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D3.1 - Stakeholder comments on Executive Board suggestion for call topics & criteria from connected entities (3.1.1), SAB (3.3.1) and online consultations of target groups (3.4.3) for first call

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Abstract

One of the main efforts of the PIANOFORTE partnership is dedicated to the organisation of three competitive open calls for research and innovation projects in radiation protection. To do so in a transparent, user-centric manner a strong focus is to document transparently the way to the selection of call topics. Within the scope of the selection and prioritisation of research topics for the calls, the wider radiation protection community is involved, both internally and externally to the PIANOFORTE partnership. Specifically to this deliverable, the Stakeholder and Advisory Board of the project and a wide range of external stakeholders have been encouraged to contribute to the prioritisation process of the subtopics of the 1st Open Call. The purpose of this deliverable D3.1 is to inform about the methodology, the implementation and the acquired feedback of the stakeholder engagement activities carried out for the preparation of the 1st Open Call.

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1. Introduction

The ambition of the PIANOFORTE Partnership is to improve radiological protection of the public, patients, workers and the environment in all exposure scenarios and to provide solutions and recommendations for optimised protection in accordance with the European Basic Safety Standards (EU BSS).

The general objectives of the partnership will, inter alia, be achieved by the results of PIANOFORTE-funded research and innovation projects in the field of radiation protection. These projects will be selected in the frame of three competitive Open Calls.

The input to define the overarching research priorities of the 1st Open Call is based on the priorities defined in the Joint Road Map developed during the H2020 CONCERT EJP but also on the results of ongoing H2020 projects and other European programmes, in particular the SAMIRA action plan.

PIANOFORTE aims to involve all relevant stakeholders at the different stages of the project and targets to assure efficient engagement throughout the project. Consequently, for the 1st Open Call a wide range of stakeholders has been involved to feedback and comment on the proposed research priorities, i.e. the proposed subtopics of the call. These measures of participation further included the possibility for stakeholders to take part in the ranking of research topic prioritisation. These activities complement similar undertakings with respect to the European platforms and PIANOFORTE's consortium members.

2. Stakeholder involvement in frame of the 1st PIANOFORTE Open Call

Within PIANOFORTE, work package two (WP2) leads the efforts to identify and prioritise topics for the 1st Open Call, starting with the involvement of the European Platforms on research in radiation protection, and later on integrating the feedback received from the PIANOFORTE consortium members / POMs and external stakeholders. In this overarching prioritisation process, WP3 was responsible to acquire and process the feedback from several stakeholder groups, including the Stakeholder and Advisory Board, with the aim to gather as much knowledge as possible on the needs of the radiation protection community, see Figure 1 on page 6.

The identification of relevant topics/subtopics which were suggested for the 1st PIANOFORTE Open Call are primarily based on the joint research challenges of the CONCERT Joint Roadmap (Figure 2 on page 6), including a harmonisation with the PIANOFORTE objectives and expected outcomes, and taking into account the results and recommendations of current and recently completed European projects on radiation protection.

Systematic stakeholder involvement in PIANOFORTE

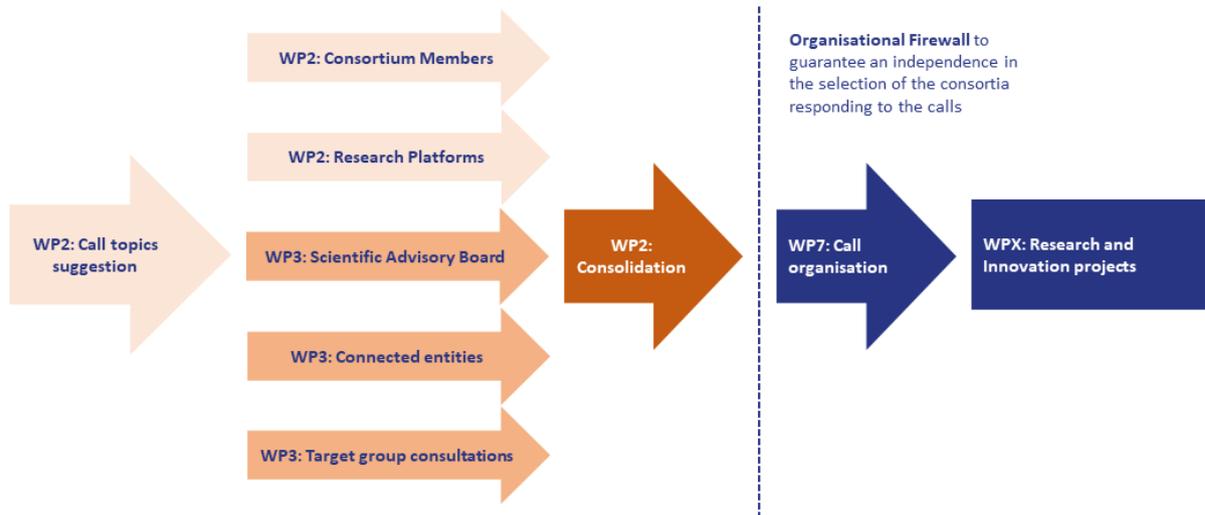


Figure 1: Systematic stakeholder involvement in PIANOFORTE

Criteria were defined to score each of the subtopics (more details in deliverable D2.1) and the six European platforms on radiation protection research were asked to score each of the subtopics proposed. Based upon these scores, WP2 ranked the subtopics in four categories: Very high; High, Moderate and Low. The ranked subtopics, together with an explanatory text of each of them were presented to and commented by the stakeholders, i.e., the Stakeholder and Advisory Board (SAB, Task 3.3.1) and the diverse group of external stakeholders which were addressed in the frame of Topical Online Meetings (TOM, Task 3.4.3).

A. Understanding and quantifying the health effects of radiation exposure
B. Improving the concepts of dose quantities
C. Understanding radiation-related effects on non-human biota and ecosystems
D. Optimising medical use of radiation
G. Optimising emergency and recovery preparedness and response
F. Developing an integrated approach to environmental exposure and risk assessment from ionising radiation
E. Improving radiation protection of workers and population
H. Radiation protection in/with society

Figure 2: Radiation Protection research challenges identified in the CONCERT Joint Roadmap

A compilation of all proposed topics/subtopics for prioritisation for the 1st Open Call is attached to this deliverable (Annex 5.1 Topics and subtopics for PIANOFORTE Call 1 starting from page 15). The text of the subtopics was supplied to the Connected Entities, the Stakeholder and Advisory Board and the external stakeholders as the basis for their feedback and comments.

