bio-Tech (ULg-GxABT) that will be considered as third party, an existing mid-infrared equation for Lactoferrin can be upgraded rather quickly. In fact, the original equation has been developed by ULg-GxABT in 2012 (Animal, 6:1830-1838) by using unstandardized spectra and can be upgraded by providing ULg-GxABT with new reference data and standardized spectra. This will constitute a focal point and an incentive for subscribing to the standardisation service.

Scientific Publication by IDF and ICAR

IDF and ICAR will publish bulletins and guidelines to support the application of the spectrum standardization with the new parameter in milk analyses

Deliverables (brief description and month of delivery)

- Milk labs, Milk Recording Organizations, Universities or Research Centers joining the standardization network as customers
- Milk labs, Milk Recording Organizations, Universities or Research Centers joining the standardization network as partners through a win-win collaboration
- Scientific meeting and special working sessions in international symposiums
- Communication plan and materials
- Communication through scientific and vulgarization meeting

Work package number	WP6	Start Date or Starting Event					
Work package title	Feedback and improvement						
Participant number	2	1	4				
Short name of participant	IfM	EMR EEIG	CRA-W				
Person/months per participant:							

Objectives
To collect feedback from end users for further improvement of the processes, including Quality Assurance system and information reports.

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

IfM collates remarks and suggestions and forwards them to CRA-W for action. CRA-W reviews all feedbacks and in consultation with IfM and EMR EEIG agrees a set of modifications required to achieve high levels of end user satisfaction. The main activity is in assimilating responses regarding the service from the pilot lab and consolidating them into a set of specifications for enhancements and a record of achievements.

1. Feedback from IfM to CRA-W on tests for Optimization

Within the frame of WP2, several aspects of the current process need to be optimized. This should lead to tests and experiments at research level, but also at real lab level. Therefore the objective of this task is to perform the tests at IfM level for field validation of results obtained at research and development level. These tests should focus on monitoring of stability, stabilization tool and ring test optimization. Feed-back on the results will be transferred to CRA-W for continuous improvement of the process (WP2) in an iterative way.

2. Feed-back to the end-users

Currently when the standardizations are done and prototype of daily check is used there is only a limited feed-back to the end-users. The goal of this task is to provide a detailed and useful feedback to the labs in the form of a monthly report automatically generated following the standardization and a daily feed-back after daily check analysis

2.1. Following test tests done in task 6.2 and regarding the inherent requirement of the labs about routine methodologies and organization, IfM will be able to provide feed-back for the best solutions to implements the tools within the end-users organizations. This will concern the way of the tools are implemented, their form and their content in order to be as user friendly as possible and to be sure they are perfectly compatible with labs organization

2.2. Following the feed-back and information provided by IfM, the web service will be adapted to achieve high level of satisfaction for end-users, providing a complete and useful monthly report following standardization and a synthetic and relevant information following daily check analysis.

3. Additionally to IfM feed-back and improvement, annual meetings will be organized with all labs participating to the standardization in order to insure a good communication and understanding with them, especially to comprehend the needs they have regarding information/feed-back provided by the web service and to evaluate what can be integrated into the reports.

Deliverables (brief description and month of delivery)

1. Test for WP2 realized on field (IfM & CRA-W)

2. Continuous feedback on stability monitoring tool provided to WP2 (IfM)
3. Continuous feedback stabilization tool provided to WP2 (IfM)
4. Continuous feedback ring test provided to WP2 (IfM)
5. Meeting with labs of the network organized annually (IfM)
6. Feed back after ring test and daily check to the end-users (CRA-W & EMR)

Table 3.1b: List of work packages

Work package No	Work Package Title	Lead Participant No	Lead Participant Short Name	Person-Months	Start Month	End month
1	Strengthening of EMR standardisation network	1	EMR EEIG			
2	Process optimizations and costs reducing	4	CRA-W			
3	International validation	3	SERVICE - ICAR			
4	Commercialisation and dissemination	1	EMR EEIG			
5	Communication and promotion	1	EMR EEIG			
6	Feedback and improvement	2	IfM			
				Total months		

Table 3.1c: List of Deliverables[4]

Deliverable (number)	Deliverable name	Work package number	Short name of lead participant	Type	Dissemination level	Delivery date

KEY

Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number>.<number of deliverable within that WP>.

