Brussels, 13 November 2018

COST 111/18

DECISION

Subject: **Memorandum of Understanding for the implementation of the COST Action "European Network for Chemical Elemental Analysis by Total Reflection X-Ray Fluorescence" (ENFORCE-TXRF) CA18130**

The COST Member Countries and/or the COST Cooperating State will find attached the Memorandum of Understanding for the COST Action European Network for Chemical Elemental Analysis by Total Reflection X-Ray Fluorescence approved by the Committee of Senior Officials through written procedure on 13 November 2018.

MEMORANDUM OF UNDERSTANDING

For the implementation of a COST Action designated as

COST Action CA18130
EUROPEAN NETWORK FOR CHEMICAL ELEMENTAL ANALYSIS BY TOTAL REFLECTION X-RAY FLUORESCENCE (ENFORCE-TXRF)

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

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

a. "Rules for Participation in and Implementation of COST Activities" (COST 132/14 REV2);
b. "COST Action Proposal Submission, Evaluation, Selection and Approval" (COST 133/14 REV);
c. "COST Action Management, Monitoring and Final Assessment" (COST 134/14 REV2);
d. "COST International Cooperation and Specific Organisations Participation" (COST 135/14 REV).

The main aim and objective of the Action is to coordinate the efforts made at the national and transnational level to establish total reflection X-ray fluorescence (TXRF) as a reference technique for reliable elemental analysis of solid and liquid matrices, both for screening and accurate quantitative determination, building capacity by training, connecting and involving stakeholders.. This will be achieved through the specific objectives detailed in the Technical Annex.

The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 60 million in 2018.

The MoU will enter into force once at least seven (7) COST Member Countries and/or COST Cooperating State have accepted it, and the corresponding Management Committee Members have been appointed, as described in the CSO Decision COST 134/14 REV2.

The COST Action will start from the date of the first Management Committee meeting and shall be implemented for a period of four (4) years, unless an extension is approved by the CSO following the procedure described in the CSO Decision COST 134/14 REV2.

OVERVIEW

Summary

The "European Network for Chemical Elemental Analysis by Total reflection X-Ray Fluorescence" Action aims to coordinate research and building capacity in the field of elemental analysis by total reflection X-ray fluorescence spectroscopy (TXRF) to develop and assess new tools, protocols, methodologies, and instrumentation for screening and accurate determination of potentially toxic elements, for health and safety reasons, as well as nutrients and beneficial ones for quality control.

The Action will create an infrastructure for scientific communication, exchange, collaboration, to enhance technical standards, advance measurement science, fostering new research activities and combining the partners' expertise in chemistry, physics, life science and engineering. This network will provide the information and tools to maximize European competitiveness in forming and attracting talented scientists, supporting new sources and capabilities that improve research productivity, quality, dissemination, efficiency, and career development.

The outcome is a novel technology portfolio for TXRF applications that will benefit science, economy and the society. The activities will enable breakthrough scientific developments leading to new concepts and products, increasing Europe's research and innovation capacities, and supporting European Commission regulation organisations in crucial fields as environmental protection, food safety, life science, and nanotechnologies. ENFORCE TXRF will create well-organized and sustainable partnerships, preparatory to joint projects by dissemination of scientific knowledge and actively engaging new stakeholders.

The Action will attract the next generation of scientists, ensuring that Europe will remain at the frontline of research for the development of new tools for the chemical analysis.

Areas of Expertise Relevant for the Action	Keywords
● Chemical sciences: Characterization methods of materials (theoretical aspects) ● Chemical sciences: Analytical chemistry ● Physical Sciences: Atomic, molecular and chemical physics ● Materials engineering: Characterization methods of materials for material engineering applications	● Total Reflection X-Ray Fluorescence (TXRF) ● elemental analysis ● sample preparation ● modelling ● data fitting

Specific Objectives

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

Research Coordination

- Development of a common definition of the state of the art by sharing competences and know how about the use, methodologies, instrumentations and applications of TXRF for elemental analysis of biological, environmental, food, and many other samples.
- Coordination of inter-laboratory studies and joint experimentation at European and non-European level of different samples, representative of critical classes of interest for stakeholders (for example: honey for food safety, urine for health, air filters for environmental monitoring, etc.).
- Improvement and comparison of models for experimental data fitting and simulations to understand the crucial factors and their effects on the analysis results, and assessment of the related software/algorithms used for data analysis.
- Performances assessment of different instrumental configurations and sample preparation methodologies, and comparison with other analytical techniques used for elemental analysis, such as atomic absorption and inductively coupled plasma spectroscopies, highlighting advantages, disadvantages,

and possibilities of use in different application fields.

● Coordination of European experts to establish a permanent reference committee to assist and advice scientists, researchers, and students to employ TXRF in their research, to improve their theoretical and practical knowledge, to develop know-how, to access available infrastructures and to collaborate with experienced research groups and companies.

● Input to standardization bodies and metrology institutes for the development of new standard items in the frame of ISO/TC201/SC10 and the establishment of a CEN mirror committee in order to propose of TXRF as a primary chemical method and to support the EC regulations.

● Cooperation with private enterprises, such as instrumental manufacturers, to give inputs for future market applications, new tools for sample preparation in TXRF analysis, and low-cost and friendly-to-use TXRF instruments devoted to specific applications.

● Coordination of the identification, collection and curation of data related to the use of TXRF in the frame of the existing European Infrastructure for promoting metrology in food and nutrition (METROFOOD), and other relevant fields of application identified.

● Dissemination of research results and Action activities to stakeholders.

Capacity Building

● Training of European stakeholders to lead an expansion of TXRF use in the world to develop consciousness about the potential applications, to evaluate and possibly improve the current state of the art, knowledge and methodologies, and to establish TXRF as a reference technique for screening and accurate elemental analysis.

● Acting as a stakeholder platform at the trans-national level on the topic, to collect the state of the art and know-how about the application fields of TXRF analysis, such as environmental, biological, life science, and food, but also infrastructures, research groups, and manufacturers, to act as a reference point.

● Increasing capability in European and selected developing countries in assessing the TXRF use for food safety, quality control and environmental monitoring. by fostering the knowledge exchange and the development of a joint research agenda around the most scientifically and socio-economically relevant topics of TXRF analysis.

● Fostering the knowledge exchange and the development of a joint research agenda about using TXRF in the new emerging applications in the medical, diagnostics, pharmacology and cosmetics field.

● Bridging the separate approaches of chemical and physical traceability needed to propose TXRF as a primary chemical method to the Consultative Committee for Amount of Substance (CCQM) and to propose dedicated standards.

● Connecting and strengthening collaborations among outstanding European and international scientists and experts, mainly chemists, physicists, engineers and life scientists with their different background to develop a joint research agenda and create successful ad wide competences consortia for joint research.

● Involving in this Action COST ITC, newly established research groups, teams from countries with less capacity, and women, since the early stage, assuring gender balance, enabling a uniform access to scientific and technological knowledge, to address vulnerabilities, and enhance knowledge sharing in the field of TXRF.

● Support ECIs, women and researchers from ITC by enabling them to take leading roles within the Action and the research framework as well as by creating a network where they can meet and exchange ideas on career moves, grant applications, possible collaborations and promotion of working opportunities.

