Guide 4: Writing Joint Research Projects (JRPs)

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If you require further help or guidance after reading this document, please contact the helpdesk

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1 Scope

This document explains how to write a Joint Research Project (JRP) proposal for an EMPIR Call. It includes information on how to complete the templates and submit your proposal, and examples to help you write your proposal.

It does not include information on:

- eligibility, this is described in Guide 1: Admissibility and Eligibility for EMPIR Calls
- resourcing and costing a proposal, this is described in Guide 5: Submitting Administrative Data for EMPIR Projects
- evaluating a proposal, this is described in Guide 6: Evaluating EMPIR projects

2 Submission

You should submit your JRP proposal electronically via the Call webpages https://msu.euramet.org/calls.html before the Call deadline. For each complete proposal, the following documents must be combined as a single ZIP file and submitted:

1. Template 4: JRP protocol (required)
2. Template 5: Project Administrative Data (required)
3. Letters of support (optional). These should be collated together as a single unsecured pdf file, which should not exceed 6 MB in size. Please note that letters of support submitted in an unsuitable format will not be provided to the referees by EURAMET.

*** While a letter of support from the Chief Stakeholder for Pre and Co-Normative proposals is not a formal eligibility requirement, their expressed need sets the context for the evaluation of the proposal. Therefore, a letter from the Chief Stakeholder explaining that need, how their organisation will make use of the outcomes from the research, and be consulted regularly by the consortium during the project to ensure that the planned outcomes are still relevant, is very important information for the referees.*

This document includes size limits for some sections of your JRP proposal, the referees will be instructed to ignore any text over these limits.

If you wish to make corrections or amendments, you should resubmit a complete set of documents as a new ZIP file via the online submission system, indicating the original submission reference number.

Proposers should note that no other documents should be submitted, and any that are, will not be passed to the referees by EURAMET.

3 Participants

You can identify and select your project participants in any way you choose, however EURAMET has created an online tool Connections https://msu.euramet.org/ to help potential participants find one another.

If you want to join or form your own consortium, we strongly recommend that you add the details of your capabilities to the Connections website.

JRPs may include four types of project participant

1. Internal Funded Partner(s)
2. External Funded Partner(s)
3. Unfunded Partner(s)
4. And rarely, Linked Third Parties

If you think you will need to include a Linked Third Party, please email msu@npl.co.uk or contact the EURAMET Management Support Unit (MSU) for advice.

The eligibility criteria for each type of participant are described in Guide 1: Admissibility and Eligibility for EMPIR Calls. EURAMET will also make further checks to establish eligibility prior to issuing contracts.

Please note that for Pre and Co-Normative Calls EURAMET encourages proposals that include representatives from industry, regulators and standardisation bodies actively participating in the projects. The proposal must also name a “Chief Stakeholder”, not a member of the consortium, but a representative of the user community that will benefit from the proposed work. The “Chief Stakeholder” should write a letter of support explaining how their organisation will make use of the outcomes from the research, be consulted regularly by the consortium during the project to ensure that the planned outcomes are still relevant, and be prepared to report to EURAMET on the benefits they have gained from the project.

4 Completing the JRP protocol

All sections of Template 4: JRP protocol, are mandatory, unless otherwise stated, and should be completed as detailed in the sections below.

The page limits given for a section MUST be adhered to using Arial font size 10. If the page limits are exceeded (for a section) then referees will be asked to disregard the text/information that is over the page limit. The mandatory page limits are summarised in the table below:

Section or sub-section	Maximum length
B1.a: Summary of the project	3.5 pages
B2.a: Projected early impact on industrial and other user communities	1 page
B2.b: Projected early impact on the metrological and scientific communities	0.5 pages
B2.c: Projected early impact on relevant standards	0.5 pages (excluding the table)
B2.d: Projected wider impact of the project	1.5 pages
B2.e: Data management	1 page
B3.a: Overview of the consortium	1.5 pages for up to 15 partners, 2 pages for up to 20 partners, 2.5 pages for up to 25 partners

4.1 Title page

Please complete and remove the <>, and ensure that the data is consistent with that in Template 5: Project Administrative Data. The JRP number and title must be the same as the SRT number and title. If your proposal is selected for funding it will be issued with a new JRP number and you may revise the title during grant preparation (if required). You should include a proposed short name/acronym for your JRP (a maximum of 13 characters including spaces) and ensure that the proposed short name is consistent between Template 4 and Template 5: Project Administrative Data.

Please do **not** delete the automatic footers from Template 4: JRP protocol.

4.2 Glossary

A Glossary is optional and, if required, should be included before the table of contents.

4.3 Section A: Key data

4.3.1 Section A1: Project data summary and Section A2: Financial summary

In order to help proposers capture the necessary data, reduce duplication of data, and minimise errors, EURAMET have created Template 5: Project Administrative Data (an Excel workbook). The data entered in Template 5 automatically populates a number of worksheets containing tables that you should copy and paste into Section A1 and Section A2 in Template 4: JRP protocol.

Pasting tables from Template 5 into Section A1 and Section A2 in Template 4: JRP protocol		
Template 5 Worksheet	**Template 4: JRP protocol Section A tables**	**Notes**
A	Section A1 Coordinator contact details	Select the right hand column inside the table and copy. Ctrl V or Paste Special as “Formatted Text”. Do not paste as “Picture”

A	Section A1 Chief Stakeholder contact details *** only for Pre and Co-Normative proposals*	For Pre and Co-Normative proposals select the right hand column inside the table and copy. Ctrl V or Paste Special as "Formatted Text". Do not paste as "Picture". For all other proposals the 'Chief Stakeholder' table and heading should be deleted.
B	Section A1 Participant details	Select the area inside the table and copy (excluding the column and row headings). Ctrl V or Paste Special as "Formatted Text". Do not paste as "Picture" Please delete any empty rows in the tables. If your project does not include Linked Third Parties then "table b. Linked Third Parties" should be deleted.
C	Section A2 Financial summary	Select the area inside the table and copy (excluding the column and row headings). Ctrl V or Paste Special as "Formatted Text" those cells that include data. Do not paste as "Picture" or re-paste the column or row headings. If your proposal includes any subcontracting, include one or two sentences under the A2 table explaining what will be subcontracted and why.

4.3.2 Section A3: Work packages summary

The information should be consistent with the work packages in Section C of Template 4: JRP protocol and the "WP months data entry" worksheet in Template 5: Project Administrative Data.

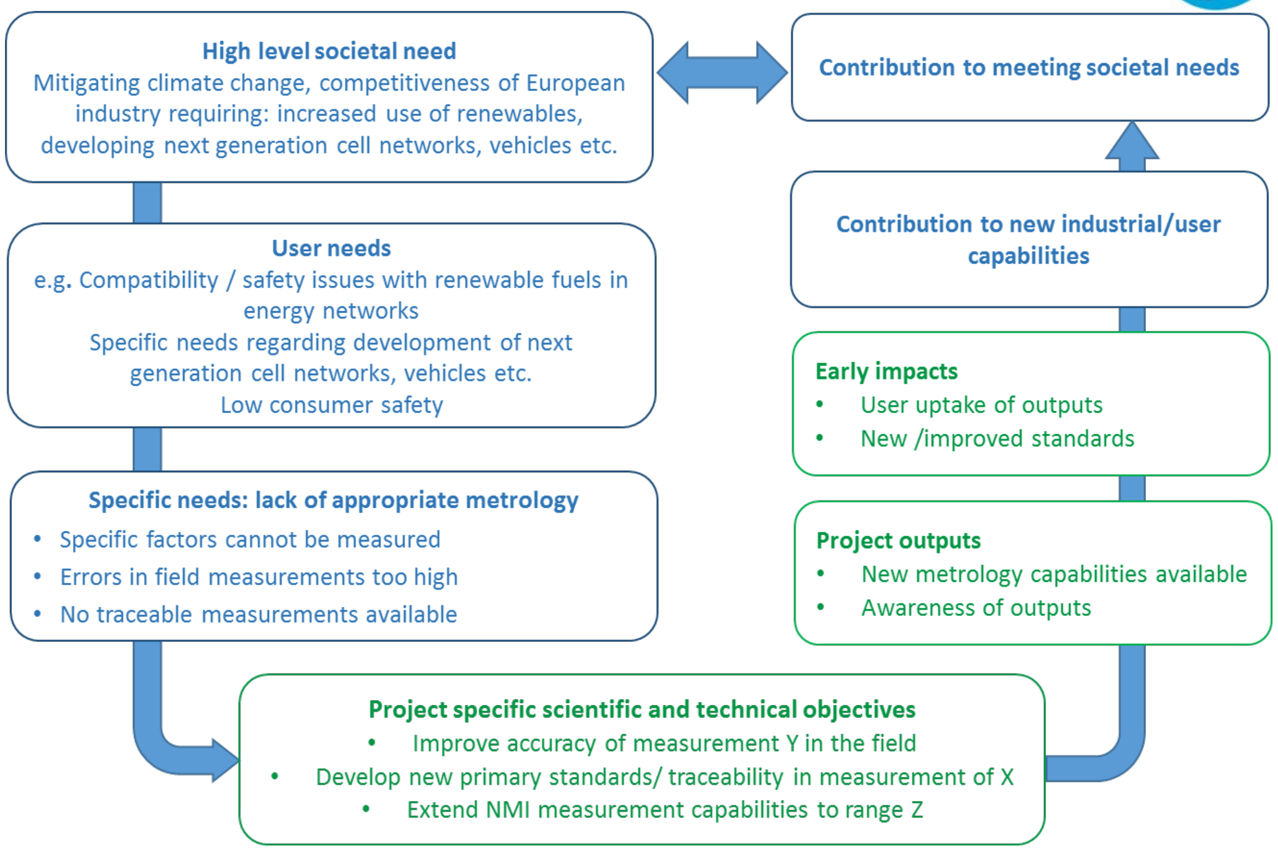
If your project includes a Linked Third Party you must include the following sentence under the work packages summary table "Some of the staff working on the project at YYY are employed by the Linked Third Party NNN. NNN will provide N months of labour resource overall to this project in WPX, WPY and WPZ. This resource is included in the table above." and you must identify the number of person months the Linked Third Party will provide to each WP.

4.4 Section B: Overview of the research

Section B should be used to explain how your project addresses each of the 3 evaluation criteria ("Excellence", "Impact" and "Quality and Efficiency of the Implementation"). Proposers should therefore take note of the evaluation criteria (see Section 5.1).

Section B should tell a coherent story about the proposed project which should follow a logical flow from the high-level needs (e.g. to contribute to mitigating climate change, improve productivity in sector X), through to the specific user needs (problems encountered in specific types of companies or public agencies) that need to be addressed, through into the objectives of the project and the project outputs, then explain how the project's outputs will be used to generate the early impacts addressing the stakeholders' needs, and how this will subsequently contribute to addressing the top level needs or drivers (see diagram below). The links between these different aspects should be clearly explained and the early impacts and benefits you describe should be specifically attributable to the outputs and aims of the project.

Please do not include any photographs in Section B. Diagrams should only be included if absolutely necessary and should be limited to one or two schematic diagrams. In addition, do not include lists of references in Section B. Lists of references should only be included in Sections E and G, as appropriate (see Sections 4.13 and 4.15).



4.5 Section B1: Scientific and/or technical excellence

4.5.1 Section B1.a: Summary of the project

This section should be aimed at a non-specialist audience and must cover the need for the project, its objectives, its key technical outputs (what it will achieve), and the wider benefits to end users and society (who will be using the outputs). The summary of the project should be a standalone and self-contained summary that can be read and understood without reading any other sections from the proposal.

The summary of the project should be no more than 3.5 pages in length and should have the following subsections with subheadings:

Subsection	Content
Overview **(50-100 words)**	This section should explain in two or three sentences the purpose of the project. It should state a high-level overview of the project including the overall need and how the project will address this need and its measurement challenge(s).
Need **(150-300 words)**	This section should explain why the project is being undertaken. It should clearly explain (to a non-specialist audience) why better measurements are needed and who needs them. It should clearly link to the project's scientific and technical objectives and explain the need for each of them. Where relevant, refer to European legislation, documentary standards, technology roadmaps etc. Your description should follow a logical flow from the high-level needs, through to the specific user needs that needed to be addressed via improved measurement capabilities. For example: • State the high-level societal need for the project, such as improving the competitiveness of European industry, mitigating the effects of climate change, or tackling global health issues. • Describe the overall need(s) of the end-users in simple language, such as new product development, improved process control, or compliance with regulation(s). Explain the specific measurement needs/problems faced by end-users, such as particular variables that can't be measured, or problems caused by a lack of traceability.

Objectives **(150-300 words)**	This section presents the objectives (including the impact objective) for the project. To give some context for the objectives, please begin with the overall goal of the project in one simple sentence.
Progress beyond the state of the art and results **(300-500 words)**	This section should describe how the project will progress beyond the state of the art and the expected final technical outputs (results) of the project. This should be done for each objective (except the impact objective). If your JRP directly continues and develops the work undertaken in a previous project please summarise the conclusions from that project.
Impact **(400-1000 words)**	This section should describe the impact the project is expected to have and the route from project outputs to impact. To do this please explain how the project will make a tangible contribution to addressing specific user needs (who the expected end users will be) and how this will in turn contribute to wider and longer-term impacts. The section should have the following subsections: • *Impact on industrial and other user communities* Summarise how relevant user communities e.g. in industry and in the public sector plan to uptake, exploit and use research outputs (e.g. new measurement capabilities, reference standards, devices, new knowledge, etc.). The text can be based on Section B2.a. • *Impact on the metrology and scientific communities* Summarise the direct effect your project will have on the metrological and scientific communities e.g. significant advances in the SI system or proposed changes to NMI/DI Calibration and Measurement Capabilities. The text can be based on Section B2.b. • *Impact on relevant standards* Summarise the impact your project will have on new or existing documentary standards that support the creation of the wider impacts. The text can be based on Section B2.c. • *Longer-term economic, social and environmental impacts* For the wider impacts, please explain the economic, social and environmental impact that your project will make across Europe (and internationally). You should provide details of who will benefit from the project, and which aspects of the project, stakeholder groups will benefit from. The text can be based on Section B2.d.

Please note that a preliminary Publishable Summary will be required for successful proposals and EURAMET will ideally use the summary in section B1.a for that purpose. You should therefore exclude any confidential material and SRT references from the summary. The Publishable Summary will not include a list of references nor a glossary, hence any key reference documents should be detailed in full in the summary and any abbreviations should be explained.

Example B1.a: Summary of the project (Industry project)

Overview
The overall aim of this project is to enable the SI traceable measurement of absolute, positive and negative gauge pressure in the intermediate pressure range from approximately 1 Pa to 10^4 Pa. Relevant industries will be targeted such as power plants, cleanroom technologies, petrochemical and pharmaceutical production and the storage of nuclear and toxic wastes, in order to support innovation and efficiency in industrial production and processes. This project will include the production of primary and transfer standards for dissemination of the pressure scale and the development of appropriate calibration methods for high-accuracy state-of-the-art pressure devices in order to establish a calibration service in this pressure range.

Need
SI traceable measurement of absolute, positive and negative gauge pressure in the intermediate range is important for industries such as power plants, cleanroom technologies, petrochemical and pharmaceutical production and the storage of nuclear and toxic wastes. Reliable, accurate, traceable pressure measurements are needed for such industries as they are subject to strict international requirements with respect to safety, precision, sterility and performance. Therefore, to ensure traceability of measurements with sufficient accuracy to meet the demands of industry, high-accuracy primary standards for disseminating the pressure scale in the intermediate range (from approximately 1 Pa to 10^4 Pa) need to be developed.

Low absolute, differential, positive and negative gauge pressure measurements all play a vital role in numerous industrial processes that demand high accuracy of positive and negative gauge pressure measurements at all stages of the traceability chain. Conventional calibration procedures applied to instruments for low differential pressures are also extremely dependent on weather conditions, especially the stability of atmospheric pressure; and often the target uncertainty level cannot be achieved. Therefore this project will develop alternative calibration approaches and techniques to ensure a constant low uncertainty, independent of ambient conditions. Moreover, the project will establish a high-accuracy calibration service.

Further to this, the EU mercury strategy includes a comprehensive plan addressing mercury pollution both in the EU and globally. In addition, the amendment of Annex XVII to Regulation (EC) No 1907/2006 by the Commission Regulation (EU) No 847/2012 on 19/9/2012 restricts the use of mercury in barometers and sphygmomanometers for industrial and professional use from 10 April 2014. This project will support the replacement of primary mercury manometers which are still in use in many research institutions and reference laboratories.

Objectives

The overall goal of this project is to enable the SI traceable measurement of absolute, positive and negative gauge pressure in the intermediate pressure range from approximately 1 Pa to 10^4 Pa with an accuracy level of 3×10^{-5} p + 0.005 Pa in order to increase the efficiency of industrial productions and processes. The specific objectives of the project are:

1. **To develop and characterise primary and transfer pressure standards -** for the realisation and dissemination of the pressure scale in the intermediate range 1 Pa to 10^4 Pa. This will enable comparisons with both primary high pressure standards, e.g. dead-weight pressure balances and liquid column manometers, and primary vacuum standards, usually static and continuous expansion systems.
2. **To develop calibration methods for positive and negative gauge pressure standards in the range from approximately -10^5 Pa to 10^4 Pa** - in order to reduce the uncertainty of the pressure calibration down to 3×10^{-5} p + 1 Pa independent of variable ambient conditions, and in industrial conditions to better than 2×10^{-4} p + 3 Pa. This will enable accurate calibrations with a high level of accuracy that is independent of variable ambient conditions.
3. **To meet the EU restrictions of mercury use in measuring devices (barometers)** - replacement of primary mercury manometers with alternative pressure standards.
4. **To establish a calibration service in the range of approximately -10^5 Pa to 10^4 Pa of gauge pressure and approximately 1 Pa to 10^4 Pa of absolute pressure** – with an accuracy level sufficient for accredited calibration laboratories and industrial companies. This will be achieved by the development of state-of-the-art pressure measurement instrumentation such as force-controlled piston gauges with a resolution of 1 mPa.
5. **To engage with industries that utilise pressure in the intermediate range 1 Pa to 10^4 Pa** - facilitating the uptake of the technology and the measurement infrastructure developed by the project.

Progress beyond the state of the art and results

Primary and transfer pressure standards for dissemination of the pressure scale in the intermediate range

Primary pressure standards - dead-weight pressure balances and liquid column manometers - enable the pressure unit to be established in terms of the SI units kilogram, metre and second and traceability to be disseminated. The lower operating range of the dead-weight pressure balance is limited to approximately 5 kPa. The lowest pressure accurately measured with mercury manometers is approximately 1 kPa. Oil is an advantageous alternative to mercury due to its low density, low vapour pressure and much better stability of the free surface, but is not widely used because of a relatively large variation of the oil density with pressure. The project will go beyond this by the *in situ* measurement of oil density in a novel oil micromanometer.