To facilitate the comments compilation of the different stakeholders to the proposed prioritised subtopics, two templates, made by WP2, were used (Figure 3 and Figure 4). The same templates were used to compile the comments of the POMs by WP2 as well.

Contributor (who made the comment)	Page, paragraph	Type of comment: ED (editorial) CO (content topic)	Original text/evaluation	New proposed text/evaluation	Comment: why is this change proposed?	Comment from Pianoforte WP2.1 group

Figure 3: Template to collect comments on the subtopics content for the 1st Open Call.

PIANOFORTE research priorities: RANKING EVALUATION				
Name of the contributor/organization:				
Topic	Subtopic	RANKING EVALUATION		
		PIANOFORTE ranking	Agree or Disagree	If disagree, argue why
A	A1	HIGH		
	A2	VERY HIGH		
	A3	VERY HIGH		
	A4	HIGH		
B	B1	MODERATE		

Figure 4: Template to collect comments on the PIANOFORTE ranking of prioritised subtopics for the 1st Open Call

2.1 Connected Entities

PIANOFORTE has set as a major priority to launch the 1st Open Call as soon as possible. The call opening is planned in March 2023. Due to the short time frame from June 2022 to March 2023 for the whole call organisation including stakeholder involvement it was decided to focus on the Stakeholder and Advisory Board, the external stakeholders (by Topical Online Meetings) and the Programme Owners and Programme Managers (POMs) for collecting feedback on the subtopic prioritisation. Another line

of feedback was intended to the other larger organisations that do not want to be part of the SAB but want to comment on the prioritization process. Some Connected Entities, namely European organisations and advisory bodies as well as international organisations in the field of radiation protection, have been approached in terms of the prioritisation of subtopics for the 1st Open Call. The dialogue comprised an open exchange on the overarching strategy concerning the selection of relevant topics and partly led to a written feedback on the proposed call topics. However, most of the organisations declined to comment in the required written format due to their “neutral” position or other political reasoning. Concerning the 2nd Open Call, the efforts will be intensified and accompanied by a longer period of feedback on the relevant call topics proposed, but it might be that ranking is better achieved via the SAB and the open consultations. For the 1st call, the only written feedback from Connected Entities was a list to compare the topics with ongoing groups in the ICRP process on modernising the system of radiation protection, without ranking (cf. Annex 5.2 on page 23).

2.2 Stakeholder and Advisory Board (SAB)

The SAB was involved in the research topics’ prioritisation process for the 1st Open Call (for SAB composition and mission see deliverable D3.5). However, the SAB is not involved in the text preparation for PIANOFORTE open competitive calls, the selection of reviewers or the Peer Review Panel meetings and the establishment of the ranked list of eligible projects.

In 2022, the SAB held several meetings supported by WP3 members of which two sessions were explicitly dedicated to evaluate and comment on the prioritised research topics/subtopics suggested for the 1st Open Call by PIANOFORTE based on the platforms’ feedback on the original set of suggested topics. The first meeting, held in November 2022, was targeted to present the prioritisation process, the subtopics selected, and the templates prepared to compile the SAB comments on the subtopics proposed. The SAB was asked to provide consensual comments, not individual ones, to WP3.

A review of the proposed research subtopics ranking and text was carried out by each SAB member independently (filling both templates; cf. Figure 3 and Figure 4). During the SAB meeting held in December 2022, the SAB members came to a consensus on the comments (both on the subtopics ranking and the text proposed) which were then delivered to WP3.

2.3 External Stakeholders (Topical Online Meetings, TOM)

Besides the aim to establish and strengthen a specific PIANOFORTE stakeholder network, it was always a clear target of PIANOFORTE to also give an open and transparent consultation process on the topics of the calls to the whole community. It was envisioned in the preparation of PIANOFORTE that these meetings could be topical in the sense that it could be target-specific online meetings for specific open call goals. Due to the timing constraint of the first call, this process was slightly adjusted and moved to an topically-open consultation process. These meetings are still called “Topical Online Meetings” in the nomenclature of PIANOFORTE and invited all members who were registered within the PIANOFORTE stakeholder network. In September 2022, the process of external stakeholder mapping and

registration was initiated. Once registered at PIANOFORTE website, stakeholders were invited to the Topical Online Meetings that were planned and organised with help of an external IT consultancy and by providing an external web platform and a microsite with all necessary information for stakeholders.

Two TOMs were planned in 2022, which were organised on 15 November 2022, as online meetings. The meetings were aimed to present and discuss the role of stakeholders foreseen in the PIANOFORTE Partnership as well as to introduce and discuss the research priorities identified for the 1st Open Call in 2023 for funding research projects within PIANOFORTE.

About 50 external stakeholders from 17 different countries participated at the meetings.

After a joint session on the presentation of research topics and subtopics, prioritisation methodology and expected outcome from the meetings, two separate meetings in parallel were held, to allow for better discussion of the research topics and subtopics selected and prioritised for the 1st Open Call:

- Group A - researchers from different research centres, universities and experts from international organizations (ex. IAEA, UNSCEAR)
- Group B – representatives from national regulatory authorities and related international organizations (such as HERCA), implementers of ionising radiation (industry and medical representatives)

The meeting participants were invited to comment on the ranking of the individual subtopics and to give their opinion on the draft text of the subtopics in terms of contents and editorial issues, by using the same templates applied to collect the comments from the SAB and the POMs (Figure 3 and Figure 4 above).

