

Norwegian University of Life Sciences
Faculty of Environmental Sciences and
Natural Resource Management

Philosophiae Doctor (PhD)
Thesis 2019:39

Risk communication in nuclear emergency preparedness: Embracing the complexity

Risikokommunikasjon i atomberedskap: Et
innblikk i kompleksiteten

Yevgeniya Tomkiv

Risk communication in nuclear emergency preparedness: Embracing the complexity

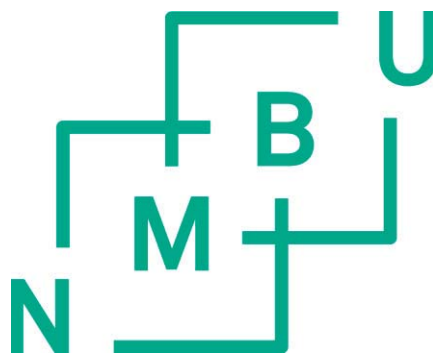
Risikokommunikasjon i atomberedskap: Et innblikk i kompleksiteten

Philosophiae Doctor (PhD) Thesis

Yevgeniya Tomkiv

Norwegian University of Life Sciences
Faculty of Environmental Sciences and Natural Resource Management

Ås (2019)



Thesis number 2019:39
ISSN: 1894-6402
ISBN: 978-82-575-1598-0

PHD SUPERVISORS

Professor Deborah H. Oughton

Faculty of Environmental Sciences and Natural Resource Management, NMBU

P.O. Box 5003 NMBU, 1432 Ås, Norway

Email: deborah.oughton@nmbu.no

Professor Brian Wynne

Department of Sociology, University of Lancaster

Lancaster LA1 4YT, United Kingdom

Email: b.wynne@lancaster.ac.uk

Dr. Tanja Perko

Belgian Nuclear Research Centre (SCK•CEN)

Boeretang 200

2400 Mol, Belgium

Email: tanja.perko@sckcen.be

EVALUATION COMMITTEE

Professor Alan Irwin

Department of Organization, Copenhagen Business School

Solbjerg Plads 3

DK-2000 Frederiksberg, Denmark

Email: ai.ioa@cbs.dk

Dr. Ciara McMahon

Environmental Protection Agency (EPA)

PO Box 3000

Johnstown Castle Estate

Wexford, Y35 W821, Ireland

Email: C.McMahon@epa.ie

Dr. Dag Anders Brede

Faculty of Environmental Sciences and Natural Resource Management, NMBU

P.O. Box 5003 NMBU, 1432 Ås, Norway

Email: dag.anders.brede@nmbu.no

ACKNOWLEDGEMENTS

This PhD has been financed mainly by the Research Council of Norway (RCN) (Grant Number 223268 [CERAD—Centre for Environmental Radioactivity], Grant Number 221391, Grant Number 226130, Grant number 263856); the European Commission FP7 projects NanoRem (Grant Number 309517), PREPARE (Grant Number 323287), and SHAMISEN (Grant Number 604984).

My supervisors during this PhD have been Prof. Deborah H. Oughton (NMBU), Prof. Brian Wynne (University of Lancaster) and Dr. Tanja Perko (SCK·CEN). I would like to thank them for their valuable contribution and support during this whole period of PhD research. Tanja, you have amazing energy and drive that is quite contagious, thank you for those boosts of inspiration and motivation. Brian, thank you for all the enlightening philosophical discussions we had during these years. Deborah, I would not have been here without you. You believed in me since the beginning, always trusted my judgement, cheered me up when I was down and always had my back. Thank you for your support, constructive criticism, and all the sleepless nights you spent reviewing my thesis and papers.

A big thank you to all of the colleagues and friends at NMBU and beyond: Lisa, Merethe, Lene, Erica, Frøydis, Cato, Anicke, Turid, Astrid, Mirian, Signe, Marit, Claire, You, Tanya, Ian, Shane, Estela, Yet, Keke, Dag. Thank you for all the countless coffees and lunches together, for Friday beers, for amazing evenings in Oslo, for northern lights in Tromsø, for (more and less) exquisite dinners, and for all the laughs.

Finally, I am very grateful to my family that always supported me and believed that I could achieve whatever I had in mind. Zuzi, thank you for always finding the right words to put things in perspective. Quentin, I cannot thank you enough for your endless support, care and silly questions. Without you, these last months would have been unbearable.

"It is our choices that show what we truly are, far more than our abilities."
Albus Dumbledore

SUMMARY

Risk communication is one of the most important challenges of emergency management, as illustrated by past nuclear accidents. Despite decades of research on risk perception, communication and public participation methods, there are still gaps between this research and its application in practice. While multiple guidelines highlight the importance of dialogue and engagement, in reality, the goal of risk communication in the field of emergency preparedness is still all too often seen to be one of educating publics.

The overall aim of this thesis was to offer a more holistic understanding of the risk communication in emergency preparedness that emphasises the relationships between the key actors. This aim was pursued by addressing the following research questions in the four individual papers comprising this thesis:

1. Investigate whether recommendations for communication of radiological risks were followed after the Fukushima accident.
2. Quantify the value of collaborative deliberation in stakeholder seminars as opposed to a one-way information provision.
3. Explore public needs concerns, responses and expectations with regard to radiological emergencies.
4. Explore the applicability of evaluation criteria for assessing the quality of stakeholder involvement.

A range of qualitative and quantitative methods (e.g. content analysis, focus group discussions, in-depth observation) were used as part of this research.

Mass media are an important channel for risk information in daily life and emergency. Although several recommendations are available on communication of radiological risks in the media, it is not clear whether they are being followed. Paper 1, carried out an analysis of media representation of risks in newspaper articles published after the Fukushima accident in five European countries and Russia. This analysis uncovered several misrepresentations and misinterpretations of radiological risks in the media coverage of the accident. A number of measurement units were presented in media without explanation of what they meant, and comparisons used were not always helpful or correct. Information on health effects and visual representation of information were largely absent. The discrepancies between recommendations and the findings in

practice indicated that there were problems with communication of radiological risks in the countries analysed. Based on these findings several suggestions for improvement were formulated, including strengthening the relationships between experts and media. The support for notions of involvement and dialogue is growing, however, experience shows that in stakeholder seminars on emergency preparedness, the opportunities for dialogue can be quite limited. Paper 2 examined the difference between the effect of one-way information provision and collaborative deliberation in stakeholder seminars performed in Norway. In this paper, questionnaires were used to measure the value of collaborative deliberation by investigating its impact on the levels of knowledge, networking, involvement and problem-solving. The results demonstrated that participants considered collaborative deliberation to have had a higher effect on all the above-mentioned aspects as compared to information provision. They also showed a positive impact on the understanding of challenges different sectors will have to address in a nuclear emergency. By demonstrating the value of collaborative deliberation, these results can be used to further promote wider stakeholder involvement in decision-making.

Understanding the factors that influence public attitudes and behaviour will support development of appropriate communication approaches and encourage actions that would reduce the impacts of accidents. A study performed in Paper 3 investigated public concerns, responses, information needs, understandings and expectations with regard to a nuclear accident. The paper used focus group discussions based on two hypothetical accident scenarios. The results of the discussion identified knowledge and trust to be the main factors defining publics' relationship with emergency management actors. Participants' willingness to follow official recommendations were affected by the perceived efficiency and safety of the protective actions, participants' personal networks and trust in the institutions issuing the recommendations. In turn, the public showed ambivalence on the issue of trust in emergency actors. On the one hand, they showed a high degree of trust towards the authorities' intentions to do what was best, but they were much less trusting in the competence of the authorities to deal with the situation. Finally, several factors that influence the way public forms their perception of radiological risks have been identified. The findings of the study indicate that there are some potential challenges for emergency preparedness in Norway.

The growing popularity of public and stakeholder engagement has triggered a transition from one-way communication to dialogue based approaches. However, there is some concern about current engagement practices and whether they actually contribute to the democratization of the decision-making processes. This highlights the need for rigorous quality evaluation that would focus on the wider social and political context of the engagement activities and the way democratic values are addressed in them. Paper 4 addresses this need by evaluating two stakeholder engagement activities in order to demonstrate the general limitations of already existing quality criteria. The evaluation demonstrated a variety of issues present with both activities and resulted in formulation of extended criteria that pay more attention to democratic values and context of engagement. These criteria are: inclusiveness, independence, flexibility, continuity, influence, transparency and mutual learning. The paper argues that more attention should be paid to the quality of the stakeholder engagement process and that the extended criteria could provide some guidance.

Based on the findings from the individual papers, this thesis identifies several factors that would contribute to improved communication in nuclear emergency preparedness. It argues that there is need for emergency actors to increase their understanding of publics by studying their perspectives, concerns and values, and their understanding of concepts and systems. In addition, there is a need for an extended public participation in deliberations within emergency preparedness, that also pays attention to both the method and process of engagement. Another major factor is that emergency preparedness needs to be aware of and address the various dimensions of complexities. These complexities include multiple actors that would be involved in emergency response and multiple publics with different knowledge and experiences that would affect their attitude towards both the risk and the actors managing that risk. Furthermore, the thesis argues there is a need to view and practice communication as a relationship that both supports and determines the quality of social interactions between all salient actors. Finally, it suggests the need for institutional change that includes acknowledgement of societal aspects, making stakeholder engagement a normal practice in policy and decision-making and critical reflection upon procedures and practices.

SAMMENDRAG

Tidligere atomulykker har vist at risikokommunikasjon er en av de viktigste utfordringene i krisehåndtering. Til tross for flere tiår med forskning på risikooppfattelse, kommunikasjon og metoder for involvering av berørte parter, er det fortsatt et gap mellom forskningen og hvordan den blir brukt i praksis. Selv om retningslinjer fremhever betydningen av dialog og involvering, er risikokommunikasjon innen kriseberedskap fortsatt ofte brukt til å utdanne og overtale publikum.

Det overordnede målet med denne avhandlingen er å tilby en mer helhetlig forståelse av risikokommunikasjonen i beredskap som legger større vekt på forholdet mellom nøkkelaktørene. Dette målet ble forfulgt ved å ta opp følgende forskningsspørsmål i de fire vitenskapelige artiklene som denne oppgaven består av:

1. Undersøke om anbefalinger for kommunikasjon av risiko fra stråling ble fulgt i forbindelse med Fukushima-ulykken.
2. Kvantifisere verdien av diskusjon og refleksjon i medvirkning i motsetning til en enveisinformasjon.
3. Utforske publikums behov, bekymringer, reaksjoner og forventninger med tanke på atomkriser.
4. Utforske anvendeligheten av evalueringskriterier for vurdering av kvaliteten på berørte parters medvirkning.

En rekke kvalitative og kvantitative metoder (for eksempel innholdsanalyse, fokusgruppediskusjoner, observasjon) ble brukt som en del av denne undersøkelsen.

Massemedier er en viktig kanal for risikoinformasjon i dagliglivet og i krisesituasjoner. Selv om anbefalinger er tilgjengelige for hvordan man skal kommunisere risiko fra stråling i media, er det ikke klart om de blir fulgt. I artikkel 1 ble presentasjonen av risiko fra stråling i avisartikler publisert etter Fukushima-ulykken i fem europeiske land og Russland analysert. Denne analysen avdekket flere uriktige opplysninger og feilfortolkninger av risiko fra stråling i mediedekningen av ulykken. En rekke måleenheter ble presentert i media uten forklaring av betydningen, og sammenligninger med andre risikoer som var brukt var ikke alltid nyttige eller korrekte. Informasjon om helseeffekter og visuell representasjon av informasjon var i stor grad fraværende. Avvikene mellom anbefalinger og det som ble gjort i praksis

indikerte at det har oppstått problemer med kommunikasjon av risiko fra stråling i de analyserte landene. Basert på disse funnene ble flere forslag til forbedring formulert, blant annet å styrke forholdet mellom eksperter og media.