TECHNICAL ANNEX

1. S&T EXCELLENCE

1.1. CHALLENGE

1.1.1. DESCRIPTION OF THE CHALLENGE (MAIN AIM)

More and more there has been an increasing ecological and global public health concern associated with environmental contamination by heavy elements. Indeed, human exposure has risen dramatically, as a result of exponential increase of their use in several industrial, agricultural, domestic, and technological applications. Sources of heavy metals in the environment comprise geogenic, industrial, agricultural, pharmaceutical, domestic effluents, waste, and atmospheric sources. Mandatory is also to quantify these elements in biological matrices, as urine, blood, saliva, and sweat, since they can be related to health problems. In biological systems, heavy metals have been reported to affect cellular organelles and components such as cell membrane, mitochondrial, lysosome, endoplasmic reticulum, nuclei, and some enzymes involved in metabolism, detoxification, and damage repair. Metal ions have been found to interact with cell components such as DNA and nuclear proteins, causing DNA damage and conformational changes that may lead to carcinogenesis or apoptosis. Because of their high degree of toxicity, arsenic, cadmium, chromium, lead, and mercury rank among the priority metals that are of great public health significance. They are all systemic toxicants that induce multiple organ damage, even at low levels of exposure.

On the other hand, metals such as cobalt, copper, chromium, iron, magnesium, manganese, molybdenum, nickel, selenium and zinc are essential nutrients that are required for various biochemical and physiological functions and inadequate supply of these micro-nutrients results in a variety of deficiency diseases or syndromes. The challenge of this Action is to coordinate the efforts made at the national and transnational level to establish total reflection X-ray fluorescence (TXRF) as a reference technique for reliable elemental analysis of solid and liquid matrices, both for screening and accurate quantitative determination, building capacity by training, connecting and involving stakeholders. The believe is that TXRF is the best tool to be considered in many applications, since it allows to perform fast and simultaneous multi-elemental determination in a wide dynamic range with very high sensitivities, by using very small amounts of samples (ng).

Today, the use of TXRF is limited to selected research field mainly due to the lack of knowledge, competencies and reliability of the measurement and evaluation methods. Thus, the main objective of the Action, entitled “European Network for Chemical Elemental Analysis by Total reflection X-Ray Fluorescence” (ENFORCE-TXRF), is to develop a collaborative and multi-disciplinary network of international experts working towards the progress of TXRF analysis, and challenging its new fields of applications, ranging from environmental to food sciences, or biomedicine, chemistry to nanomaterials and health, for instance. This platform will broadly disseminate gathered scientific knowledge, discuss yet unmet characterization needs, promote innovative solutions via process analytical technology, design of experiments, and quality by design protocols. The network is partnering with industry to provide commercially exploitable processes, methods, and it will discuss and propose the development of new standards and operationally deployable good laboratory practices and certification procedures to regulatory organisations at the European level. ENFORCE-TXRF will empower the scientists in maximizing the potential outputs of the TXRF technique not only for scientific or technological purposes, but also for social and economic matters, enhancing European general competitiveness.

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The support of COST action is crucial to foster "knowledge sharing" and for supporting networking activities such as meetings, training schools, conferences and workshops, round-robin studies or Short Term Scientific Missions (STSM). Thanks to these activities, ENFORCE-TXRF will develop the tools and capabilities that improve the productivity, quality, dissemination and efficiency of TXRF based research, providing a legacy to Europe of beyond state-of-the-art knowledge. It will contribute to build sustainable cooperation partnerships, and to define and establish new chemical characterization opportunities.

1.1.2. RELEVANCE AND TIMELINESS

Several European Regulations include chemical elemental analysis as a fundamental issue. The European Regulation (2000/60/EC) for water ensures the quality and availability for European citizens, economy and environment. Following this regulation, further existing regulations deal with monitoring by chemical analysis (2009/90/EC) and with the treatment of urban waste water (91/271/EEC). European Regulation about air quality has been set (2008/50/EC). By means of the working document "Thematic Strategy for Soil Protection" the European Commission (EC) set up comprehensive and coherent rules also for soil (COM (2006) 231). The European Regulation (2002/178/EC) establishes the principles of risk analysis for food by the European Food Safety Authority (EFSA). The EC established a "Modus operandi for the management of new food safety incidents" with a potential for extension involving chemical substances. The new European Regulation for Cosmetics (2009/1223/EC) strengthens the safety of cosmetic products taking into consideration the latest technological developments, including the possible use of nanomaterials.

This Action will enhance the role of Europe towards not European countries, where the importance of TXRF is assessed for social reasons. European RTD organisations are committed to promote TXRF use where other analytical techniques are not implemented. Training activities have already been organized in different European laboratories.

Key markets in Europe are related to food, life science, chemistry, pharma, medical technology, in vitro diagnostics and biotechnology. Furthermore, Europe is a major player in the development and manufacture of nanomaterials. This Action will support the quality control and, thus, the safety issues of these critical markets. Stakeholders, such as the X-ray spectrometry equipment industry and analytical laboratories, rely on the availability of new applications, reliable procedures (ISO 17025) and standards, addressing specific kinds of samples and materials. Moreover, consolidation of existing views on priorities for standardisation are more and more important to achieve harmonization of products and analytical methods. The need of new standards in the field of TXRF analysis is mandated by the recently convened Subcommittee 10 (SC10) of the International Standard Organization (ISO) Technical Committee 201 (TC201). The corresponding European TC within the European Committee for Standardization (CEN) is missing. This Action will help to verify the need to propose to establish it.

A broad-based international effort is needed for pre-standard measurement research and inter-comparison of test results, also with existing technologies, required for procedure validation. Several independent initiatives have been carried on, aiming to the development of new procedures, methods and reference materials, to be translated into standards.

In summary, this Action is addressing the needs of: A) Scientists, researchers and PhD students in Chemistry, Environmental science, Engineering, and life science, who need to improve their knowledge about elemental analysis research exchange, and to enrich their different background working as a team towards the resolution of scientific and technological challenges; B) Stakeholders, X-ray spectrometry equipment industry and analytical laboratories, which require accurate, reliable, and standardized methods; C) The EC which needs new and trustable tools to upgrade and develop regulations (see next paragraph) demanded for quality management (ISO 17025); D) Standardization bodies, which need traceable measurements to be transferred into standards.

1.2. OBJECTIVES

1.2.1. RESEARCH COORDINATION OBJECTIVES

Through the proposed Action, European and not European research groups working on novel applications of TXRF analysis will create one transnational team, thus supporting the sharing of the know-how and the discussion on future challenges in the field of chemical analysis for environment, food safety, health, and industrial quality control. All the following listed specific objectives cannot be achieved without international coordination.

1. Development of a common definition of the state of the art by sharing competences and know how about the use, methodologies, instrumentations and applications of TXRF for elemental analysis of biological, environmental, food, and many other samples.

2. Coordination of inter-laboratory studies and joint experimentation at European and non-European level of different samples, representative of critical classes of interest for stakeholders (for example: honey for food safety, urine for health, air filters for environmental monitoring, etc.).

3. Improvement and comparison of models for experimental data fitting and simulations to understand the crucial factors and their effects on the analysis results, and assessment of the related software/algorithms used for data analysis.

4. Performances assessment of different instrumental configurations and sample preparation methodologies, and comparison with other analytical techniques used for elemental analysis, such as atomic absorption and inductively coupled plasma spectroscopies, highlighting advantages, disadvantages and possibilities of use in different application fields.