3. Stakeholder feedback on the research subtopics proposed for the 1st Open Call

3.1 Stakeholder and Advisory Board (SAB)

As it was previously mentioned, the SAB sent comments agreed upon by all its members, to the ranking of the prioritised research subtopics for the 1st Open Call. Regarding the evaluation of the PIANOFORTE ranking of the subtopics, the SAB agreed with the ranking given to subtopics A1, A2, A4, D3, E1, F2, G2 and H1 (cf. Annex on page 15 ff.). For the subtopics A3, C1, D1, F1 and G1, the SAB proposed a lower ranking than the one given by PIANOFORTE, and for the subtopics B1, C2; D2 and F3, the SAB thought that the ranking should be higher than the one given by PIANOFORTE (cf. Figure 5 on page 10).

The SAB also sent comments and suggestions to the text proposed for each of the subtopics prioritised for the 1st Open Call. These comments are going to be analysed jointly with the comments received from other stakeholders and from the POMs. Each of the comments received will be individually answered by WP2, explaining how they have been considered, or why they have not been taken into account in the final text of the corresponding subtopic. This process will be documented in deliverable D2.1 from WP2.

Topic	Subtopic	RANKING EVALUATION		
		PIANOFORTE ranking	SAB ranking	If disagree, argue why
A	A1	HIGH	HIGH	
	A2	VERY HIGH	VERY HIGH	
	A3	VERY HIGH	HIGH	Radiotherapy related research is very well covered, but the low dose studies is high priority. Some issue are already covered by other European research projects (e.g REQUITE & follow-on projects).
	A4	HIGH	HIGH	
B	B1	MODERATE	HIGH	Important area that will underpin the research done in A subtopics.
C	C1	HIGH	MODERATE	The subtopic is not innovative. It looks more like re-visiting, re-assessing, re-discussing the information gathered during previous decades. C1 and C2 could be merged.
	C2	MODERATE	HIGH	C2 is more innovative and original than C1.
D	D1	VERY HIGH	HIGH	There is a strong link between D1 and D2, but D2 is a more important, applicable, innovative and original.
	D2	MODERATE	HIGH	Area becoming increasingly important. Impressive deployment of AI methods and innovative technologies in medical applications. The impact of this research can be very significant.
	D3	MODERATE	MODERATE	
E	E1	MODERATE	MODERATE	
F	F1	HIGH	MODERATE	Lack of clarity in the description of the subtopic made it difficult to identify whether there was some innovation.
	F2	HIGH	HIGH	
	F3	MODERATE	HIGH	It includes the development of innovative methods.
G	G1	HIGH	MODERATE	This subtopic could be better ranked if the main focus was on societal issues. Social and psychological aspects could be prioritised over radiological aspects because relatively recent events (Chernobyl, Fukushima) showed enormous societal impacts.
	G2	HIGH	HIGH	
H	H1	HIGH	HIGH	

	Agreement with PIANOFORTE ranking
	Disagreement (SAB ranking < PIANOFORTE ranking)
	Disagreement (SAB ranking > PIANOFORTE ranking)

Figure 5: Comparison of the PIANOFORTE ranking and the SAB ranking of the subtopics proposed for the 1st Open Call.

3.2 External stakeholders (Topical Online Meetings, TOMs)

Within the context of the TOMs, WP3 was able to receive a written feedback on subtopic prioritisation from 23 stakeholders from 12 European countries (Italy, Germany, Portugal, Croatia, Turkey, Spain, Slovenia, Norway, Denmark, Sweden, Poland and UK) and IAEA. Inputs were received from researchers and implementors in the field of medical use of ionising radiation, national authorities responsible for radiation protection, researchers and implementors in the field of natural ionising radiation, low dose radiobiology, environmental radioactivity and radioecology. About half of the received stakeholder inputs supported the ranking of subtopics proposed by PIANOFORTE WP2 based on the platforms' input. The analysis of the other feedback showed, that in general, most of the stakeholders suggested a higher ranking of particular subtopics.

Figure 6 below shows a comparison of the originally proposed rankings and the external stakeholders which provided written feedback after the TOMs. In the event that at least 2 external stakeholders had

an equal opinion including a justification to increase/decrease the ranking of a subtopic, the opinion was considered. In the case of several different opinions on the ranking the diverging “votes” were counted and a simple majority decision was made whether the ranking should be increased/decreased or not.

Topic	Subtopic	Ranking		RANKING EVALUATION If disagree, argue why
		PIANOFORTE	TOM	
A	A1	HIGH	HIGH	
	A2	VERY HIGH	VERY HIGH	
	A3	VERY HIGH	VERY HIGH	Radiotherapy related research is very well covered, but the low dose studies is high priority. Some issue are already covered by other European research projects (e.g REQUITE & follow-on projects).
	A4	HIGH	VERY HIGH	
B	B1	MODERATE	HIGH	Important area that will underpin the research done in A subtopics.
C	C1	HIGH	VERY HIGH	The subtopic is not innovative. It looks more like re-visiting, re-assessing, re-discussing the information gathered during previous decades. C1 and C2 could be merged.
	C2	MODERATE	HIGH	C2 is more innovative and original than C1.
D	D1	VERY HIGH	VERY HIGH	There is a strong link between D1 and D2, but D2 is a more important, applicable, innovative and original.
	D2	MODERATE	HIGH	Area becoming increasingly important. Impressive deployment of AI methods and innovative technologies in medical applications. The impact of this research can be very significant.
	D3	MODERATE	MODERATE	
E	E1	MODERATE	HIGH	
F	F1	HIGH	HIGH	Lack of clarity in the description of the subtopic made it difficult to identify whether there was some innovation.
	F2	HIGH	HIGH	
	F3	MODERATE	MODERATE	It includes the development of innovative methods.
G	G1	HIGH	VERY HIGH	This subtopic could be better ranked if the main focus was on societal issues. Social and psychological aspects could be prioritised over radiological aspects because relatively recent events (Chernobyl, Fukushima) showed enormous societal impacts.
	G2	HIGH	VERY HIGH	
H	H1	HIGH	HIGH	

	Agreement with PIANOFORTE ranking
	Disagreement (TOM ranking > PIANOFORTE ranking)

Figure 6: Comparison of the PIANOFORTE ranking and the TOM ranking of the subtopics proposed for the 1st Open Call

In the following, the comments of the external stakeholders on the proposed subtopics C2, D2 and E1 are synthesised. These three subtopics have been commented most of all, with at least 5 written comments each.