Ideer om involvering og dialog får mer og mer støtte, men erfaring viser at mulighetene for dialog i beredskapsseminarer fortsatt er begrenset. I artikkel 2 undersøkes forskjellen mellom effekten av enveisinformasjon og felles refleksjon og diskusjon i medvirkningsseminarer utført i Norge. Spørreskjemaer ble brukt til å måle verdien av felles refleksjon og diskusjon ved å undersøke hvordan det virket på kompetanseheving, nettverksbygging, involvering og problemløsning. Resultatene viste at ifølge deltakerne har felles diskusjon hatt en bedre effekt på alle de ovennevnte aspektene sammenlignet med enveisinformasjon. Det hadde også en positiv innvirkning på forståelsen av utfordringer som ulike sektorer må forholde seg til ved en atomulykke. Ved å demonstrere verdien av felles refleksjon og diskusjon, kan disse resultatene brukes til å fremme bredere involvering av berørte parter i beslutningstaking.

Det å forstå faktorer som påvirker publikums holdninger og atferd, vil støtte utvikling av hensiktsmessige kommunikasjonsmetoder og oppmuntre til handlinger som vil redusere konsekvenser av ulykker. En studie utført i artikkel 3 undersøkte publikums bekymringer, reaksjoner, informasjonsbehov, forståelse og forventninger med tanke på en atomulykke. Artikkelen brukte fokusgruppediskusjoner basert på to hypotetiske ulykkescenarier. Resultatene av diskusjonen pekte på at kunnskap og tillit er de viktigste faktorene som definerer publikums forhold til beredskapsaktører. Deltakernes vilje til å følge offisielle råd og anbefalinger ble påvirket av hvor effektive og sikre de oppfattet dem å være, deltakernes personlige nettverk samt tillit til institusjonene som utstedte anbefalingene. Publikums tillit til offentlige institusjoner var påvirket av både antatte intensjoner og kompetanse – deltakere hadde høy tillit til at institusjonene prøvde å gjøre det som var best for samfunnet, men hadde mindre tillit til deres kompetansenivå. I tillegg ble flere faktorer som påvirker hvordan publikum gjør seg opp en mening om risiko fra stråling identifisert. Resultatene fra studien indikerer at det er flere potensielle utfordringer for beredskap i Norge.

Den økende tilslutningen til involvering av befolkning og berørte parter har utløst en overgang fra enveiskommunikasjon til dialogbaserte kommunikasjonstilnærminger. Det er imidlertid noen bekymringer rundt hvordan medvirkning blir praktisert og om

medvirkningsprosessene som de gjøres nå faktisk bidrar til demokratisering av beslutningstaking. Dette understreker behovet for streng kvalitetsevaluering som vil fokusere på den bredere sosiale og politiske konteksten av medvirkning og måten demokratiske verdier tas opp. Artikkelen 4 adresserer dette behovet ved å evaluere to medvirkningsseminarer for å demonstrere de generelle begrensningene av eksisterende kvalitetskriterier. Evalueringen demonstrerte en rekke problemer som var tilstede i begge seminarene og resulterte i utvikling av utvidede kriterier som legger større vekt på demokratiske verdier og kontekst av medvirkningen. Disse kriteriene er: inkludering, uavhengighet, fleksibilitet, kontinuitet, innflytelse, åpenhet og gjensidig læring. Artikkelen hevder at det bør rettes mer oppmerksomhet mot kvaliteten på medvirkning, og at de utvidede kriteriene kan gi noe veiledning i denne prosessen.

Basert på konklusjonene fra de enkelte artiklene, identifiserer denne oppgaven flere faktorer som vil bidra til bedre kommunikasjon innen beredskap. Forfatteren hevder at det er behov for at beredskapsaktører øker sin forståelse av befolkningen ved å studere dens perspektiver, bekymringer og verdier, samt dens forståelse av begreper og systemer. I tillegg er det behov for økt befolkningsdeltakelse i refleksjoner og diskusjoner innen beredskap som også tar hensyn til både metoden og prosessen av denne medvirkningen. En annen viktig faktor er at institusjonene som er ansvarlige for beredskap må være oppmerksom på og adressere de ulike dimensjoner av kompleksitet. Dette omfatter et mangfold av aktører involvert i beredskap samt flere befolkningsgrupper med forskjellig kunnskap og erfaringer som vil påvirke deres holdning til både risikoen og aktørene. Forfatteren argumenterer at det er et behov for å se og praktisere kommunikasjon som et forhold som både støtter og bestemmer kvaliteten på sosiale samspill mellom alle viktige aktører. Til slutt, understrekes behovet for institusjonelle endringer som vil føre til at institusjonene anerkjenner hvor viktig de sosiale aspektene er, vedtar medvirkning som en legitim beslutningstaking og utfører en kritisk refleksjon av deres egne aktiviteter og prosedyrer.

Contents

List of papers	3
List of abbreviations and definitions.....	4
1. Introduction	6
1.1 The goal and structure of this thesis	8
2. Contextual background	10
2.1. Introducing the context: Nuclear emergency management.....	10
2.1.1 Nuclear emergency preparedness in Norway.....	13
2.2 Introducing the research field: risk communication and participation	16
2.2.1 Risk perception.....	16
2.2.1a Historical aspects of nuclear risks and their impact on public attitudes	19
2.2.2 Risk communication	24
2.2.3 Public and stakeholder participation.....	28
2.3 Risk communication and engagement research in nuclear emergency preparedness.....	30
3 Methods.....	35
3.1 Media content analysis.....	35
3.2 Questionnaires	36
3.3 Focus groups	37
3.4 Stakeholder engagement seminars.....	38
3.5 Ethical considerations.....	38
4 Research findings	40
4.1 Paper 1 How did media present the radiation risks after the Fukushima accident: a content analysis of newspapers in Europe?	40
4.2 Paper 2 The power of collaborative deliberation in stakeholder dialogue seminars.....	42
4.3 Paper 3 Embracing the complexities: the value of listening to public in nuclear emergency preparedness.....	44
4.4 Paper 4 Assessing Quality of Stakeholder Engagement: From Bureaucracy to Democracy	45
5 Discussion	49
5.1 Linking the papers	49
5.2 Theoretical contribution to the research field.....	49
5.3 Communication in emergency preparedness: a step towards holistic approach.....	51
5.3.1 Listening to people.....	52
5.3.2 Embracing the complexities	55

5.3.3 Communication as a relationship	57
5.3.4 Need for institutional change.....	60
6. Limitations.....	63
7. Future research.....	65
8. Conclusions.....	67
References	69
Annex 1 – Other scientific publications.....	92
Annex 2 - Consent and information document for the participants of the focus group discussions.....	94

List of papers

Paper 1. How did media present the radiation risks after the Fukushima accident: a content analysis of newspapers in Europe. (Tomkiv, Y., Perko, T., Oughton, D., Prezelj, I., Cantone, M. C., & Gallego, E. (2016). How did media present the radiation risks after the Fukushima accident: a content analysis of newspapers in Europe. *Journal of Radiological Protection*, 36(2), S64. DOI:[10.1088/0952-4746/36/2/S64](https://doi.org/10.1088/0952-4746/36/2/S64))

Paper 2. The power of collaborative deliberation in stakeholder dialogue seminars. (Liland, A., Tomkiv, Y., Oughton, D., Navrud, S., Romstad, E., & Skuterud, L. (2017). The power of collaborative deliberation in stakeholder dialogue seminars. *Journal of Risk Research*, 1-25. <https://doi.org/10.1080/13669877.2017.1378247>)

Paper 3. Embracing the complexities: the value of listening to public in nuclear emergency preparedness. (Tomkiv, Y., Oughton, D., Wynne, B. (2019) Embracing the complexities: the value of listening to public in nuclear emergency preparedness. Manuscript.)

Paper 4. Assessing Quality of Stakeholder Engagement: From Bureaucracy to Democracy. (Tomkiv, Y., Liland, A., Oughton, D. H., & Wynne, B. (2019). Assessing Quality of Stakeholder Engagement: From Bureaucracy to Democracy. *Bulletin of Science, Technology & Society*, 37(3), 167–178. <https://doi.org/10.1177%2F0270467618824027>)

List of abbreviations and definitions

CONFIDENCE	Research project “Coping with uncertainties for improved modelling and decision making in nuclear emergencies” (https://portal.iket.kit.edu/CONFIDENCE/index.php)
DSA	Norwegian Radiation and Nuclear Safety Authority
EAGLE	Research project “Enhancing education, training and Communication Processes for informed behaviours and decision-making related to ionising radiation risks) (finished)
ENGAGE	Research project “Enhancing stakeholder participation in the governance of radiological risks (http://www.engage-concert.eu/)
EU	European Union
EURANOS	Research project “European approach to nuclear and radiological emergency management and rehabilitation strategies” (finished)
EURATOM	A complementary research programme for nuclear research and training under Horizon 2020
FP7	European Union's Research and Innovation funding programme for 2007-2013
GMO	Genetically modified organisms
Horizon 2020	EU Research and Innovation programme (2014 – 2020)
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
OECD	Organisation for Economic Co-operation and Development
OPERRA	Open Project for European Radiation Research Area
NEA	Nuclear Energy Agency
NPP	Nuclear power plant
STRATEGY	Research project “Sustainable restoration and long-term management of contaminated rural, urban and industrial ecosystems” (finished)
NERIS	European Platform on preparedness for nuclear and radiological emergency response and recovery
NERIS-TP	Research project “Towards A Self Sustaining European Technology Platform (NERIS-TP) On Preparedness For Nuclear And Radiological Emergency Response And Recovery” (finished)

PREPARE	Research project “Innovative integrative tools and platforms to be prepared for radiological emergencies and post-accident response in Europe” (finished)
TERRITORIES	Research project “To enhance uncertainties reduction and stakeholders Involvement towards integrated and graded Risk management of humans and wildlife in long-lasting radiological Exposure Situations”
UK	United Kingdom
US	United States
US EPA	United States Environmental Protection Agency
WHO	World Health Organization

1. Introduction

Past nuclear and radiological events have demonstrated that communication is one of the most important challenges of emergency management (Abbott, Wallace et al. 2006, Covello 2011). The Fukushima accident in Japan, in 2011 once more highlighted the difficulties in communicating about radiation risks, as well as the many different types of communication that impact on emergency management. These range from a very narrow understanding of communication that centered on risk messages sent from risk experts to public, to a much broader definition that emphasises the relationships between actors, starting with how the message is framed to ways of involving the public in decision-making. While conventional communication assesses success in terms of the outcome, and focuses on the technical dimensions of risk, other approaches stress the importance of the quality and nature of that communication, as well as the need for a more nuanced understanding of public concerns.

After the Fukushima accident, national and international organizations reviewed their communication plans and updated the strategies (Coates, Webb et al. 2012, IAEA 2013). Nuclear emergency authorities acknowledged the need to include communication aspects into emergency preparedness exercises and training (Perko, Raskob et al. 2016) and several research projects that addressed risk communication in nuclear emergencies were funded (e.g. PREPARE, EAGLE, CONFIDENCE, TERRITORIES, etc). However, even if international guidance shows that there is a need for a complex, multiple way communication process that would take into account views, concerns, expectations, values and questions of different stakeholders, those in positions of authority still seem to be mainly inspired by the idea of educating the general public (Železnik, Marega et al. 2014). There is still a gap between the idea of dialogue and engagement that has been discussed and applied for decades in science and technology studies, and its practical application in the field of emergency management and response.

In part, this gap reflects that emergency management systems are highly hierarchical, instrumental, autocratic and technocratic. The public are removed from the policymaking and decisions are made by a small group of expert-trained bureaucrats, experts and policy-makers. These instrumental technocratic actors also, crucially, impose a framing

of the issue that excludes public concerns or meanings that do not coincide with their own. The exclusion is often easily justified by citizens' lack of expertise and the classified nature of emergency plans (Baudé, Hériard-Dubreuil et al. 2013, Schmid 2013, Ehold, Perko et al. 2018, Kamaté 2018). Experts assume people are only interested in safety and marginalize their concerns to scientific issues, while a vast amount of research has demonstrated that public concerns are not limited to risk or safety, but influenced by a variety of factors.