New force-balanced piston gauges (FPGs) allow gauge and absolute pressures to be accurately measured from 15 kPa downwards to zero, but have only been used as secondary standards so far. This project will go beyond this by developing appropriate 3D flow models taking into account the molecular properties of gas. By combining these models with dimensional measurements carried out on piston-cylinders, for the first time their effective area will be determined as a function of variable pressure conditions. In this way the FPGs will be characterised as primary pressure standards.

Calibration methods for positive and negative gauge pressure standards in the range from approximately -10^5 to 10^4 Pa

To solve the problem of limited accuracy pressure calibrations due to unstable ambient conditions, new procedures and techniques will be developed for low differential pressures calibrations. This will reduce the calibration uncertainty down to $3\cdot10^{-5}\times p$ + 1 Pa independent of variable ambient conditions and which will benefit accredited and industrial calibration laboratories.

EU restrictions of mercury use in measuring devices (barometers)

Mercury manometers are operated by very few European NMIs nowadays, but are still used by numerous calibration, industrial and research laboratories. European Commission Regulations restrict the use of mercury in barometers and sphygmomanometers for industrial and professional use. This project will enable users of mercury-containing pressure devices to meet the restrictions on the use of mercury in pressure measurements by identifying and evaluating alternative approaches. Within the project, two strategies will be followed: firstly investigation of alternative standards based on refractometry techniques, and secondly comparisons between mercury-containing and existing mercury-free pressure standards. The comparisons will be used to specify conditions and methods with which the alternative pressure standards have comparable or even better measurement capabilities than those of mercury manometers.

Calibration service in the range of approximately -10^5 Pa to 10^4 Pa gauge pressure and approximately 1 Pa to 10^4 Pa absolute pressure

Advanced FPGs, which accurately measure pressure in the range 15 kPa downwards to zero, can only be calibrated against dead-weight pressure balances or mercury manometers at pressures above a few kilopascals. Below these pressures, there are no alternative pressure standards. Therefore, by developing new reference pressure standards and calibration methods an adequate calibration service in Europe will be provided by this project. Currently, the traceability for industrial calibration services in the range of approximately -10^5 Pa to 10^4 Pa gauge pressure and approximately 1 Pa to 10^4 Pa absolute pressure is insufficient. Thus this project will develop a calibration service better than $2\cdot10^{-4}\times p$ + 3 Pa under industrial conditions.

Impact

The project will impact many industries such as power plants, cleanroom technologies, petrochemical and pharmaceutical production, and the storage of nuclear and toxic wastes. It will also improve the reliability and accuracy of low gauge, differential and absolute pressure measurements at NMIs, accreditation laboratories and with end users.

Impact on industrial and other user communities

The project will establish a new primary standard and support the dissemination of the pressure scale in the intermediate pressure range 1 Pa to 10^4 Pa. This will improve the reliability and accuracy of low gauge, differential and absolute pressure measurements at many levels from NMIs, to accredited commercial laboratories, to the end users. This traceability is the basis for more accurate pressure measurement (e.g. for the cleanroom technologies and processes) and will allow realisation of tighter tolerances of non-equilibrium conditions and, as a consequence, reduce energy consumption and costs without the loss of safety, sterility and precision. The costs of operations involving toxic and nuclear materials as well as the storage of environmentally dangerous toxic and nuclear wastes should also be reduced and the safety of these processes increased.

The project will also establish an improved calibration service that will provide end-users with access to calibrations in the range 0 Pa to 15 kPa absolute pressure with uncertainties at the level $3{\cdot}10^{-5}{\times}p$ + 5 mPa. Such conditions will be beneficial for example for more efficient and safe use of airspace by aircraft and will provide access to improved capabilities for national and accredited laboratories in Europe and support consistency in measurement capabilities.

The project's outcomes will be disseminated to calibration laboratories and industrial stakeholders such as manufacturers of pressure measuring devices by organising workshops and presenting the project's results at conferences and in scientific journals. At least one international and one national workshop aimed at collaborators and stakeholders will be organised by the project for the measurement and traceability issues in the gauge and absolute pressure ranges below 15 kPa, improvement of pressure measurement accuracy under variable ambient atmospheric conditions and industrial environment. Knowledge will also be disseminated to end users through training courses and an advisory group consisting of industrial stakeholders will be established and will meet regularly to exchange information with the consortium and to ensure that the project is delivering relevant outputs and information for end users. The participation of industrial partners in the project will also help to align the project with industrial needs.

Impact on the metrological and scientific communities

Based on the project's results, a recommended *mise en pratique* for assuring traceability in the range 1 Pa – 15 kPa using FPGs in both absolute and gauge mode will be developed. This will create a large impact on calibration laboratories and will be presented to the accreditation authorities in Europe as well as to end users and manufacturers of FPGs.

In the area of FPGs, knowledge transfer from experienced NMIs to those less experienced on how to use this new type instruments will be very beneficial. On a broader scope, the project will strengthen the collaboration of European NMIs and will increase their competitiveness and consistency by producing a draft calibration guide for the use of FPGs in both absolute and gauge mode (to be submitted to EURAMET for publication).

Further to this, improved calibration methods for positive and negative gauge pressure standards in the range from approximately -100 kPa to 15 kPa will be developed. A calibration guide for positive and negative gauge pressure standards will be drafted that will describe different calibration systems, conditions under which they are to be operated, procedures to be followed, the target uncertainties and the best working practices. The draft guide will be submitted to EURAMET and made available to end users.

Impact on relevant standards

The project will contribute to the implementation of European Commission Regulation (EU) No 847/2012 which restricts the use of mercury in barometers and sphygmomanometers for industrial and professional use. The execution of the Regulation will be facilitated by providing equivalent alternative non-mercury based pressure standards. It will also support the reduction in the number of mercury-containing pressure-measuring devices in Europe. In addition, the consortium will promote the results of the project within the standardisation community and will provide input into the standardisation process e.g. CCM WG P (Pressure), COOMET TC 1.6 "Mass and related quantities", DIN NATG-D Standard Committee Technical Basics - pressure, flow, temperature and IMEKO TC 16 "Pressure and Vacuum Measurement". For ISO, the standards relevant to the project that are in preparation/revision will be identified, and the work on these standards will be suggested to the appropriate working groups or committees.

Longer-term economic, social and environmental impacts

By improving the pressure scale at the NMI level in the range of lower gauge, absolute and differential pressure this project will provide a better measurement capability. In combination with new calibration methods, a more adequate dissemination of the unit "pressure" will also be obtained. Further to this, European calibration laboratories and industry should be able to engage with the new calibration services and to have their instruments calibrated within Europe without the need to send their devices to the US. This will meet the demand of industry to obtain high accuracy calibration services in Europe, whilst making calibrations less time and cost consuming.

The European mercury strategy [Commission Regulation (EU) No 847/2012 on 19/9/2012] restricts the use of mercury in barometers from 10 April 2014 which is an issue for research institutions and reference laboratories in the avionic industry and weather monitoring and forecast services, which all use mercury barometers. Many European NMIs also realise the pressure scale on low gauge, absolute and differential pressure using mercury based liquid column manometers and these devices usually contain 6 kg to 10 kg of mercury. Therefore, a new primary standard, using alternative manometric liquids such as oil, will fulfil the EU demands and reduce the risk of accidental environmental pollution by mercury.

As mentioned, many industries such as pharma-biotech, semiconductor, micro- and nano-technology, petrochemical, aviation, energy production, weather monitoring and forecast services will benefit from the project's output and this should strengthen the European industrial infrastructure for the development of new services and products (that rely on pressure). As a wider impact, Europe's innovative capacity should be increased, leading to higher employment and wealth for society. Finally, the project will improve collaboration between European NMIs, in particular, between smaller/less experienced NMIs and more experienced NMIs.

4.5.2 Section B1.b: Overview of the scientific and technical objectives

This section should describe the scientific and technical objectives of your project and it should be approximately half a page. A numbered list is required for your objectives and you should indicate which work package(s) address each objective. Objectives should be quantified e.g. parameters, ranges, materials and target uncertainties included where applicable. The list of specific objectives should be preceded by a sentence at the start of the section describing the overall aim of the project.

The description of the scientific and technical objectives should align with those in Section B1.a and with the SRT objectives. They may be the same as the SRT objectives, or they may be slightly revised or refocused. However, if there is a divergence from the SRT objectives, please:

- Identify any SRT objectives or parts of objectives that the proposed project does not address and explain why.
- Explain why any additional scientific and technical objectives (i.e. that are not part of the SRT objectives) are included.

Example 1: B1.b: Overview of the scientific and technical objectives (Environment project)

The overall objective of this project is to enable the SI traceable monitoring of radon (222Rn) at low radon activity concentrations including calibration and radon mapping, in particular in support of the European Council Directive 2013/59/EURATOM (EU BSS). The project will contribute to the creation of a coordinated metrological infrastructure for radon monitoring in Europe.

The specific objectives of the project are:

1. To develop novel procedures for the traceable calibration of radon (222Rn) measurement instruments at low activity concentrations (100 Bq/m3 to 300 Bq/m3) with relative uncertainties ≤ 5 % (k=1). As part of this, to develop new radioactive reference sources with stable and known radon emanation rates (WP1).
2. To investigate and to reduce the influence of thoron (220Rn) and its progeny on radon end-user measurements and radon calibrations (WP2).
3. To compare existing radon measurement procedures in different European countries and from the results optimise the consistency of indoor radon measurements and soil radon exhalation rate measurements across Europe (WP3).
4. To analyse and develop methodologies for the identification of radon priority areas (i.e. areas with high radon concentrations in soil, as defined in the EU BSS), including the development of the concept of a Radon Hazard Index (RHI), and to investigate the relationship between soil radon exhalation rates and indoor radon concentrations (WP4).
5. To validate traceability of European radon calibration facilities, and to publish guidelines and recommendations on calibration and measurement procedures for the determination of radon concentration in air (WP5).
6. To facilitate the take up of the technology and measurement infrastructure developed by the project by end users (regulators, radiological protection bodies and policy makers), standards developing organisations (ISO/TC45, CEN/TC351, ISO/TC85, CENELEC/TC 45, IAEA) and the measurement supply chain (accredited laboratories, instrumentation manufacturers).

Example 2: B1.b: Overview of the scientific and technical objectives (Research Potential project)

The overall objective of this project is to develop reproducible calibration methods and measurement uncertainty evaluation models for different groups of AWIs, which operate in a dynamic mode. The project also aims to increase expertise among EURAMET members in the provision of reliable traceability of automatic weighing instruments. The specific objectives of the project are:

1. **To develop and validate appropriate measurement methods for the calibration of the 3 selected categories of AWIs** (automatic catchweighers, automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments). The results obtained using the new methods for calibration of AWIs operating in the dynamic mode will be compared with the static weighing of objects. The key elements of the specific content of a calibration certificate for calibration of an AWI will be defined. The reproducibility of methods developed will be confirmed by comparison of the dynamic weighing measurements performed by the partners. (WP1, WP2)
2. **To develop and validate error models for the dynamic weighing process** for these 3 categories of automatic weighing instruments and to determine the potential sources of measurement uncertainty for these instruments. (WP1, WP2)
3. **To develop uncertainty budgets for the determination of the uncertainty of measurement for the calibration of AWIs and for the determination of the uncertainty of a weighing result**. The uncertainty budgets will be validated by comparisons and cross-checked with static methods. (WP1, WP2)
4. **To develop 3 draft calibration guides; one for automatic catchweighers, one for automatic instruments for weighing road vehicles in motion and one for automatic gravimetric filling instruments** respectively and to submit them to EURAMET for approval either as three separate EURAMET Calibration Guides or as one combined Guide. (WP1, WP4)
5. **To develop an individual strategy for each participant for the long-term operation of the capacity developed, including regulatory support, research collaborations, quality schemes and accreditation**. Also to develop a strategy for offering calibration services from the established facilities to their own country and neighbouring countries. The individual strategies will be discussed within the consortium and with other EURAMET NMIs/DIs, to ensure that a coordinated and optimised approach to the development of traceability in this field is developed for Europe as a whole. (WP3)

Example 3: B1.b: Overview of the scientific and technical objectives (Normative project)

The overall objective of the project is to develop traceable measurement and characterisation methods for use in the standards being developed by ISO TC 197 "Hydrogen Technologies" and related groups. The specific objectives of the project are:

1. To provide a substantial contribution to the revision of standards in the ISO 14687 series (Hydrogen fuel - Product specification) in fuel cell applications for road vehicles. The contribution to be focused on measurement methods for the characteristics of hydrogen fuel in order to assure uniformity of the hydrogen product as produced and distributed. (WP1)
2. To provide a substantial contribution to the development of EN 16726 (Gas infrastructure – Quality of natural gas – Group H) by developing traceable measurement methods for the determination of the chemical properties of H_2/natural gas mixtures with different hydrogen levels in the blends. (WP2)
3. To work closely with the European and International Standards Developing Organisations, and the users of the standards they develop, to ensure that the outputs of the project are aligned with their needs, communicated quickly to those developing the standards, and in a form that can be incorporated into standards at the earliest opportunity. (WP3)

4.5.3 Section B1.c: List of deliverables

You should list your deliverables in the table provided in Template 4: JRP protocol. The deliverables should align with the project's scientific and technical objectives in Section B1.b and hence the SRT objectives. There should be a maximum of 10 deliverables including 6-8 technical deliverables (approximately one or possibly two deliverable(s) for each objective) plus a mandatory deliverable for impact and a mandatory deliverable for the completion of the project's reporting.

Deliverable descriptions should include parameters, ranges and target uncertainties where appropriate and must provide evidence of a tangible high-level project output, such as the key output of a work package. Please remember that each deliverable should be able to be sent to EURAMET and stored, and must have been reviewed and approved by the whole consortium before being submitted to EURAMET by the coordinator.

For each deliverable you should also include the number of the activity (e.g. A1.4.5) where the deliverable is delivered to EURAMET in the first column of the deliverable table under the objective number(s).

Example 1: B1.c: List of deliverables (Environment project)

Relevant objective (Activity delivering the deliverable)	Deliverable number	Deliverable description	Deliverable type	Partners (Lead in bold)	Delivery date
1 (A1.2.5)	D1	Method for the traceable calibration of radon (^{222}Rn) measurement instruments at low activity concentrations (100 Bq/m^3 to 300 Bq/m^3) with relative uncertainties ≤ 5 % (k=1)	Calibration method	**BBB**	M36
1 (A1.4.8)	D2	Report on the influence of thoron on radon monitors used in Europe including (i) procedures for checking their sensitivity to thoron, (ii) recommendations on the construction of radon monitors that are not sensitive to thoron and (iii) technical approaches aimed at reducing thoron-related bias in the radon signal in existing monitors	Report, Recommendations	**CCC**, BBB, AAA, EEE, FFF, GGG, HHH, III	M30
2 (A2.1.4)	D3	Report on indoor and geogenic radon surveys in Europe, including their strategies, the methodologies employed, inconsistencies in the results, and potential methodologies to harmonise data and reduce inconsistencies	Report	**EEE**, AAA, BBB, DDD, III	M24
2 (A2.4.6)	D4	Report on the results from the on-site comparison of indoor radon measurements and geogenic radon measurements under field conditions together with recommendations to	Comparison report	**CCC**, AAA, BBB, DDD, EEE, FFF, GGG, HHH, III	M34

		assist the implementation of the EU-BSS			
3 (A3.3.3)	D5	Guideline on the definition, estimation and uncertainty of radon priority areas (RPA)	Guideline	**FFF**, AAA, BBB, CCC, DDD, EEE, GGG, HHH, III	M27
3 (A3.5.7)	D6	Report on the concept and establishment of a Radon Hazard Index (RHI) including an RHI map of Europe showing areas with high geogenic radon potential and conclusions on the relationships and correlation between indoor Rn concentration and quantities related to geogenic Rn	Report, Map	**FFF**, BBB, GGG, HHH	M34
4 (A4.1.4)	D7	Validation report on the traceability of primary and secondary radon calibration facilities in Europe	Validation report	**EEE**, AAA, BBB, DDD, III	M34
4 (A4.2.4)	D8	Guideline on calibration and measurement procedures for the determination of radon concentration in air	Guidelines	**EEE**, III	M34
5	D9	Evidence of contributions to the EU-BSS and to new or improved international standards and recommendations with a specific focus on ISO/TC85/SC2, CENELEC/TC45, IEC/TC45, IAEA-Nuclear Data, CEN/TC351/WG3, CCRI and EURAMET TC-IR. Examples of early uptake of project outputs by end users	Reporting documents	**CCC**, all partners	M36
n/a	D10	Delivery of all technical and financial reporting documents as required by EURAMET	Reporting documents	**BBB**, all partners	M36 + 60 days

Example 2: B1.c: List of deliverables (Research Potential project)

Relevant objective (Activity delivering the deliverable)	Deliverable number	Deliverable description	Deliverable type	Partners (Lead in bold)	Delivery date
1 (A1.2.6)	D1	Draft calibration methods for automatic catchweighers, automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments	Draft calibration methods	**BBB,** AAA, CCC, DDD, EEE, FFF	M12
2, 3 (A2.2.8)	D2	Report on error models and procedures for evaluation of the measurement uncertainty for automatic catchweighers, automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments, including uncertainty budgets for the calibration and weighing result	Report	**EEE**, BBB, CCC, FFF	M15
1, 3 (A3.1.4)	D3	Summary report and analysis for the validation of the draft calibration methods and uncertainty budgets for automatic catchweighers, automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments	Summary report	**DDD**, AAA, BBB, CCC	M22
1, 3 (A3.2.5)	D4	Reports for the interlaboratory comparisons of the calibration of automatic catchweighers, automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments	Comparison reports	**BBB**, AAA, CCC, DDD, EEE, FFF	M28

4 (A4.2.5)	D5	3 calibration guides for (i) automatic catchweighers, (ii) automatic instruments for weighing road vehicles in motion and (iii) automatic gravimetric filling instruments	Calibration guides	**DDD**, AAA, BBB, CCC	M33
5 (A5.1.3)	D6	Summary report of the partners establishment of suitable traceability of AWIs which operate in the dynamic mode	Summary report	**AAA**, BBB, CCC, DDD, EEE, FFF	M29
5 (A5.1.5)	D7	Agreed individual strategies for all partners for (a) the long-term development of their research capability in dynamic mass metrology and (b) the provision of calibration services from the established facilities in their own country and / or neighbouring or other countries	Documented strategies	**AAA**, BBB, CCC, DDD, EEE, FFF	M36
4 (A5.3.2)	D8	Email confirmation that the draft calibration guides for automatic catchweighers, automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments have been submitted to EURAMET TC-M for approval as EURAMET Calibration Guides	Email	**FFF,** AAA, BBB, CCC, DDD, EEE	M36
4, 5	D9	Evidence of contributions to or influence on new or improved international guides, recommendations and standards with a specific focus on the following guides and committees: EURAMET guide *Calibration of automatic weighing instruments*, EURAMET TC-M, WELMEC Committee, WELMEC WG2 and WG6, OIML TC9/SC2 and CECIP. Examples of early uptake of project outputs by end-users	Reporting documents	**AAA**, all partners	M36
n/a	D10	Delivery of all technical and financial reporting documents as required by EURAMET	Reporting documents	**AAA**, all partners	M36 + 60 days

Example 3: B1.c: List of deliverables (Normative project)

Relevant objective (Activity delivering the deliverable)	Deliverable number	Deliverable description	Deliverable type	Partners (Lead in bold)	Delivery date
1 (A1.1.6)	D1	Calibration procedures for quadrupole mass spectrometers (QMS), specified for different end user use of QMS	Calibration procedures	**CCC**, AAA, DDD, BBB	M24
1 (A1.3.4)	D2	Report on the intercomparison of different QMS from different manufacturers, including recommendations for a standardised procedure for general characterisation of the QMS	Comparison report	**CCC**, AAA, DDD, BBB	M30
1, 3 (A1.4.4)	D3	Letter from ISO TC 112 confirming that the results from JRP NRM99, related to QMS, have been incorporated in an approved Technical Specification TS 20175	Letter from the Technical Committee	**CCC**, AAA, DDD, BBB	M36
2 (A2.1.7)	D4	Report on a standardised measurement procedure and a statement of uncertainty for partial and total outgassing rate measurements	Report	**BBB,** III	M32
2, 3 (A2.2.8)	D5	Letter from ISO TC 112 confirming that the results from JRP NRM99, related to outgassing rate measurements, have been incorporated in an approved	Letter from the Technical Committee	**BBB**, III	M36

		Technical Specification for TS 20177			
4 (A3.1.6)	D6	Evidence of contributions to new or improved international standards with a specific focus on, to be submitted to ISO TC 112 WG2 and DIN Technical Committee "Vacuum Technology" Examples of early uptake of project outputs by end users	Reporting documents	**CCC**, all partners	M36
n/a	D7	Delivery of all technical and financial reporting documents as required by EURAMET	Reporting documents	**CCC**, all partners	M36 + 60 days

4.5.4 Section B1.d: Need for the project

This section must explain a clear need for the project i.e. why the project is being undertaken. It should be approximately 1–1.5 pages in length and should explain the background to the need for the project, i.e. why improved measurement capability, measurement techniques and better measurements are needed and who needs them.