C2 - Determine the effects of ionising radiation on ecosystem functioning and biodiversity, as well as their potential consequences to human wellbeing (e.g. culture, food consumption, work and recreational activities) [...]

Current ranking – MODERATE; suggestion to increase the ranking as the importance to investigate the potential effects of ionising radiation on ecosystem functioning and biodiversity is acknowledged internationally. The potential secondary effects are also related to human wellbeing in various ways. This subtopic is very much correlated with "One Health" concept that was already recognized by the European Commission in 2021 as priority for the G20. Additionally, in October 2022 the One Health Joint Plan of Action was launched by the Quadripartite – the Food and Agriculture Organization of the

United Nations (FAO), the United Nations Environment Programme (UNEP), the World Health Organization (WHO), and the World Organisation for Animal Health (WOAH, founded as OIE) - This topic is in line with this Joint Plan Action.

D2 - Improving the quality of medical imaging and radiation therapy especially but not limited to cancer-treatment [...]

Current ranking – MODERATE; suggestion to increase the ranking as improving the quality of medical imaging is one of the mainstay issues in radiation dose decrease in medical procedures. Important of highlighting the new technologies and AI software further development, which can help at the (re)definition of acquisition protocols. Protocols should be expected to be as patient centric as much as possible, with the support of increasingly effective and efficient systems and algorithms.

E1 -Developing a knowledge base and analytical tools to improve radiation protection of workers and thus to contribute to the translation of the BSS into practice by focusing on one or more of the following objectives [...]

Current ranking – MODERATE; suggestion to increase the ranking significantly. The quality assured online dosimetry with new technologies has a very high impact in radiation protection and will contribute to implementation of EUY BSSD. The development of new measurement techniques has a high importance for Europe in various fields - from hospitals, NPPs, non-nuclear industry, waste handling etc. Subtopic should be somewhat re-phrased to include more specifically public aspects for radiation protections (currently missing), but in general further developments and improvements on techniques in this field should be very much prioritized by PIANOFORTE.

In addition, subtopics under topic B and topic G were considered as of more of importance by the participants of the TOMs. In terms of the subtopics under G, this should according to the stakeholders be done with respect to new threats, current situation in emergency and preparedness and use of big data, AI and new technologies.

4. Summary of stakeholder feedback on the prioritisation of proposed call subtopics

In the WP2 deliverable *D2.1 Research priorities for the first open call* a comprehensive analysis of the proposed rankings by the SAB, TOMs and also POMs as well as of all proposed editorial and content changes in the subtopics text is elaborated and documented, so we will not double these efforts here. Here, only a brief summary and comparison of the stakeholder feedback on prioritisation is outlined.

Overall, the proposed rankings of PIANOFORTE based on the platforms input, the SAB and the external stakeholders are in accordance. Only in the case of 2 subtopics the opinions of the three are opposite. Considering for the rest of the topics, there was an overall consensus on the ranking or just one of the three respondent bodies had a differing point of view (“slight difference”). Figure 7 and Figure 8 show

a comparison of the individual rankings and further the degree of consensus in the proposed ranking of PIANOFORTE, SAB and external stakeholders.

Topic	Subtopic	RANKING EVALUATION		
		PIANOFORTE	SAB	TOM
A	A1	HIGH	HIGH	HIGH
	A2	VERY HIGH	VERY HIGH	VERY HIGH
	A3	VERY HIGH	HIGH	VERY HIGH
	A4	HIGH	HIGH	VERY HIGH
B	B1	MODERATE	HIGH	HIGH
C	C1	HIGH	MODERATE	VERY HIGH
	C2	MODERATE	HIGH	HIGH
D	D1	VERY HIGH	HIGH	VERY HIGH
	D2	MODERATE	HIGH	HIGH
	D3	MODERATE	MODERATE	MODERATE
E	E1	MODERATE	MODERATE	HIGH
F	F1	HIGH	MODERATE	HIGH
	F2	HIGH	HIGH	HIGH
	F3	MODERATE	HIGH	MODERATE
G	G1	HIGH	MODERATE	VERY HIGH
	G2	HIGH	HIGH	VERY HIGH
H	H1	HIGH	HIGH	HIGH

	Overall consensus
	Slight difference
	Deviation

Figure 7: Comparison of the ranking of subtopics for the 1st Open Call proposed by PIANOFORTE, SAB and ext. stakeholders

It was clear from the general feedback that the SAB had only one clear favourite to fund (so it was easy to accommodate this opinion for call one), while the list of equally high relevance topic will lead to more difficult discussions for the second call. It was also clear from the wider consultation that there is a need to look in the direction of applied results that are useful for users, so a strong argument from the stakeholder side was made to integrate some more practical topics in health or emergency preparedness, which led in the end to the inclusion of an emergency preparedness topic for the first call suggestions.