Experience from past accidents like Windscale (1957), Three Mile Island (1979), Chernobyl (1986), Fukushima (2011), demonstrated that there are broad societal consequences of such accidents that impact on public response, and that responsible institutions should be ready to address (Bay and Oughton 2005, Murayama 2012, Oughton, Hansson et al. 2013, Liland 2015). Communication has been recognised as a crucial component in dealing with radiological emergencies and one that could alleviate the consequences, especially psychological and social, but also in terms of material deaths and morbidity (Carr, Maeda et al. 2018).

Although improving communication is a step in the right direction, there is a need to pay more attention to how that communication is being carried out. We cannot view the public as the problem while ignoring systemic and institutional issues that require reflexivity about existing procedures and systems. Another issue is the persistence of a top-down approach – although many institutions recognise the importance of dialogue and two-way communication on paper, in practice their structures are not well suited to accommodate such communication. As various analysts have emphasised, genuine communication involves dialogue, and dialogue means listening, as well as talking. This would require experts to take publics of various kinds seriously, be more attuned to their needs and concerns, and consider ways in which communication procedures can be designed to address these aspects.

In order to meet some of these challenges, this thesis aims to promote communication practices that recognise the complexity and rethink the relationship between publics and institutions, by exploring issues centred around four research questions:

- Investigate whether recommendations for communication of radiological risks were followed after the Fukushima accident
- Quantify the value of collaborative deliberation in stakeholder seminars as opposed to a one-way information provision
- Explore public needs concerns, responses and expectations with regard to radiological emergencies
- Explore the applicability of evaluation criteria for assessing the quality of stakeholder involvement

1.1 The goal and structure of this thesis

The overall goal of this thesis is to offer a more holistic understanding of risk communication within nuclear emergency preparedness that goes beyond analysis of the message and messenger, and also considers the relationships between publics and responsible institutions. This should, in turn, enable a more robust emergency preparedness that is capable of addressing public understanding and responses in a more open and engaging process. A secondary aim is to demonstrate how social science can contribute to improving communication in emergency preparedness.

It should be pointed out that the research carried out in this thesis largely concerns radiological risk in a country without nuclear energy production. However, there is a variety of sources of nuclear and radiological risks in Norway, such as nuclear research reactors, contaminated environment due to historical accidents, use of radionuclides in hospitals, industry and research and the global dimensions of nuclear threats (Schmid 2013). Although I will be focusing on radiological emergencies, many of the elements discussed in this thesis could be relevant also for other emergencies.

The research was performed (and funded) through a combination of different projects related to radiation protection and emergency preparedness and response. This approach allowed several communication related topics to be addressed, and reflects the diversity of topics that any emergency actor has to address in their preparedness work, whether it is communicating to media and public or involvement of stakeholders. Another benefit of this approach was that the PhD research was connected to both ongoing research and practice within radiation protection and emergency preparedness

and response, which increased the potential to have practical impact on policy. However, the constraint of being connected to specific research programs, with specific goals, meant that it was not possible to perform follow up studies to address some of the issues and limitations of the papers.

I hope that insights from this thesis may offer actors in emergency preparedness (e.g. radiation protection authorities, emergency managers) ways to create better approaches to communication about radiological risk and other related topics. Four papers constitute the major part of this thesis and the introduction constitutes the general framework within which the papers may be understood and contextualized. Chapter 2 gives the contextual background for the research and introduces the central research problem of the thesis. Chapter 3 discusses the methodological choices including data collection and analysis. Chapter 4 presents a summary of the main research findings from the appended papers. Chapter 5 contains a discussion of findings and linkages between the papers, including their contribution to the theoretical field. Chapters 6 and 7 address limitations of the thesis and suggestions for future research. Chapter 8 closes the thesis with brief concluding remarks.

2. Contextual background

This chapter introduces the contextual background that will help to place the individual papers comprising this thesis into a larger strategic, multidisciplinary and multi-sectorial perspective. It starts by presenting the context in which the research is set - nuclear emergency management, then introduces the theoretical frameworks of risk communication and public participation, and concludes with a summary of the way in which communication is addressed in emergency management today.

2.1. Introducing the context: Nuclear emergency management

The terms nuclear and radiological emergency are used interchangeably to describe “*a non-routine situation or event involving a radiation source that necessitates prompt action to mitigate serious adverse consequences for human health and safety, quality of life, property or the environment, or a hazard that could give rise to such serious adverse consequences.*” (Council Directive 2013/59/EURATOM, Council directive 2013/59/EURATOM 2013). In some countries, the term “nuclear emergency” is reserved for incidents and accidents at nuclear power plants; while ‘radiological emergency’ is used to describe other types of irregular activities that involve the release of radioactive materials (e.g. radioactive sources that are out of control, dirty bombs, releases from foreign facilities etc.) (CSN 2010). In this thesis I will use the term ‘nuclear’ emergency to cover both cases.

The definition of the term ‘emergency’ alone already indicates some of the characteristics that make emergencies different to routine situations. Emergencies have high stakes, they are urgent and full of contingencies (Leonard and Howitt 2008). They are also unanticipated, dynamic and unpredictable and will always be different from what one has prepared for (Schmid 2013, Charron, Lafage et al. 2016). They can range from those affecting single persons to those that affect large numbers of people such as floods, earthquakes, outbreaks of diseases and accidents. For nuclear emergencies, the significance of an event is expressed in The International Nuclear and Radiological Event Scale (INES) scale that has 7 levels: levels 1-3 are termed ‘incidents’, while levels 4-7 are termed ‘accidents’ (IAEA 2008).

Accidents can cause a good deal of disruption in the economic, social and cultural life of people, which results in physical and psychological damage and dramatically destroys their living environment (Felt and Chhem 2016). They also tend to restructure existing groups of people, objects, institutions so that the world after is never quite the same - causing fundamental changes in the society (Clancey and Chhem 2016). In post-accident situations, what previously seemed like solid knowledge is compromised and tested, and previously reliable frames and structures, references and values collapse (Charron, Lafage et al. 2016, Clancey and Chhem 2016). Expertise and experts become incredibly important, but at the same time, people's ambivalence towards them becomes more visible. Expert ignorance is emphasised, as none of them are able in real-time to say exactly what has happened, what has been released, what might happen next, what will change and how this is going to affect public interests of various kinds. Expertise is challenged and contested (Felt and Chhem 2016) and so is trust towards the institutions responsible. All of these factors add to the complexity of emergency management.

Nuclear emergency management is composed of several phases: assessment, preparedness, response, recovery and evaluation (see Figure 1) (Petak 1985). Each of the phases is associated with specific actions for the actors involved, measures to protect the population, as well as communication needs and strategies.

Emergency response is a critical phase. In routine risk management and decision-making, the actors have detailed knowledge about the situation, there are comprehensive procedures and sufficient time for assessments, deliberation and consultation, while in emergency there is no such luxury. It follows that much of the success of emergency response lies in good preparedness. Therefore, the preparedness phase is the key phase for establishing connections, building mutual understanding, and developing resilient systems.

The Fukushima accident uncovered many gaps in nuclear emergency preparedness, especially the off-site preparedness that goes beyond securing the safety of the reactor on the site of the emergency and focuses on protection of the potentially affected populations and other issues in the wider society (Schneider, Lafage et al. 2016, NERIS 2017). There were no plans for off-site management or communication with affected population, largely because the authorities did not believe such an accident could happen

(IAEA 2015) and lack of awareness of the wider consequences (Baumont 2018). There was lack of coordination and information flow between local and regional actors, protective actions were improvised and uncoordinated (National Research Council 2014), and dose criteria for relocation were absent (IAEA 2015). There was a variety of radiation standards, which were revised in the aftermath of the accident, which contributed to public confusion and distrust (National Research Council 2014). During the first days after the accident, the affected population was unaware of the accident and did not receive evacuation orders (NAIIC 2012). The accident highlighted that communication prior to an emergency plays important role in effectiveness of communication in emergencies (IAEA 2015, Sellnow 2015, Perko, Tomkiv et al. 2016), however, research on communication in preparedness remains underdeveloped (Coombs 2009, Perko, Van Oudheusden et al. 2019).

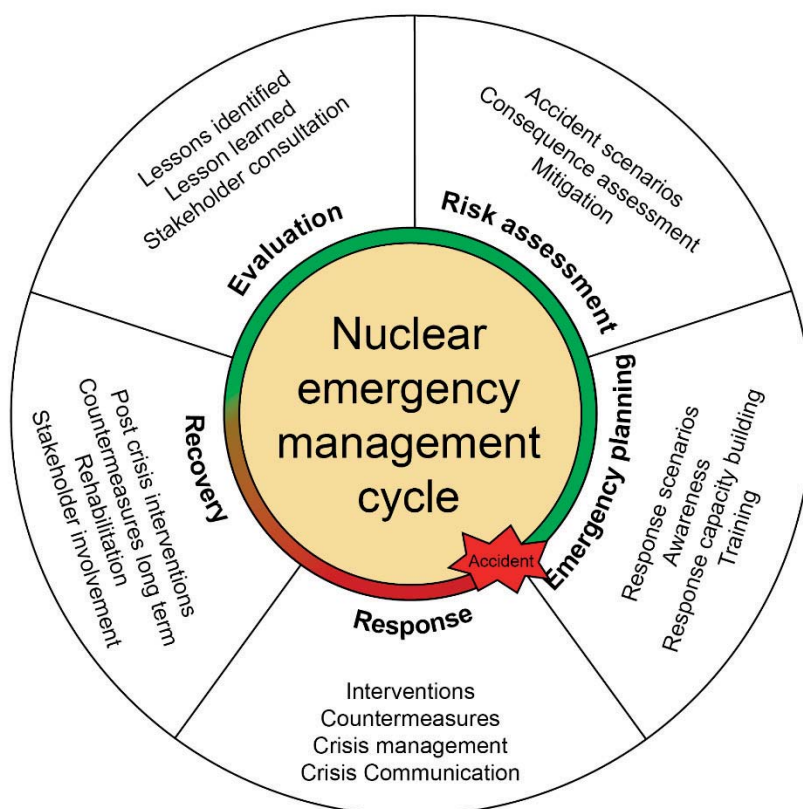


Figure 1 Nuclear emergency management cycle

The existing literature on communication in emergency preparedness identifies several objectives: to proactively inform people about potential risk (IAEA 2006, Rojas-Palma, Liland et al. 2009); help them to understand pre-event warning signals, prepare them with knowledge about countermeasures and protective actions (e.g., iodine tablets, evacuation, sheltering), and prevent inappropriate or unnecessary actions by the individuals (Callen and McKenna 2018). But its most important task is to establish dialogue between all the stakeholders (including public) and joint problem-solving.

I return to the challenges of communication in the following sections. Since some of my research was performed in the context of Norwegian emergency preparedness, I will first give a short description of how nuclear preparedness systems is organized in Norway.

2.1.1 Nuclear emergency preparedness in Norway

The Norwegian Nuclear and Radiological Preparedness Organisation was established in 1993 as a consequence of the lack of preparedness for managing such types of accidents seen in Norway after the Chernobyl Accident (Royal Decree 2013). It consists of the Crisis Committee for Nuclear Preparedness, the Crisis Committee's Advisors, and the County Governors (Figure 2). Representatives of the central authorities (e.g., civil protection, food safety, public health, police etc.) constitute the Crisis Committee lead by the Norwegian Radiation and Nuclear Safety Authority (DSA). County Governors are responsible for coordinating preparedness on the regional level and have regional nuclear preparedness committees (Statens strålevern 2012).

The Crisis Committee's mandate is to deal with any nuclear accident (regardless of probability) and intentional actions that could affect Norway or its interests; to have full responsibility over acute/late response and all preparedness work; to protect lives, health and environment and other societal interests. The Crisis Committee is fully authorised to impose actions upon state and private businesses and to request actions from the Norwegian Armed Forces, to initiate and implement countermeasures, and to decide the content of information to be communicated (Royal Decree, 2013). When an emergency occurs, the leader of the Crisis Committee decides whether the Committee should be summoned. In addition, any of its members can request that the Crisis Committee is summoned.