5. Coordination of European experts to establish a permanent reference committee to assist and advice scientists, researchers, and students to employ TXRF in their research, to improve their theoretical and practical knowledge, to develop know-how, to access available infrastructures and to collaborate with experienced research groups and companies.

6. Input to standardization bodies and metrology institutes for the development of new standard items in the frame of ISO/TC201/SC10 and the establishment of a CEN mirror committee in order to propose TXRF as a primary chemical method and to support the EC regulations.

7. Cooperation with private enterprises, such as instrumental manufacturers, to understand their needs and to give inputs for future market applications, new tools for sample preparation in TXRF analysis, and low-cost and friendly-to-use TXRF instruments devoted to specific applications.

8. Coordination of the identification, collection and curation of data related to the use of TXRF in the frame of the existing European Infrastructure for promoting metrology in food and nutrition (METROFOOD), and other relevant fields of application identified.

9. Dissemination of research results and Action activities to stakeholders.

1.2.2. CAPACITY-BUILDING OBJECTIVES

Capacity building objectives can be summarized under the following main topics.

1. Training of European stakeholders to lead an expansion of TXRF use in the world to develop consciousness about the potential applications, to evaluate and possibly improve the current state of the art, knowledge and methodologies, and to establish TXRF as a reference technique for screening and accurate elemental analysis.

2. Acting as a stakeholder platform at the trans-national level on the topic, to collect and make accessible the state of the art and know-how about the application fields of TXRF analysis, such as environmental, biological, life science, and food, but also infrastructures, research groups, and manufacturers, thus becoming the reference point for TXRF.

3. Increasing capability in European and selected developing countries in assessing the TXRF use for food safety, quality control and environmental monitoring by fostering the knowledge exchange and the development of a joint research agenda around the most scientifically and socio-economically relevant topics of TXRF analysis.

4. Fostering the knowledge exchange and the development of a joint research agenda about using TXRF in the new emerging applications in the medical, diagnostics, pharmacology and cosmetics field.

5. Bridging the separate approaches of chemical and physical traceability needed to propose TXRF as a primary chemical method to the Consultative Committee for Amount of Substance (CCQM) and to propose dedicated standards.

6. Connecting and strengthening collaborations among outstanding European and international scientists and experts, mainly chemists, physicists, engineers and life scientists with their different background to develop a joint research agenda and create successful ad wide competences consortia for joint research.

7. Involving in this Action COST ITC, newly established research groups, teams from countries with less capacity, and women, since the early stage, assuring gender balance, enabling a uniform access to scientific and technological knowledge, to address vulnerabilities and to enhance knowledge sharing in the field of TXRF.

8. Support ECIs, women and researchers from ITC by enabling them to take leading roles within the Action and the research framework as well as by creating a network where they can meet and exchange ideas on career moves, grant applications, possible collaborations and promotion of working opportunities.

1.3. PROGRESS BEYOND THE STATE-OF-THE-ART AND INNOVATION POTENTIAL

1.3.1. DESCRIPTION OF THE STATE-OF-THE-ART

TXRF spectroscopy is a variant of conventional energy dispersive X-ray fluorescence (EDXRF) spectroscopy, where the exciting beam hits the sample below the critical angle of the substrate/sample carrier so the beam is totally reflected. The background is very low compared to conventional XRF and the standing wave field can be generated above the surface. Thanks to this factor a large intensity enhancement can be achieved. Several types of TXRF instrumentations with different features, from benchtop spectrometers to synchrotron radiation laboratories addressing different atomic weight elemental ranges, and sensitivities, exist. The performances of TXRF instrumentation are comparable, or even better, with respect to those of conventional spectroscopic techniques like atomic absorption spectroscopy (AAS) and inductively coupled plasma (ICP) spectroscopy [1]. TXRF has emerged as alternative and complementary to these techniques, having many advantages, such as the very small amount of sample required, the easy sample preparation and experimental setup, and the relative low cost of the instrumental systems. Moreover, the simultaneous detection of all the giving the unique opportunity of fast screening.

TXRF has been operated for more than 30 years, and it led more than 4000 publications, and at least one monograph. It is a worldwide distributed method with a broad education of users (physicists, chemists, engineers, etc.). TXRF was identified as a primary chemical analysis method, but this approach has not been concluded and not transferred to industry yet [2]. More recent literature reports successful applications of TXRF in environment [3-5] and food [6,7]. While, new applications are emerging principally in the fields of medicine, biology, pharmacology and nanotechnology [8-11]. Crucially, there is an underlying lack of standardisation in the analytical protocols for the acquisition, processing and reporting of TXRF data, as it is clearly stated in the work program of ISO/TC201. In 2011 ISO/TC201 Working Group 3, now become Sub-committee 10, started facing this need with a comprehensive study about the use of TXRF for environmental and biological analysis, reported in the "Technical Specification for the use of TXRF in environmental and biological analysis" (ISO/TS18507). Inter-laboratory tests have shown the potentiality of TXRF for the analysis of drinking waters [12].

1.3.2. PROGRESS BEYOND THE STATE-OF-THE-ART

Sample preparation, measurement parameters and set-up geometries have a crucial role for the traceability of the results of TXRF analysis. Modifications related to the reflector material and smoothness, sample concentration and droplet matrix, may dramatically impact the uncertainty of measurements. Theoretical and experimental studies are needed for a deep understanding of the impact of the relevant parameters on the results.

The state of the art will be improved as following: A) Specific sample preparation methods and protocols will be developed and optimized, considering the characteristics of samples to achieve homogeneity of the residue and improve measurement repeatability. B) New analytical methodologies will be developed within the framework of green analytical chemistry, for instance based on the analysis of solid samples by means of slurry preparation or the use of micro-extraction techniques for liquid sample analysis. C) Proper quantification procedures will be developed via the selection and use of defined and suitable elemental internal standards to achieve accurate and precise results. D) Statistical evaluation procedures for data analysis and results will be assessed to monitor repeatability, reproducibility and accuracy. E) Complementary validation activities through comparative studies with existing technologies, such as AAS, ICP, Ion Chromatography (IC), and primary chemical methods accepted by the CCQM, will be developed. F) Computer based simulations will be performed to understand and properly address cause-effects relations between sample composition, topology, deposit mass and shape, and results. Absorption and saturation effects will be considered and properly addressed for metrological issues. G) Improvements of the existing TXRF instrumentation and related sample preparation tools and devices will be introduced, focussing on single application and sustainability (low power, environmental friendly, and ease of use) to make TXRF available to a larger users' community. H) Pre-normative and standardization activities will be conducted at the international framework. Inter-laboratory tests will be realized with a stronger effort of joint research, knowledge and know-how sharing at the cross-national level. I) Challenges related to the propagation of TXRF-based analysis in industry will be identified more precisely. Relations between cost and performances, data reduction, and the lack of industry-ready software for quantitative data analysis of samples with various composition, roughness, shapes will be evaluated. L) Advantages and limitations of TXRF in comparison with complementary techniques for surface chemical analysis (Ion Beam Analysis, conventional XRF, FTIR, etc.) will be included to assess the need for TXRF. The possible impact of TXRF on samples (degradation of bio samples for instance), will be investigated. M) The possibility to establish TXRF as Key Enabling Technology (KET), will be also considered. Complementary applications, for instance relating to energy and environment will be explored, to widen the scope and increase the number of stakeholders, leading to higher impact and visibility of the Action.