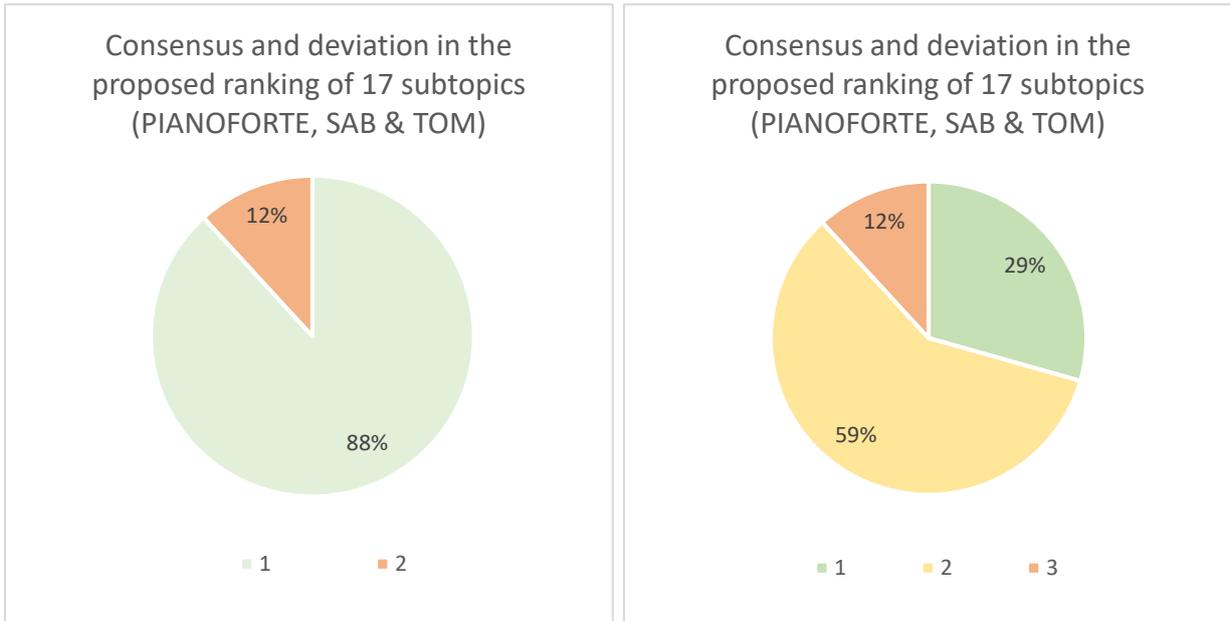


Figure 8: Consensus and deviation in the proposed ranking of subtopics by PIANOFORTE, SAB & external stakeholders (TOM)

5. Annex

5.1 Topics and subtopics for PIANOFORTE Call 1

The indication of the ranking in the following list of topics/subtopics describes the ranking that was made by PIANOFORTE out of the scoring of subtopics by the six European radiation protection research platforms. The document was provided just as below to the various stakeholder groups.

Overview of topics and subtopics

General note: Under Horizon Europe, “the effective integration of social [sciences and humanities] SSH in all clusters, including all Missions and European partnerships, is a principle throughout the programme” (European Commission, 2022¹). SSH are considered to be “a key constituent of research and innovation” (idem). In accordance with these principles and the PIANOFORTE commitments and objectives, **all projects funded by PIANOFORTE are expected to take into account the social, economic, behavioural, institutional, historical and/or cultural dimensions, as appropriate for the topic addressed. Contributions from one or more SSH disciplines may be required to ensure the social robustness and social impact of the research and innovation chain.**

Guidelines for integration of Social Sciences and Humanities in PIANOFORTE funded projects are currently under development and will be made available before the launching of Call 1.

A. Understanding and quantifying the health effects of radiation exposure

A1. HIGH PRIORITY

Define the risk of ionising radiation-induced non-cancer diseases after low and intermediate doses (below 500 mGy) by understanding disease pathogenesis through assessing near-field, out-of-field and non-targeted effects after therapeutic doses and dose-rates and following interventional radiology. The focus should be on developing a knowledge base on the mechanisms of cardiovascular, cerebrovascular, neurocognitive diseases, metabolic and immune disorders applying biologically-based risk models and/or available human cohorts, followed by related social, psychological and communication studies. Studies related to ionising radiation-induced cataracts and establishment of new human cohorts are not within the focus of the current call.

¹ European Commission, 2022. Horizon Europe (HORIZON). Programme guide. https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/programme-guide_horizon_en.pdf

Proposals should address one or several objectives of the topic. The topic is suitable for both large and smaller, more focused proposals.

A2. VERY HIGH PRIORITY

Developing knowledge base for a better understanding of disease pathogenesis of ionising radiation-induced cancer to improve risk assessment. While the role of DNA damage in the carcinogenic process after IR was extensively studied, by now it is clear that other processes significantly modulate cancer development, such as the role of microenvironment, the immune status, metabolic processes and epigenetic factors.

The proposals should focus on investigating the role of epigenetics, metabolic status, immune status, cellular interactions and microenvironmental effects applying biologically relevant experimental in vivo or in vitro models. Since our current understanding of radiation carcinogenesis is almost exclusively based on high dose IR, while at low doses other mechanisms may prevail priority should be given to low dose studies.

Proposals should address one or several objectives of the topic. The topic is suitable for both large and smaller, more focused proposals.

A3. VERY HIGH PRIORITY

Developing a knowledge base and analytical tools to understand the major features of variability in the radiation response including radio-sensitivity (tissue reactions), radio-susceptibility (cancers) and radiation-induced aging by focusing on one (or both) of the following subtopics:

- A better understanding of the role of genetic factors, epigenetic factors, sex, co-morbidities, environmental and lifestyle factors and the interactions between these depending on dose levels. Studies should focus on a better understanding of the mechanisms and link to advancing individualised cancer treatment, including communication among patients, caregivers, medical personnel and other stakeholders in order to empower them for informed decision-making and informed consent.
- Seeking biomarkers of individual risk through cellular/molecular, systems biological approaches, radiomics investigations. Evaluating potential predictive factors and correlating them with health outcomes. Biomarker investigations should include validation of proposed biomarkers in suitable cohorts. In case of studies related to previously identified biomarkers validation and quality control should be included.

Larger projects are favoured. Nevertheless, smaller, more focused projects may also be considered.

A4. HIGH PRIORITY

Define how the temporal and spatial variations in dose delivery affect the risk of health effects following radiation exposure through the integration of experimental and epidemiological data and including optimised detection and dosimetry by focusing on one of the following subtopics:

-
- Understanding the link between exposure characteristics (radiation quality, dose and dose-rate, acute and chronic exposures) and the cancer and non-cancer effects.
 - Understanding the effects of intraorgan dose distribution through observations in patients exposed to inhomogeneous dose distributions and experiments with organotypic tissue models
 - Addressing the difference between risks from internal and external exposures through the integration of new knowledge on the effects of chronic exposures, intra-organ dose distribution and radiation quality considering energy deposition at different scales (from intracellular to organs).

The topic is suitable for both large and smaller, more focused proposals.

B. Improving the concepts of dose quantities

B1. MODERATE PRIORITY

To quantify correlations between microscopic energy deposition and radiation damage, including improved measurement and simulation techniques.

The dependence of biological effectiveness on radiation quality is commonly believed to be related to the differences in the energy deposition pattern on a microscopic and nanoscopic scale. Identification and quantification of the relevant statistical characteristics of the microscopic spatial pattern of interactions (e.g., spatially correlated occurrence of clusters of energy transfer points) are an essential prerequisite for improvement of present dose concepts and understanding the radiation damage mechanism.