The Crisis Committee meets twice a year, one of those meetings is an exercise and another one is a seminar that involves regional representatives and advisors (Kriseutvalget for atomberedskap 2015). The Crisis Committee and advisors have been involved in research activities carried out under the EU projects STRATEGY, EURANOS, NERIS-TP. However, these activities involved mainly national actors and experts, and the stakeholders from the Chernobyl affected communities were involved to a minor degree only (Liland, Tomkiv et al. 2017).

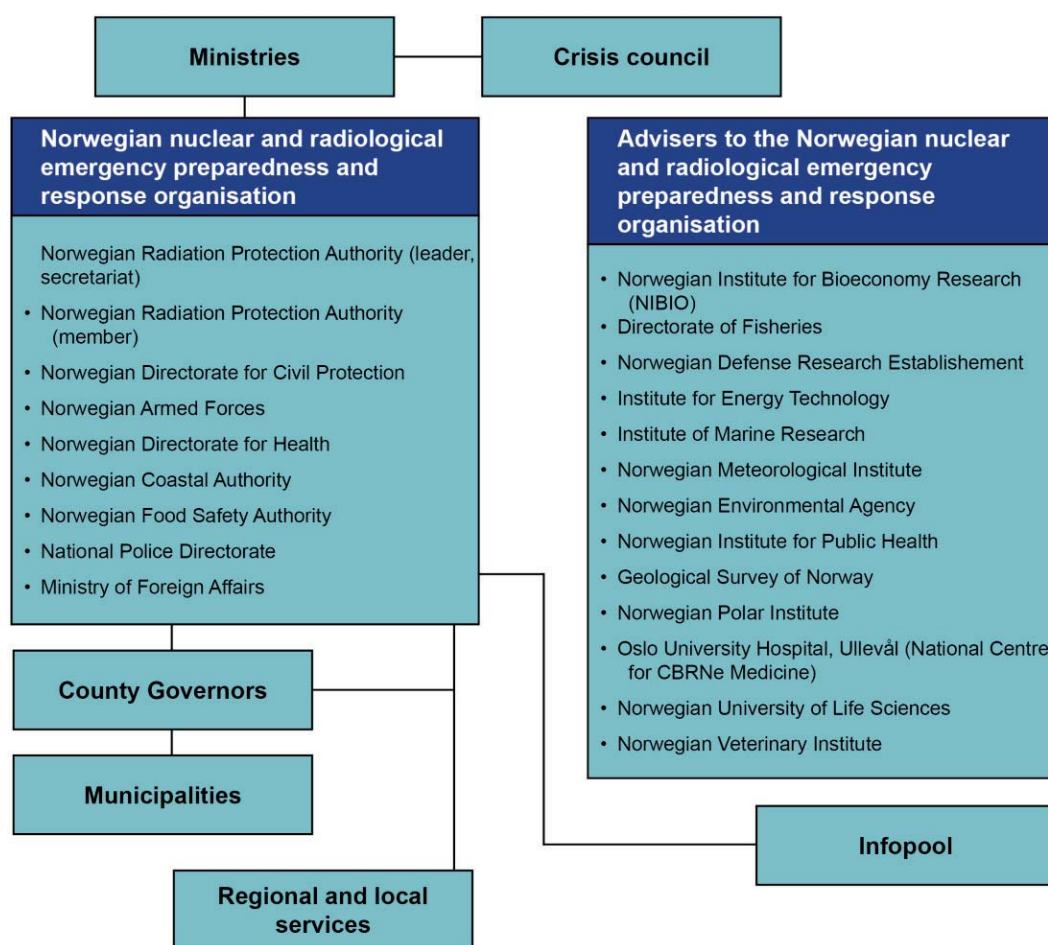


Figure 2 The Norwegian Nuclear and Radiological Preparedness Organisation (Statens strålevern 2012)

There are six different scenarios of radiological events that constitute the base of nuclear preparedness in Norway (Statens strålevern 2014):

1. Large airborne release from a facility abroad (e.g. Chernobyl)

2. Large airborne release from a facility in Norway (e.g. research reactors)
3. Local incident in Norway - random location (like above but during transport or use of radiological sources)
4. Local incident that evolves over time (e.g. Litvinenko case)
5. Release to the marine environment (e.g. from a submarine)
6. Incident abroad that does not directly affect Norwegian territory (e.g. Fukushima)

The scenarios are based on a systematization of experience from past events and assessments of existing or future activities. For each of the scenarios there is a communication plan that describes communication aims, defines target groups and communication channels, gives overview of relevant countermeasures and key points to include in the main message (Statens strålevern 2015).

There are number of factors that have changed the nature of radiological threats and hazards in the last years. There is increased likelihood of radiological material being used in malicious act or a such act being directed towards nuclear or radiological facilities; increased activities of naval nuclear-powered vessels in the North as well as civil nuclear-powered vessels and vessels carrying nuclear waste along the Norwegian coastline. In addition, due to recent political and security developments in the world, the Crisis Committee for Nuclear Preparedness is currently developing a seventh scenario that comprises use of nuclear weapons against Norway or close to Norway (Selnæs, Eikermann et al. 2018).

Norwegian authorities have first-hand experience of how challenging communication about radiological risks can be. They were highly criticized for their communication after the Chernobyl accident when they did not manage to address the high demand for information about accident from the population (Hernes 1986). Their response lacked coordination; information was not complete and contained mistakes (Hernes 1986, Larsen, Evensen et al. 2011). This lead to a crisis of trust between authorities on one side and media and public on the other (Hernes 1986). The Fukushima accident raised new challenges like the relocation of Norwegian embassy from Tokyo, citizens in Norway requesting iodine tablets and organisation of extra flights for Norwegian citizens from Tokyo to Oslo in the weeks after the accident.

Despite the initial problems with communication after Chernobyl, Norway provided an early example of the involvement of local stakeholders in post-accident sampling and mapping of contamination, as well as in development, testing and practical implementation of countermeasures. These actions recognized the value of expertise that local people have and how crucial it is to involve them in the development of recovery strategies (Liland and Skuterud 2013).

To conclude, communication is a key factor for all phases of emergency management, but more attention should be paid to its development within the emergency planning and preparedness phase. In the next subsections, I give some theoretical background on risk communication and participation research before I move to how they are currently addressed in nuclear emergency preparedness.

2.2 Introducing the research field: risk communication and participation

The publics' perception of risk is often highlighted as one of the main challenges for risk management and effective risk communication. Since historically, perception studies formed the basis of the whole field of risk communication, I will address the field of risk perception first.

2.2.1 Risk perception

"... I see the need to analyse the truly irrational perceptions surrounding issues of risk. ... In particular, I see a need to analyse the irrational perception within the technical community that almost everyone else must be irrational." (Freudenburg 2001)

The origins of risk perception studies can be traced back to 1960s with the rise in public opposition to certain new technologies. Industry, scientists and authorities were puzzled by the fact that people were alarmed about risks that in the experts' opinion were safe (Covello and Sandman 2001). Many technical experts believed that this perception gap in the estimation of risk from technologies was caused by a lack of technical education, misinformation and irrationality (Otway and Thomas 1982, Gardner and Gould 1989). Hence, the general idea behind many early risk perception studies was that people's

perceptions are faulty and should be corrected. The growing criticism of this view lies behind the negative association that the term 'risk perception' has attained in certain fields, especially if it is used to support the idea that nontechnical publics are irrational and misperceive risks (Otway 1992, Eiser, Bostrom et al. 2012). Several alternative theories and concepts have been developed to explain how risk perceptions are being formed. In this section, I give an overview of some of them.

Some of the first perception studies tried to define the psychological factors that influence individual risk preferences. The main examples here are the heuristics biases and psychometric paradigm. Heuristics are cognitive shortcuts that individuals use to reduce complex judgements to more simple ones, for example when assessing the probability of an uncertain event (Tversky and Kahneman 1974). There are various judgemental heuristics: representability, availability, adjustment from an anchor, affect heuristic, etc. (Tversky and Kahneman 1973, Tversky and Kahneman 1974, Finucane, Alhakami et al. 2000). As an example of availability heuristics, one may assess the risk of getting a cancer among middle-aged people by recalling such occurrences among one's acquaintances. Reliance on the different heuristics can lead to bias in risk judgements. Heuristics created the foundation for the psychometric paradigm associated with the Decision Research Group in Oregon, USA (Fischhoff, Slovic et al. 1978, Slovic, Fischhoff et al. 1981, Slovic 1987). Research within the psychometric paradigm, found that there is a range of hazard characteristics that influence the way people perceive risks of that particular hazard. These include voluntariness, controllability, familiarity, fairness, benefit distribution, catastrophic potential, delayed effect, and dread. The psychometric paradigm has been criticized for not addressing differences in individual perceptions (Sjöberg 1996, Siegrist, Keller et al. 2005, Siegrist, Keller et al. 2006) and for not including the social context in which perceptions are formed (Otway and Wynne 1989).

Other scholars attempted to address risk as a social construct and demonstrated how risk perceptions can be influenced by people's social experiences (such as previous interactions with institutions), the values to which they have been exposed and their entire world views (Douglas 1982, Krinsky and Golding 1992). Cultural theory was developed by Douglas and Wildavsky (1982) as a challenge to the psychometric paradigm. It is largely based on anthropological research and emphasises that risk

evaluations are linked to the relationships of individuals and populations and are thus affected by contextual and cultural structures of individuals within the social groups. The theory proposes that differences in risk perceptions between groups of society arise from different social characteristics and patterns of social relationships, rather than that one group is rational and the other is not. Proponents of the cultural theory introduced the concept of 'cultural rationality' that gives equal weight to personal experiences and to technical calculations (Plough and Krinsky 1987, Fischer 2005). So consequently, public risk perceptions are shaped by the "the circumstances under which risk is identified and publicised, the standing or place of the individual in his or her community, and the social values of the community as a whole" (Fischer 2005, p.55).

Another prominent paradigm utilising a societal approach to risk perception is the Social Amplification of Risk Framework (SARF) that combines findings from psychology, sociology, anthropology and communication theory (Kasperson, Renn et al. 1988). According to SARF risk signals are transformed when they pass through the social and individual amplification stations which can amplify or attenuate perceptions of risk (Kasperson, Renn et al. 1988, Kasperson, Kasperson et al. 2003). Moreover, amplification can produce secondary or tertiary consequences that will go beyond original impacts of events, for example, market impacts, changes in regulation, stigmatization of particular product or community (Kasperson, Renn et al. 1988, Kasperson, Kasperson et al. 2003). Within SARF, mass media is one of the important amplification stations for risk events (Lichtenberg and MacLean 1991, Renn 1991), increasing coverage of certain risks while neglecting others (Mazur 1990). Filtering of the information, change of the context and framing in media's reporting about events, can influence public perception of the risks (Renn 1991, Frewer, Miles et al. 2002, Chung and Yun 2013). The framework has been criticized for implying that there is an external 'objective' risk signal (Rayner 1988), for being too focused on the expert-lay divide (Merkelsen 2011) and being unable to support more interpretive approaches to risk perception (Horlick-Jones, Sime et al. 2003).

In addition, research has shown that public uses different definition of 'risk', 'benefit' and 'acceptability' than the experts (Gardner and Gould 1989). For instance, while experts tend to present benefit in economic terms, the public's definition of benefit includes aspects like usefulness, pleasure, safety and security (Gardner and Gould 1989), but also

who gets the benefit and what social institutions will be favoured by the particular technology (Otway 1992). Moreover, as Otway (1980) observes, perceptions depend on *“information people have been exposed to, what information they have chosen to believe, dynamics of stakeholder groups, the vagaries of the political process, and the historical moment in which it is all happening.”* Lastly, the most important issue that influences public perception of risk is trust to and trustworthiness of the institutions managing those risks (Wynne 1980, Pijawka and Mushkatel 1991, Clarke and Short 1993, Slovic 1999, Wynne, Waterton et al. 2007, Wynne 2013). I will address this issue in more detail in sub-chapter 2.2.2.

This overview of the theories and concepts is not exhaustive, as this thesis does not aim to give a complete history of the risk perception research. Nevertheless, this subchapter demonstrates the complexity of public risk perception and the variety of direct and indirect factors that influence its formation, including societal and institutional relationships. Since this thesis focuses on nuclear risks that are quite controversial and have previously received a good deal of opposition, I will use the example of nuclear technology to illustrate some of the issues that have impacted public attitudes.