For example, deliverable 4.2 would be the second deliverable from work package 4.

Type:

Use one of the following codes:

R: Document, report (excluding the periodic and final reports)

DEM: Demonstrator, pilot, prototype, plan designs

[4] If your action taking part in the Pilot on Open Research Data, you must include a data management plan as a distinct deliverable within the first 6 months of the action. This deliverable will evolve during the lifetime of the action in order to present the status of the action's reflections on data management. A template for such a plan is available on the Participant Portal (Guide on Data Management).

DEC: Websites, patents filing, press & media actions, videos, etc.
OTHER: Software, technical diagram, etc.

Dissemination level:
Use one of the following codes:
PU = Public, fully open, e.g. web
CO = Confidential, restricted under conditions set out in Model Grant Agreement
CI = Classified, information as referred to in Commission Decision 2001/844/EC.

Delivery date
Measured in months from the action start date (month 1)

3.2 Management structure and procedures

- Describe the organisational structure and the decision-making (including a list of milestones (table 3.2a))
- Explain why the organisational structure and decision-making mechanisms are appropriate to the complexity and scale of the action.
- Describe, where relevant, how effective innovation management will be addressed in the management structure and work plan.
  ⚠ *Innovation management is a process which requires an understanding of both market and technical problems, with a goal of successfully implementing appropriate creative ideas. A new or improved product, service or process is its typical output. It also allows a consortium to respond to an external or internal opportunity.*
- Describe any critical risks, relating to action implementation, that the stated action's objectives may not be achieved. Detail any risk mitigation measures. Please provide a table with critical risks identified and mitigating actions (table 3.2b)

Table 3.2a: List of milestones

Milestone number	Milestone name	Related work package(s)	Estimated date	Means of verification

KEY
Estimated date
Measured in months from the action start date (month 1)

Means of verification
Show how you will confirm that the milestone has been attained. Refer to indicators if appropriate. For example: a laboratory prototype that is 'up and running'; software released and validated by a user group; field survey complete and data quality validated.

Table 3.2b: Critical risks for implementation

Description of risk	Work package(s) involved	Proposed risk-mitigation measures

3.3 Consortium as a whole

⚠ *The individual members of the consortium are described in a separate section 4. There is no need to repeat that information here.*

- Describe the consortium. How will it match the action's objectives? How do the members complement one another (and cover the value chain, where appropriate)? In what way does each of them contribute to the action? How will they be able to work effectively together?

3.4 Resources to be committed

⚠ *Please make sure the information in this section matches the costs as stated in the budget table in section 3 of the administrative proposal forms, and the number of person/months, shown in the detailed work package descriptions.*

Please provide the following:

- a table showing number of person/months required (table 3.4a)
- a table showing 'other direct costs' (table 3.4b) for participants where those costs exceed 15% of the personnel costs (according to the budget table in section 3 of the administrative proposal forms)

Table 3.4a: Summary of staff effort

Please indicate the number of person/months over the whole duration of the planned work, for each work package, for each participant. Identify the work-package leader for each WP by showing the relevant person-month figure in bold.

	WPn	WPn+1	WPn+2	Total Person/ Months per Participant
Participant Number/Short Name				
ParticipantNumber/ Short Name				
Participant Number/ Short Name				
Total Person/Months				

Table 3.4b: 'Other direct cost' items (travel, equipment, other goods and services, large research infrastructure)

Please complete the table below for each participant if the sum of the costs for' travel', 'equipment', and 'goods and services' exceeds 15% of the personnel costs for that participant (according to the budget table in section 3 of the proposal administrative forms).

Participant Number/Short Name	Cost (€)	Justification
Travel		

Equipment		
Other goods and services		
Total		

Please complete the table below for all participants that would like to declare costs of large research infrastructure under Article 6.2 of the General Model Agreement[5], irrespective of the percentage of personnel costs. Please indicate (in the justification) if the beneficiary's methodology for declaring the costs for large research infrastructure has already been positively assessed by the Commission.

Participant Number/Short Name	**Cost (€)**	**Justification**
Large research infrastructure		

[5] Large research infrastructure means research infrastructure of a total value of at least EUR 20 million, for a beneficiary. More information and further guidance on the direct costing for the large research infrastructure is available in the H2020 Online Manual on the Participant Portal.