The topic should focus on one or more of the following subtopics:

- Investigating the physical characteristics of energy deposition on microscopic scale with the aim of developing a novel, unified concept of radiation quality as a general physical characteristic of the radiation field that would allow separating the physical and biological components contributing to the eventual biological effects of radiation.
- Developing microdosimetric and nanodosimetric detectors, revising their measurement concepts, and developing a 'gold standard' for track structure simulation codes along with their validation. Establishment of robust uncertainty budgets for micro- and nanodosimetric quantities obtained by measurement or simulation and identification of the major uncertainty sources.
- A comprehensive multi-scale characterization of the physical aspects of radiation energy deposition with quantitative investigation and correlation of track structure with biological effects at molecular and cellular level and their consequences at supra-cellular levels. Radiobiological experiments should be performed with relevant micro- and nanodosimetric metrological methods, thereby facilitating the identification of useful connections for further advancements in radiobiological modelling. The cancer development processes should also be considered in the modelling to obtain an estimation of low dose risk.

The topic is suitable for both large and smaller, more focused proposals.

C. Understanding radiation-related effects on non-human biota and ecosystems

C1. HIGH PRIORITY

Resolving the controversy with regard to the effects on wildlife reported in the Chernobyl and Fukushima exclusion zones. Many studies have reported no significant effects of radiation on wildlife (e.g. in the Chernobyl and Fukushima exclusion zones), whereas others reported significant radiation effects on different wildlife populations at very low dose rates (even below natural background exposure). The re-interpretation and achievement of robust, consensus-based data on the long-term ecological effects attributable to radiation in those emblematic contaminated territories would have a very significant impact on the robustness and credibility level of the radiation protection of the environment (e.g., robustness of 'no-effect' benchmark dose-rates). Priorities are to characterise the influence of exposures on the populations currently living in contaminated environments, through (1) robust exposure assessments (considering past exposures and including internal exposure, heterogeneity, differing radiation qualities) and considering other stress factors; (2) the identification of the key factors determining the vast reported variation in wildlife populations' sensitivity to radiation; (3) the identification and validation of biomarkers of exposure and effects that are relevant for effects at the population's level.

The topic is suitable for both large and smaller, more focused proposals.

C2. MODERATE PRIORITY

Determine the effects of ionising radiation on ecosystem functioning and biodiversity, as well as their potential consequences to human wellbeing (e.g. culture, food consumption, work and recreational activities).

The demonstration of the increased sensitivity of ecosystem processes to ionising radiation, in comparison with the reported effects at the population level, would strongly question the robustness of risk assessments that rely only on population-effect data. On the other hand, if it is shown that the functional or structural redundancy (biodiversity) of the ecosystems brings greater robustness against the effects of radiation and potential other threats or anthropogenic degradations (multi-contamination, climatic change...), the conservatism of the current assessments would be comforted. Although the subject is very broad, some targeted studies are achievable within a reasonable timeframe: experimental research on the effects of ionising radiation on functional processes is expected in controlled conditions (e.g., microcosms and mesocosm studies), as well as the reinterpretation (e.g. by ecological modelling) of the reported data on of the current state of ecosystems and their temporal evolution in contaminated territories.

Moreover, the consequences of the impact on ecosystem functioning may have many dimensions, not only biophysical, but also economic and socio-cultural. Those societal issues are also to be addressed,

in the aim to provide finally a coherent framework encompassing both the radiation protection of human and ecosystems.

Larger projects are favoured. Nevertheless, smaller, more focused projects may also be considered.

D. Optimising medical use of radiation

D1. VERY HIGH PRIORITY

Individualise diagnostic as well as therapeutic procedures with regard to optimisation of the benefit/risk ratio. This includes the development of evidence-based procedures and encompasses applications such as molecular imaging, interventional procedures and theranostic applications. As imaging of anatomical structures is a major task in clinical practice, corresponding optimisation in terms of benefit/risk ratio is also crucial and relevant research should be included to complement and build upon the initial work carried out in recent projects. Evidence-based procedures should rely on benefit and risk based on patient data.

The topic is suitable for both larger and smaller, more focused proposals.

D2. MODERATE PRIORITY

Improving the quality of medical imaging and radiation therapy especially but not limited to cancer-treatment. This includes means to i) set up of reliable computational methodologies such artificial intelligence (AI) methods for medical applications including radiation dose prediction and image quality enhancement and e.g. pharmacokinetic modelling, ii) strategies for testing and validation of data and methods used for AI/Machine Learning (ML) applications or modelling and c) methods to allow generalizability of ML models to allow application independent of hospital equipment.

Social, ethical and legal dimensions of the use of AI and other computational models should also be addressed, in particular, how the use of AI will impact current practices; what the effect will be on the gaps observed between best practice and guidelines, on the one hand, and current practices, on the other; and what the concerns and expectations of patients and other stakeholders are in the context of these technological developments.

The proposed research should contribute to the harmonization and application of technology and, in the context of informed consent, communication throughout Europe. Patient organizations must be involved.

The topic is suitable for both larger and smaller, more focused proposals.

D3. MODERATE PRIORITY

Implementing EU-wide epidemiological studies of patients to enhance quality and safety of medical radiation applications and developing a knowledge base and analytical tools to better predict and reduce risk of secondary cancer and non-cancer disease in cancer patients treated with radiotherapy.

Well-designed clinical epidemiological studies should conduct long term follow up, and focus on most at risk populations. The results of the clinical epidemiological studies should be used to optimise treatment and imaging protocols and patient follow-up. The studies should consider patient-specific dose modifiers in derivation of dose estimates as appropriate to different settings and can increase capabilities for radiation dose tracking and managing programmes to provide relevant and standardized dose estimates. Only already existing cohorts should be considered, building up new cohorts does not fit in the timeframe and budget of the call.

The topic should explore ways to improve communication among patients, caregivers, medical personnel and other stakeholders in order to empower them for informed decision-making and consent and improve radiation protection behaviours.