2.2.1a Historical aspects of nuclear risks and their impact on public attitudes

“Nuclear power – an exemplar, paradigmatic example capturing the essential features of a technological gridlock: a focus on hardware and technological fix to the neglect of citizens concerns and democratic processes, producing polarisation between citizens, on one hand, and policy-makers, experts, and managers, on the other hand, with the net result being impasse over technological choices.” (Rosa and Clarke 1999)

Much of the original research on risk perceptions (e.g. psychometric paradigm, SARF and others) appeared in response to public opposition to nuclear energy (Otway 1975, Pahner 1976, Fischhoff, Slovic et al. 1978, Kasperson, Renn et al. 1988). Paul Slovic and colleagues have shown in their research that nuclear and radiological risks score high on a list of psychometric factors underlying individual risk perceptions. Nuclear risks are often seen by public as involuntary, controlled by others, having little or no benefit, unfairly distributed, man-made, catastrophic, originating from unknown sources, unfamiliar, exotic, and affecting children (Slovic 1987). However, aspects influencing the publics' attitude to nuclear risks go beyond these psychological factors. Numerous

scholars have noted that social challenges (in this case opposition to nuclear energy) appear when people think that the responsible organisations have not done their job well and that the history of organisation is often intertwined with the problem (Freudenburg and Youn 1999). So what can the history of nuclear industry tell us about the reasons for public attitudes?

Originating from the military sector and the famous Manhattan project in the USA, the nuclear industry inherited not only technology itself, but the centralised, closed structure and culture of secrecy (Rosa and Clark 1999). It has historically been insulated from public scrutiny, public participation and public debate over nuclear policy (Rosa and Clark 1999, Freudenburg 2001). If the nuclear industry was willing to listen to publics, it would have found out that most of the determinants of risk perception discovered by psychometric research had already been brought up by the public during public hearings to explain their opposition to siting of nuclear facilities (Otway in Short 1999). Instead, any public criticism or opposition to nuclear risks were immediately characterised as irrational and radiophobic (DuPont 1982, Daghli 1988, Jack and Sanderson 1995). Although various scholars have repeatedly criticized the use of term 'radiophobic' to describe public opposition, saying it should be reserved strictly for psychiatric use (Mitchell 1984, Drottz-Sjoberg and Persson 1993), the term is still common in both the literature and debates about public attitudes (Myslobodsky 2001, Атомная энергия 2.0 2013, McGann, Miaullis et al. 2015, Sacks, Meyerson et al. 2016).

Another key aspect of nuclear technology is that it was born in wartime effort and is strongly associated with mushroom-shaped clouds of nuclear weapons and Hiroshima Nagasaki victims (Grove-White, Kearnes et al. 2006). This association is not just historical either since civil nuclear power is the source of weapons-grade uranium and plutonium. When experts analyse and discuss nuclear risks, they often focus on the reactors themselves while ignoring the other aspects of the fuel cycle. People, on the other hand, recognise that civil nuclear industry has never been fully separated from nuclear weapons technology and materials (Grove-White, Kearnes et al. 2006) and this aspect impacts on their attitude.

The history of radiation risks has also demonstrated how the potential consequences of new technologies can be uncertain, underestimated and unpredictable. Since its

discovery, radioactivity was marketed as a miracle cure for almost anything (Moore 2017). For instance, there were radium baths, a range of beauty products containing thorium chloride and radium, or products like Radithor – diluted radium salts - a patent medicine that was described as a cure for more than 150 maladies (Macklis 1993, Gray 2004). The women that worked in the production of radium-painted dials saw their job as incredibly beneficial – they got exposed to radium for free while others had to buy it as tonic or one of the hundred other above-mentioned treatments that were available on the market (Moore 2017). Little did they know about the health consequences they were going to suffer due to the ingestion of radium paint. As opposed to health and beauty products, use of radium in dial paint was useful application, but the occupational health risks of this particular application were misunderstood.

Another highly publicised example of an unpredicted consequence was the severe exposure of the Japanese fishing vessel Lucky Dragon and its crew to the fallout from the 1954 US Bikini atoll test (Hohenemser, Kasperson et al. 1977). The first citizen opposition to siting of nuclear plants in US appeared in response to this incident and started a period of intense debate over the atomic fallout from nuclear bomb testing (1955-1961) (Kasperson, Berk et al. 1980). The emerging knowledge about the health effects of radiation exposures illustrates the type of uncertainty referred to as ‘unknown unknowns’ – unexpected situations and consequences that were not considered in early assessments (Wynne 1992). The factor of “we just don’t know enough about this risk” can play a role in the formation of perceptions (Tomkiv, Oughton et al. 2019).

After 1965, when nuclear weapons and war decreased as the main issues of nuclear industry, concerns about threats to the natural environment and a general distrust of high technology and its promoters replaced earlier fears (Hohenemser, Kasperson et al. 1977). Already in 1976, the US anti-nuclear activist Ralph Nader and several others (e.g. Langdon Winner, David Dickson, and Brian Easlea) stated that the main ideological issue with nuclear was ‘the democratic control of technology’ (Kasperson, Berk et al. 1980). The issue of nuclear energy became a condensed symbol for many features of industrial and bureaucratic authority (Weart 1991), a symbol of “*an effort to reform legal system inherited from the days when kings imposed their will on recalcitrant vassals*” (Sweet 1977). Today, the term ‘nuclear paternalisms’ is used to describe the situation when

those managing the nuclear industry believe they are acting in public interest when they are really working in the interest of patrons (Kultgen 2015).

The broad public attitudes of alienation from and mistrust of nuclear industry were strengthened by real radiation emergencies that demonstrated the environmentally destructive effects of the technology and highlighted inadequacies in its regulation and operation. There have been many different kinds of radiation emergencies, but nuclear reactor accidents with off-site consequences have been the most important, and perhaps definitive. Past nuclear accidents differ in reason, scale and consequences, but what connects them all (besides the presence of radiation), is that they in one way or another caused a communication crisis within a much larger and more multidimensional crisis (Fujigaki and Ng 2016). An overview of some of the main accidents and incidents, focusing on issues primarily relevant for communication, are given in Table 1.

Table 1- Selected historical accidents with significant radiological and socio-psychological effects

The Windscale accident (1957) was not readily admitted by the British authorities at the time of the accident. The incidence of an uncontrolled and completely unexpected (by the experts) fire in the graphite reactor core of what was an open, air-cooled military plutonium production pile was deliberately not communicated, and no protective measures were taken for the local population apart from banning local milk-consumption nearly a week after the accident started, by pouring the milk away. Despite the radioactive cloud passing over the downwind settlements, full monitoring data were never released (Wynne 1989). Plant operators and authorities denied contamination of the Cumbrian highlands as a result of the fire. Only after the Chernobyl accident over thirty years later deposited radioactive fall-out over the same fells, did the environmental monitoring show that up to half of the contamination in the highlands could be attributed to the Windscale fire and other releases from Sellafield, while the other half was from Chernobyl (Wynne 1989).

Three Mile Island (TMI) (1979). The analysis of media coverage of the TMI accident showed that most of the negative statements in the newspapers were about the quality of the information that was being released about the accident (Stephens and Edison 1982). The officials were to blame for not giving regular updates, but journalists did not know what questions to ask either (Friedman 2011). Lack of information caused self-evacuation of the local population, despite initial advice to remain.

The Chernobyl accident (1986) took place in Soviet Union, a country with controlled and censored press. The release of radiation was picked up by Swedish monitoring

stations on April 27th and this led to an international alarm about the event. In the USSR, the first announcement about the accident was made only on April 28th, a day after Swedish authorities, and the town of Pripjat was evacuated days later. The effects of the accident were played down; the town of Pripjat containing 45,000 people was referred to as 'a settlement'. The media reports in the USSR only provided short undetailed updates on the situation while focusing instead on all the other incidents on American and European nuclear installations, and blaming Western world for their hypocrisy. The Chernobyl accident is the biggest nuclear accident so far and it showed how consequences could affect large territories far away from the country where the accident occurred. It has underlined the difficulty of communicating technical knowledge about risks or lack of thereof (Friedman, Gorney et al. 1987, Friedman 2011), but also highlighted how the behaviour of experts, even individually, affects their credibility as a whole, which in turn influences the effectiveness of communication to publics (Wynne 1989).

The Goiania accident (1987) is an example of radiological accident. It took place in Brazil when a group of metal scrappers illegally removed a Cs-137 radiological source from abandoned radiotherapy hospital (IAEA 1988). The radioactive substance had been spread over a large area, four people died from radiation sickness and over 20 required intensive medical treatment. The accident demonstrated the possible extent of the stigma-induced secondary consequences in the society when sales of agricultural products from Goiânia decreased (although contamination of produce was never found), hotels elsewhere in Brazil turned away Goiânia residents, and cars with Goiânia license plates were stoned (Kasperson, Jhaveri et al. 2012).

The Fukushima accident (2011) happened in the time of internet and social media, so the amount of information available after the accident was immense. Nevertheless, from the resident's perspective, information was inconsistent, very patchy at best, hard to understand and there were no explanations for the decisions taken (e.g. evacuation or lack thereof, regulatory values for food etc.). Exposed populations experienced lack of communication of *accurate* information and delayed disclosure (Miyazaki 2016). Lost trust in authorities and widespread public anger towards the plant operator TEPCO and Japanese authorities has been a prominent outcome (Figueroa 2013, NAIIC 2012).

Taking into account that public's experience of technologies is "rooted in socio-historical context in which they are embedded and experienced" (Grove-White, Kearnes et al. 2004, Fischer 2005) – their scepticism to nuclear can be justified for all the above-mentioned reasons. Nuclear risks are a pertinent illustration of the complexity of the factors that affect people's perceptions. However, for these and other risks, this understanding of

complexity seems to be largely limited to academia. In practice, many decision-makers still view the public as irrational and phobic towards the various risks, and concentrate their efforts on finding the magic solution to make them perceive risks in the 'correct' way (Marris, Wynne et al. 2001, Árvai 2014). In these attempts to find solutions, institutions responsible for managing risks are paying more attention to risk communication.

2.2.2 Risk communication

"Communication begins before a word is said."

(Fischhoff 1995)

As risk perception research appeared from the attempt to overcome controversy about the societal acceptability of hazardous technologies, risk communication research emerged primarily to solve a very practical problem – that the public needed to be persuaded and educated (Otway and Wynne 1989, Leiss 1996).

The evolution of risk communication underwent several stages and various typologies exist in the literature (see for example Fischhoff 1995, Leiss 1996, Krinsky 2007). In general, the development of the field can be summed up in three main phases. The first phase focused on risk and technical tools for its assessment and management. Professionals assumed that as long as the calculations were correct and numbers were satisfactory, there was no need to talk about the risks, and when information was requested, giving public the numbers (probabilities) was good enough (Fischhoff 1995). Public reactions to such communication were met with open contempt, as Leiss put it – the 'arrogance of technical expertise' emerged during this phase (Leiss 1996). In the experts' opinion, risk assessments were objective, analytic and rational, while the public was subjective, emotional and irrational (Slovic 1999). Numerous risk perception studies followed from this point.

During the second phase, risk communication adopted the approach of persuasion – the messages were supposed to persuade the listener that the point of view presented was correct. The approach was borrowed from marketing and utilized a wide range of techniques for enhancing trust and credibility for messages (Leiss 1996). Experts were still the key participants in the process, and they received a variety of guides, or "etiquette

books” as Otway and Wynne (1989) put it, advising them to use simple language, tailor messages to audience, and pay attention to body language (Palenchar 2009). However, even the perfect messages might not be perceived as such, since they will be impacted by the trustworthiness of communicator (Freudenburg 2001).