As a consequence, the following specific goals will be reached in the field of TXRF: 1. Quality assurance, robustness and traceability of analyses results; 2. Development of good laboratory practice procedures; 3. Development of new processes, tools, products and fields of applications; 4. Development of new standards and update of existing ones; 5. Strengthening of the Europe's innovation capacities and progress beyond the state-of-the-art; 6. Improvement of the use of TXRF-based analysis in industry; 7. Assessment of the "need" of TXRF in surface chemical analysis; 8. Assessment of TXRF as KET.

1.3.3. INNOVATION IN TACKLING THE CHALLENGE

This Action will offer a unique trustworthy environment to share data and protocols through dissemination, round-robin studies and Short Term Scientific Missions (STSMs) thus enabling each laboratory to experience and integrate new approaches and the establishment of standardized TXRF methodologies across Europe.

ENFORCE TXRF will provide innovative interactive activities and a new training strategy centred on practical applications, comparison with other techniques (AAS, ICP, IC, etc) and statistical evaluation. This training will emphasise the difference between general TXRF overall processing (from sample preparation to data analysis) and specific and case by case TXRF processing, extracting parameters of importance for each type of scientific application as each distinct field of expertise will be covered in each activity, with the final aim of creating integrated competences. The engagement of the various actors of ENFORCE TXRF will be encouraged by discussions forums, and new publication channels for practical tools.

Innovation lied in the development of communication and business routes to innovate, improve and operationally deploy TXRF in laboratory. Through round-robin studies and pseudo-operational trials, new knowledge will be acquired on the full potentialities, as well as limitations, of the TXRF analysis applied in the various fields of research which will be exploited to drive innovation (e.g. green new nanomaterials, solar cells, water or pharmaceutic purity). The strong link established within this network between laboratory institutes, metrology institutes, and private companies from equipment suppliers to control quality laboratories towards the end user (and regulatory agencies or governments), is one of the most innovative features of ENFORCE-TXRF, and this link is essential to devise operational technologies/methodologies. Altogether, exploitable and innovative improvements are foreseen in instrumentation, software, methodologies and users' operational protocols, via the establishment of new workflows which will be conceptualised.

1.4. ADDED VALUE OF NETWORKING

1.4.1. IN RELATION TO THE CHALLENGE

Establishing a network within ENFORCE-TXRF will bring about immediate results by maximising the use of important existing resources: instruments, know-how in sample preparation and best laboratory procedures, software and data treatment methodologies, and a broad scientific community from academics, metrology institutes, suppliers and end-users. Translational science in TXRF will only be granted through a synergistic approach. Academia adds value to the network by sharing cutting edge knowledge and state of the art facilities, end users will shape and channel innovation as they are the main repository of the knowledge with respect to operational and legal requirements, industry has the scientific expertise and the business vision to turn an academic idea into an actual product and metrology institutes are the warranty of the correct and efficient applicability of the technique, ensuring reproducibility/repeatability/ and scientific exploitation guidelines for the industries.

The networking activities proposed in ENFORCE TXRF will promote a positive cycle of experimenting, learning, refining and adoption of common procedures which will enable a deep understanding and knowledge of the participants' capabilities, expertise, requirements and needs. Technical developments will be boosted by bringing distributed expertise and technologies within the different WP, whereas the European mobility from various sectors and disciplines will consolidate the network and contribute to the sharing of best practice, knowledge and further drive innovation. Benefits and impacts on the economy should derived from these activities and create an efficient channelling of investments and resources into robust, applicable and commercially exploitable TXRF aspects and applications, in turn increasing the potential for timely innovation, and competitiveness returns to scientists and European overall Society.

1.4.2. IN RELATION TO EXISTING EFFORTS AT EUROPEAN AND/OR INTERNATIONAL LEVEL

Several independent initiatives have been performed at the National and European level facing above mentioned challenges. Considering the positive consequences on the industrial sector, the Italian Ministry of Economic Development have funded a project dedicated to the development of new procedures for TXRF analysis of environmental and biological samples. Pre-normative and standardization activities have been carried out. For example, the VAMAS project A10c ended in December 2016, and a new one, dedicated to TXRF analysis of foodstuff, supplements, and materials in contact with it, has been proposed for the years 2018-2020. The target of VAMAS project is confined to inter-laboratory validation of assessed analysis protocols, as engagement towards certification organisations at the European (CEN) or worldwide (ISO) level. The METROFOOD infrastructure is devoted to the realization of reference materials, available also for TXRF analysis. These endeavours need a strong effort at the cross-national level and international level to achieve their objectives.

This Action will benefit from the experience, knowledge and know-how of the established networks gathering them to fulfil the proposed objectives, some bridges will be built between these networks, e.g. to facilitate standards and good laboratory procedures via targeted methodologies needed by domains of applications. The integration of active participants of already existing networks in this Action will allow for rapid exchange of the state of the art, immediate operability, and will define both the common and separated challenges which can be tackled by the most relevant experts in the consortium. The interaction among Working Groups (**WG**s) will therefore been ensured at the early beginning of the action, emphasising the complementarity of approaches and activities.

The networking tools of this Action, such as WG meetings, STSMs, training schools, and open access publications, will facilitate the progress and development of new knowledge and research exchanges, enabling the former targeted activities to truly develop and achieve maximum effectiveness and providing a boost for new ones. All the participant countries will take benefit of the knowledge and experience of this Action network individually but also as a whole, being it composed by several participants with experience in different topics. The open, bottom-up and inclusiveness character of participation framework offered by COST would allow to run ENFORCE TXRF in an effective way. This specificity also allows a wide participation of Academia, Metrology institutes or industry, which will enhance European research and innovation capacities to achieve excellence.

2. IMPACT

2.1. EXPECTED IMPACT

2.1.1. SHORT-TERM AND LONG-TERM SCIENTIFIC, TECHNOLOGICAL, AND/OR SOCIOECONOMIC IMPACTS

This Action will have a great impact on the TXRF scientific community and on the society. Indeed, the outputs will be relevant for industrial quality control, environmental monitoring, and safety as well as traceability of food, cosmetics, and drug. The main expected impacts will be related to boosting the TXRF knowledge in Europe via carefully designed training sessions, assessment and production of reference materials, open access publications. Free access will be given to all the results and the discussion, by open access publication, white papers, and the web site of the Action; Assessment and standardization of preparation methods for relevant samples. Overall this Action will contribute to the development of new knowledge in understanding the critical issues to be addressed to achieve reliable quantitative analysis; Dissemination of the potentialities of TXRF analysis. The possible fields of research and samples where ultra-trace analysis is needed, related in particular to environmental, food safety, quality assurance for nanomaterials manufacturing, health, medicine and diagnostics will be explored and eventually assessed. The long-term impact will be an overall increase in successful and reliable studies using TXRF, and more scientific publications and end-user applications.