Proposals should address one or more objectives of the topic. The topic is suitable for both large and smaller, more focused proposals.

E. Improving radiation protection of workers and population

E1. MODERATE PRIORITY

Developing a knowledge base and analytical tools to improve radiation protection of workers and thus to contribute to the translation of the BSS into practice by focusing on one or more of the following objectives:

- Improvement of biokinetic models and personalised dosimetry that will lead to the improvement of the assessment of internal exposure for occupational exposed workers;
- Development of real time practical individual dosimetry of workers by harnessing the developments in new connected technologies, with due account to individual behaviour and social group culture;
- Development of a practical neutron personal dosimeter.

The topic is suitable for both large and smaller, more focused proposals.

F. Developing an integrated approach to environmental exposure and risk assessment from ionising radiation

F1. HIGH PRIORITY

Robust modelling of radiological contamination in the human food chain, for an integrated dose and risk assessment of post-emergency situations, with focus on building resilient and sustainable

societies. The topic should take into account future changes in the European agricultural practices and the need to further develop marine dispersion and biota transfer models due to the fact that NPPs are often built on the coast and the future tendency of building them on floating vessels.

The topic is suitable mainly for smaller, more focused proposals.

F2. HIGH PRIORITY

Identifying and quantifying the key processes that influence radionuclide behaviour in existing environmental contamination situations with a special focus on:

- the management and clean-up of existing sites, as well as to the licensing (including social licensing) of future discharges and large quantities of NORM residues.
- developing the modelling basis for accurate dose assessment and establishment of holistic and sustainable remediation approaches.

The topic is suitable for both larger and smaller, more focused proposals.

F3. MODERATE PRIORITY

Integrating risk assessment and management and especially focusing on risk integration for radiation and other stressors. Specific emphasis is required on integrated and holistic risk assessments. There is a need for the improvement and/or development of innovative methods to characterise the source terms to delineate the multiple-hazard footprint (e.g., geostatistical interpretation of environmental, radiological, chemical data) of a site in space and time. Innovative modelling approaches are also needed to support decision making and to identify the most significant sources of uncertainty related to the impact on human and environmental health including social considerations.

Larger projects are favoured. Nevertheless, smaller, more focused projects may also be considered.

G. Optimising emergency and recovery preparedness and response

G1. HIGH PRIORITY

Improvement of radiological impact assessments, decision support and response and recovery strategies by focusing on one or more of the following aspects:

- the use of AI and big data technologies in radiological impact assessments, in the development / optimisation of measurement strategies, for the calculation (along with other novel methodologies) of uncertainties in model results and for optimization and operationalization of emergency preparedness and response practices; integration of AI and big data technologies in Decision Support Systems for better guidance of the end user in countermeasure strategy definition;

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- compilation of the databases that are required by AI technologies, with historic and scenario information - including besides nuclear/radiological accidents, scenarios of new threats, such as war situations;
 - improved communication/dialogue with stakeholders due to better information availability, considering data protection regulations (GDPR).

The topic is suitable for medium-sized proposals.

G2. HIGH PRIORITY

Development of risk assessment and risk management approaches and technological capabilities to cope with scenarios arising from threats due to war or armed conflicts situations, which have not been studied so far, taking into consideration social, ethical and legal issues. Proposals should focus on identifying and addressing missing links related to one or more of the following objectives within a war, armed conflict or significant natural disaster situation:

- Review of whether the current assumptions made in the existing systems for radiation emergency preparedness and response are resilient in armed conflict or natural disaster situations
- Development of event scenarios, including assessment of potential source terms for both attacks on nuclear facilities but also in relation to nuclear detonation scenarios;
- Further improvement, evaluation and operationalization of inverse modelling for localisation and quantification of unknown emission sources of radioactive material, including exploitation of different types of monitoring data, capabilities to handle multiple-source scenarios and potential employment of novel approaches such as AI and big-data technologies;
- Uncertainty quantification in the abovementioned scenarios, development of advanced methods to improve calculation efficiency of uncertainties, such as AI/Machine Learning methods, efficient computational and/or statistical methods and the integration of latest developments in risk science;
- Monitoring strategies with mobile and advanced monitors in such armed conflict situations, relying also on a citizen science approach and providing early detection of threats;
- Development of indicators for protective action strategies that can be applied even with little information on the affected area, with consideration of technical and non-technical aspects;
- Development of communication strategies including methods and material appropriate for use in such situations;
- Social and psychological challenges for emergency actors and citizens and their impacts on the effectiveness of protective actions, legal basis and practical arrangements for emergency response and recovery;
- Societal resilience, stakeholder involvement and ethical considerations.

The topic is suitable for medium or large-sized proposals.

H. Radiation protection in/with society

H1. HIGH PRIORITY

Effective translation mechanisms between social and technical dimensions of radiation protection.

The objective of the topic is to investigate how different radiation protection actors perceive the added value of inter- and transdisciplinary collaborations in the field of radiation protection; what their expectations and needs are; what challenges and enablers of collaborations can be found in the different radiation protection fields; and what are the main barriers for the institutional uptake of results from inter- and transdisciplinary collaborations. Projects addressing this topic should contribute to developing systematic approaches to inclusion of societal dimensions within the radiological protection system and methodological innovation enabling inter- and transdisciplinarity in radiation protection research.

The topic is suitable for smaller-, more focused projects, as well as medium-sized projects addressing different radiation protection fields.