Following understanding that trust is an essential element of communication and that lack of trust is ubiquitous in risk issues, the third phase can be characterised by an emphasis on social context and interrelations between different actors (Leiss 1996). According to Otway (1992) *“risk communication requirements are a political response to popular demands... the main product of risk communication is not information, but the quality of the social relationship it supports. Risk communication is not an end in itself; it is an enabling agent to facilitate the continual evolution of the relationships”*. This and other more recent approaches highlight the importance of communication approached that support dialogue and relationship-building (Palenchar 2009, Bieder 2018).

Although this progress can be viewed in terms of successive phases, the reality is that both one-way and two-way communication approaches co-exist in current practices (Irwin 2014, Bieder 2018). This is reflected in the definitions of risk communication adopted by the different organizations. For example, US EPA defines risk communication as *“the process of informing people about potential hazards to their person, property, or community.”* (EPA 2019) adopting a one-way communication approach. WHO, on the other hand refers to it as *“an exchange of real-time information, advice and opinions between experts and people facing threats to their health, economic or social well-being.”* (WHO 2019) or *“two-way and multi-directional communications and engagement with affected populations so that they can take informed decisions to protect themselves and their loved ones.”* (WHO 2014). Moreover, the approaches to risk communication in practice also differ. Risk communication is still often seen as means of educating people about risk assessments and to correct their misperceptions by aligning them with that of experts (Árvai 2014). Wynne argues that the term ‘risk communication’ itself is problematic as organisations that are responsible for risks and for communicating about them rarely explain what they actually mean by risk. Neither do they investigate whether their meaning corresponds with those of people they are communicating with. This highlights the importance of reflexive risk communication as a dialogue between multiple

participants aiming at mutual understanding of issues for all the parties involved (Hampel 2006, Árvai 2014, Bieder 2018, Bourrier 2018)

Risk communication is complicated by several aspects, one of them being the differences in perceptions that were discussed in the previous sub-chapter. Another challenge is that many of the risks, whether they are nuclear, nano- or biotechnology related, are complex scientific topics that people in general are not acquainted with. Getting the content of the message right, which was a focus of this field in the beginning, is still an important task that requires significant analytical and empirical effort (Fischhoff 1995). A vast amount of research has been carried out that investigates how to explain numbers and use comparisons, the benefits of narrative communication and visual presentation of data (Covello, Sandman et al. 1988, Lipkus, Samsa et al. 2001, Garcia-Retamero, Okan et al. 2012, IAEA 2012, Gonzalez, Akashi et al. 2013, Bodemer, Meder et al. 2014, King 2015, Murakami 2018). For example, the guidelines on how to communicate about radiological risk recommend to be careful with the use of quantities and units of radiation and to compare exposures in an accident to background radiation, medical exposures and flying (Slovic, Fischhoff et al. 1981, IAEA 2012). At the same time, one cannot simply assume that people are only interested in scientific information. After the Fukushima accident, the population were not primarily interested in radiation factors, instead, they wanted to know whether they could eat locally produced food and let their children play outside (Bieder 2018). It is important to answer the questions that people want answers for. However, there is evidence that responsible organisations rarely investigate the information needs, understanding, or knowledge of public (Mays, Valuch et al. 2016)

Another aspect that complicates risk communication is the effect of the communication channels. A lot of risk information reaches public through various media (traditional or social) and not directly from the organizations responsible for managing the risks (Wåhlberg and Sjöberg 2000, Covello and Sandman 2001). Mass media are important actors in the communication process, and risk communicators often rely on them to reach general public (Latré, Perko et al. 2017). While they can play important role in framing and interpretation of risks (Vyncke, Perko et al. 2016, Latré, Perko et al. 2017), they may have their own agendas and interest that do not necessarily coincide with those of organizations that manage (and communicate) risks. The explosion in popularity of social

media (e.g. blogs, social network websites, photo- and video-sharing websites, microblogs, etc.) also offer both challenges and opportunities for risk communication. Social media provide the ability to effectively disseminate information and potential for audience interaction; at the same time, it raises concerns with credibility and accuracy of the information (Rains, Brunner et al. 2015, Perko, Tomkiv et al. 2016).

Finally, as already mentioned the importance of trust has been repeatedly identified as a key factor influencing public compliance with recommendations, the effectiveness of risk communication efforts, and successful risk management (Slovic 1999, Sjöberg 2001, Renn 2003, Trumbo and McComas 2003, Viklund 2003, Earle and Siegrist 2006, Wray, Rivers et al. 2006, Löfstedt and Six 2008, Slovic 2010). It is especially important when people lack the knowledge needed to make decision (Siegrist, Cvetkovich et al. 2000). The risk communication and engagement literature stresses the importance of restoring and building trust, believing it can be solved with more information, transparency and explanation (Kasperson 2014). However, as some scholars have discussed – the issue is not of trust but of the trustworthiness of the institutions that are making decisions about risk (Wynne 1992). So one needs to first reflect upon what or who is there mistrust of and for what reason (Wynne 2006) and how does it influence the quality of social relationships between the various actors. Trust is complex as it is influenced by the degree of ambivalence, powerlessness and dependency that people feel towards experts and institutions that manage risks (Krimsky and Golding 1992, Wynne 1992).

Effective communication requires sustained effort, and so does trust (Kasperson 2014). There is need for the institutions to make a commitment to communicate responsibly, paying attention to actions as well as words, and to daily practice as well as emergencies (Leiss 1996). This means that a more pluralistic set of participants should take part in risk communication and deliberation processes should be expanded and upgraded (Kasperson 2014). Since public and stakeholder participation play an important role both in establishing of the trust and in fostering two-way communication approaches, next sub-chapter describes the development of the field and some of the issues.

2.2.3 Public and stakeholder participation

“... we have always had an uneasy relationship with people, tending to treat them as a variable to be considered in analysis, but not as legitimate contributors to decision.” (Otway 1987)

There is certain ambiguity in the terminology of public participation. The variety of participatory methods are usually distinguished based on the degree of information flow, degree of commitment of the parties involved, and the power among these parties and fall under four general categories: information, consultation, collaboration and empowerment (Kemp, Bennett et al. 2006, Chilvers 2007, Krütli, Stauffacher et al. 2010). ‘Involvement’, ‘engagement’ and ‘participation’ belong to the category of collaboration and although, there are some subtle differences between these terms (Woolley, McGowan et al. 2016), they will not be addressed in this thesis and terms will be used interchangeably. However, I feel it is important to address the distinction between the terms ‘public’ and ‘stakeholder’. Public engagement is usually used to describe processes where the members of general public are involved in decision-making or issue deliberation. Stakeholder engagement can be defined in a similar way, and the public is clearly a key and legitimate stakeholder. But in practice it is often limited to the parties that have a more direct stake in the decision or issue, and often excludes the broader and more diffuse public at large. In this thesis I refer to ‘public involvement’ when activities are aimed primarily at the general public and ‘stakeholder involvement’ for processes aimed at public and other stakeholders as representatives of the various institutions.

Participation emerged in the 1950-60s to express opposition of the marginalized and often oppressed members of the society (Arnstein 1969). Since the late 1990s, it became popular in science and technology and this popularity has been growing (Hagendijk and Irwin 2006, Irwin 2006, Attar and Genus 2014). The development of public engagement has been fuelled by the criticism of the deficit model (Irwin and Wynne 1996) and by the deepening crisis of trust between public and experts and crisis of legitimacy of the governance of science and technology (Attar and Genus 2014). Public engagement is now replacing the traditional one-way process of educating public, although this process has been varied and uneven. It is often mistaken for simply being a more dialogue-based method of communication (Abelshausen et al 2018). While dialogue is a an important

part of the process, engagement is also condition of democracy and democratic decision-making for a stable and responsible society with legitimate institutions (Held 2013).

Scholars distinguish three distinct types of imperatives, rationales and motivations for participation: normative, instrumental, and substantive (Fiorino 1989, Stirling 2005, Stirling 2008). Normative imperatives are based on “*principles of democratic emancipation, equity, equality and social justice*” (Stirling 2005, p.220) otherwise known as ‘the right thing to do’. Substantive motivations focus on achieving better decisions through participation, through engaging citizens as subjects in pursuit of more robust solutions (Grove-White, Macnaghten et al. 2000, Stirling 2005). Instrumental motivation for participation aims at ‘securing the end point’ either through enhancing social credibility of the particular decisions, or through fostering more public trust towards institutions by demonstrating their track record of public engagement (Stirling 2005). It can also be used to inform decision-makers, although the outcomes of such deliberations (e.g. recommendations made), often remain ignored (Renn, Webler et al. 1995).

Not only the imperatives for participation vary, so do perspectives on who is the appropriate public for the particular participation process. Shall participants be representative of the wider population or shall processes only include those that are especially interested or potentially affected by the particular decision (Marris and Rose 2010)? For instance, Wynne (2007) argues that stakeholder exercises often become obsessed with whether participants are representative enough of society. However, they do not recognize that the innovation processes to be discussed are not representative of wider societal concerns and needs, as they are developed long before any public involvement occurs. This means that stakeholder process come “*too far downstream in the life-cycles of innovation, regulation and impacts*” (Wynne 2007). Moreover, as Wynne also argues, many public engagement exercises do not necessarily need a fully representative sample of ‘the public’ to be involved. In order to improve a public policy or corporate innovation trajectory, it might be enough that central actors reflect more upon concerns and impacts that they have neglected or overlooked.

Another important question to address in participation is who gets to engage. In controversial situations, powerful parties often become entrenched and dogmatic, and not open to reflection or change. The participatory process, then, typically occurs through

specialist forms of ‘engagement’ and not representative public mobilization. This and related points also caused Wynne to emphasise the important differences between *invited* and *uninvited* forms of engagement (Wynne 2007). While invited participation nearly always introduces a frame (not necessarily deliberately), the uninvited forms of engagement are usually about challenging those frames and normative social commitments (Wynne 2007).

The development of public engagement has not been without problems. It has been occasionally criticized for ignoring participants’ advice and using them mainly to add credibility to decisions already taken (Cooke and Kothari 2001, Kothari and Cooke 2001, Oughton 2004, Sundqvist and Elam 2010). There are tendencies in public involvement to predetermine and pre-frame the issues, constructing them in primarily technical way and to use involvement to educate public about the real as opposed to perceived risk (Wynne 2005, Goven 2006, Irwin 2006, Wynne 2006). A lot of public engagement processes fall short of the democratic ideal, fail to address fundamental issues of economic power, and are restricted in content, structure, and intention (Wynne 2005, Goven 2006, Wynne 2006, Callon, Lascoumes et al. 2009, Horst 2010, Irwin, Jensen et al. 2013).

Finally, the popularity of participation led to the development and application of hundreds of participation methods (Rowe and Frewer 2005), including within nuclear emergency preparedness. However, less attention has been paid to the quality of stakeholder involvement and evaluation of that quality.

2.3 Risk communication and engagement research in nuclear emergency preparedness

“The main challenge for (radiological protection and others) experts in the next 50 years could well be to change their own perception, instead of trying to change public’s perception.”
(Smeesters 2013)

“We must take the population’s insecurity and information needs seriously and work to curb irrational fear.” Extract from a communication plan (Statens strålevern 2015)

Several legal documents define requirements for communication and involvement in emergency preparedness and response. Basic requirements for involvement of different interested parties, including the public, in emergency preparedness and response are set in the Aarhus convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention 1998):

“In the event of any imminent threat to human health or the environment, whether caused by human activities or due to natural causes, all information which could enable the public to take measures to prevent or mitigate harm arising from the threat and is held by a public authority is disseminated immediately and without delay to members of the public who may be affected”.

Another example can be seen in the ICRP’s recommendations for the protection of people in emergency exposure situations (Clarke and Valentin 2009):

“During planning, it is essential that the plan is discussed, to the extent practicable, with relevant stakeholders, including other authorities, responders, the public, etc. Otherwise, it will be difficult to implement the plan effectively during the response. The overall protection strategy and its constituent individual protective measures should have been worked through with all those potentially exposed or affected, so that time and resources do not need to be expended during the emergency exposure situation itself in persuading people that this is the optimum response. Such engagement will assist the emergency plans by not being focused solely on the protection of those at greatest risk early in an emergency exposure situation.”