The explanation of the need for the project should link clearly to the project's scientific and technical objectives and explain the need for each of them. Ideally you should structure the section with a subheading for each objective.

The description should follow a logical flow from the high-level needs (e.g. to contribute to mitigating climate change, improve productivity in sector X), through to the specific user needs (problems encountered in specific types of companies or public agencies) that needed to be addressed via improved measurement capabilities at NMIs/DIs. For Research Potential projects, the needs and drivers for the development of the capability from end users and stakeholders outside the metrology community must be described.

If your project continues the work undertaken in a previous JRP please summarise why further work is needed in this area.

You may also include evidence of support from the "end user" community (e.g. letters of support; see Section 2), but please note that all references to letters of support will be removed during grant preparation, therefore the need should be adequately explained without requiring reference to them.

Where relevant, you should refer to the European legislation, documentary standards, technology roadmaps etc. that need to be addressed. In addition, in SRTs for pre- and co-normative JRPs there may be a requirement for the proposed research to be justified by "clear reference to the measurement needs within strategic documents published by the relevant Standards Developing Organisation (SDO) or by a letter signed by the convenor of the respective TC/WG". In those cases this section must fully explain the need expressed by the SDO, web links to the relevant SDO strategic documents must be provided, and any letter from the convenor of the respective TC/WG included in the letters of support.

For most proposals the need for the research extends beyond the metrology community, so you should clearly identify the potential stakeholder groups. If commercial organisations stand to benefit from the research you should explain why it is appropriate for EMPIR to support this research rather than commercial organisations. Finally, you should explain why bringing together a critical mass of European expertise, will enable progress in this area; and why a non-collaborative approach would be less successful.

Example 1: Section B1.d: Need for the project (Environment project)

Radon is a radioactive, colourless, odourless, tasteless noble gas, which occurs naturally through geological based processes (geogenic) as an intermediate step in the normal radioactive decay chains through which thorium and uranium slowly decay into lead. Radon is produced by the radioactive decay of radium-226, which is found in uranium ores, phosphate rock, shales, igneous and metamorphic rocks such as granite, gneiss, and schist, and to a lesser degree, in common rocks such as limestone. Radon can also occur in ground water - for example, in some spring waters and hot springs. Radon gas is a health hazard and is often the single largest contributor to a person's background radiation dose, but due to differences in local geology, the level of the radon gas hazard differs from location to location. Despite its short half-life of 3.8 days, radon gas from natural sources can accumulate in buildings, particularly in confined or unventilated spaces. As radon decays it produces other radioactive elements known as radon progeny. Unlike gaseous radon, these radon progeny are solids and stick to surfaces, such as dust particles in air, which can then also cause lung cancer if inhaled.

European legislation

The European Council Directive 2013/59/EURATOM (EU-BSS) which lays down basic safety standards (BSS) for protection against the dangers arising from exposure to ionising radiation, evokes new challenges for metrology and radon measurements and calibrations in Europe. EU member states are required to ensure that levels of relevant radon activity concentrations as laid down in the EU-BSS do not exceed 300 Bq/m^3, and are obliged to transpose the EU-BSS into national legislation by 2018 for immediate implementation. According to the Council Directive 2013/59/EURATOM (EU-BSS), European member states are obliged to consider several aspects when preparing their **national radon action plan,** which is a strategy for conducting surveys of indoor radon concentrations. This requires reliable calibration and measurement methods for low radon activity concentrations between about **100 Bq/m^3 and 300 Bq/m^3**. A significant improvement in the metrological infrastructure in Europe in the field of radon calibrations at low activity concentrations is a prerequisite in order to be able to fulfil the EU-BSS requirements.

The EU-BSS will impact a range of stakeholders including those responsible for the transposition of the EU-BSS into national law and its implementation: from regulators and policy makers, professionals designing, performing, evaluating and interpreting radon surveys, radon instrument manufacturers to the construction industry. The construction industry will need to comply with national legislation and regulations related to the EU-BSS whilst their practical experience in implementing building codes is crucial in the assessment of its impact on society. Since national radon action plans (a major requirement of the EU-BSS) are also of considerable interest beyond the EU, as other countries are also concerned with radon control even if not committed to the EU-BSS.

Radon protection for European citizens

The objective of the new EU-BSS is to provide a sound and fair basis of radon protection for European citizens. Meeting this objective requires that all links in the radon protection “supply chain” – some of which are explicitly mentioned in the EU-BSS article on Rn action plans (article 103 and annex XVIII) - are quality assured. The chain consists of many conceptually different links, starting from appropriately designed Rn surveys, through metrologically sound measurements, to statistically reliable evaluation and interpretation, to the generation of aggregated objects such as “Rn priority areas” (RPAs), which are those areas that form the basis for certain actions envisaged and required by the EU-BSS. Since RPAs were introduced, their identification has been an important topic in all EU member and candidate states (and beyond, as some non-member states have also decided to adopt the regulation or parts of it).

Quality assurance of all steps in the radon protection chain is necessary, in particular given they are methodically different but have important potential economic and political impact.

Public health and economy

Radon is estimated to cause between 3 % and 14 % of all lung cancer cases depending on the average radon level in the country (WHO, Fact sheet N°291, 2014). For Europe, this corresponds to between 15,000 to 20,000 people per year dying of lung cancer caused by radon exposure. Accurate and reliable radon measurement data are necessary in order to optimise counter measures to reduce the public’s exposure to radon and hence also to reduce the related follow-up costs. The greater the accuracy and reliability of the measurement data, the lower the risk that unnecessary or excessive counter measures will be implemented, with low radiological but high financial impact.

Moreover, member states need to define approaches, data and criteria to be used for establishment of RPAs, for the cost-efficient delineation of areas with potentially high exposure to radon (EU-BSS, Article 103). Harmonisation of radon data at a European level is therefore of crucial importance for European member states as well as the development of methodologies for the identification of areas with potentially high exposure to radon. This is essential for an exchange of knowledge and comparable information on radon levels on a European level and to reduce economic barriers across Europe allowing instrumentation manufacturers to provide their instruments to a harmonised market.

Calibrations and traceability of radon measurements

Effective implementation of the EU-BSS will require accurate and reliable measurement of low radon activity concentrations. According to the BIPM key comparison database of calibration and measurement capabilities, there are currently only a few European facilities that offer radon activity calibrations, and all of them relate to very high radon activity concentrations (of the order of MBq/m^3), which are not relevant in the context of the EU-BSS. The established metrological procedure (primary standard) is to use a decaying radon gas standard in a defined volume for calibrations of radon activity concentrations above 1 kBq/m^3. Using this method for low activity concentration calibration is not practical, as it is time consuming and expensive due to the need for a radon gas standard for each calibration and specific very leak-tight chambers.

Thoron

The influence of thoron (^{220}Rn) on the radon (^{222}Rn) activity concentration measurements has already been observed with some radon monitors. This influence, if not properly corrected, can introduce bias in the radon risk estimates or can generate false alarms if these detectors are used to identify dwellings with radon concentrations that exceed reference/action levels. Detailed knowledge of the influence of thoron on radon measurements is however limited and techniques to correct for or to reduce its influence do not currently exist.

Radon priority areas

National or regional approaches chosen to identify areas with observed or suspected high probability of radon concentrations in buildings above the reference level (Art. 103, EU-BSS) can vary. One strategy relies on directly measured indoor radon data, others on indirect concepts based on the geogenic radon potential (e.g. based on soil radon exhalation rates). There are also different methods used to define the geogenic radon potential of an area. In order to ensure that radon data and decisions on the identification of RPAs are comparable regardless of the approach used, these methods need to be compared and standardised in order to provide comparable results with moderate uncertainties.

Harmonisation of radon measurement approaches and data

Measurements of radon concentrations have been conducted in Europe for years and while they have been subject to quality assurance by comparison exercises in the past (at least for relatively high radon activity concentrations), research needs be undertaken in order to harmonise the different radon measurement techniques (objective 3) and calibrations (objective 1 and 5). These will apply in particular for solid-state nuclear track detectors that are the most common devices used for measurement in dwellings. This issue has been discussed on numerous occasions at conferences and in articles (recently, at the International Workshop of the European Atlas of Natural Radiation, Verbania, Italy, Nov. 2015), which proves the urgency for this topic. The current state of the art is that strong heterogeneities of radon data still exist in Europe.

The European Commission Joint Research Centre in Ispra, Italy, is responsible for the creation of European radon maps (as part of the European Atlas of Natural Radiation). The data harmonisation, aimed at by this project, will provide the possibility to combine radon measurements at a European level and to develop a consistent European radon map.

Example 2: Section B1.d: Need for the project (Research Potential project)

With the development of weighing technology, the number of Automatic Weighing Instruments (AWIs), which carry out measurements in a dynamic mode, has increased. Notwithstanding a generally higher purchase price than for Non-automatic Weighing Instruments (NAWIs), AWIs are more effective and efficient for their users in the long term and improvements in the accuracy of AWIs mean that they are now used in an increasing number of applications. For example automatic catchweighers and automatic gravimetric filling instruments are used extensively in the preparation, production and quality assurance of pre-packed products and other products, where their content or composition is determined by weighing. Based on data from the PRODCOM database, the total annual market size is estimated to be around 15 000 automatic catchweighers and 14 000 automatic gravimetric filling instruments, and these two groups together represent almost 80 % of AWIs sold annually in Europe.

In addition, automatic instruments for weighing road vehicles whilst they are in motion are increasingly used for the time efficient weighing of trucks for trade, supervision, transport safety and law enforcement purposes in a number of European countries including Poland, Czech Republic, Slovenia, Austria, France, the United Kingdom, Portugal and Hungary.

Traceable measurements are enabled by calibration against higher order reference standards that are themselves traceable to the SI. Calibrations also require a robust and reliable estimate of the uncertainties associated with the measurements. While NAWIs are routinely calibrated by accredited calibration laboratories (based on the Guidelines on the Calibration of Non-Automatic Weighing Instruments EURAMET/cg-18), the calibration of AWIs is not as well defined. In addition, due to the variety of AWIs and their operation in the dynamic mode, there is no standard approach for their calibration. In Spain, for example, there were no legal requirements for AWIs before the Measuring Instruments Directive (MID) “2004/22/EC of the European Parliament and of the Council of 31 March 2004 on measuring instruments” came into force.

There is also an increasing need for the metrological quality of AWIs to be confirmed by calibration in order to meet the requirements of ISO 9001 or specific laws that apply for regulated industries as pharma or food (Good Manufacturing Practice – GMP and Food Safety Standards – IFS, BRC, SQF). The producers of the pre-packed products according to directive “76/211/EEC of 20 January 1976 on the approximation of the laws of the Member States relating to the making-up by weight or by volume of certain pre-packaged products, require a reliable estimation of the measurement uncertainty in order to better evaluate and optimise the production process. Therefore, users of AWIs need information on their measurement uncertainty and repeatability (in the dynamic mode) to enable informed decisions to be made. Appropriate measurement methods for the calibration of selected categories of AWIs and error models for the dynamic weighing process therefore need to be developed and validated.

The concept of the measurement uncertainty has also been introduced in legal metrology. At the world-wide level, the Organization Internationale de Métrologie Légale (OIML) Technical Subcommittee TC3/SC5 (Metrological Control/Conformity Assessment) is drafting a new OIML Document on the role of measurement uncertainty in conformity assessment decisions in legal metrology. The main aim of this OIML Document is to provide guidance on incorporating text into OIML publications that describes when and how to take measurement uncertainty into account when using measured values obtained during the testing or verification of a measuring instrument, as the basis for making pass-fail decisions in legal metrology. This OIML Document will influence all OIML Recommendations, including Recommendations for AWIs. Therefore, knowledge and information on the estimation of measurement uncertainty, including for example uncertainty budgets for the calibration of AWIs and for the determination of the uncertainty of a weighing result, are needed in order to support further OIML activities in this field.

Further to this, in order to ensure a consistent approach and reliable and comparable measurements for AWIs operating in the dynamic mode, calibration laboratories, conformity assessment bodies (notified bodies and other nationally designate conformity assessment authorities), accreditation bodies and producers of AWIs require guidance on calibration methods and uncertainty evaluation.

The inclusion of emerging EURAMET member countries in the research and development of methods for calibration of automatic weighing instruments operating in a dynamic mode is necessary to bridge an existing gap between countries with different levels of services in respect of traceability of weighing instruments. In particular countries with an association agreement with the EU need to develop their scientific and conformity assessment competence, to support the implementation of the MID (measurement uncertainty is important in the conformity assessment decision process).

Finally, it is important to avoid the scenario where NMIs or other organisations individually develop national solutions for standardised calibration methods for weighing instruments operating in a dynamic mode. Instead, calibration procedures and uncertainty evaluation need to be harmonised at a European level in order to support a common market. This can be achieved by a consortium that includes a number of NMIs, which can jointly develop the required guidance, whilst interacting with and taking into account the needs of stakeholders. It is also important to ensure a coordinated and sustainable approach to development of measurement capabilities of less developed or experienced NMS/DIs, and hence the development of individual strategies the relevant NMI/DIs for the long-term operation of the capacity developed, including regulatory support, research collaborations, quality schemes and accreditation, and for offering calibration services from the established facilities to their own country and neighbouring countries would be beneficial.

4.5.5 Section B1.e: Progress beyond the state of the art

This section must describe the current state of the art in the technical area(s) of the project's research. This section should be approximately 1.5-2 pages in length and should state the best uncertainties and/or range that can currently be achieved and whether parameters can be measured or if the measurement is possible but is inefficient, inaccurate, unreliable or time-consuming.

It is recommended that you structure this section into subsections for each of the scientific and technical objectives of the project and then describe the current state of the art and progress beyond for each of them. The current state of the art and progress resulting from the project should be clearly differentiated.

You should state why progress is required to meet the needs described in Section B1.d, and how your project progresses beyond the state-of-the-art in numerical terms, including target uncertainties or ranges. If your project directly continues and develops the work undertaken in a previous JRP please summarise the conclusions from that JRP and indicate how your project progresses beyond that project. In addition if there are other closely linked JRPs please indicate how your proposal progresses beyond those projects.

Please note, that in Research Potential projects the state of the art may be equivalent to the current capabilities within a group of countries rather than the best available across Europe as a whole and due to the different needs between countries or regions, the progress may not be beyond the best capabilities available in some other countries. Please note that proposals should not include lists of the equipment currently available. For Pre- and Co-Normative projects the progress beyond the state of the art relates to the establishment of data, methods and techniques that are suitable for implementation and regular use as part of the standardisation process or to underpin the development of new documentary standards.

Example 1: B1.e: Progress beyond the state of the art (Environment project)

Traceable calibration of radon (^{222}Rn) measurement instruments at low activity concentrations and radioactive reference sources with stable and known radon emanation rates (Objective 1):

Current state of the art

Under the EU-BSS, EU member states are required to ensure that levels of relevant radon activity concentrations do not exceed 300 Bq/m^3, hence effective implementation of the EU-BSS will require accurate and reliable measurement of low radon activity concentrations. Currently traceable radon measurements are only conducted at activity concentrations >500 Bq/m^3. The established metrological procedure (primary standard) is to use a decaying radon gas standard in a defined volume for calibrations of radon activity concentrations above 1 kBq/m^3. Using this method for low activity concentration calibration is not practical, as it is time consuming and expensive due to the need for a radon gas standard for each calibration and specific very leak-tight chambers. Better, more (long-term) stable and reliable sources and methods that are easier to use and could be used at more calibration facilities, need to be developed in order for traceable calibrations and measurements to be performed below this limit with reasonable uncertainties.

Progress beyond the state of the art

The project will develop new radioactive reference sources for ^{220}Rn (radon) and ^{222}Rn (thoron) with stable and known radon emanation rates for the realisation of reference fields for radon activity concentration in air. Novel procedures for the traceable calibration of ^{222}Rn (radon) measuring devices (active and passive monitors) in stable radon atmospheres at low activity concentrations (100 Bq/m^3 to 300 Bq/m^3) with relative uncertainties ≤ 5 % (k=1) will be developed.

Although an intercomparison of calibration for high radon activity concentrations has been conducted in the past, this was more than 10 years ago and hence two new two CCRI(II) comparisons of existing radon gas primary standards at different European NMIs/DIs for ^{222}Rn and ^{220}Rn in the range of a few kBq will be undertaken.