5.2 PIANOFORTE-Topics compared with the ICRP Research Areas Paper topics

	PIANOFORTE-Topic	PIANO-FORTE Ranking	Mentioned in Laurier, Rühm et al. 2022 (ICRP Research Areas Paper)	Could for example (!) inform the following ICRP Task Groups
A1	Define the risk of ionising radiation-induced non-cancer diseases after low and intermediate doses (below 500 mGy)	High	Subsection "Potential impact of diseases of the circulatory system on radiation detriment"	<u>Task Group 119</u> "Effects of Ionising Radiation on Diseases of the Circulatory System and their Consideration in the System of Radiological Protection"
A2	Developing knowledge base for a better understanding of disease pathogenesis of ionising radiation-induced cancer to improve risk assessment.	Very high	Subsection "Cancer risk models and tissue weighting factors"; Section "Basic Research"; Subsection "Dose-rate effects and cancer"	<u>Task Group 122</u> "Update of Detriment Calculation for Cancer" <u>Task Group 123</u> "Classification of Harmful Radiation-induced Effects on Human Health for Radiological Protection Purposes"
A3	Developing a knowledge base and analytical tools to understand the major	Very high	Section "Individual response of humans to radiation"	<u>Task Group 111</u> "Factors Governing the Individual Response of

	features of variability in the radiation response including radio-sensitivity (tissue reactions), radio-susceptibility (cancers) and radiation-induced aging			Humans to Ionising Radiation”
A4	Define how the temporal and spatial variations in dose delivery affect the risk of health effects following radiation exposure	High	Subsection “Dose-rate effects and cancer”; Section “Definition of dosimetric targets in organs and tissues”	<u>Task Group 91</u> “Radiation Risk Inference at Low-dose and Low-dose Rate Exposure for Radiological Protection Purposes” <u>Task Group 118</u> “Relative Biological Effectiveness (RBE), Quality Factor (Q), and Radiation Weighting Factor (wR)”
B1	To quantify correlations between microscopic energy deposition and radiation damage, including improved measurement and simulation techniques.	Moderate	Section “RBE, quality factor and radiation weighting”	<u>Task Group 118</u> “Relative Biological Effectiveness (RBE), Quality Factor (Q), and Radiation Weighting Factor (wR)”
C1	Resolving the controversy with regard to the effects on wildlife reported in the Chernobyl and Fukushima exclusion zones.	High	Specific example not mentioned	<u>Task Group 99</u> “Reference Animal and Plant (RAP) Monographs” <u>Task Group 121</u> “Effects of Ionising Radiation Exposure in Offspring and Next Generations” <u>Task Group 125</u> “Ecosystem Services in Environmental Radiological Protection”
C2	Determine the effects of ionising radiation on	Moderate	Subsection “Strengthening	<u>Task Group 125</u>

	ecosystem functioning and biodiversity, as well as their potential consequences to human wellbeing		dosimetric targets and methodology for the protection of the environment”	“Ecosystem Services in Environmental Radiological Protection”
D1	Individualise diagnostic as well as therapeutic procedures with regard to optimisation of the benefit/risk ratio.	Very high	Section “Individual response of humans to radiation”; Subsection “Medical use implications in treatment and protection”	<u>Task Group 108</u> “Optimisation of Radiological Protection in Digital Radiography, Fluoroscopy, and CT in Medical Imaging” <u>Task Group 109</u> “Ethics in Radiological Protection for Medical Diagnosis and Treatment”
D2	Improving the quality of medical imaging and radiation therapy especially but not limited to cancer-treatment	Moderate	Subsections “Medical use implications in treatment and protection”; “Implications of Artificial Intelligence (AI) to radiological protection practice”	<u>Task Group 108</u> “Optimisation of Radiological Protection in Digital Radiography, Fluoroscopy, and CT in Medical Imaging”
D3	Implementing EU-wide epidemiological studies of patients to enhance quality and safety of medical radiation applications and developing a knowledge base and analytical tools to better predict and reduce risk of secondary cancer and non-cancer disease in cancer patients treated with radiotherapy.	Moderate	Subsection “Potential impact of diseases of the circulatory system on radiation detriment”	<u>Task Group 91</u> “Radiation Risk Inference at Low-dose and Low-dose Rate Exposure for Radiological Protection Purposes” <u>Task Group 119</u> “Effects of Ionising Radiation on Diseases of the Circulatory System and their Consideration in the System of Radiological Protection” <u>Task Group 122</u> “Update of Detriment Calculation for Cancer”

E1	Developing a knowledge base and analytical tools to improve radiation protection of workers	Moderate	Subsection "Implications of Artificial Intelligence (AI) to radiological protection practice "	<p><u>Task Group 95</u> "Internal Dose Coefficients"</p> <p><u>Task Group 96</u> "Computational Phantoms and Radiation Transport"</p> <p><u>Task Group 103</u> "Mesh-type Reference Computational Phantoms (MRCP)"</p>
F1	Robust modelling of radiological contamination in the human food chain,	High	Section "Dosimetry in emergency situations"	<p><u>Task Group 112</u> "Emergency Dosimetry"</p> <p><u>Task Group 120</u> "Radiological Protection for Radiation Emergencies and Malicious Events"</p>
F2	Identifying and quantifying the key processes that influence radionuclide behaviour in existing environmental contamination situations	High	Subsections "Industrial and academic applications, including Naturally Occurring Radioactive Material (NORM)", "Natural sources of radiation exposure"	<p><u>Task Group 97</u> "Application of the Commission's Recommendations for Surface and Near Surface Disposal of Solid Radioactive Waste"</p> <p><u>Task Group 98</u> "Application of the Commission's Recommendations to Exposures Resulting from Contaminated Sites from Past Industrial, Military and Nuclear Activities"</p>
F3	Integrating risk assessment and management and especially focusing on risk integration for radiation and other stressors	Moderate	Identified as a long-term goal, Section "Effects of combined exposures"	-

G1	Improvement of radiological impact assessments, decision support and response and recovery strategies	High	Subsections “Implications of Artificial Intelligence (AI) to radiological protection practice”, “Mechanisms for stakeholder involvement and communication science”	<u>Task Group 112</u> “Emergency Dosimetry” <u>Task Group 120</u> “Radiological Protection for Radiation Emergencies and Malicious Events”
G2	Development of risk assessment and risk management approaches and technological capabilities to cope with scenarios arising from threats due to war or armed conflicts situations	High	Not mentioned because paper was written before the war in Ukraine	<u>Task Group 120</u> “Radiological Protection for Radiation Emergencies and Malicious Events”
H1	Effective translation mechanisms between social and technical dimensions of radiation protection.	High	Subsections “Social science research on perception and understanding of radiation and its use”, “Ethics”, “Behavioural science”	<u>Task Group 114</u> “Reasonableness and Tolerability in the System of Radiological Protection” <u>Task Group 124</u> “Application of the Principle of Justification”