After the Chernobyl accident in April 1986, the European Commission accepted several legal requirements dealing with early exchange of information, on informing the general public about health protection measures in the event of a radiological emergency and other basic safety standards for radiation protection (Council decision 67/600/Euratom 1987, Council Regulation 2218/89/EURATOM 1989, Council directive 2013/59/EURATOM 2013). These basic safety standards as well as the amended Nuclear Safety Directive focus on increased transparency and public information. They oblige Member States to inform the public during normal operation and in the event of emergency. The requirements are quite minimal, but the directives don’t limit the additional measures that can be decided by member states. A recent study deployed by

European Commission shows that on paper, current arrangements for information and transparency are compliant with the EU legislation (Perko and Martell 2019). However, this and other studies also point out that there is a gap between announced provisions and the reality, which is absence or poor implementations of those provisions (Železnik and Klemenc 2015, Perko and Martell 2019).

Nuclear emergency authorities acknowledge the need to include communication aspects in emergency preparedness exercises and training (Perko, Raskob et al. 2016). There are also citizen-science initiatives in the radiation protection field, for example radiation mapping solutions provided by Safecast in Japan (Brown, Franken et al. 2016). In addition, European Commission and EUROATOM have recently financed a number of research projects focusing on communication and involvement in emergency preparedness (e.g., FP7 projects EAGLE, PREPARE, OPERRA and H2020 projects CONFIDENCE, ENGAGE, TERRITORIES). These projects often include partners from national emergency management actors, thus, establishing a link between research and practice. However, these project activities are not without flaws. For instance, in the PREPARE project, ten national panels were organised to discuss emergency preparedness on how to handle contaminated food and goods after an accident (Charron, Lafage et al. 2016). The types of stakeholders that were invited to participate differed from country to country and almost none of them included general public (PREPARE 2015). In addition, each of the countries used different methods and procedures for stakeholder involvement and no evaluation of the quality of those exercises have been performed.

Despite the fact that both researchers and emergency actors take part in the above-mentioned research projects, it is hard to say whether and how this research is affecting the actual policies in those countries. There is some evidence about practical implementation of the recommendations produced (Pözl-Viol, Turcanu et al. 2018), but no systematic follow up has been carried out. More importantly, there is no agreement on why stakeholders, including public, should be involved. A recent review of stakeholder engagement in emergency preparedness and response for the ENGAGE project showed that stakeholder engagement is rarely organised in response to the normative

imperative. The motivation is rather providing acceptance of the decisions and finding better solutions by including more stakeholders (Abelshausen, Perko et al. 2018).

While international guidelines stress the importance of multi-directional communication that will take into account expectations, views, concerns and questions from different stakeholders, communication about emergencies and emergency preparedness is currently still interpreted as a one directional transfer of information (Železnik, Marega et al. 2014) and legal documents do not require two-way communication (Perko and Martell 2019). In addition, many documents are not legally binding and exist in the form of recommendations or guidelines (e.g. IAEA, OECD, ICRP). For example, IAEA recommendations for development of communication plans states that responsible organisations should collect public opinion, attitudes, issues and concerns in order to understand public environment and context in which the communication strategy is to be implemented (IAEA 2015). However, a 2014 EAGLE survey of regulators, R&D organisations, radiological protection organisations, nuclear industry and other institutions and organisations involved with the radiological risks, showed that the majority of them provide information or education/training to public, but almost none of them systematically investigate their information needs, knowledge and interpretation of the issues (Daris, Kralj et al. 2015, Mays, Valuch et al. 2016). The majority of preparedness actors have communication departments, although those departments mostly carry out public relation activities and keep webpages and social media accounts up to date. The research activities performed by emergency management organisations (e.g. radiation protection authorities) include, information campaigns and quantitative perception surveys (see for instance Raitio 2018), but as noted by Löfstedt (2018), these tasks are often outsourced to communication consultancies that lack academic background and risk communication expertise. A survey of participants at the IAEA's communication workshop in 2018 demonstrated that only one third of them seek feedback on the messages prior to posting them (IAEA 2018).

Those in position of authority often retain the view that public perceptions of risk are inadequate and differ from the 'real' risk (IAEA 2015):

“the demand for public communication may be high in an emergency regardless of the actual risk, as the public tends to react to its perception of risk rather than the actual risk.”

Another persisting idea is that public should be “educated” (Bourguignon, Bérard et al. 2017, Ehold, Perko et al. 2018, Panteleev, Segal’ et al. 2019). Both of these views impact on the way communication strategies are devised and implemented.

To conclude, despite decades of research on risk perception, communication and public participation methods, there are still gaps between this research and its application in practice within emergency preparedness. The key issues for this thesis are related to factors influencing the relationships between the different communication actors. The work carried out explores several aspects of communication in emergency preparedness: the presentation of radiological risks in media and its compliance with recommendations; public needs and concerns in radiological emergencies; and the value and quality of stakeholder involvement.

3 Methods

In order to answer the research questions, the research papers comprising this thesis employ both quantitative and qualitative methods, and sometimes a combination of the two (Table 1). This chapter will give a short description of the selected research methods, as well as overview on the type of data they produced and their appropriateness for the research purposes. The detailed description of the methods used can be found in the appended papers.

Table 1 Methods of data collection and analysis applied in the papers

Paper	Methods used
Paper 1: How did media present the radiation risks after the Fukushima accident: a content analysis of newspapers in Europe	Content analysis, qualitative text analysis
Paper 2: The power of collaborative deliberation in stakeholder dialogue seminars	Stakeholder seminar, questionnaires (combination of close- and open-ended questions)
Paper 3: Embracing the complexities: the value of listening to public in nuclear emergency preparedness	Focus groups, qualitative text analysis
Paper 4: Assessing quality of stakeholder engagement: from bureaucracy to democracy	Case study based on in-depth participant observations

3.1 Media content analysis

Content analysis can be used to analyse written, verbal or visual communication messages and can be performed in both a qualitative and a quantitative way (Cole 1988, Elo and Kyngas 2008). It is a common method for analysing media coverage (Krippendorff 1980, An and Gower 2009, Manganello and Blake 2010, Penta and Baban 2014). For paper 1, this method was applied to analyse newspaper articles from five European countries (Belgium, Italy, Norway, Slovenia, Spain) and Russia, published after the Fukushima accident (11.03-11.05.2011). Two quality newspapers were chosen in from each country. News articles (N=1340) directly and indirectly related to Fukushima were coded using a system of codes developed to determine whether the radiation information in each article was presented in a quantitative and/or qualitative way. Each

article was coded by two trained coders, and inter-coder reliability was $>0,84$ as calculated by Krippendorff's alpha (Krippendorff 2011). After the coding had been carried out, direct quotations of relevant information were collected from the newspaper articles containing radiation units and risk comparisons. These quotations were analysed qualitatively and examined for misinterpretations and mistakes. All articles were also checked for the presence of visual information on radiation doses and effects.

Our content analysis produced two types of data. The first set of data was a frequency distribution of the various ways risk information was presented in the newspaper articles. This allowed us to identify the differences in the approaches utilised in the analysed countries and follow how these approaches varied over analysed time period. However, this data could only tell us *what* was said in the newspapers, but not *how* it was said. The second set of data was a collection of the text segments, where risk information was mentioned. Using this data, we were able to see how risk-related information was formulated, which examples were used, what kind of context this information had or lacked, and uncover instances of misleading information. The combination of quantitative and qualitative analysis provided a deeper insight into the quality of media coverage of radiological risk.

3.2 Questionnaires

In paper 2, a questionnaire was used to measure the extent to which collaborative deliberation increases learning, networking, involvement and problem solving when compared to information provision alone. Two questionnaires were developed to address this—one was distributed after the first day of information provision (26 January 2015) and the second after the collaborative deliberation follow-up on the third day (10 March). The questions asked were similar or identical for the two questionnaire surveys. The participants had the same participant number in both surveys to enable direct comparison of the results after the first and last day for each respondent. The questionnaires contained both close- and open-ended questions. The closed-ended questions were developed to be able to quantify the added value of the collaborative deliberation element compared to the information provision. The open-ended questions were used to explain the quantitative answers given and to capture the viewpoints of the participants on the seminar itself and emergency preparedness in general.

This study attempted to measure the effect of discussion with a questionnaire, which is challenging since it is hard to develop a questionnaire that would fully capture the effect of discussion. However, the use of open-ended questions avoided framing of participants' answers and allowed us to gather even non-anticipated answers (Geer 1991, Gaskell, Hohl et al. 2016). The questionnaires were administered 6 weeks apart so the participants were probably not able to remember exactly what they answered previously, which strengthens the results, although their self-assessment could be prone to bias. We did not deliberately attempt to cross-corroborate the quantitative results of this study. However, some of the feedback we received from participants through open-ended questions and personal communication supported our overall conclusions.

3.3 Focus groups

In paper 3 we used the method of focus group discussions that collects data through semi-structured or focused group interactions on a given topic (Morgan 1996). A total of 48 participants were divided into 6 focus groups and received a progressively developing scenario of a hypothetical nuclear accident as a basis for discussion. The two proposed scenarios differed in terms of potential consequences for Norway and countermeasures that would be applied. The recordings of the discussions were transcribed and analysed for emerging topics

Focus groups are a well-established method that is used in a variety of disciplines (Morgan 2010, Morgan and Botorff 2010, Barbour and Morgan 2017). As the purpose of our study was to explore public reactions, concerns and understandings, focus groups were a natural choice as this method can provide "*valuable insights into the processes through which opinions are constructed, expressed and, subsequently, hardened into attitudes.*" (Macnaghten 2017). The resulting rich body of qualitative data we obtained further confirmed our choice of method as interactions within the group stimulated participants' reflection producing more data than could be achieved had we interviewed them separately. The participants were not familiar with the topic of nuclear emergency management, but as the aim was to gain insight into their immediate responses to emergency situations, we deliberately did not include a more general warm-up conversation. The discussion guide was also broad enough to allow for a wide range of responses and concerns to take place. As in any hypothetical discussion, we cannot

assume that that in a real emergency situation, the participants would behave in the ways they reported, but our aim was to understand what influenced their decisions and attitudes. We aimed for a typical rather than a representative public, trying to include a variety of backgrounds and perspectives. In general, this study can be characterised as a pilot study and more concrete and systematic research building on our results should follow.

3.4 Stakeholder engagement seminars

Both paper 2 and 4 used stakeholder engagement seminars and the method utilised in both cases concerns organization of such stakeholder seminars. However, while in paper 2 we describe how the seminars were organised practically, paper 4 uses in-depth observation to focus on more contextual issues in organisation of engagement processes and looks into how democratic principles were followed and considered when making organisational decisions.

There is a variety of methods for stakeholder engagement (Rowe and Frewer 2005), but while some of them (e.g. consensus conferences and citizen juries) have more or less rigid procedures, others, like stakeholder seminars can be adapted to every particular situation. This allows organisers to create tailored fit-for-purpose approaches. However, as stressed in the two papers, it is also important to reflect upon the way engagement process is designed to ensure that quality is not compromised.

3.5 Ethical considerations

It is important to include ethical considerations in any research performed, especially if human subjects are used. One of the most important issues here would be voluntary participation, informed consent and privacy of the personal information (NESH 2016).

The condition for voluntary participation was met in the studies. The participants of the focus groups (paper 3) were informed about the way data would be collected, analysed, reported and stored and gave their verbal consent (see Annex 2). They were also given the freedom to withdraw their consent at any time. The results of the focus group discussions were anonymised. With regard to participants of the stakeholder seminars (paper 2 and 4), the agreement to participate is often assumed as consent. In addition, the seminars were organised under the Chatham house rule. This rule states:

*“participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed”*¹. The reports did not contain any personal information about the participants and all the quotes were anonymised.

The focus group study was also submitted to and approved by the Norwegian centre for research data² (NSD).

¹ <https://www.chathamhouse.org/chatham-house-rule>

² <https://nsd.no/nsd/english/index.html>

4 Research findings

This chapter will provide short description of key research findings from the four individual papers included in this thesis focusing on challenges and key findings.

4.1 Paper 1 How did media present the radiation risks after the Fukushima accident: a content analysis of newspapers in Europe?