Influence of thoron (^{220}Rn) and its progeny on radon end-user measurements and radon calibrations (Objective 2):

Current state of the art

It has been observed that the presence of thoron and its progeny (^{212}Pb, ^{212}Bi+^{212}Po/^{208}Tl) can have an influence on radon activity concentration measurements. Although several scientific studies on the influence of thoron on radon measurements are available in the literature, this information is in general not harmonised and therefore not usable by end users and decision makers. Detailed knowledge of the influence of thoron on radon measurements is therefore limited and techniques to correct for or to reduce thoron's influence on radon activity concentration measurements do not currently exist.

Progress beyond the state of the art

The sensitivity of radon monitors and detectors to thoron will be evaluated, with traceability to a primary thoron system, and in addition the sensitivity of radon (thoron) monitors and detectors to radon and thoron under mixed radon + thoron atmospheres and under temperatures in the interval typical for the real environment (e. g. -15 °C to +60 °C) will also be investigated. Conclusions about the dependence of the signal on the specific environmental conditions (radon to thoron ratio, temperature, time variations of radon/thoron concentrations and temperature) will be drawn and the consequences for the design of radon surveys under real conditions (e.g. working places, soil gas etc.) will be considered and analysed. Separately, technical concepts and solutions will be proposed to firstly potentially correct the thoron-related bias to the radon signal in radon monitors and secondly to reduce the thoron-related bias to the radon signal in radon monitors through the use of membranes that act as a barrier to thoron.

Existing radon measurement procedures and approaches to optimise the consistency of indoor radon measurements and soil radon exhalation rate measurements across Europe (Objective 3):

Current state of the art

Radon surveys (both indoors and outdoors) and radon measurements are carried out differently in European countries, dependent on political decisions, the aim of the survey, availability of resources and infrastructure, and these different methodologies and procedures may lead to inconsistencies, i.e. different values of the nominally same quantity. Intercomparisons on surface soil radon exhalation rates and radon concentrations in soil gas are rare and there are few laboratories whose results have been tested under in-situ conditions, and hence comparability of data cannot be not guaranteed.

Progress beyond the state of the art

Existing indoor and geogenic radon survey data will be analysed and evaluated in order (i) to identify the rationale and methodologies used, (ii) to identify the extent and possible sources of inconsistencies in the results of indoor radon surveys and (iii) to propose approaches to reduce inconsistencies and improve harmonisation of indoor and geogenic radon data. The project will carry out inter-comparisons of the magnitudes of surface soil radon exhalation rate and radon concentrations in soil gas, thus improving knowledge of the relationship between the two and also increasing the number of laboratories whose results have been tested under in-situ conditions. By comparing existing radon measurement procedures in different European countries, the results will be used to optimise the consistency of indoor radon measurements and soil radon exhalation rate measurements across Europe. Information about indoor radon and geogenic radon surveys in Europe regarding strategy, methodologies and their potential for use as a basis for implementation for the EU BSS will be provided to the relevant stakeholders, including results of the on-site inter-comparison exercise. Methodologies to harmonise indoor data (i.e. seasonal correction, short-term and long-term measurements) will be published.

Methodologies for the identification of radon priority areas, the development of the concept of a Radon Hazard Index (RHI), and the relationship between soil radon exhalation rates and indoor radon concentrations (Objective 4):

Current state of the art

As the definition of radon protection areas (RPA) in the EU BSS allows a wide range of interpretation, different concepts and methodologies have been proposed and some already adopted. Currently there are many approaches ways used to define geogenic Rn risk areas which usually form the basis for the definition of RPAs, and this leads to most data being incomparable as the models and concepts used are vastly different.

Progress beyond the state of the art

This project will analyse and develop methodologies for the identification of radon priority areas (RPA), to investigate the relationships between indoor Rn concentration and quantities related to geogenic Rn, including soil exhalation. The use of compact discs (CDs) and DVDs for retrospective radon measurements and their potential to define radon priority areas will be evaluated. These methods employ CDs or DVDs that are available in almost all public and private buildings in Europe as “detectors” and allow the average radon concentration to be assessed in retrospect, as well as systematic changes due to constructive (including energy-efficiency) interventions. New techniques for measurement of radon exhalation from soil, based on liquid scintillation counting of polymers or track-etching of CDs, will be developed and evaluated. The aim is to analyse and develop methodologies for the identification of radon priority areas (i.e. areas with high radon concentrations in soil, as defined in the EU BSS), including the development of the concept of a Radon Hazard Index (RHI), and to investigate the relationship between soil radon exhalation rates and indoor radon concentrations. Definitions of radon priority areas (RPA) optimised to the radon action plan and their estimation optimised to the availability of the input data will be established, including strategies to deal with RPAs which have been defined inconsistently across borders. Finally, a methodology for a harmonised “radon hazard index” (RHI) will be proposed which could be used as a tool to help identify radon priority areas.

Validation of the traceability of European radon calibration facilities, and guidelines and recommendations on calibration and measurement procedures for the determination of radon concentration in air (Objective 5):

Current state of the art

The desire to improve and harmonise radon measurements in air has increased over the last decade or so, as radon activity concentrations in air measured with different radon monitors were found to be inconsistent with each other when the monitors are were placed in the same environment. At present, secondary radon standards are calibrated at relatively high activity concentrations, however calibrations and measurements at low activity concentrations with sufficiently low uncertainties, as required in the context of the EU-BSS, are not available. The traceability and reliability of measurements at low radon activity concentrations by existing European radon calibration facilities e.g. NMIs/DIs, accredited laboratories, other calibration laboratories and universities is therefore unclear.

Progress beyond the state of the art

A validation of the traceability of existing European radon calibration facilities will be undertaken both by comparisons of the calibrations of radon measuring instruments in the range from 300 Bq/m^3 to 10 000 Bq/m^3 and by comparison of the secondary standards used by European radon calibration facilities in the range from 100 Bq/m^3 to 300 Bq/m^3 to the reference device calibrated in a reference radon atmosphere traceable to a primary standard. Such calibrations in stable radon atmospheres will enable sufficiently low uncertainties to be achieved for low radon activity concentration measurements. Information about the validation of traceability of European calibration facilities for radon concentration measurement in air will be provided to all relevant stakeholders and guidelines and recommendations on calibration and measurement procedures for the determination of radon concentration in air will be published.

Progress beyond ENV57 MetroERM and IND57 MetroNORM

Within ENV57 MetroERM the focus was on environmental monitoring of man-made radionuclides (e.g. ^{137}Cs, $^{239/240}Pu$, etc.). Only the influence of radon and its progeny on these monitoring measurements was considered, not the measurement of radon itself (e.g. the influence of radon progeny concentrations on dose rate detectors (Task 1.6 MetroERM)). In the scope of IND57 MetroNORM only very specific questions regarding radon exposure of workers in waterworks and the emanation of radon from building materials were addressed (Task 3.3 MetroNORM). In this project the focus lies on the measurement of radon itself and all relevant exposure situations are considered (exposure due to radon in dwellings and workplaces).

Example 2: B1.e: Progress beyond the state of the art (Research Potential project)

Calibration methods

Current state of the art

Automatic catchweighers and automatic gravimetric filling instruments are by far the two most numerous groups of automatic weighing instruments (AWIs). Together they represent almost 80 % of AWIs sold annually in Europe, and are widely used in many industries, in particular in the food industry. In addition the number of automatic instruments for weighing road vehicles in motion, which are mostly used for weighing trucks for trade and law enforcement purposes, has increased significantly during the last decade in several European countries. This type of weighing instrument has also undergone the highest rate of improvement in accuracy compared to other groups of weighing instruments.

Other groups of AWIs such as continuous totalising automatic weighing instruments (belt weighers), discontinuous totalising automatic weighing instruments (totalising hopper weighers) and automatic rail weighbridges are not as widely used. Their testing is logistically very demanding and goes beyond the capabilities of this project. Discontinuous totalising automatic weighing instruments can also reasonably be calibrated as static instruments.

The EURAMET guideline cg-18 is a well-established guide which is commonly used by calibration laboratories. It is recognised by accreditation bodies in Europe and also in other regions as a standard method for calibration of non-automatic weighing instruments (NAWI). However, the guide does not address AWIs, especially not those instruments that operate in the dynamic mode and there is no existing harmonised and standardised method for evaluation of the measurement uncertainty of the calibration of AWIs. Traceability of AWIs is also not currently ensured by accredited calibration based on harmonised calibration procedures.

At present automatic weighing systems are often only calibrated in a static way, rather than dynamically as they are used in practice. In practice the approximation is generally made that the measurement uncertainty of the AWI's calibration in the dynamic mode equals the uncertainties determined for the static calibration only. This is misleading for all parties concerned, since dynamic operation can introduce additional sources of errors and influences that may not be apparent when an instrument is calibrated statically. The same applies to determining the weighing instrument's performance at varying speeds of the operation of automatic instruments as there are currently only limited reliable and traceable data for the connection between speed and weighing performance. Therefore, producers and users of weighing instruments find that the methods for validation and calibration of automatic weighing applications are vague and can be interpreted in a variety of ways.

In the field of legal metrology there are a number of OIML Recommendations (OIML R50, R51, R61, R106, R107, R134), which cover requirements and conformity assessment procedures for AWIs. These OIML Documents (with the exception of OIML R134) also serve as normative documents referenced in the MID. Currently, the OIML Recommendations for AWIs only define the maximum uncertainty level of the reference standards. In conformity assessment the measurement uncertainty information is crucial for the conformity decision, and the importance of the measurement uncertainty in the conformity decision process has been recognised by OIML. Consequently, a new OIML document on 'The role of measurement uncertainty in conformity assessment decisions in legal metrology' is in preparation.

Beyond the state of the art

In order to maximise the impact from the available project resources, three categories of AWIs representing the most commonly used instruments were selected and will be addressed in the project, i.e. automatic catchweighers, automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments.

The project will develop and validate appropriate measurement methods for the calibration of the selected AWIs. The results obtained using the new methods for calibration of AWIs operating in the dynamic mode will be compared with the static weighing of objects. The relevant specific content of a calibration certificate for the calibration of an AWI will also be defined and the reproducibility of methods developed will be confirmed by comparison of dynamic weighing measurements between the partners.

The project will develop error models for the dynamic weighing process for these 3 categories of AWIs and will determine the potential sources of measurement uncertainty for these instruments. Uncertainty budgets for the determination of the uncertainty of measurement for the calibration of AWIs and for the determination of the uncertainty of a weighing result will be developed and will be validated by comparisons and cross-checked with static methods.

Calibration guides based on the methods developed in the project will be prepared for the 3 selected categories of AWIs; automatic catchweighers, automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments and in this way the highest metrological and economic benefits are expected for end-users. EURAMET calibration guides are prepared and published by EURAMET technical committees, therefore the draft calibration guides will be submitted to EURAMET Technical Committee for Mass and related Quantities (EURAMET TC-M) for further approval by EURAMET. The harmonised calibration guidance will also serve as input on the measurement uncertainty evaluation for international organisations such as OIML and the European Cooperation in Legal Metrology (WELMEC), which deal with the conformity decision process for AWIs for legal metrology purposes.

The research in this project is not aimed at improving the dynamic properties of AWIs, which would result in improved characteristics of AWIs and lower measurement uncertainties. The uncertainties and the measurement range will depend on the calibrated AWI itself. In addition, the project does not aim to define specific measuring ranges and measurement uncertainties, which the guidance documents will address. The guides will instead be targeted to provide more general guidance on the calibration of selected groups of AWIs, irrespective of their measurement range. It is expected, that the dynamic properties and other characteristics of the calibrated instruments will influence the measurement uncertainty the most, and not the reference standards used. However, some indicative estimates of the relative measurement uncertainty of the error of indication may be given, namely 0.005 % - 0.05 % for automatic catchweighers, 0.02 % - 0.1 % for automatic gravimetric filling instruments and 0.2 % - 2 % for automatic instruments for weighing road vehicles in motion.

Research potential

Current state of the art

Several EURAMET members and representatives of industry take part in regular modifications and the updating of Guidelines on the Calibration of Non-Automatic Weighing Instruments EURAMET/cg-18. This approach demonstrates significant impact and knowledge transfer of EURAMET activities in this field to national accreditation bodies responsible for accreditation of calibration laboratories for NWAIs. Users of NWAIs profit from EURAMET research activities through having their instruments calibrated by well elaborated and widely recognised calibration methods.

To date there have been no coordinated activities between NMIs in the field of traceability of AWIs operating in the dynamic mode, since the NMIs currently primarily focus on traceability and research in the field of mass standards with a smaller part of these activities being related to NAWI calibration methods. In addition the weighing instruments legal metrology community has not so far launched activities on evaluation of measurement uncertainty related to the automatic instruments and dynamic measurements.

Several emerging EURAMET countries are in the process of transposing the MID into national legislation and they need to increase their expertise and research potential in the field of AWI. Their first aim is related to conformity assessment of these groups of weighing instruments, but there is also a need to develop expertise in this field for the purpose of establishing proper traceability to meet the needs of industry, particularly related to the production and supervision of the mass of pre-packaged products.

Beyond the state of the art

The project will extend the scope of research capabilities of NMIs to the field of dynamic mass measurements by AWIs. The partners with significant expertise in the field of calibration of AWIs or NAWIs are also authorised by their legislation or governments for the conformity assessment of AWIs, which forms the fundamental basis for their research excellence in the field of calibration of dynamically operated automatic weighing instruments.

Collaboration between EURAMET NMIs/DIs that are less experienced in the field of testing or calibration of AWIs with NMIs/DIs with greater experience will develop their metrology research capabilities and in particular their metrological infrastructure for traceable dynamic mass measurements. The partners from emerging EURAMET countries will also be trained, and will cooperate and independently carry out tasks in the project. These capacity building activities will consequently enable development of the calibration infrastructure on lower levels in their countries and will also support proper implementation of the MID and Pre-packages Directives, which are important for free movement of goods within the EU internal market.

In addition, the partners will develop individual strategies for the long-term development of their research capability in dynamic mass metrology including priorities for collaborations with the research community in their country and the establishment of appropriate quality schemes and accreditation (including participation in key comparisons and submission of CMCs to the KCDB). The partners will also develop a strategy for offering calibration services from established facilities to their own country and neighbouring countries. The individual strategies will be discussed within the consortium and with other EURAMET NMIs/DIs, to ensure that a coordinated and optimised approach to the development of traceability in this field is developed for Europe as a whole.

Achieving the project objectives will lead to an improvement in European metrological capability and infrastructure beyond the lifetime of the project. Harmonised and validated reproducible calibration methods and uncertainty evaluation models for AWIs in the form of a EURAMET guide will be available to producers, calibration laboratories and accreditation bodies after conclusion of the project and consequently end-users of AWIs will benefit from traceably calibrated of AWIs operating in the dynamic mode. Finally high level expertise and research capabilities in this field will become available in a number of European NMIs, which will facilitate the transfer of project outputs to stakeholders.

4.6 Section B2: Potential outputs and impact from the project results

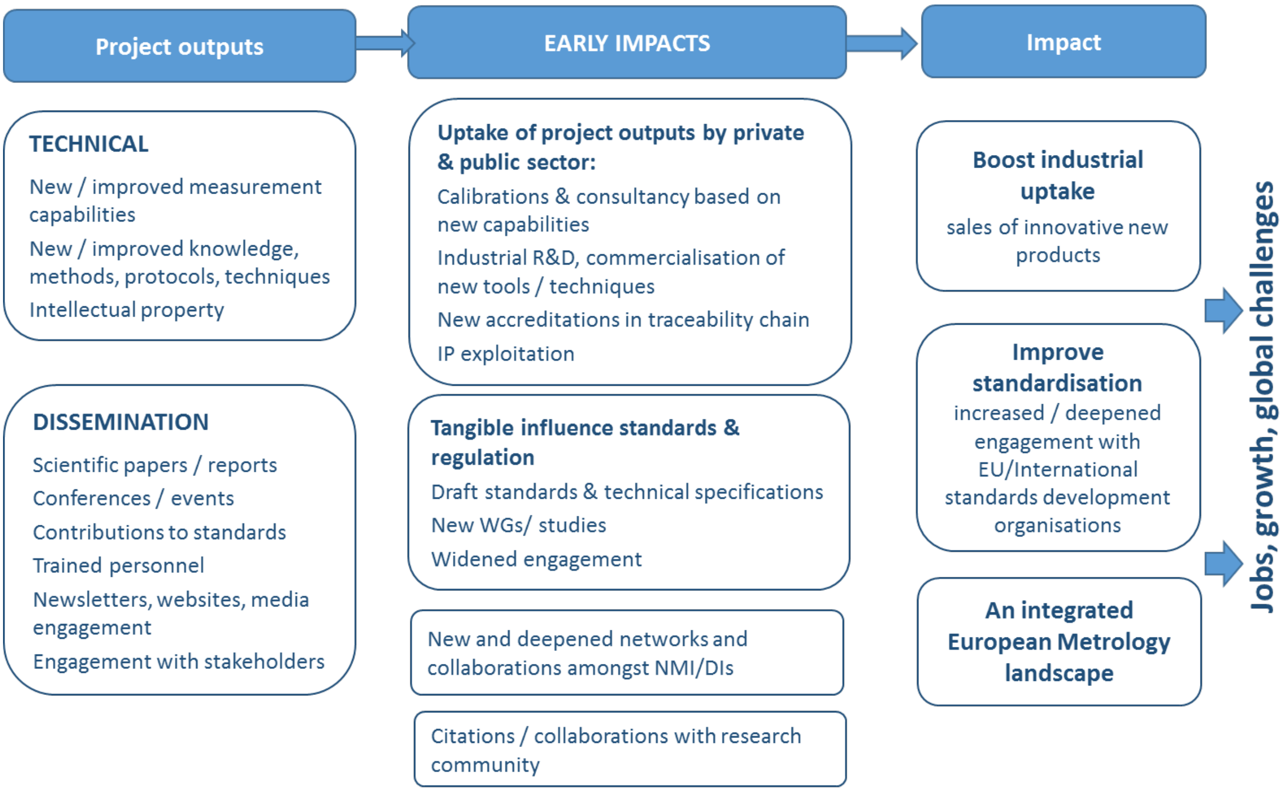
This section is made up of four sub-sections. In Sections B2.a, B2.b and B2.c you should provide details of the **early impacts** (see definition below) in three areas (i) user uptake and use of project outputs amongst industrial and other user communities and (ii) uptake and use by the wider metrological and scientific communities and (iii) improved standards and uptake by the standardisation community, (respectively). Then in Section B2.d describe the **wider economic and social impacts** that your project will contribute to and the routes to facilitate them.

You should describe how your project will make a positive difference to Europe (and internationally) by addressing the needs described in Section B1.d. This should not be a statement of what your project will do (i.e. you do not need in-depth technical details), but a statement of the benefits the project will bring to those who make direct use of the new measurement capabilities (**early impact**) (such as reduced uncertainties, extended measurement ranges, new reference standards, new or improved methods, devices, new knowledge, etc.) and how these early impacts will contribute to the wider economic and societal benefits (**wider impacts**). You should also ensure that the impact you describe can realistically be achieved by your project.