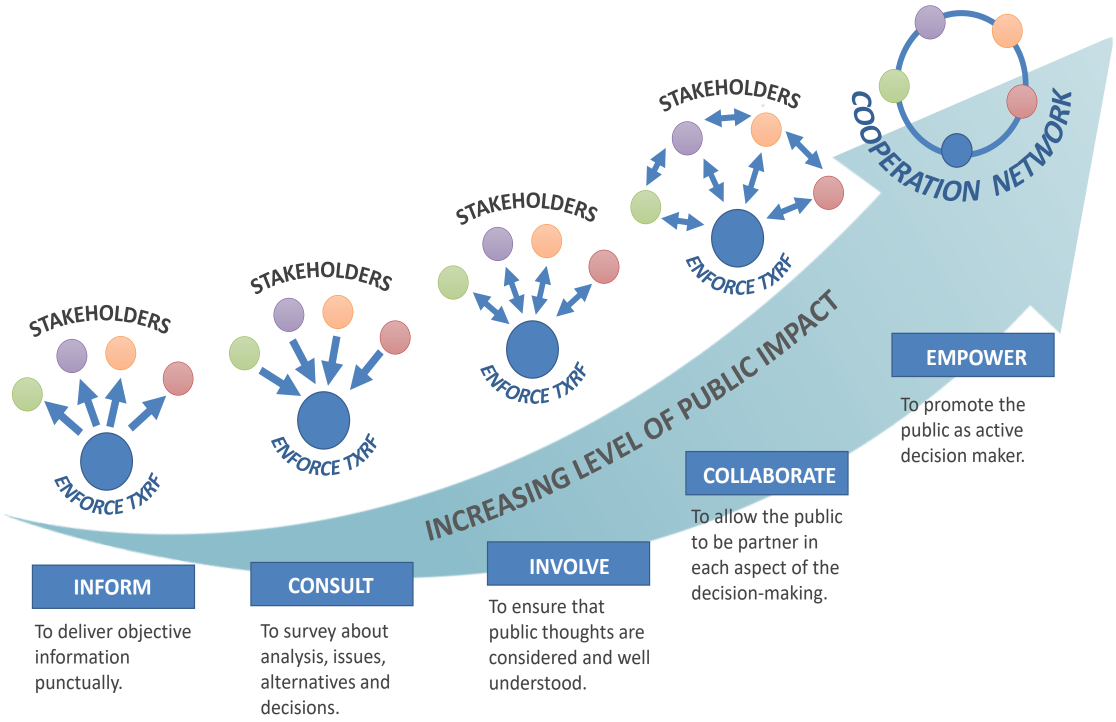
The outputs of this Action will significantly support the standardization community, and the development, and certification of new reference materials. The success in standardization bridges the gap between research and applications of TXRF, improving the analytical reliability of quantitative analysis. Indeed, stakeholders rely on the availability of standards and qualified applications for both quality control equipment and analytical services. This substantially supports and strengthens the competitiveness of those industries as the availability of standards and well characterized samples directly has an impact on the quality of TXRF analysis results. The enhancement of communication between the various actors of the Action through discussion-based interactions during the scheduled events will have a positive impact in the reliability and fields of applicability of TXRF studies, most likely able to generate new ideas for the implementation of TXRF to suit the practical needs of the scientific communities, resulting in term in a much wider use of TXRF.

The technological goals will be achieved by providing: good laboratory and quality management practices; reference samples; new standards for applications of TXRF analysis; establishment of TXRF for control of quality and limits defined by EC directives and regulations; comparison of TXRF with other analytical methods, such as ICP, and secondary ion mass spectroscopy (SIMS), to focus the most promising applications as a low cost and fast screening tool. The appropriate participation and links to the “end user” community, engaged during this Action, will promote the knowledge transfer and accelerate the uptake of the research outputs.

This Action will contribute to the following socioeconomic targets by carrying out cutting-edge research and positively impact societal challenges, as in public health: direct analysis of bioindicators or on the unconventional samples may help to map the pollution conditions of cities and Countryside, thus improving the input for local, national and European regulations; Sustainability: the development of new concepts and products contributes to the birth of new businesses thus improving and strengthening economy and trade at the national and European level; Food safety and traceability: the improvements in TXRF analysis of food as a new tool for screening of products, allows to monitor the presence of potentially toxic metals/elements in animal feedstocks, raw food and throughout the whole food production chain, ultimately improving food safety.

The foreseen outputs will support the improvement of standards, contributing to the sustainability and competitiveness of the environmental, agri-food, cosmetics and drugs and nanomaterials products. In short, ENFORCE TXRF will increase Europe's knowledge-based industry and competitiveness via innovation, and foster the development and leverage of intellectual property, as the provision of guidelines and best practice documents will be made public to the wider community.

The path to increase the public impact is summarized in the following diagram.



2.2. MEASURES TO MAXIMISE IMPACT

2.2.1. PLAN FOR INVOLVING THE MOST RELEVANT STAKEHOLDERS

Key stakeholders will include laboratories, equipment manufacturers, environmental protection agencies, food and drug administrations, food producers and consumers, cosmetics and pharmaceutical industries, national and international standardization body and metrological institutes, European RTDs, the scientific community and Action participants. ENFORCE-TXRF will try to capitalise on previously successful projects, such as VAMAS or PRO-METROFOOD, to become operative and a reference rapidly in these fields of research.

The internal network information flow will be considered as a priority; communication among partners will be facilitated using the website and the social networks (see for example the existing Facebook page https://www.facebook.com/TXRFSpectrometry/). The project website will contain a restricted area designed to be the interface among the partners. WG leaders will be invited to address the need of specific subject and to widen the group of the related stakeholders. The Action website, will work as a nexus of communication, with user-contributed features that will ensure feedback to the project activities, presented in a constantly updated way.

To engage end users, an inclusive approach will be applied. Activities such as workshops and round robin tests will be organized around the priority challenges defined by the end users themselves. These activities will evolve through the course of the COST project to include operational trials in collaboration with Academia and Industry. The constant participation of all actors will be actively pursued. The application to STSMs will enable to train, integrate protocols and procedures facilitating the application of TXRF. Industry has an obvious target, i.e. the expansion of sales portfolio. They will be involved as presenters reporting on their technological innovations, as support to collaborative studies. Metrology and Academia institutes will progress and develop research through stronger multi-disciplinary tasks, adoption of TXRF technologies and methodologies, as well as contribute to the formation of next generation scientists. In particular, the use of the STSMs will bridge the network as they will enable ECI to train and acquire and or exchange knowledge on the most relevant part of TXRF and technological applications. This should generate a good consortia and additional networks which will contribute to the enhancement of professional development and career through collaborative projects efforts within Europe.

2.2.2. DISSEMINATION AND/OR EXPLOITATION PLAN

One of the main targets is actively participate in conferences, workshops, trade shows and to organize courses also in collaboration with other framework projects and initiatives (clustering activities). Surveys will be organized to involve the stakeholders and to collect their needs regarding elemental analysis. Dissemination activities will include raising awareness, training, capacity building, technology transfer, and standard formulation. During the Action, the planning of dissemination activities will be continuously updated by means of the board of the scientific experts (BSE), that will plan, manage, and monitor the disseminations and exploitation activities and verify that they are valuable and well timely distributed. Approaches adopted will face the dissemination challenges in an efficient way, including responsible research and innovation (RRI).