You should clearly explain what the impacts will be and the route to impact. You should clearly explain:

- What the new measurement capabilities will be at the end of the project (**project outputs**) and how these will lead to benefits for the direct users of the new measurement capabilities, and who these direct users will be (**early impact**) (Sections B2.a, B2.b and B2.c)
- How the **early impacts** will lead to wider economic and social benefits (**route to wider impact**) such as such as, improving industrial productivity, mitigating climate change, supporting the implementation EC Directive (Section B2.d)

The early impacts and benefits you describe should be specifically attributable to the outputs and aims of the project.



4.6.1 Section B2.a: Projected early impact on industrial and other user communities

This section is mandatory. It may be less directly relevant for Fundamental projects, but is still required.

The section should be a maximum of 1 page and should describe the direct effect your project will have on the users of the new measurement capabilities e.g. in industry and in the public sector. The early impacts described in this section should relate to the uptake, exploitation and use of project outputs (new measurement capabilities such reduced uncertainties, extended measurement ranges, new reference standards, methods, devices, new knowledge, etc.) by the early users of the project's outputs. These impacts will begin in the short-term, (towards the end of the project and very soon after its completion). The beneficiaries are expected to be the people and organisations in the target user community, with which the project has had direct interactions, such as the project's non-NMI/DI partners, collaborators and stakeholders, advisory board members etc. (particularly those in industrial and other user communities such as organisations that deliver public services such as hospitals, environmental monitoring).

You should describe your expected early impacts including: details of who the organisations are (specific organisations and types of organisations) that will benefit from the new measurement capabilities; which project outputs different types of beneficiaries will benefit from, as well as describing how you will ensure the maximum benefits are achieved. Please ensure that the impact you describe in this section is consistent with the activities in your "Creating impact" work package (see Section CN-1) – however this section should not simply be a description of dissemination activities.

Example 1: Section B2.a: Projected early impact on industrial and other users (Industry project)

The project will develop a range of new pressure-related measurement capabilities at NMIs of direct relevance to industrial communities.

The project will establish a new primary standard and support dissemination of the pressure scale in the intermediate pressure range 1 Pa to 10^4 Pa. This will improve the reliability and accuracy of low gauge, differential and absolute pressure measurements at many levels from NMIs, to accredited commercial laboratories, to the end users. This traceability is the basis for more accurate pressure measurement (e.g. for the cleanroom technologies and processes) and will enable realisation of tighter tolerances of non-equilibrium conditions and, as a consequence, reduce energy consumption and costs without loss of safety, sterility and precision. The project's results should also support the use of more neighbouring zones with individual pressure conditions which will offer new ways for process optimisation. The costs of operations involving toxic and nuclear materials as well as of the storage of environmentally dangerous toxic and nuclear wastes should also be reduced and the safety of these processes increased.

In addition, the project will establish an EU based calibration service that is expected to be competitive to that available in the USA. The calibration service will provide end-users with access to calibrations in the range 0 Pa to 15 kPa absolute pressure with uncertainties at the level of $3{\cdot}10^{-5}{\times}p$ + 5 mPa. This will be realised with state-of-the-art pressure measurement instrumentation such as force-controlled piston gauges with a resolution of 1 mPa. Such conditions will be beneficial for more efficient and safe use of airspace by aircraft, for example through more reliable monitoring of aircraft vertical separation.

Dissemination of traceability from NMIs in the intermediate pressure range will provide access to improved capabilities for national and accredited laboratories in Europe and support consistency in measurement capabilities. Additionally, it will benefit the industrial companies that rely on such calibration services. Information on the calibration services will be disseminated via accredited bodies (for pressure) in Europe, calibration laboratories or, in Germany, via the Deutsche Kalibrierdienst (DKD)/committee of experts for pressure. Transportable medium vacuum range calibration equipment will also be created to provide a calibration service at an end user site.

To facilitate up take of the project's outputs there will be considerable engagement throughout the project with industrial stakeholders including manufacturers of pressure measuring devices as well as end users and calibration laboratories. The participation of industrial partners in the project and the establishment of a Stakeholder Community will also ensure that the project is aligned with industrial needs. In addition at least one international workshop as well as seminars at the national level will be held to share project outputs and engage with the target user communities. Uptake of the new measurement capabilities developed in the project by partners and key stakeholders is expected during and shortly after the project. Early uptake will be among the accredited laboratories and the manufacturers of pressure measuring sensors instrumentation and equipment that relies on pressure measurements such as clean room equipment, process equipment for the energy sector and avionics instrumentation; enabling them to confidently demonstrate the performance of their products and ensuring they remain internationally competitive.

Finally, the project will create preconditions for the replacement of mercury-containing pressure-measuring instruments with mercury-free alternatives. The results will be provided to policy makers and stakeholders in European industry including the CCM Pressure Working Group, IMEKO TC 16, the project Stakeholder Committee and pressure subcommittees of the RMOs, weather monitoring and forecast services and airlines.

4.6.2 Section B2.b: Projected early impact on the metrological and scientific communities

This section is mandatory. It should be a maximum of half a page in length and should describe the direct impact your project will have on the metrological and scientific communities.

In the metrological community, early impacts will include contributions to advances in the SI system, important inputs to high-level metrology committees such as the Consultative Committees, and/or changes (or proposed changes) to NMI/DI Calibration and Measurement Capabilities (CMCs) statements recorded in the BIPM Key Comparison Database (KCDB). In the scientific community, early impacts will include significant or widespread use of the project's outputs by the scientific research community, as indicated, for example, by highly cited publications or further significant collaborations with the scientific community. Please ensure that the impact you describe in this section is consistent with the activities in your "Creating impact" work package (see Section CN-1).

Example 1: Section B2.b: Projected early impact on the metrological and scientific communities (Industry project)

Based on the project results, a recommended *mise en pratique* for assuring traceability in the range 1 Pa - 15 kPa using force-balanced piston gauges in both absolute and gauge mode will be derived. This will significantly impact on calibration laboratories, as intervals and intermediate checks differ widely between laboratories and the evaluation of uncertainties during assessment requires a common understanding and general principle for assuring traceability. The recommendation is to be presented to the accreditation authorities in Europe as well as to end users and manufacturers of force-balanced piston gauges.

In the area of the force-balanced piston gauges (FPGs), knowledge transfer from experienced NMIs to those less experienced in how to use this new type of instrument will be very beneficial. It will help to raise their knowledge and measurement capabilities and will promote consistency within pressure metrology. On a broader scope, the project will strengthen the collaboration of European NMIs and will increase their competitiveness with NMIs outside Europe. Secondary accredited commercial laboratories will also gain a better calibration service from the European NMIs which will avoid high costs and associated downtime associated with the calibration of their standards abroad and will increase their calibration capabilities. In particular, uncertainties and calibration techniques when using FPGs will be investigated and recommendations for ensuring the traceability of measurements with FPGs in the range 1 Pa - 15 kPa will be produced. A draft calibration guide for using FPGs in both absolute and gauge mode will be produced and submitted to EURAMET for publishing as a EURAMET calibration guide.

Improved calibration methods for positive and negative gauge pressure standards in the range from approximately -100 kPa to 15 kPa will be developed. A EURAMET calibration guide for positive and negative gauge pressure standards will be drafted that will describe different calibration systems, conditions under which they are to be operated, procedures to be followed, uncertainties aimed at and the best working practices. The draft guide will be submitted to EURAMET and made available to end users.

Research papers will also be submitted for publication in high impact peer-reviewed journals and as part of the knowledge transfer a workshop on intermediate pressure measurement will be organised and held, to which representatives of industry (both manufacturers and users), academic and NMIs will be invited.

4.6.3 Section B2.c: Projected early impact on relevant standards

This section is mandatory. It may be less directly relevant for Fundamental projects, but is still required.

The section should be a maximum of 0.5 page (excluding the table) and should describe the early impact your project will have on relevant documentary standards. These standards should be at a European or International level and may be standards developed and published by formal standards developing organisations (such as ISO, CEN, OIML etc.) or important well-recognised industry standards (such as those developed by IEEE, etc.). If a standard has been mandated by the European Commission (usually in support of an EC Directive) or is a critical need specified by an industry body this should be noted (and references provided).

Early impact should be described in terms of expected tangible contributions to specific new or improved standards (or draft standards) that the project will contribute to. You should identify the most important documentary standards and the organisations/standards bodies/committees that will provide the **most likely route to delivering impact** and which will be the focus of the project's research and dissemination activities regarding standards. It is also important to consider which standards are in need of updating or improvements and are due to be updated in the next 2 to 4 years (i.e. where the project can deliver impact).

You should indicate;

- Whether your consortium has existing links with the organisations/standards bodies/committees
- Whether your consortium plans to build new links to organisations/standards bodies/committees
- Which partners are involved and what they plan to do

Please ensure that the impact you describe in this section is consistent with the activities in your "Creating impact" work package (see Section CN-1).

Example 1: Section B2.c: Projected early impact on relevant standards (Industry project)

The project will have an impact on the Commission Regulation (EU) No 847/2012 of 19.9.2012 which restricts the use of mercury in barometers and sphygmomanometers for industrial and professional use. The project will have a significant positive impact on the execution of the Regulation by providing equivalent alternative pressure standards. It will also support the reduction in the number of mercury-containing pressure-measuring devices in Europe without any associated disadvantages for industries currently using mercury manometers.

In addition, the consortium will promote the results of the project within the standardisation community and will provide input into the standardisation process (ISO, CEN, and EA). For ISO, the standards relevant to the project that are in preparation/revision will be identified, and the work on these standards will be suggested to the appropriate working groups or committees. However, this process can be very lengthy and will extend beyond the duration of this project.

The partners who are members of corresponding technical committees will inform them about the results of this project and will endeavour to ensure they are incorporated in any updates to the standards or guidelines (see table below). For example, the representatives on the corresponding committee or working group from the project partners will jointly ask the chairperson to include a point in the agenda to briefly present the outputs of the project related to the working group activities and ask for comments to the other committee/working group members. Where appropriate a written report will be submitted for consideration by the committee or working group.

Standards Committee / Technical Committee / WG	Partners involved	Likely area of impact / activities undertaken by partners related to standard/committee
EURAMET TC-M	**BBB**, AAA, CCC, DDD, EEE, FFF, GGG, HHH, III, KKK, LLL	EURAMET TC-M meets annually in February-March. At the next meeting in 2016, the TC-M will be informed about ongoing activities in the project. A draft of a guideline for calibration of force-balanced piston gauges will be presented at TC-M meeting in 2017 and recommendations for negative gauge pressure measurements in 2018.

CCM WG P	**AAA,** BBB, CCC, DDD, EEE, FFF, GGG, HHH, III, KKK, LLL	CCM WG P (Pressure) usually meets every 3 years with the next meeting expected in 2017. CCM WG P will be informed about experience of negative gauge pressure measurements, alternative methods and results of supplementary comparisons. Based on this information, it will be discussed to include negative pressures in the list of key comparisons. Information on potential transfer standards based on CDGs and force-balanced piston gauges gained within the scope of the project will be provided to CCM WG P to be taken into account in the organisation of future key comparisons.
COOMET TC 1.6 "Mass and related quantities"	**BBB**	COOMET TC 1.6 meets annually in September-October. At the next meeting in 2015, the COOMET TC 1.6 will be informed about ongoing activities in the project. Based on the new measurement capabilities developed within the project, it will contribute to the activities of COOMET TC 1.6 on the standardisation of measurement methods for saturated vapour pressure of oils and oil products.
DIN NATG-D Standard Committee Technical Basics - pressure, flow, temperature	**BBB**	BBB has been involved in this committee for several years and will attend committee meetings to disseminate the outputs of the project particularly in relation with the revision of standards DIN EN 13190 and DIN EN 837.
IMEKO TC 16 "Pressure and Vacuum Measurement"	**CCC**, AAA, BBB, DDD, FFF, GGG, HHH, III	IMEKO TC 16 meets every 2 to 3 years in connection with TC conferences and IMEKO World Congresses. CCC is the Scientific Secretary of the IMEKO TC 16. Most project partners are members of TC 16 and will take part in the TC 16 meeting and the next IMEKO World Congress to be held in Prague in September 2015 and disseminate information about the ongoing project.

4.6.4 Section B2.d: Projected wider impact of the project

This section should help the referees understand why your project is important and should be a maximum of 1.5 pages. You should describe the wider (i.e. longer-term) impacts that your project will contribute to and the routes to facilitate them (i.e. the links between the early impacts and the wider impacts).

For the wider impacts, please explain the **economic, social and environmental** impact that your project will make across Europe (and internationally). Where possible quantify each of the impacts numerically. You should also provide details of who will benefit from the project, and which aspects of the project each stakeholder group will benefit from.

If your project is expected to contribute to wider impact through EC Directives, regulations and/or legislation, you should provide details of this. Finally, describe how you will ensure that the maximum benefits and impact is achieved by your project.

Example 1: Section B2.d: Projected wider impact of the project (Industry project)

Economic impact:

By improving the pressure scale at the NMI level for low gauge, absolute and differential pressures this project will provide a better measurement capability. In combination with new calibration methods, a more adequate dissemination of the unit “pressure” will also be obtained. Further to this, European calibration laboratories and industry should be able to engage with the new calibration services and to have their instruments calibrated within Europe without the need to send their devices to the US. This will meet the demand of industry to obtain high accuracy calibration services in Europe, whilst making calibrations less time consuming and expensive.

The following industries will benefit directly from smaller uncertainties for low gauge, absolute and differential pressure measurement:

- The clean room condition is directly affected by smaller uncertainties of pressure measurement. To establish clean room conditions in e.g. pharmaceutical, semiconductor or nanotechnology industries different zones are separated by different local ambient pressure levels which prevent contaminated air entering a critical zone. With smaller uncertainties in pressure measurements, smaller pressure differences between these zones are possible which enables the use of more zones at a time but with the same resources in terms of energy and costs. This will make new more efficient, complex and energy saving clean room productions possible.
- In power plants, smaller uncertainties for low gauge, absolute and differential pressure measurement are relevant for safety, efficiency and costs. Such safety systems help to identify environmentally harmful or toxic leakage and prevent pipes or vessels from bursting. In this way they also protect the infrastructure and the environment. Therefore efficiently controlled processes using measurands that avoid non-optimal operating conditions, will be more efficient, less cost intensive and avoid the production of unwanted by-products.
- Steadily increasing numbers of aircraft within European airspace have made it necessary to reduce the standard vertical separation (RVSM) between aircraft from 600 m to 300 m. Avionic altimeters use absolute pressure measurement for height detection, but only specially certified altimeters and autopilots are allowed to enter the RVSM airspace, and these need to be calibrated traceably to the SI via NMI standards. In the future, an even more intensive usage of the airspace will consequently increase the need for smaller uncertainties of low absolute pressure measurements.

Environmental impact:

The European mercury strategy [amendment of Annex XVII to Regulation (EC) No 1907/2006 by Commission Regulation (EU) No 847/2012 on 19/9/2012] restricts the use of mercury in barometers from 10 April 2014 which is an issue for research institutions and reference laboratories in the avionic industry and weather monitoring and forecast services, which all use mercury barometers. Many European NMIs also realise the pressure scale for low gauge, absolute and differential pressures using mercury based liquid column manometers and these devices usually contain 6 kg to 10 kg of mercury. Therefore, a new primary standard, using alternative manometric liquids such as oil, will fulfil the EU demands and reduce the risk of accidental environmental pollution by mercury.

Social impact:

As mentioned, many industries such as pharma-biotech, semiconductor, micro- and nano-technology, petrochemical, aviation, energy production, weather monitoring and forecast services will benefit from the project's output and this should strengthen the European industrial infrastructure for the development of new services and products (that rely on pressure). As a wider impact, Europe's innovative capacity should be increased, leading to higher employment and wealth for society. Finally, the project will improve collaboration between European NMIs, in particular, between smaller/less experienced NMIs and more experienced NMIs.

4.6.5 Section B2.e: Data management

For EMPIR call 2017 onwards, the Grant Agreement will contain conditions related to open access to research data. Projects that 'opt-in' will be required to prepare a Data Management Plan (DMP) which will describe the data management plans for all of the data sets that will be collected, processed or generated by the project.

Please note that even if projects 'opt-in' to having a DMP they will not be required to open up all of their research data. The DMP applies primarily to the data needed to validate the results presented in scientific publications.

The use of a DMP is obligatory for all projects that do not 'opt-out'. Projects can opt-out on the following grounds:

- Incompatibility with the Horizon 2020 obligation to protect results that are expected to be commercially or industrially exploited
- Incompatibility with the need for confidentiality in connection with security issues
- Incompatibility with rules on protecting personal data
- Incompatibility with the project's main aim
- If the project will not generate / collect any research data, or
- If there are other legitimate reasons not to provide open access to research data

Further information on DMPs is available in the EMPIR Reporting Guidelines Part – 9 Preparing data management plans and in Reporting Template 9 – Data Management Plan.

A proposal will not be evaluated more favourably if the consortium agrees to share its research data, nor will it be penalised if it opts-out.

The consortium's approach to research data management should be detailed in section B2.e for projects that both opt-in and opt-out, and should include the following issues:

- How will data be exploited and/or shared/made accessible for verification and reuse? If data cannot be made available, why?
- What standards (including data security and ethical aspects) will be applied?
- How will data be selected, managed and preserved?

You must state whether your proposal will 'opt-in' or 'opt-out' and explain why. This section should be a maximum of 1 page.

Example 1: Section B2.e: Data management (opt-in)

The project chooses to 'Opt-in' to the open access data requirement.

The consortium has chosen to opt-in as the deliverables and/or outputs from the project include publications in peer reviewed journals. Thus, for these to be disseminated as widely as possible and used by as many stakeholders as possible, the data should be freely accessible. Furthermore, the consortium intends the outputs of the project to be adopted and up taken by as many end users as possible. Therefore as the consortium includes NMIs/DIs who will generate data sets which can be considered traceable to the SI, these data sets should be available to other organisations for use in tests and validation.

The project will make its research data Findable, Accessible, Interoperable and Reusable (FAIR) in order to ensure that it is soundly managed. The consortium will produce a suitable Data Management Plan (DMP) which will describe the data management plans for all of the data sets that will be collected, processed or generated by the project. The DMP will cover the following aspects:

- the handling of research data during and after the end of the project;
- specification of the data that will be collected, processed or generated;
- the methodology and standards (including data security and ethical aspects) that will be applied;
- plans for data curation and preservation (including after the project).

An outline DMP will be created within the first month of the project and agreed by the consortium. The consortium intends prepare a first draft of the DMP for discussion at the project kick-off meeting. Each subsequent project meeting will include an agenda item on the DMP.

The consortium agrees to deposit its open access data sets in suitable repositories. These will be located by the consortium using the Registry of Research Data Repositories (http://www.re3data.org/). Possible examples include Zenodo (https://zenodo.org/), which will allow the consortium to deposit both publications and data, and the EUDAT B2SHARE tool (https://b2share.eudat.eu/) which includes a license wizard for data licence selection.

In order to follow current best practice on data management further information will be obtained by the consortium from the Digital Curation Centre (http://www.dcc.ac.uk/dmponline), ScienceMatters (https://www.sciencematters.io/) and the Research Data Alliance (http://rd-alliance.github.io/metadata-directory/). The project will also seek to follow current best practice guidance on open data such as that from the Open Data Institute (https://theodi.org/).

As a minimum, the consortium will ensure that the data selected for open access:

- can be linked to and is available in a standard, structured format (e.g. JSON, XML, ASCII or TIFF), so that it can be easily shared;
- is consistently availability over time, so that end users can reliably use it;
- is stored self-descriptively or with a link to the publication/document (e.g. identified with a DOI) that accurately describes the data format and parameters used.

The selection of data to be openly accessible will be made on a case by case basis and agreed by the consortium. This will include ethical aspects and data security such as for the protection of IP for any project outputs that are considered to be commercially exploitable. In such cases, it may be necessary to withhold all or some of the data generated. This will be decided by the relevant partner(s) and managed by the DMP, the Consortium Agreement and if appropriate the project's exploitation plan.

Example 2: Section B2.e: Data management (opt-out)

The project chooses to 'Opt-out' to the open access data requirement.

The consortium has chosen to opt-out because of incompatibility with the Horizon 2020 obligation to protect results that are expected to be commercially or industrially exploited.

The consortium believes that the protection of innovative research at an early stage or, more generally, IP protection, is a way the EU can grow and compete with non-EU economies. As the project is of fundamental nature and has the potential to lead to genuine innovation regarding novel theoretical models, experimental solutions and the design and fabrication of artificial materials, all data produced within the project should not be disclosed by default, even if it only relates to the validation of the results presented in the scientific outputs. In fact, the validation data or methods can themselves be very valuable and subject to potential IP protection.

However, all scientific publications generated within the project will be submitted to scientific journals as open access (as per EMPIR/Horizon 2020 requirements). Additionally, if required by a specific journal, or deemed useful for the broader scientific community, data obtained from the experiments or numerical computations can be made available on the publisher's website.

Furthermore, all partners agree on the importance of having a Data Management Plan (DMP), and a DMP will be maintained by the coordinator and updated as required. The consortium will produce a suitable DMP which will describe the data management plans for all of the data sets that will be collected, processed or generated by the project. The DMP will cover the following aspects:

- the handling of research data during and after the end of the project;
- specification of the data that will be collected, processed or generated;
- the methodology and standards (including data security and ethical aspects) that will be applied;
- plans for data curation and preservation (including after the project).

The DMP will be set up at the beginning of the project and agreed by the consortium. The consortium intends prepare a first draft of the DMP for discussion at the project kick-off meeting. Each subsequent project meeting will include an agenda item on the DMP.

4.7 Section B3: The quality and efficiency of the implementation

4.7.1 Section B3.a: Overview of the consortium

This section should be a maximum of 1.5 pages for proposals with 15 partners or less (up to 20 partners a maximum of 2 pages, and up to 25 partners a maximum of 2.5 pages) and should explain how the consortium brings a balance of skills and high quality experience to the project. You should explain how your consortium makes the best use of the available capabilities and if there are any duplicated skills or facilities between your partners, you must justify this. Similarly if a few partners dominate particular parts of the project this should be explained.

You must explain the contribution of all partners on a partner by partner basis, even if they have a small role in the project. Please do not name individual people or include collaborators.

Example: Section B3.a: Overview of the consortium

The consortium brings together the leading European NMIs and DIs in high-accuracy pressure metrology, and they are complemented by a number of research institutes and companies that bring in their specific knowledge and experience. In total, 9 NMIs/DIs, 3 universities and 1 company are included.

- BBB has expertise operating liquid column micromanometers, mercury manometers and micromanometers, force-balanced piston gauges of Furness Rosenberg Standard (FRS) type, static and continuous expansion systems, state-of-the-art density measurement capability, used e.g. in the Avogadro project, and facilities for dimensional measurements on piston-cylinders, modelling the rarefied gas flow in the piston-cylinder gap, application of optical methods for dynamic vacuum measurements. Further to this BBB has experience in coordinating previous pressure-related EMRP projects (JRP IND99 MEASURE).
- AAA has experience operating force-balanced piston gauges (FPG) of 8601 type, possesses a continuous expansion system covering the pressure range up to 3 Pa, and has expertise in the adjustment of the piston in cylinder by a capacitance measurement method and in weather-independent pressure calibration approaches, calibration and measurement of low pressures using CDGs.
- CCC has facilities in the intermediate pressure-to-vacuum range, such as a primary mercury column, a force-balanced piston gauge, a static and a dynamic expansion systems. These capabilities are important in the characterisation of pressure standards for use as alternatives to mercury manometers.
- DDD can calibrate force-balanced piston gauges against state-of-the-art pressure balances operated in gauge and absolute pressure mode. In particular it has experience in the measurement of negative gauge pressure by different methods and has piloted comparisons of negative gauge pressure measurements. DDD also has experience in standardisation work and thus the development of recommendations and norms for negative gauge pressure calibrations.
- EEE has a background in laser spectroscopy of atoms notably with atomic beams and vapour cells for tests of fundamental physics, measurement of fundamental constants and surface physics related to mass standards. It also supervises work on flow metrology and collaborates in projects related to the measurement of the Boltzmann constant via acoustic thermometry. EEE has capability in the assessment of methods for negative gauge pressure calibration as well as the evaluation of alternative pressure standards.
- FFF has primary standards in the intermediate pressure-to-vacuum range such as pressure balances, non-rotating piston gauges of FPG- and V1600D-type, static and continuous expansion systems, facilities and expertise in liquid density measurements. FFF will contribute to the experimental study of force-balanced piston gauges as secondary standards, development and characterisation of transfer standards for the intermediate pressure range and analysis of oils suitable for liquid column micromanometers.
- GGG has pressure balances, force-balanced piston gauges of FPG and FRS type, a static expansion system as well as a measurement capability of refractometric index of gases using Fabry-Perot techniques which can be used for the investigation of alternative systems for pressure measurement by optical methods in the range 1 Pa to 104 Pa. Having close contacts with related industries, GGG will coordinate engagement with industries that utilise pressures in the intermediate range from 1 Pa to 104 Pa and facilitate the uptake of the technology and measurement infrastructure developed by the project.
- HHH has facilities for measurement of density of oils at variable gas saturation conditions and pressures, as well as for measurement of oil viscosity with the uncertainty levels that meet the requirements of the oil micromanometer to be developed within WP1.
- III has special facilities and experience in measuring kinetics of gas absorption and desorption which are required to study potential manometric oils and to predict their density dependence on gas pressure change and time. III has low absolute and gauge pressure standards which will be used for the characterisation of CDGs in the range from 10 Pa to 100 kPa.
- JJJ has expertise in modelling gas flow in the viscous, transient and molecular regimes based on the Direct Simulation Monte Carlo (DSMC) method and approximations based on the Boltzmann kinetic equation. This knowledge is required for analysis and primary characterisation of the force-balanced piston gauges.
- KKK has experience and instrumentation for vacuum generation and measurement, leak testing and vacuum technology, high vacuum gauges calibration, reference leak calibration and leak testing. The measurement capabilities of KKK are useful for the development and characterisation of transfer pressure standards in the intermediate pressure range to be carried out within WP4.
- LLL possesses a force-balanced piston gauge of FPG type and has their specific dimensional measurement techniques and methodology for the effective area calculation which will be applied to characterise their FPG as a primary pressure standard.
- MMM is a worldwide company providing calibration facilities and service for pressure and vacuum to global leaders in industries such as aerospace, automotive, chemical, electronics, energy, pharmaceutical and telecommunications. MMM's participation in the project is important for producing impact in industries that utilise pressures in the intermediate range from 1 Pa to 10^4 Pa and for facilitating the uptake of the technologies and measurement infrastructure developed by the project.

4.8 *Section C: Detailed project plans by work package*

This section should describe the technical work planned to meet the scientific and technical objectives described in Section B1.b and to deliver the summary list of deliverables in Section B1.c.

Your proposal must contain:

- A maximum of 5 technical work packages.
- 1 "Creating impact" work package (mandatory).
- 1 "Management and coordination" work package (mandatory).

PLEASE NOTE that each work package should have a clear aim, be suitably challenging, and explain how the research goes beyond the current state-of-the-art. Each work package should also demonstrate that the project is collaborative, and therefore should usually have a good balance of partners. In addition, unless stated, it is expected that the activities within the work packages will be carried out using the equipment available at the project partners and under their supervision.

Please do NOT include any photographs, diagrams or lists of references in Section C. Lists of references should only be included in Sections E and G, as appropriate (see Sections 4.13 and 4.15).

4.8.1 Special case of similar work in proposals

In previous Calls there have been occasions where projects addressing different SRTs require similar work. In such cases, you should treat the work as part of your own project, but you should also identify in the relevant tasks where there is synergy with another proposal. Should both projects be selected for funding the overlapping work in each of the projects will be examined and an appropriate resolution will be reached to avoid double funding. It would therefore simplify grant preparation if you design the work in such a way that the potential duplicate work could be removed with minimal changes.

4.8.2 Section C1: Technical work packages

You should choose a suitable and concise title that describes the work in the work package. Then provide a brief overview of the work package, which is a maximum of half a page and includes;

- The aim of the work package, including target uncertainties and ranges (where appropriate),
- A brief overview of the background for the work package and tasks,
- How the tasks of the work package fit together and the task aims. PLEASE NOTE that the task aims must match those stated in each task.

4.8.3 Section C1.a: Technical tasks

You should choose a suitable and concise task title that describes the work/aim of the task. Then describe the aim of the task including the target uncertainties. This should be a maximum of 2 short paragraphs ONLY.

For each task use the activity table format in Template 4: JRP protocol. Using this table, describe the activities that will be undertaken and the role of each partner in the activity. You should include target uncertainties, the number of samples, parameters and selection criteria etc. Where an activity relies on input from another activity, the text should include reference to that dependency. You should also include the end date of each activity e.g. M15, under the activity number in the first column (these dates replace information that was previously included in the 'Summary list of all activities'). Activities should be scheduled so that all necessary inputs will be available in time. All partners involved in the activity should mentioned in the activity text and listed in the appropriate column, with the lead partner in bold.

For each deliverable in Section B1.c you need to include an activity for the submission of the completed deliverable to EURAMET.

Finally, if a Linked Third Party is included in your project, they should not be mentioned in the activities. Instead, a sentence similar to "The Linked Third Party NNN will work with partner BBB on this task." should be included under the activities table.

Example 1: Technical tasks (Industry project)

Task 3.1: Development of methods for accurate, weather-independent calibration of low gauge pressure instruments

Frequently, the calibration uncertainty for gauge pressure measuring instruments is much larger than the accuracy of the instruments themselves and the uncertainty of the reference standard, due to the instability of the atmospheric pressure. Therefore, the aim of this task is to develop methods for the accurate calibration of instruments that measure low gauge pressure in such a way that results are independent of ambient atmospheric conditions and provide a measurement uncertainty in industrial conditions better than $2\ 10^{-4} \times p$ + 3 Pa.

Activity number	Activity description	Partners (Lead in bold)
A3.1.1 M11	CCC will carry out tests of reference atmospheric pressure stabilisation when calibrating an existing precision gauge pressure measuring instrument against an existing FPG. A hermetic chamber capable of enclosing both the FPG and the calibrated gauge will be used. The calibration results as well as the pressure fluctuation records will be compared by CCC with those obtained under normal/ambient laboratory conditions.	**CCC**
A3.1.2 M18	BBB will carry out tests with a variable volume chamber that is open to the atmosphere or controlled by a pressure controller and used as a source of ambient reference pressure. BBB will use the variable volume chamber to calibrate an existing precision gauge pressure measuring instrument against an existing FRS piston gauge. The calibration results as well as the pressure fluctuation records will be compared by BBB with those obtained under normal/ambient laboratory conditions.	**BBB**
A3.1.3 M22	III will build sensors and electronics that are hermetically sealed and backfilled with nitrogen, in order to prevent humidity influencing the sensor signals. III will provide the sensors and electronics to CCC, who will test the performance of the new sensors and electronics at variable conditions using their hermetic chamber. CCC will provide the results of the tests to III as a statement of the capability of the sensors and electronics.	**CCC**, III
A3.1.4 M24	Using input from the tests in A3.1.2-A3.1.3, EEE will analyse the influence of environmental conditions and their uncertainty on low gauge pressure instruments. From the results EEE will design appropriate methodology (including a pressure circuit) for calibrating low gauge pressure measuring instruments independently of the environmental conditions and with a measurement uncertainty in industrial conditions better than $2\ 10^{-4} \times p$ + 3 Pa. EEE will provide the methods to BBB, CCC and III who will review and agree them.	**EEE**, BBB, CCC, III
A3.1.5 M24	CCC, BBB, EEE and III will review the calibration methods from A3.1.4 and will send them to the coordinator. Once the calibration methods have been agreed by the consortium, the coordinator on behalf of BBB, EEE and III will then submit them to EURAMET as **D3**: '*Calibration methods for accurate, weather-independent calibration of low gauge pressure instruments with an uncertainty in industrial conditions better than 2* $10^{-4} \times p$ *+ 3 Pa*'.	**CCC**, BBB, EEE, III

Example 2: Technical tasks (Research Potential project)

Task 2.2: Inter-laboratory comparison of calibration of AWIs

The aim of this task is to organise and perform the first set of international inter-laboratory comparisons in the field of AWIs. The results from the inter-laboratory comparisons will be used to check the reproducibility of the draft calibration methods and uncertainty budgets developed in Tasks 1.1 and 1.2 for the calibration of the 3 selected categories of AWIs automatic catchweighers, automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments.

Activity number	Activity description	Partners (Lead in bold)
A2.2.1 M19	CCC and KKK will liaise with the collaborators (most probably XXX, Turkey) and will obtain confirmation from them that their AWI facilities (automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments) will be available for the intercomparisons in A2.2.4 and A2.2.5. MMM will provide access to one of their automatic catchweighers for the intercomparison in A2.2.3. CCC, KKK and MMM will determine the requirements for access to each of the facilities. In the event that one or more of the facilities is not available, CCC, KKK and MMM will liaise with the other partners in this task to arrange one or more alternative location for the tests.	**CCC**, KKK, MMM
A2.2.2 M21	Using the inputs from Tasks 1.1 and 1.2 (calibration methods from A1.1.2, A1.1.3 and A1.1.4, and measurement uncertainty budgets from A1.2.2, A1.2.3 and A1.2.4), CCC, BBB, KKK and III will jointly develop a general technical protocol and measurement report template, which will be applicable for the intercomparisons of the calibration of the 3 categories of AWIs: automatic catchweighers, automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments.	**CCC**, III, BBB, KKK

A2.2.3 M27	Using input from the general technical protocol and measurement report template from A2.2.2, BBB and MMM will develop a detailed technical protocol and measurement report template for the intercomparison of the calibration of automatic catchweighers. The methods and scheduling for the comparison will be based on the partners' experience with inter-laboratory comparisons in the field of NAWIs, but will take into account the conditions typical for the dynamic mode of operation (speed/rate of operation, properties of weighed articles, dynamic setting parameter, etc.). For each category of AWI all partners in the activity will perform their measurements on the same AWI. MMM will provide access to one of their stable automatic catchweigher for the intercomparison. BBB, PPP, CCC, III, SSS, KKK and MMM will each perform a complete set of measurements on the automatic catchweigher according to the technical protocol. Each participant will produce a measurement report and a calibration certificate according to A1.3.2. The data will be analysed and a Draft A of the final report on the interlaboratory comparison of the calibration of automatic catchweighers, including a statement on the reproducibility of the methods, will be prepared by BBB. The report will be agreed with the partners and a Draft B version of the report produced. The agreed comparison report will be provided as input to A1.3.2 and used to update the draft calibration method, errors model and measurement uncertainty budget, as necessary.	**BBB**, PPP, CCC, III, SSS, KKK, MMM
A2.2.4 M27	Using input from the general technical protocol and measurement report template from A2.2.2, CCC and SSS will develop a detailed technical protocol and measurement report template for the intercomparison of the calibration of automatic instruments for weighing road vehicles in motion. In cooperation with a collaborator (probably XXX), CCC will arrange access to a stable automatic instrument for weighing road vehicles in motion. CCC, PPP, GGG, III and SSS will each perform a complete set of measurements according to the technical protocol. Each participant will produce a measurement report and a calibration certificate according to A1.3.3. The data will be analysed and a Draft A of the final report on the interlaboratory comparison of the calibration of automatic instruments for weighing road vehicles in motion, including a statement on the reproducibility of the methods, will be prepared by CCC. The report will be agreed with the partners and a Draft B version of the report produced. The agreed comparison report will be provided as input to A1.3.3 and used to update the draft calibration method, errors model and measurement uncertainty budget, as necessary.	**CCC**, PPP, GGG, IIII, SSS
A2.2.5 M28	Using input from the general technical protocol and measurement report template from A2.2.2, KKK and CCC will develop a detailed technical protocol and measurement report template for the intercomparison of the calibration of automatic gravimetric filling instruments. In cooperation with a collaborator (probably XXX), KKK will arrange access to a stable automatic gravimetric filling instrument. KKK**,** CCC, III and RRR will each perform a complete set of measurements according to the technical protocol. Each participant will produce a measurement report and a calibration certificate according to A1.3.4. The data will be analysed and a Draft A of the final report on the interlaboratory comparison of the calibration of automatic gravimetric filling instruments, including statement on the reproducibility of the methods, will be prepared by BBB and III. The report will be agreed with the partners and a Draft B version of the report produced. The agreed comparison report will be provided as input to A1.3.4 and used to update the draft calibration method, errors model and measurement uncertainty budget, as necessary.	**KKK,** CCC, III, RRR
A2.2.6 M29	CCC, PPP, GGG, III, SSS, RRR, BBB, KKK, and MMM will review the reports from A2.2.3, A2.2.4 and A2.2.5 and will send them to the coordinator. Once the calibration methods have been agreed by the consortium, the coordinator on behalf of PPP, GGG, III, SSS, RRR, BBB, KKK, and MMM will then submit them to EURAMET as **D4** *'Reports for the interlaboratory comparisons of the calibration of automatic catchweighers, automatic instruments for weighing road vehicles in motion and automatic gravimetric filling instruments'*.	**CCC**, PPP, GGG, III, SSS, RRR, BBB, KKK, MMM

Example 3: Technical tasks (SI Broader Scope project)

<u>Task 1.1 Evaluation of the properties of materials for use as mass transfer standards to disseminate the unit of mass</u>

The aim of this task is to evaluate the properties of at least 7 materials to assess their suitability for use as mass standards to disseminate the unit of mass from the new primary realisations. The materials will be evaluated for the properties required when used in the primary realisation experiments and as primary standards for the dissemination of the redefined unit of mass. The density, hardness, magnetic permeability and surface sorption characteristics of the materials (in increasing order of importance) will determine which are the most suitable.