Dissemination activities will target a wide variety of stakeholders and delivery tools, to maximize the impact and to meet their expectations. Delivery methods will be matched to the stakeholder target audience and will comprise face-to-face meetings, workshops, training events, Training Schools, preparation and distribution of hard copy and virtual documentation, presentations at scientific meetings, articles and reports in both the scientific and popular press, special events at industry gatherings, training events, WG special symposia, press releases, social media. Surveys will be proposed to the stakeholders before and after the dissemination activities to evaluate their needs and the impact.

A dedicated website will be reference point for the dissemination infrastructure. The website will serve as focal point for social media activities and on-line promotion of the Action. In addition, other social media communication tools, such as blogs, Twitter, Facebook, Linked-in, will be set up and managed by a responsible selected by the Management Committee (MC). The electronic annual newsletter will be issued to disseminate the activities and the main results in TXRF research. Advertising material with the unique graphic identity of the Action will be created and updated every year. The Layman's report for each WG will be realized.

The training of PhD students, young scientists, and technicians will be performed by advanced training courses and Summer Schools, organized and hosted by the participants and promoted by all the members to ensure the widest audience. The lectures will be recorded and used as e-learning material. Webinar Series targeting scientists and wider audience will be organized to reach a broader audience than those attending the summer courses. There will be a specific focus on good practice guidance and tools.

Open access peer reviewed publications will be encouraged, and, when possible, economically supported. Workshop will be organized at least one a year to assess the activities of the WGs. European and international conferences and professional events, such as the TXRF Conference and the European conference X-ray spectrometry, will be employed as platforms to disseminate the Action activities.

An "Impact Areas and Exploitation Plan" will be prepared which will summarize problems, needs and feedback from the target sectors. It will outline a strategic plan for the use of intellectual property (IP) generated in the Action and for liaising with other initiatives to maximize impact. This will include further research areas, promising sectors of application, and post Action flow involving the partners network.

End products of the inter-laboratory tests will be the development of guidelines and codes of practice to perform measurements, the realization of reference materials and eventually their certification. Detailed analysis of experimental activities results will be published in international journals and/or presented to Conferences. Implementation and exploitation of results within the Action will help ensure the knowledge generated is applied in a timely manner to increase national, transnational, and international exchange and funding opportunities.

2.3. POTENTIAL FOR INNOVATION VERSUS RISK LEVEL

2.3.1. POTENTIAL FOR SCIENTIFIC, TECHNOLOGICAL AND/OR SOCIOECONOMIC INNOVATION BREAKTHROUGHS

On a scientific basis, this Action will produce critical data to understand needs, benefits and limitations of TXRF to pursue and improve its evolution through: the development and optimization of reliable protocols for measurements and analysis; software assessment and design of new workflows pushing towards process benchmarking; to speed up tasks and ensuring higher confidence; the implementation of new and green methodologies of sample preparation; the assessment of true and precise procedures for quantitative analysis; the validation of results by inter-laboratory studies and comparison with existing techniques and primary chemical methods; the theoretical and computer based modelling of interactions between radiation and matter relevant to metrological issues; the exploration and search of new application fields.

On a technological basis, efforts will focus on spreading TXRF based analysis to a wider users' community of scientists, researchers, technicians, laboratories, agencies and industries by: the identification of needs and entry barriers related to cost and performances; the modification and/or improvement of existing instrumentation; the development of new and dedicated sample preparation tools and devices to; the validation of standards; the definition of a realistic development roadmap.

One of the main focuses is therefore to describe complex TXRF protocols as standardised workflows and sequences of elementary operations (Set up, sample preparation, standards, data treatment, etc.) with clearly identified input, output and function. The design of these workflows (see WPs) from existing material (i.e. water round-robin tests, and standardisation) will stress the relationship of the various steps so that other compatible materials can be applied to the TXRF technique with minimum problems. These workflows, with their modularity, will ensure innovation, speed up analysis tasks and allow for benchmarking the results.

In social and economic terms, this Action will lead to: trans and inter disciplinary exchanges among stakeholders, who will benefit and contribute to the mutual growth; dissemination of the technique in Europe, especially in less favoured or trained regions; strengthening links of industry and academics. Risk is lowered by the high motivation expressed by the network of proposers, some of them being key players in the field of TXRF. Dissemination, workshops and round robin tests as well as short term scientific missions will be the warrant of the active involvement of ECI from all the sectors/topics involved in the Action. These activities will ensure mobility, professional and scientific development thus implementing good practices, ethic and forefront knowledge exchange across Europe.

All these activities will contribute to scientific, socioeconomic and technological innovation breakthrough, with a minimal level of risk, considering the networking nature of the project. From a scientific point of view, risks are mainly related to the possibility to obtain lower quality results with respect to other existing techniques. Nevertheless, it is useful to establish analytical capabilities, advantages and drawbacks of TXRF and to obtain information about the fields where it may play a relevant role, and where efforts should be intensified. The importance of intellectual property will be considered. Agreements will be signed to ensure productive and trustworthy dialogue between academia, metrology institutes, standardisation bodies and industry. This will positively impact on new concepts, methodologies, procedures and technologies, whilst minimising the risks of information misuse.

3. IMPLEMENTATION

3.1. DESCRIPTION OF THE WORK PLAN

3.1.1. DESCRIPTION OF WORKING GROUPS

This 4 years Action is organised in 6 distinct and highly interconnected Working Groups (WGs), with specific objectives and activities.

WG1 Observation, regulation, implementation and coordination

Objectives: To create links among the research groups of different countries dealing with similar topics, to propose joint activities; To develop a network of research groups interested to work on new identified topics, facing the challenges of EU regulations in the specific field of application; To enable and coordinate joint research activities, fostering knowledge exchange in the field of TXRF analysis for defined applications; To keep up-to-date the MC about the progress and outputs of WG activities.

Activities: A list of the main European and International stakeholders will be made, to contact and involve them in the specific activities of each WG. During the meetings and throughout the whole coordination, a strong effort will be made to interact with stakeholders, and improve the Action spreading through the proposal of joint research activities (WG2, WG3, WG4), meeting, STSM, training schools (WG6), workshops, conferences and publications (WG5). Each WG Leader will be asked to provide a summary about the state-of-the-art of the tackled topics and subjects. Leaders will share with other members the document contribution to the booklet, according to their skills and expertise. The usefulness to establish thematic sub-groups, dedicated to environmental, agri-food and cosmetics, biological, medical and diagnostics, and surfaces and nanomaterials applications, will be discussed.

WG2 Instrumentation, modelling, data evaluation and software

Objectives: To enable equal access to research infrastructures instrumentation and facilities; To understand the most relevant issues about measurements, software and data analysis affecting the quality of results.

Activities: The presence of members having limited access to capacity building infrastructures, such as Synchrotron radiation facilities, will be assessed to coordinate and facilitate it. The presence of researchers with additional competencies and infrastructures to participate in METROFOOD will be assessed as well, and a dedicated sub-group will be established cross-sectional between WG3 and WG4. Activities dedicated to understanding differences and cause-effects relations among sample matrix, residues mass and shape, and quantitative results, focussing on absorption and saturation effects, will be established cross-sectional between WG3, WG4 and WG5, due to the high interdisciplinary degree. The presence in WG4 of expertise in parallel trace elemental analysis techniques will assure traceability of the results.

WG3 Metrology and standardization

Objectives: To validate protocols for sample preparation and TXRF analysis by means of interlaboratory studies and comparison with other independent techniques; To provide input for exploitation activities.