Activity number	Activity description	Partners (Lead in bold)
A1.1.1 M4	The homogeneity and cleanliness of at least 7 materials will be evaluated by analysis of the topography using AFM (CCC, EEE), Perthometer (FFF) and SEM (DDD) and by analysis of the surface chemistry using XPS (EEE, FFF) and TDS (BBB). Potential materials include the platinum-iridium alloy currently used for primary mass standards, pure iridium, gold platinum alloy, stainless steel, (SS), Ni-based superalloy and single crystal tungsten	**CCC**, EEE, DDD, FFF, BBB
A1.1.2 M10	Using the same 7 materials from A1.1.1, BBB and CCC will perform heat treatment cycles over a range of durations and temperatures (a minimum of four cycles over a typical temperature range 20 °C - 120 °C for a few minutes to several hours) and then evaluate the growth of oxide layers.	**BBB**, CCC
A1.1.3 M16	FFF and AAA will evaluate the mechanical resistance and adherence of overlayers by indentation in order to evaluate the efficiency of the protective layers on the 7 materials from A1.1.1.	**FFF**, AAA
A1.1.4 M18	Following the heat treatment of the 7 materials in A1.1.2, CCC and FFF will evaluate the static charge accumulation and retention on silicon artefacts.	**CCC**, FFF
A1.1.5 M20	Using input from the evaluations of the 7 materials in A1.1.1-A1.1.4, a report will be written, led by CCC with contributions from AAA, BBB, DDD, EEE and FFF, on the properties of the 7 different materials and their suitability for use as mass standards to disseminate the unit of mass from the new primary realisations. The report will include recommendations on the most suitable materials.	**CCC**, AAA, BBB, DDD, EEE, FFF

Task 1.2: Comparison of production techniques for high quality surface finishes

The aim of this task is to test and compare production techniques used to produce high quality surface finishes for mass standards, in order to select the most efficient technique according to the material used. The finishing processes to be considered include: lapping and mechanical polishing; mechanical polishing; chemical polishing and diamond turning. A comparison of the production techniques will be made with particular reference to the surface finish which can be achieved.

Activity number	Activity description	Partners (Lead in bold)
A1.2.1 M7	AAA, EEE and CCC will produce samples with high quality surface finishes using lapping, mechanical polishing and diamond turning.	**AAA**, EEE, CCC
A1.2.2 M19	Using the samples from A1.2.1, the surface finish of the samples will be evaluated by AFM (BBB, FFF), Perthometer (AAA), optical roughness meter (CCC) X-ray reflectometer (CCC) and white light interferometry (EEE). Based on the results of this evaluation, a report will be produced by BBB with support from FFF, CCC, AAA and EEE.	**BBB**, FFF, CCC, AAA, EEE
A1.2.3 M21	Using input from A1.2.2, AAA with support from BBB, FFF, CCC and EEE will produce a flow chart for the selection of the optimised finishing technique depending on the material.	**AAA,** BBB, FFF, CCC, EEE

Task 1.3: Production of artefacts for use as mass transfer standards to disseminate the unit of mass

The aim of this task is to produce a range of artefacts for use as mass transfer standards to disseminate the unit of mass from primary realisations. The artefacts will be manufactured from the materials identified in Task 1.1 as the most suitable and using the production techniques selected from Task 1.2.

Activity number	Activity description	Partners (Lead in bold)
A1.3.1 M23	Using input from A1.1.5 and A1.2.3, CCC, DDD and EEE, in consultation with the projects advisory group (A4.1.2), will determine the range and number of artefacts to be produced as mass transfer standards to disseminate the unit of mass from primary realisations. The range of mass artefacts selected will be based the materials with the most suitable properties and where the best surface finishes can be obtained using the relevant finishing techniques identified using the flowchart from A1.2.3.	**CCC**, EEE, DDD
A1.3.2 M28	Based on the conclusions from A1.3.1, CCC, DDD and EEE will jointly manufacture the selected range of mass artefacts using the finishing techniques most suited to the individual materials.	**CCC**, EEE, DDD
A1.3.3 M32	Based on the results from A1.1.5, A1.2.2-A1.2.3 and A1.3.1-A1.3.2 CCC, EEE and DDD will write a paper on the range of artefacts produced for use as mass transfer standards to disseminate the unit of mass from primary realisations.	**CCC**, EEE, DDD
A1.3.4 M32	CCC, EEE and DDD will review the paper from A1.3.3 and will send it to the coordinator. Once the paper has been agreed by the consortium, the coordinator on behalf of CCC, EEE and DDD will then submit it to EURAMET as **D6**, *'Paper on the range of artefacts produced for use as mass transfer standards to disseminate the unit of mass from primary realisations'*.	**CCC**, EEE, DDD, BBB

4.8.4 Section CN-1: Creating impact

This work package should include all partners in a wide range of activities to disseminate the outputs of the project and to particularly encourage their uptake by end-users.

You should ensure the work package includes adequate and appropriate links with the end-user community, as well as ensuring there are adequate and appropriate links with stakeholders in standards developing organisations (and their relevant committees and working groups), regulatory bodies and industrial/policy advisory committees. You should also establish a project advisory group or stakeholder committee, in order to support interaction with the end-user community and to ensure the project can meet their needs.

It is recommended that you structure your work package into 3 tasks:

Task N-1.1 **Knowledge transfer** This task should include a wide range of activities such as establishing a stakeholder committee or advisory board, establishing and maintaining a project website, producing peer-reviewed publications, good practice guides, articles in the popular press, presentations at conferences and workshops, work with standards developing organisations, etc. The activity related to peer-reviewed publications should clearly indicate the target number of papers the project will produce and the number of these that will be collaborative publications. All peer-reviewed scientific publications must be open access (see section 29.2 of the Model Grant Agreement).

Task N-1.2 **Training** This task should include activities such as workshops or training courses organised and delivered by the project including web or e-based training and modules developed within the project but delivered as part of wider training activities e.g. as part of university course.

Task N-1.3 **Uptake and exploitation** This task should describe your plans to proactively encourage and facilitate the uptake and use of the project's outputs by relevant users in the industrial and public service communities. This may include the development of commercial measurement services, the marketing and selling of reference materials, software or other outputs. It may also include the commercialisation of specific technologies developed in project. Where these are protected by formal intellectual property (IP) such as patents you should produce a plan for managing and exploiting the IP.

For Research Potential proposals only – the consortium will need to provide information demonstrating the narrowing of the capability gap between their consortium and the wider European NMI/DI community. You should include an activity for your consortium to identify measures that they will use to demonstrate that the project has narrowed the gap between the capabilities of their consortium and other NMIs/DIs in Europe and to report the outcomes at midterm and at the end of the project.

Under the activity table you should include the sentence "All IP and potential licencing/exploitation will be handled in accordance with the Grant Agreement and Consortium Agreement."

Example: WPN-1: Creating impact

Task N-1 Knowledge transfer

Activity number	**Activity description**	**Partners (Lead in bold)**
AN-1.1.1 M36	The project will create a Stakeholder Committee of at least 20 members including CCM and BIPM representatives, balance and weight manufacturers and national accreditation and legal metrology bodies, representing at least 12 European countries. The aim of the stakeholder committee is to clarify the needs of the various interested parties and to feed these into the project. Interaction of the Stakeholder Committee will be achieved via a central website (see below) and ad-hoc meetings will be held at suitable events where the committee are in attendance.	**AAA**, all partners
AN-1.1.2 M36	A project webpage will be created on BBB website with public access and a part restricted for partners only. The webpage will be regularly updated with information such as project reports, papers published by the partners, project meetings. The part of the website with restricted access will be dedicated to exchange information and reports throughout the project. It will also include a digital archive of all presentations, reports and papers from the project.	**BBB**, all partners

<table>
<tr><td>AN-1.1.3
M36</td><td>The partners plan to present at least 4 papers at the following international conferences;
• XX IMEKO world congress (Republic of Korea, 9-14 September 2019)
• TEMPMEKO (Autumn 2020)
• Metrologie 2020 (tbc)
• NEWRAD 2021
Further relevant conferences may be identified during the project.</td><td>CCC, all partners</td></tr>
<tr><td>AN-1.1.4
M36</td><td>The partners will submit at least 15 papers in total to peer-reviewed journals during the project (all these peer--reviewed papers are identified in activities in the technical WPs.). Target journals include Metrologia, International Journal of Thermophysics, Measurement Science and Technology.
The expectations are that at least 9 out the 15 publications will be the result of a collaborative effort from partners from different countries.
The authors of the peer reviewed papers will clearly acknowledge the financial support provided through the EMPIR as required by EURAMET.</td><td>CCC, all partners</td></tr>
<tr><td>AN-1.1.5
M36</td><td>The output of this project will provide vital information for development and publication of a written mise-en-pratique for the (redefined) kilogram. Additionally, two good practice guides on weighing in vacuum and storage of mass standards will be produced as will a document outlining the impact of the redefinition of the kilogram for end users. The target audience for the good practice guides will be NMIs who maintain primary mass standards and have weighing in vacuum facilities and also watt balance and Avogadro researchers and will be available as an electronic download from the website. The guide outlining the impact of the kilogram redefinition will be aimed at a wider audience and will be produced in electronic form and as a hard copy.</td><td>CCC, all partners</td></tr>
<tr><td>AN-1.1.6
M36</td><td>To enable other interested parties beyond the thermometry community to understand the results of the projects 5 articles will be submitted to trade journals such as Physics World.</td><td>CCC, all partners</td></tr>
<tr><td>AN-1.1.7
M36</td><td>Information on the results of the project will be disseminated to a range of standards bodies and committees and feedback sought (see details below and in the table in Section B2.c).
<table>
<tr><th>Standards Committee / Technical Committee / Working Group</th><th>Partners involved</th><th>Likely area of impact / activities undertaken by partners related to standard / committee</th></tr>
<tr><td>IS0 TC/212 WG2</td><td>AAA</td><td>ISO TC212 ‘Clinical Laboratory Testing and IVDs’ aims to provide guidelines on standardisation in the field of laboratory medicine and in vitro diagnostic test systems. This includes, for example, quality management, pre- and post-analytical procedures, analytical performance, laboratory safety, reference systems and quality assurance.
This project has an expert representative on ISO TC212 WG2 (reference systems) which meets biannually in May and October.
AAA will input to the recently approved revision of ISO 17511 - Reference systems for in vitro diagnostics, through submission of a relevant case study to the proposed annex to the standard.</td></tr>
<tr><td>CEN TC/140/WG10</td><td>AAA, CCC</td><td>This CEN WG meets annually in March and it has a specific remit for the standardisation of reference method(s) for the in vitro testing of the susceptibility of bacteria, with importance in human infections, to antimicrobial agents. It also has a remit for standardisation in the field of bacteriology relating to the performance of antimicrobial susceptibility devices which are used for testing the susceptibility of bacteria to antibiotics in most medical laboratories.
AAA and CCC will discuss with the DIN secretariat whether the WG could develop a new programme of standards to capture the specific guidance generated by the project.</td></tr>
<tr><td>JCTLM, WG1 Nucleic Acid Review Team</td><td>AAA (Chair), CCC</td><td>The JCTLM NA review team meets annually in December and reviews “higher order” molecular diagnostic RMs and reference measurement procedures for clinical molecular diagnostic tests for approval and listing on the JCTLM database.
CCC, with support from AAA, will submit a JCTLM nomination for a reference method for the quantification of</td></tr>
</table></td><td>CCC, all partners</td></tr>
</table>

		antimicrobial resistant microbes by nucleic acid amplification techniques.
CCQM Nucleic Acid Analysis Working Group (NAWG)	**AAA (chair),** DDD, CCC, EEE	NAWG meets biannually in April and October and coordinates international comparison studies to facilitate the development of traceable and comparable measurement capabilities for nucleic acids. AAA, with support from DDD, CCC and TUBITAK, will propose a CCQM NAWG study to evaluate capability for viral measurement by PCR methods.

The representatives on the corresponding committee or WG from the partners will jointly ask the chairperson to include a point in the agenda to briefly present the outputs of the project related to the WG activities and ask for comments. Where appropriate a written report will be submitted for consideration by the committee or WG.

Task N-1.2 Training

Activity number	**Activity description**	**Partners (Lead in bold)**
AN-1.2.1 M31	Two workshops for stakeholders will be organised and held during the project. During the first day of the kick off meeting at BBB a special 0.5 day session will be dedicated to a workshop for the stakeholder community. European NMIs and DIs that are not partners, accredited laboratories and temperature instruments manufacturers will be invited (the target number of delegates will be between 15 and 30). Possible attendees among the stakeholders and the EURAMET-TC representatives will be contacted directly by e-mail. A second stakeholder workshop (1-1.5 days' duration) will be organised and held in M30 at CCC. The workshop will be open to all NMIs, instrument manufacturers and accredited laboratories. The workshop will present the results achieved by the project but will allow time for discussion of the results with all the participating stakeholders and instrument manufacturers. The target number of delegates is around 50.	**BBB**, all partners
AN-1.2.2 M26	A two-day training course will be organised and held on the day preceding the second stakeholder workshop in M25, probably at CCC. The training course will be targeted at medical physicists, stakeholders (industrial, national authorities etc.) and will focus on the new methods and techniques developed in the project for use in hospitals and clinics. The target number of delegates is between 15 and 25. The training course will be publicised through the website and by e-mail to the TC-T members and stakeholders.	**CCC**, all partners
AN-1.2.3 M36	A video for e-training on the use of the new methods for quality controls will be developed by CCC and EEE and posted on the project website.	**CCC**, EEE

Task N-1.3 Uptake and exploitation

Activity number	**Activity description**	**Partners (Lead in bold)**
AN-1.3.1 M36	An exploitation plan will be created at the beginning of the project and reviewed and updated at least at each project meeting.	**CCC**, all partners
AN-1.3.2 M36	DDD, CCC and AAA will introduce new calibration services for low dose level miniature dosimeters based on the techniques developed in WP2.	**DDD,** CCC, AAA
AN-1.3.3 M36	Once the sensor is available from WP3 and WP4, an e-service based on dedicated software for the unfolding of the raw read-out data to derive the time and position dose distribution will be launched after the end of the project. It is intended that the sensor design will be patented after the end of the project.	**CCC**, BBB, DDD
AN-1.3.4 M34	The database of bio-chemical reference material properties will be made publicly available on the DDD's website.	**DDD**
AN-1.3.5 M36	DDD, CCC and AAA will develop new draft CMCs for the new calibration services for low dose level miniature dosimeters based on the techniques developed in WP2 and will submit these draft CMCs to EURAMET TC-IR.	**DDD,** CCC, AAA

AN-1.3.6 M18, M36	*Research Potential proposals only* The consortium will identify measures that they will use to demonstrate that the project has narrowed the gap between the capabilities of their consortium and other NMIs/DIs in Europe. Summaries will be produced at months 18 and 36, demonstrating how the project helped emerging/smaller NMIs in the consortium to develop their capabilities closer to the wider European NMI/DI level. Where appropriate this improvement will be quantified. All partners will provide input to these summaries and the coordinator will provide this information demonstrating the narrowing of the capability gap at the mid-term review and at the end of the project.	**AAA**, all partners

All IP and potential licencing/exploitation will be handled in accordance with the Grant Agreement and Consortium Agreement.

4.8.5 Section CN: Management and coordination

This work package must involve all partners as each has to contribute to project reporting and should attend project meetings. It is recommended that you structure your work package into 3 tasks:

Task N.1 **Project management**

Task N.2 **Project meetings**

Task N.3 **Project reporting** The dates for the submission of reporting documents will depend upon the duration of the JRP. However, there must be 2 periods and hence 2 periodic reports. Therefore for a 36 month JRP reporting documents must be submitted at months 9, 27 (+ 45 days) and 18, 36 (+ 60 days).

Under the activity table you should include the sentence “All formal reporting will be in line with EURAMET’s requirements and will be submitted in accordance with the Reporting Guidelines.”