Activities: The participation to WG3 of, at least, one Member from each of the other WG, preferably the WG leader, will be strongly encouraged. Indeed, participants shall be up to date with recent developments of the research activities ongoing in the other WG. The WG leader will review the state of the art of TXRF related standardization and exploitation activities and present it during the meeting. Discussion during the WG meeting shall led to long term program of the four years, and a development plan with definition of roles among participants and an exact timeline for the activities of the next year. Coherently connections with liaison bodies such as standardization entities (ISO, CEN, and corresponding National standardization bodies), regulation entities (European Commission), pre-normative research networks (VAMAS), metrology institutes and stakeholders will be taken and new projects for standard development will be proposed. In conjunction with the main dissemination events such as Conferences and training Schools, sessions and workshops dedicated to standardization will be organized. Drafts of standard documents will be prepared in collaboration with expert participants from other WGs.

WG4 Sample preparation and analytical procedures

Objectives: To increase the capability of European and selected developing countries to assess the use of TXRF for applications in the biological, environmental, nanomaterial, food, drug, and cosmetics fields; To improve the knowledge and methodology for the assessment of sample preparation strategies and TXRF measurements for screening, quality control and monitoring applications.

Activities: Joint research activities on the identified fields of application will be developed, leading to the improvement of researchers' capabilities and knowledge (WG6) and results dissemination (WG5). A sample datasets and benchmarking will be realized to create a framework that allows comparison of aspects of existing solutions for the various steps of the TXRF analysis, and per application area, becoming a source for real data, from existing sample data collection, and an input for illustrative purposes, to support teaching and knowledge dissemination (WG6), and to highlight the most suitable procedure for standardization purposes (WG3).

WG5 Exploitation, dissemination and recommendation

Objectives: To understand the needs of stakeholders; To identify the topics currently most interesting for the research community; To identify new topics of interest for further research development and exploitation; To provide the document contribution about the use of TXRF analysis for the specific topic and/or application to the booklet summarizing the state-of-the-art and of TXRF analysis.

Activities: Dedicated survey questionnaire of stakeholders will be performed to outline needs and constraints and give recommendation for further research directions, topics of interest and exploitation. Conferences and workshops will be organized on selected topics upon the input of the other WGs. Open Access publications will be fostered. The strict relation between Action participants and existing study groups, such as the "European group of fundamental parameters in XRF analysis", will be strongly encouraged and it will assure high interconnection among the WGs since the very beginning. WG meetings will be held possibly in conjunction with other meeting of related communities and study groups.

WG6 Training, Career path and Short Term Scientific Missions.

Objectives: To expand the use of TXRF in the world creating a new generation of trained technicians, scientists, and researchers in the selected field of application; To develop training materials to build capacity in TXRF analysis for the specific applications; To assist European researchers to lead the expansion of TXRF uses in the world.

Activities: Joint Training School, and workshops will be realized to strengthen the effectiveness and interconnection among WGs participants. The coordination activities of interlaboratory studies will be cross-sectional among WGs and will be coordinated by meeting and other networking activities. Effective methods to identify talent young researchers, seeking career opportunities and development will be fostered.

Milestones and deliverables are shared through the whole Action.

Milestones: 1) WG meetings once a year; 2) Core Group and research group meetings every two months; 3) Mid-term reviews after six months from WG meeting.

Deliverables: 1) Writing the chapter about the specific WG topic be inserted in the booklet summarizing the state-of-the-art and fields of applications of TXRF; 2) Development plan of WG Activities on a yearly basis; 3) Annual Report of WG Activities, within 1 month from WG meeting; 4) Report of research groups activities, within one month from the end of each one; 5) Publication and/or Contributions to Conferences of Action participant joint research projects results; 6) Draft documents of the validated protocols; 7) Layman's report of WG activities at conclusion.

3.1.2. GANTT DIAGRAM

Tasks description	Responsible	YEAR 1					YEAR 2				YEAR 3				YEAR 4			
		1	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
Action management	MC	◆				◆				◆				◆				◆
Setup of WGs	MC		◆															
WG Coordination and development of joint research activities	WGs Leaders		★		◆		◆ ★		◆		◆ ★		◆		◆ ★		◆	
Involvement of stakeholders	WG1 Leader			◆		◆				◆				◆				◆ ★
Set up of the State of the Art booklet	WG1 Leader			◆						★								
Definition of thematic subgroups	WG1 Leader			◆		◆						◆						◆ ★
Definition of research infrastructure accessibility	WG2 Leader				◆	★				★				★				★
Establishment of cross-sectional subgroups	WG2 Leader									★								
Development plan and definition of roles	WG3 Leader			◆			★							◆				◆
Connection with Liasoning bodies	WG3 Leader									★								
Development of datasets and benchmarking data	WG4 Leader			◆						★	◆							★ ◆
Input to standardization	WG4 Leader						★				★				★			★
Survey questionnaire	WG5 Leader			◆				★										
Identification and assessment of the topics of interest	WG5 Leader								◆					◆				
Schedule of dissemination activities	WG5 Leader																	
Development and assessment of effective scouting methods	WG6 Leader			◆					◆					◆				
Schedule of Short Term Scientific Missions	WG6 Leader			◆ ★				★				★				★		◆ ★

Legend: Milestone ◆ Deliverable ★

3.1.4. RISK AND CONTINGENCY PLANS

Considering the networking nature of the project, the success of this Action is heavily dependent on participants, their availability, effectiveness and efficiency in developing, coordinating and carrying on the related activities. The risk and contingency plan of this Action is following presented. Risks are listed, evaluated (levels in brackets), and the corresponding corrective actions are proposed.

1) Low participation of proposers (Low). Most experts participating in this Action are scientists working with TXRF focussing on different subjects, whose breakdown is well represented by WGs. All the proposers are interested in the successful development of this Action, being advantageous for their field of interest and/or research.

2) Risk of disengagement of some countries due to lack of funds (medium). Organization of local activities in these Countries venues.

3) Risk of disengagement of companies and non-academic (medium-high). Stronger involvement and assignment of leading role to their participants.

4) Delays in activities (medium). Clear agenda of meeting, milestones and deliverables shared with all the MC members and WG leaders. Regular check of activities progress, every three months, by cross-matching between WG and MC. Monitoring mechanisms put in place, compilation of regular reports (progress made, description of issues, action plan to counteract the issues) and ratification by the coordination group of the modified milestones.

5) Low activity of the WGs outside scheduled events (medium). Fostering online tools, assigning precise and specific tasks, increase communication between WGs leaders, rotation of the chairs, transfer of tasks to motivated newcomers, newsletters etc.

6) Management cost (high). Limited by 1 meeting per year and quarterly video conferences and dedicated thematic online meetings.

7) Difficult coordination due to high number of participants (high). Assigning more participants per task and pushing local activity (training, seminar, etc).

8) Long meeting (medium). Organizing parallel sessions, dedicated courses and training.

9) Expensive WG meeting/dissemination (low). Multi-tasks role of the attendees with interventions as teachers, speakers, learner; search for local and/or industrial sponsorship, minimal fee for attendees as a last resort.

10) Low teacher availability (med). Rotate speakers, train students/newcomers for becoming teachers, etc.

11) Difficulty in engaging industry in benchmarking and/or data standardisation (medium-high). Offer to build their own protocols following WG instruction and to participate anonymously in the standardisation processes.

12) Not deliver anticipated breakthroughs when several experts deal with large data sets (medium). Providing online platform in multiple domains such as investigation case, joint team, analysis of work files, etc. upon agreed sub-network (invited members) with password, etc.

13) Legal and financial risks (medium). Definition of agreements featuring potential commercial and/or intellectual properties issues.

14) Low participation to round robin tests (medium). Evaluation of the risk before finalization of the project, facilitating access under special conditions, involving instruments and complementary tools industries.

3.2. MANAGEMENT STRUCTURES AND PROCEDURES

The MC will be the promoter and supervisor of the overall technical and scientific progress. Within the MC it will be created a restricted group of experts dedicated to define and assess dissemination tools. The MC will deal with: Taking all actions to enable proper decision making by this decision body; Ensuring smooth operation: work plan maintenance, monitoring, the progress, analysing results, problems and exploitation for future research; Writing periodic reports; Submitting deliverables and financial statements to the COST; Communicating information regarding the Action to COST and participants. The MC will be responsible for the strategic orientation i.e. the overall direction of the activities (Meetings, Training Schools, STSM, dissemination) and re-orientation whenever necessary, for example WG budget revision, measures towards defaulting WG leaders). The secretariat will be provided by the Administrative Secretary. The MC will deal with financial management of WG and will supervise the work of the Administrative Secretary. Meetings of MC will be held once a year.

Daily administrative management work and handling logistics will be handled by the MC Chair with the help of the Administrative secretary. It will be responsible of: Action administration (including planning, preparation and follow-up of meeting minutes); Consolidation of the annual Action reports; Financial administration (monitoring of expenses against budget allocations, consolidation of financial summary sheets, etc.); Individual assistance to Action participants on specific administrative issues; Internal Action communication (including a collaborative platform through the web-site).

A group of experts dedicated to coordinating dissemination activities, the board of experts, will be created within already present European and International network and communities. WG deliverables and milestones will follow a procedure with fixed regular reminders sent by the MC Chair to WG leaders. This procedure will result in on time high quality deliverables and milestones meeting expectations. The scientific management of each WG is in charge to the WG leader and will include: the coordination of scientific and networking activities between WG participants; the coordination of the data and knowledge management activities; the monitoring and the assessment of the scientific quality of the results compared to state-of-the-art knowledge; the preparation of detailed work plans for the following periods; risk management, by implementing mitigation measures, alternative approaches and corrective actions, whenever necessary (playing a mediation role if required).

A specific development plan is foreseen for the coordination of WG activities. First WG meeting will assess the Core Group of researchers interested to joint research activities. WG will be established and the leaders will deal with the coordination of specific research projects, providing a brief outline of the objectives, timeline, and the necessary networking tools. Sub-groups will be established eventually to deal with more complex projects. Sub-group participants shall meet, at least, every two months. At the end of each project the open access publication of results is expected. Sub-group leaders will provide short reports of the activities performed in the frame of this Action and present them at WG meetings held, at least, once a year. Survey questionnaire will be provided to WG participants to be submitted to potential stakeholders. WG Leaders will provide a progress report of activities, with the budget proposal at least two months in advance to MC meeting.

3.3. NETWORK AS A WHOLE

The network of the 49 proposers of this Action is mainly made by Higher Education & Associated Organisations (79.6%), followed by Business enterprise (6.1%), Private Non-Profit without market revenues (NGO, 4.1%), Government/Intergovernmental Organisations except Higher Education (8.2%), and Standards Organization (2.0%). A total number of 39 fully or mostly public Higher Education & Associated Organisations participate, the most part of which are research oriented (21) and part are education oriented (18), with 10 different Field of Science: Chemical sciences (15), Interdisciplinary (2), Physical Sciences (10), Health Sciences (3), Other engineering and technologies (3), Materials engineering (1), Environmental engineering (1), Earth and related Environmental sciences (2), Mechanical Engineering (1), Animal and dairy science (1). Two national Private Non-Profit NGOs without market revenues. Four Government/Intergovernmental Organization except Higher Education, three of which are Central and Federal Government Organizations, and one is European Union. Three Private SME Enterprises, one Independent, one owned by a foreign multinational group, and one owned by a national group, in the market sectors of Manufacturing (1) and Professional, Scientific and Technical Activities (2), participate.

Core Expertise of Proposers is wide, distributed in 6 Sub-Fields of Science: Chemical sciences (44.9%), Physical Sciences (26.5%), Nano-technology (6.1%), Earth and related Environmental sciences (8.2%), Health sciences (4.1%), and other (10%). The network of proposers brings together an international and multidisciplinary team of highly educated people whose 93% holds PhD, and number of 15 are early career investigators. A good gender balance is achieved with 53.1% Males and 46.9 Females.

The size of the network and Core Expertise of the participants, are appropriate to many of the tasks envisaged to solve the previously mentioned Challenge to assess proper tools and methods to perform a reliable elemental analysis of different kind of matrices, both solid and liquid, and assess with expertise such as biology, pharmacy, physical chemistry, nanotechnology will be encouraged. Overall, the group formed within ENFORCE-TXRF is composed of relatively young, confirmed scientists with multi-disciplinary backgrounds, who have developed careers not only in applying TXRF, but also in designing, developing, and characterizing a wide range of materials. This is central to address the challenge of the Action as it will ensure experience and scientific vision required to channel the efforts of the TXRF community towards scientific production in TXRF. The technical skills of this group of professionals, including Academia, metrology institutes and industries, equipment supplier which is put here in synergy, will allow this Action to achieve the most challenging and technical objectives, and increase potential and impact of the TXRF analysis.

Many of the proposers are involved in the activity or creation of TXRF laboratories and many of them are also active in international initiatives. This broad contribution will ensure proper exchange and synergy within the Action network, and it will allow to keep the consortium abreast of technological developments and scientific challenges, notably in life, environmental sciences and nanomaterial developments. Geographically, COST has no specific limit as it will try to support all institutes equipped or dealing with TXRF. However, the action will also try to canvass ITC with less organised networks for young scientists and dealing with applications of TXRF. Competitiveness of companies, industries will be boosted by joint methodology and metrological developments within this COST Action, which may result in new inventions and improved access to TXRF.

All the countries, whose researchers helped to set up this Action, have a stake in the Challenge participating in the network. COST Member Countries have different stakes. Some countries have well assessed laboratories interested to improve their cross-national and international collaborations. Others are interested to improve their scientific and technological knowledge and to have access to instrumentation and high capacity facilities available in the consortium.

The Russian Federation, participates through a young talented researcher affiliated to the Kazan National Research Technological University, who has just started working with TXRF during his PhD. The interest is mainly related to the participation in training courses and inter-laboratory studies to improve the knowledge and understanding of theoretical and practical aspects of this technique. Albania participated through a chemist professor with expertise in elemental analysis by AAS for environmental monitoring. The network will benefit of this expertise for comparative studies of TXRF with parallel existing trace elemental analysis techniques.

Japan participates having strong interests among its stakeholders, both scientists and companies. Chile, Kenia and Venezuela participate having strong interest in the development of TXRF as a low cost and easy technique for trace elemental analysis available in remote places. USA and China participate with the interest to encourage the birth and development of local research communities on the topic, mainly based on European experts.

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