Example: WPN: Management and coordination

Task N.1: Project management

Activity number	Activity description	Partners (Lead in bold)
AN.1.1 M36	The project will be managed by the coordinator from AAA, who will be supported by the project management board consisting of one representative from each partner; including the leaders of each work package. The members of the project management board will guide the project, attend the project meetings, organise the progress meetings at their local institutes and call additional meetings if needed to ensure the overall project’s success.	**AAA**, all partners
AN.1.2 M36	The work package leaders will report on the on-going progress to the coordinator by e-mail and telephone conferences.	**AAA**, all partners
AN.1.3 M36	The coordinator, with support from the partners, will manage the project’s risks to ensure timely and effective delivery of the scientific and technical objectives and deliverables.	**AAA**, all partners
AN.1.4 M36	The consortium will ensure that any ethics issues identified (see Section D3) are addressed.	**AAA**, all partners

Task N.2 Project meetings

Activity number	Activity description	Partners (Lead in bold)
AN.2.1 M2	The kick-off meeting involving all partners will be held approximately one month after the start of the project, at AAA.	**AAA**, all partners
AN.2.2 M36	There will be five formal project meetings. These meetings include the kick-off, mid-term (around M18) and final meeting (around M36). In addition, two further meetings will be held around M9 and M27. The meetings will be held prior to reporting. The meetings will review progress and will be used to ensure partners are clear as to their role for the next period. The location of the meetings will rotate among the partners. Where possible, meetings may be held as satellite meetings to important conferences or committee meetings.	**AAA**, all partners
AN.2.3 M36	In addition, technical meetings of work package groups may be held whenever necessary, and will be arranged on an ad-hoc basis.	**AAA**, all partners

Task N.3 Project reporting

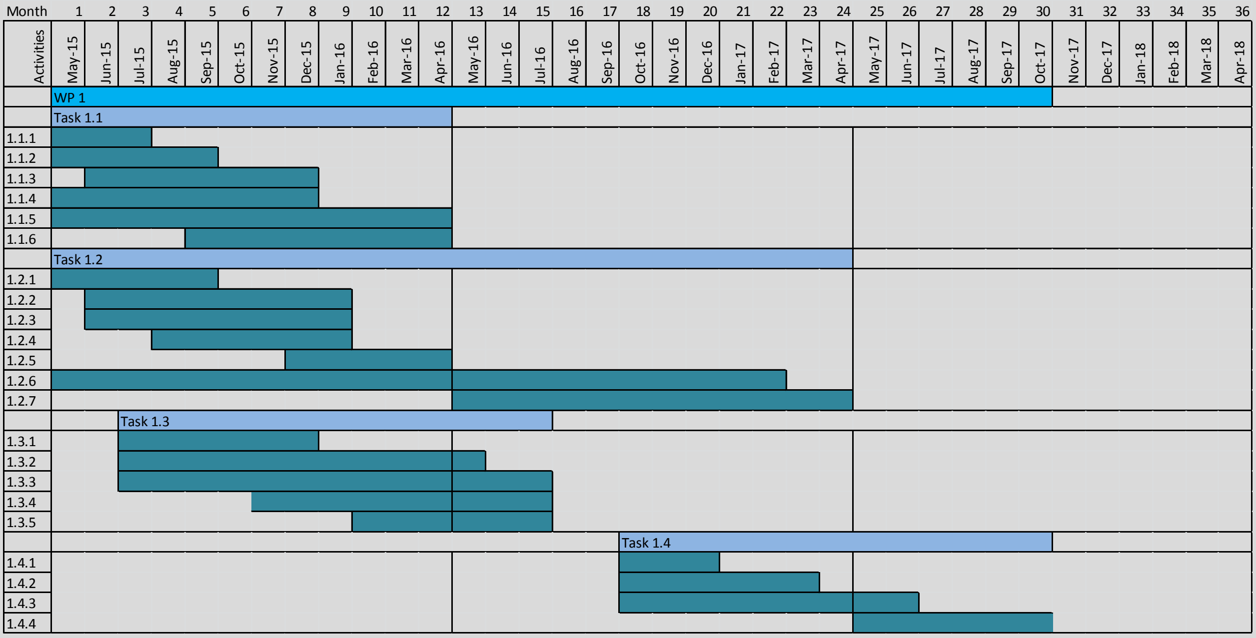
Activity number	Activity description	Partners (Lead in bold)
AN.3.1 M1	One month after the start of the project a publishable summary and data management plan (DMP) (if applicable) will be produced and submitted to EURAMET.	**AAA**, all partners
AN.3.2 M36 +60 days	Following Articles 17 and 20 of the grant agreement, information will be submitted to EURAMET, in accordance with the procedures issued by them to enable EURAMET to comply with its obligations to report on the programme to the European Commission. • Progress reports will be submitted at months 9, 27 (+ 45 days), 18, 36 (+ 60 days). • Impact/Output reports and data management plans (if applicable) will be submitted at the same times. All partners will provide input to these reports and the coordinator will provide these and updated publishable summaries to EURAMET.	**AAA**, all partners
AN.3.3 M36 +60 days	Periodic Reports (including financial reports and questionnaires) will be delivered at months 18 and 36 (+ 60 days) in accordance with Article 20 of the grant agreement. All partners will provide input to these reports and the coordinator will provide these to EURAMET.	**AAA**, all partners
AN.3.4 M36 +60 days	Final Reports will be delivered at month 36 (+ 60 days) in accordance with Article 20 of the grant agreement. All partners will provide input to these reports and the coordinator will provide these to EURAMET.	**AAA**, all partners

All formal reporting will be in line with EURAMET's requirements and will be submitted in accordance with the Reporting Guidelines.

4.9 Section CN+1: Gantt chart

The Gantt chart can be produced using MS Excel or MS Project but it must show the duration of each work package, task, and activity (by month). Please do NOT include lists of partners involved or the title for work packages or tasks.

Example: CN+2: Gantt Chart



4.10 Section D: Risks and risk mitigation

This section should be completed using the tables in Template 4: JRP protocol. You should separate your risks into 2 categories:

Section D1 **Scientific/technical risks** (problems related to the research)

Section D2 **Management risks** (problems with staff, IP etc)

PLEASE NOTE that where a collaborator is providing access to their facilities or equipment or a 'Linked Third Party' is included in your proposal you should include specific risks associated with their involvement.

Technical risks should be considered on a Task by Task, although some tasks may be grouped for identical or similar risks. For each risk, you should identify:

- What the risk is
- What is the likelihood of the risk occurring and what impact this would have on the project
- What could the consortium do to decrease the likelihood of the risk occurring (mitigation)
- What the consortium could do if despite the mitigation the risk still occurs (contingency)

Example: Section D1 scientific / technical risks

Risks (description)	**Likelihood and impact of occurrence**	**Mitigation** i.e. what the consortium will do to decrease the likelihood of the risk occurring	**Contingency** i.e. what the consortium will do if despite the mitigation the risk still occurs
Tasks 1.1-1.4: Technique A: Gas pressure deforms the capacitor, increasing the measurement uncertainty of capacitance in an unknown way	Likelihood without mitigation: High Impact: Incorrect measurement of the capacitance, will affect the uncertainty of the main result, potentially beyond 10^{-6}. Likelihood after mitigation: Low	Time will be spent on the capacitor design and this will significantly reduce this risk. Detailed investigations of the material properties and comparison of different capacitor designs will be carried out in parallel with theoretical simulations. A "go/no-go" review will assess the feasibility of overcoming the risks relating to capacitor design and use.	Should the resulting capacitor design be ambiguous, an independent laboratory could provide additional independent checking. This checking would take an additional 8 weeks.
Task 2.3: Technique B: The molar mass and the ideal gas heat capacity ratio of the gas cannot be determined with the target uncertainty of < xx %	Likelihood without mitigation: Low Impact: The uncertainty due to molar mass and heat capacity will affect the uncertainty of the EMPIR constant, potentially beyond 10^{-6}. Likelihood after mitigation: Very low	Published data values are available, and should be suitable for use. If the published values have too high an uncertainty, the lead partner will determine more accurate values anchored to an absolute calibration.	None required as the risk is low and mitigation should avoid the need for action.
Task 3.2: Poor quality of radionuclide materials for production of selected standard sources (e.g. impurities)	Likelihood without mitigation: Medium Impact: Some selected radionuclides cannot be used. Likelihood after mitigation: Low	A number of suppliers will be identified early in the project. If the purity of the radionuclides appears to be an issue different/more suppliers of radionuclide materials will be used with emphasis on their purity.	Additional purification of radionuclide materials will be performed in the partner's radiochemical laboratories.
Task 4.1: Reference clock or distribution system fails	Likelihood without mitigation: Medium Impact: Number of possible comparisons will be smaller. Likelihood after mitigation: Low	Time and frequency distribution is a key task of the participating sites. Reference clocks and microwave distribution systems are available at all partners and two partners have more than one system thus providing some back up.	If the equipment at one participating station fails, the equipment at the other three participating institutes will still be available enabling a reduced number of optical clock comparisons to be made.

Task 4.5: Unable to obtain access to collaborators'/end-users' facilities to evaluate the project devices	Likelihood without mitigation: Low Impact: Verification of the results on-site will not be possible. Likelihood after mitigation: Very low	Partners will contact collaborators at the start of the project to ensure that there are enough collaborators that have initially indicated their willingness to provide access suitable facilities so that the device can be tested on at least one site.	In the event that none of the collaborators can/will provide access to suitable facilities, the partners will hire a foundry and test the devices.
Tasks 5.1-5.3: End user installations are not available for on-site testing	Likelihood without mitigation: High Impact: Unable to undertake in-situ / on-site testing and reduced use of results by end-users. Likelihood after mitigation: Medium	The on-site testing will be planned in such a way as to avoid any interruption of the production process. Measurement results will be published as per agreement with end-users.	If, after mitigation, this cannot be achieved, the consortium will discuss the situation with EURAMET and re-scope this WP. Simulation of in-situ / on-site testing will be considered as an alternative solution.

Example: Section D2 management risks

Risks (description)	**Likelihood and impact of occurrence**	**Mitigation** i.e. what the consortium will do to decrease the likelihood of the risk occurring	**Contingency** i.e. what the consortium will do if despite the mitigation the risk still occurs
Key personnel are lost to the project	Likelihood without mitigation: Low Impact: The loss of key team members would create difficulties in delivering the project, or specific tasks or deliverables. Likelihood after mitigation: Very low	None of the team members are planning to leave or retire within the project. The grouping of experts within the consortium should minimise the areas where knowledge is held by a single person. All the partners will identify backups for key workers wherever possible to reduce the overall risk to the project. Project plans will be shared within the consortium and results and methodology will be documented.	If a key member leaves the project, then the partner concerned will be responsible for appointing a replacement. However this may still lead to a delay in delivery.
Complexity of managing a large consortium	Likelihood without mitigation: Medium Impact: Failure to fully cooperate or communicate effectively within the consortium could endanger efficient delivery of the project. Likelihood after mitigation: Low	The partners are all experienced with complex multinational projects. Many have previously developed close relationships through collaborating within other European consortia. Regular communication and feedback will ensure that potential problems are identified early and that all partners are clear on their roles.	WP leaders will play an important role in flagging up potential problems to the coordinator and the project management board, who will then decide on the best course of action to take. If necessary, work will be reassigned to an alternative partner, or parts of the work re-scoped in agreement with EURAMET.
Inter-dependencies between technical activities and tasks are too complex	Likelihood without mitigation: Medium Impact: Tasks are delayed or it is not possible to deliver them. Likelihood after mitigation: Low	Technical meetings run by WP leaders have been scheduled to ensure proper sharing of knowledge. The interdependencies between tasks will be considered at meetings to ensure that this is addressed. The technical WPs will be closely managed by their WP leaders to ensure that they deliver their own outputs.	In most cases, activities on the critical path have some overlap in time and thus a delay in the output of one deliverable does not necessarily cause an immediate delay in another.

Problems dealing with Intellectual Property (IP) ownership and/or exploitation might occur and could be a source of potential conflict	Likelihood without mitigation: Medium Impact: Disagreement between the partners could delay the project (in implementing the work and publishing results). Likelihood after mitigation: Low	All partners will sign the grant agreement and consortium agreement, which includes IP clauses.	Independent arbitrators will be used in the event of disagreement between partners.
The Linked Third Party does not deliver their key parts of the work	Likelihood without mitigation: Low Impact: Parts of the project may not be delivered effectively. Likelihood after mitigation: Very low	Under the terms of the grant agreement partner YYY would be liable for the relevant parts of the project if the Linked Third Party defaults.	If partner YYY also defaults on their obligations then the other partners become liable. The tasks affected would have to be reassigned or re-scoped in agreement with EURAMET.
A collaborator fails to provide access to facilities or equipment	Likelihood without mitigation: Low Impact: The consortium may not be able to complete the planned work, or the work might need to be delayed until another collaborator or alternative access to facilities or equipment is found. Likelihood after mitigation: Very low	The coordinator or relevant partner will liaise with the collaborator early in the project regarding access to the facilities' / equipment. All collaborators are professional organisations and experienced in working in projects. Each WP leader will work closely with each associated collaborator to report any issues back to the coordinator. Project meetings are held every 9 months, so any issues will be discussed at these meetings.	The WP leader will work with the coordinator to find an alternative collaborator or alternative access to facilities or equipment.

4.11 Section D3: Ethics

EURAMET is required by the Horizon 2020 Rules for Participation to undertake an ethics review of all EMPIR projects. This will be part of the evaluation process and there are 4 possible outcomes for a proposal following the ethics review:

1. Ethics clearance (the proposal is 'ethics ready')
2. Conditional ethics clearance (clearance is subject to conditions, i.e. ethics requirements. The requirements must either be fulfilled before grant signature or become part of the grant agreement)
3. Ethics Assessment recommended (i.e. the proposal raises serious and/or complex ethics issues)
4. No ethics clearance (the proposal will not be funded)

The MSU will complete Section D3 as part of the negotiation of successful proposals therefore please do not complete this section at the proposal stage. Examples of text included during the negotiation following the ethics review are shown below.

Example 1: Section D3 Ethics

The EMPIR Ethics Review 2014 has given JRP 14RPT99 POTENTIAL "Ethics clearance".

Third Countries

The consortium will ensure that any partners or collaborators from Third Countries fully adhere to H2020 ethics standards, no matter where the research is carried out. The consortium will also, in the case of dual use applications, clarify whether any export licence is required for the transfer of knowledge or material.

Data protection

The consortium will ensure that all participants in training activities and meetings give a valid informed consent for the processing of personal data.

Ethical integrity

The consortium will ensure that the ethical policy to be followed in the project complies with the highest standards of research integrity (as set out in the European Code of Conduct for Research Integrity).

Example 2: Section D3 Ethics

The EMPIR Ethics Review 2014 has given JRP 14IND88 MATERIALS “Conditional ethics clearance”.

Third Countries

The consortium will ensure that any partners or collaborators from Third Countries fully adhere to H2020 ethics standards, no matter where the research is carried out. The consortium will also, in the case of dual use applications, clarify whether any export licence is required for the transfer of knowledge or material.

Data protection

The consortium will ensure that all participants in training activities and meetings give a valid informed consent for the processing of personal data.

Ethical integrity

The consortium will ensure that the ethical policy to be followed in the project complies with the highest standards of research integrity (as set out in the European Code of Conduct for Research Integrity).

Dual use

The ethics reviewers identified that the project aims to address the strength of materials. The objectives do not have direct dual use implications but the indirect dual use risks must be monitored and addressed as the research proposed deals with the issue of "strength of materials". The idea that the ultimate strength comes from the strength of the chemical bonds which hold it together indicates that any research on this topic could have dual use implications and this must to be assessed and monitored throughout the project life time by the consortium as a contractual obligation.

The consortium will assess and report on the potential of dual use applications and, if applicable, how dual use risks can be mitigated. The report will be submitted after the grant signature, with the last technical report. As the dual use issue is an ongoing issue it will be continuously assessed during the entire course of the project.

4.12 Section E: Operational capacity

EURAMET is required by the Horizon 2020 Rules for Participation to assess the Operational capacity of all partners in a proposal to deliver EMPIR projects. This will be part of the evaluation process and carried out by the referees. Section E asks for information on each partner in order to allow the referees to make their judgement on whether each partner has the necessary basic operational capacity to carry out their proposed activities.

Therefore, for each partner, you should write a description, including key roles and contributions (usually half a page per partner) and include:

- A brief curriculum vitae or description of the profile of the organisation and persons who will be primarily responsible for carrying out the proposed research;
- A description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work;
- A list of up to five relevant previous projects or activities;
- A list of up to five relevant publications, and/or products, services (including widely-used datasets or software), or other relevant achievements;
- A description of any third parties that are not represented as project partners, but who will nonetheless be contributing towards the work (e.g. providing facilities, computing resources). This description is only required for third parties which supplement the infrastructure of a partner – it should NOT include collaborators.

For the proposed coordinator please also include evidence of their experience in managing similarly complex and large projects.

Please note that if your project is selected for funding this section will be deleted before the grant agreement is issued.

4.13 Section F: Potential collaborators

You should add details of any potential collaborators to the table in Template 4: JRP protocol, identifying the work packages where they plan to collaborate and their role.

Please note that if your project is selected for funding this section will be deleted before the grant agreement is issued.

4.14 Section G: References

All references, other than those identified under the individual partners in Section E, should be listed in this section. Please only include key references.

4.15 List 4: Checklist for Template 4

To help you complete your JRP proposal the MSU has identified a number of common issues with proposals submitted in previous Calls, and produced List 4: Checklist for Template 4. The purpose of List 4 is to allow proposers to review their completed JRP proposals and check that all necessary information is included prior to submission.

5 Evaluation

5.1 Evaluation criteria

The evaluation criteria for proposals are described in Guide 6: Evaluating EMPIR projects. They are:

1. Excellence.
2. Impact.
3. The quality and efficiency of the implementation.

Due to the limited time EURAMET has between announcing the selection of projects and contract signature, opportunities for negotiation will be limited and therefore referees will evaluate each proposal as submitted and not on its potential if certain changes were to be made.

If the referees identify shortcomings (other than minor ones and obvious clerical errors) in the proposal, they will reflect these in a lower score for the relevant criterion.

Proposals with significant weaknesses that prevent the project from achieving its objectives or with resources being seriously over-estimated will not receive above-threshold scores.

5.2 Evaluation meetings

The dates for evaluation meetings will be given on https://msu.euramet.org/. The evaluation of JRP proposals will usually take place at a review conference, although evaluation at a consensus group meeting is possible (see the table of Budget and Features for each Call for details). In the case of a review conference:

- One representative only of each consortium must attend the review conference
- The representative must present a poster and answer referees' questions
- Following this the referees will privately agree consensus marks for each proposal

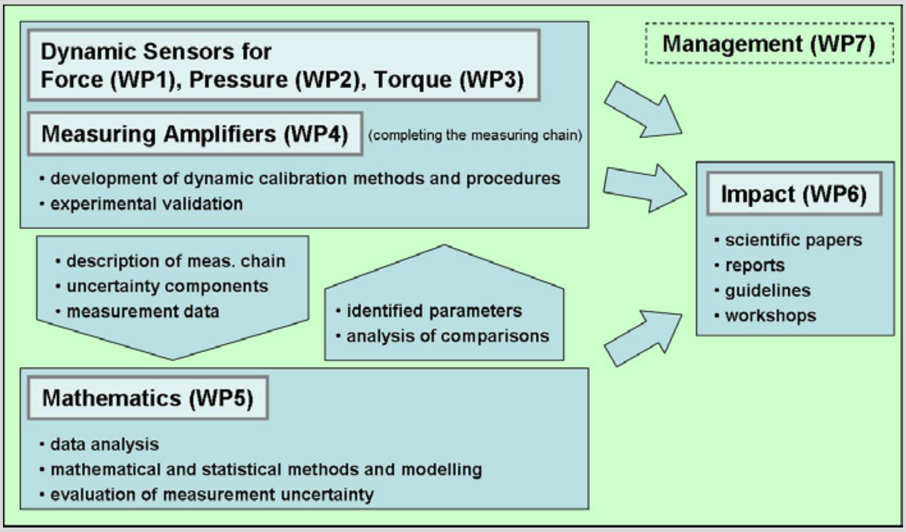
5.3 Preparing a poster for the review conference

In the case where a JRP proposal is evaluated at a review conference, every consortium must prepare a poster for the event. The poster should not be laminated nor attached to a hardboard backing. The poster should:

- Have a portrait orientation and a maximum size of A0 (841 mm × 1189 mm)
- Present the key aspects of your proposal in a clear and concise manner
- Help the referees evaluate your proposal against the 3 evaluation criteria

You may also wish to include a diagram of how the work packages fit together. At past review conferences, consortia have also provided individual A4 copies of their posters to referees.

Example of a work package diagram for a review conference poster



Organisations' logos should only be included on review conference posters where (i) the organisation is a project partner or (ii) the organisation has specifically supported the project i.e. through a letter of support.

6 Contractual requirements after selection

The Horizon 2020 Rules for Participation require EURAMET to sign Grant Agreements within 8 months of call close. The dates for the expected announcement of selection and the consequential time-frame for negotiation are given in the table of Budget and Features for the Call. If your proposal is selected for funding you will be invited to take part in grant preparation; this may cover any scientific, legal or financial aspects of the proposal, based on the comments of the referees or other issues.