Paper 1 investigated the way radiological risks were represented in European newspapers during the two months after the Fukushima accident in March 2011. As summarised in Chapter 2, there is a vast amount of research on how to communicate about radiological risk so that it is easily understood, meaningful and provides information about things the public is interested in hearing about. This research has, in turn, been used as a basis for numerous recommendations directed towards those responsible for communication about risks related to radiation exposures. Typical recommendations warn against the use of quantitative information and radiation measurement units, suggest comparing exposures in emergency to those received from medical treatments and flying, and recommend paying extra attention to communication of health effects. However, despite the availability of the recommendations, little is known about whether they are being followed. Bearing in mind that traditional media have been and still are an important information source for the public, the main objective of the paper was to investigate the degree to which the above-mentioned guidelines were followed in the media coverage of the Fukushima accident.

The newspaper articles were analysed using a combination of quantitative and qualitative content analysis methods. The results found several misinterpretations and misrepresentations of radiological risks in the newspaper articles, and demonstrated the need for more clear communication of radiological risks. Many newspaper articles contained more than one measurement unit and there was a lack of explanation about what these units mean or how they relate to each other. The comparisons used were not the ones recommended and were not always helpful or correct in the context of the information presented. Health effects were rarely discussed and, when they were mentioned, these were almost always related to very high doses of radiation that were

not relevant for Fukushima. There was little use of visual material to explain radiation doses and effects. We also identified a number of mistakes and misrepresentations of radiological risks, such as comparison with norms that did not exist or that were not correct in the context (such as comparing seawater levels with drinking water standards), and oversimplifications of the rationale behind those norms.

Based on the results we formulated several recommendations for improvement. Information should be presented in several ways, with both results of measurements and several benchmarks for context and comparison. Estimations of health effects that are expected to occur (or not occur) at the relevant radiation levels should be included. Expert risk communicators need to be pro-active in building relationships with the media and in developing both textual and visual material already in the preparedness phase.

The findings from this paper lay the foundation for some of the work carried out in the rest of the thesis. Firstly, discrepancies between recommendations and practice show that there are problems with communication of radiation risks in many countries, including Norway. Many factors could have impacted the quality of reporting. It could be related to changes in the dynamics of the media world and how it impacts the quality of reporting. Competition with social media puts pressure to get something out immediately. The media tended to sensationalise the Fukushima news (such as comparison with Chernobyl or health effects at very high doses), but this could have been done consciously – to sell more newspapers or due to the lack of any other frame in which to present it. There are few science reporters meaning journalists are dependent on experts and authorities. Did the mistakes reflect difficulties in finding information that would help contextualise radiological risks or in getting in contact with relevant people that could provide such context? To what degree are the institutions responsible for communication to public and media to blame here? Overall, the results point to the need for a more systematic review of what goes wrong in emergency response and the relationships between different actors.

These findings are also important because news media are often the main source of information for the public, especially, as was shown in Paper 3 in the initial phase of the accident. Although this first paper study did not give insight into the way risk information presented in newspapers impacted on the way public perceived those risk, follow up

studies in paper 3 suggested that it would be wrong to simply assume that the public believes everything they read. Although the media sometimes misrepresented regulatory norms for radionuclide content as something that divides food/drinking water into dangerous and safe (Paper 1), the focus group discussions in Paper 3 revealed that many participants had a very clear understanding that this is not how regulatory levels are set, they knew they were conservative and were calculated with several safety margins. To conclude, Paper 1 underlines the importance of studying one's audience and their response to the ways information is presented.

4.2 Paper 2 The power of collaborative deliberation in stakeholder dialogue seminars

Paper 2 examines the use of collaborative deliberation in stakeholder seminars as opposed to information provision. There is an increasing amount of support for involvement of a wider variety of stakeholders in the decision-making processes, and a general agreement that two-way communication should be used instead of one-way communication. In practice, however, the dialogue aspect of communication in stakeholder seminars can be quite limited. Stakeholder involvement seminars in Norwegian nuclear preparedness are usually organised in the form of information provision – the participants receive a number of lectures covering a variety of relevant topics while discussions (if present) are limited.

Building on a series of nuclear emergency preparedness seminars carried out in Norway, Paper 2 deals with the quantification of the effect of dialogue and discussion (collaborative deliberation as we called it in the paper) against one-way communication – information provision. The study used questionnaires to quantify the value of collaborative deliberation as seen by the national, regional and local actors participating in the seminars. In doing this, the study contributes to the ongoing academic and practical discussion of how to demonstrate that engagement is worth the effort, time and resources and whether the process has paid off in terms of result achieved.

Results demonstrated that discussions were more useful than one-way information provision. Participants deemed that collaborative deliberation contributed significantly to knowledge gaining, networking, involvement and problem solving than information

provision, mainly through discussion within and across the different sectors present and informal communication between participants. Collaborative deliberation also had a positive impact on the understanding of the challenges different sectors would face in a nuclear emergency and the roles the participating actors would play in it.

An important result of Paper 2 was that home reflection on the issues did not work for the majority of the participants, only for the few people from institutions that were interested in working with the issue to begin with. This highlights another important issue in the engagement discussion – that it is often dependent on active individuals that see the value and importance of engagement and common deliberation on issues and will show initiative.

These findings are relevant for two different reasons. Firstly, there are few studies that have tried to quantify the benefit of dialogue for knowledge, networking, involvement and problem solving. My personal view is that the benefits of this type of dialogue actually go beyond these outcome-based factors, and the approach has value in itself, as does stakeholder involvement in decision-making. However, those with a more pragmatic approach, like decision makers and politicians, often need a more tangible demonstration of benefits. Hence our study could be valuable material to demonstrate that dialogue and deliberation pays off.

Secondly, the findings give an indication of problems that are present in the Norwegian emergency preparedness system. One of the most apparent challenges is both the lack of and need of stakeholder involvement in nuclear emergency preparedness. At the same time, there is a clear challenge of how to get people to participate in stakeholder engagement when it is not part of their immediate tasks. This concern was also brought up in Paper 3, where one of the worries that public representatives expressed was whether a coordinated response to an event can be achieved with all the different actors involved. The public also questioned whether all relevant actors/people are indeed included in this type of decision-making. Again, a systematic analysis of what is currently being done in emergency preparedness, what kind of stakeholders are being involved and how is needed. These factors are also raised in paper 4, which discusses what a quality stakeholder involvement process is and how important it is that such stakeholder

involvement initiatives are open about their purpose and impact and who would benefit from it.

4.3 Paper 3 Embracing the complexities: the value of listening to public in nuclear emergency preparedness

In Paper 3 we wanted to investigate public concerns, responses, information needs, understandings and expectations with regard to radiological accidents. This study was motivated by the need to understand attitudes and behaviour of public in order to develop appropriate protection and communication strategies and to encourage actions that would reduce the impacts of accidents. In emergency preparedness practice, public opinions are usually collected through quantitative surveys, where the majority of questions are close-ended. Although such surveys provide some indication of public attitudes, they fail to answer what motivates people to act in certain ways, what factors they take to be relevant when deciding how to act and why they respond to and perceive risk in the ways they do.

The study was based on scenario-based focus group discussions with representatives of Norwegian populations. Two scenarios were presented: an accident during transport of a reactor off the coast of Norway and an accident at the Sellafield reprocessing plant, both leading to deposition of radionuclides on Norway.

Results from the focus group discussions were analysed according to four main topics: a) how the publics involved define their relationships with emergency preparedness actors; b) what factors influence public responses to countermeasures; c) how publics construct their risk perceptions of radiation; and d) what kind of questions they asked about the scenarios.

We identified two main factors that heavily influenced the public's relationship to emergency actors. One of them was knowledge – the majority of participants had no idea that there was any preparedness for radiological accidents in Norway, nor who would be responsible for managing it and making decisions should an incident occur. They did not know who to go to for information and acknowledged that they had forgotten about the old routines that used to be part of civil defence. The other factor was trust towards authorities and official institution. Discussions uncovered that although the general levels

of trust are high; it is topic-dependent and is affected by historical experiences with governmental decisions and actions (in both positive and negative way). The public would appear to trust more in the intentions of the authorities to act for the public's best, than their competence to deal with the emergency situation. With regard to official recommendations, our findings showed that formulations play an important role. Personal networks influenced the readiness for following recommendation, as people would naturally want to make sure their loved ones were safe. Participants were generally more positive towards recommendations they saw as effective and safe. We also observed that a range of factors contributes to the way publics construct their perception of radiation. Things like lack of control over exposure, persistence of contamination, lack of knowledge about effects of radiation and responsibility for potential effects on their children played a big role in this process. The questions people asked demonstrated a variety of aspects that public would be interested to know about and that responsible authorities should be ready to answer.

Although the findings of this study cannot be generalised to the whole population of Norway, since we did not have a representative sample, they do indicate some of the existing issues with and potential challenges for emergency preparedness. First, they demonstrate the kind of useful insights into the ways public construct: i) their perceptions of risk; ii) their relationships with emergency actors and sources of knowledge; and iii) their responses to emergency management.

4.4 Paper 4 Assessing Quality of Stakeholder Engagement: From Bureaucracy to Democracy

Paper 4 addresses the lack of quality evaluation of stakeholder engagement activities and frameworks (criteria) for such evaluation. The rapid increase in popularity of stakeholder engagement in research and practice has been applauded as symbolizing the transition from one-way communication practices to a dialogue. Stakeholder engagement was a shift towards a more democratic process that was expected to remediate the crisis of trust between public and experts. However, not everybody shares this enthusiasm about stakeholder engagement and there have been questions about whether it has any actual impact on the democratization of practices, or whether it is used simply to add credibility to decisions already taken. There is evidence that stakeholder engagement has not

resulted in the change of attitude of experts and decision-makers towards the role of public and stakeholders in those activities, making it often just another bureaucratic exercise. The existence of hundreds of participatory methods and mechanisms only emphasize the need for thorough evaluation. But how does one evaluate stakeholder engagement? Those who view it as a way to get their decision accepted, aim for outcome-based evaluation although this view and approach have been criticized for not adhering to democratic principles. Others focus on evaluating whether the method used is efficient and works. However, in our opinion, there is a need for a third type of evaluation – one that is context based and focuses on the ways democratic principles are followed, that examines power relationships between the participants and investigates how issues and decisions are framed. The aim of this study was two-fold: we wanted to explore the applicability of the existing evaluation criteria for assessing quality of stakeholder engagement or broader public engagement. At the same time, we wanted to use our two cases to highlight existing limitations and issues in stakeholder involvement and evaluation frameworks, demonstrating the need for a deeper analysis that goes beyond simply methodological considerations.

The paper uses two stakeholder engagement activities, one in nuclear emergency preparedness and one in nanotechnology to demonstrate limitations of existing criteria in assessing the quality of the stakeholder involvement process. Evaluation of the cases demonstrated that there was a variety of issues: lack of representation of relevant stakeholder groups, which resulted in experts constructing opinions about public concerns; conflict of interests and possible bias in choice of participants; lack of flexibility to be able to take issues that appeared during the discussions aboard; lack of influence on both results of the process and limits for the discussion and stakeholders' unawareness of what was going to happen with feedback. Another observation that we made while evaluating the exercises was that both activities tended to put a lot of focus on expert knowledge and “education” of participants.

Based on the findings of the study, we concluded that existing criteria could be used for systematic comparison of stakeholder engagement activities, but they were not sufficient to address the democratic issues of the quality. Therefore, we proposed to expand the criteria so that more attention is devoted to democratic values and context evaluation of

the engagement processes. Our proposed framework suggests to focus on **inclusiveness** in terms of ensuring a diversity of perspectives and opinions (including those that are usually excluded) and joint reflection on the ways the different parties might be affected. **Independence** of stakeholder engagement processes should not be limited to the economic independence from sponsor, but also independent deliberation on framing of issues to be discussed. This is important since framing is something which is usually fixed early in or even before multi-actor engagement and deliberation begins, and has a tendency to focus only on risk, as if this were the only public concern. Inclusiveness and independence are also in line with the call for upstream as distinct from downstream engagement (Wynne, 2001). Attention should also be paid to minimize bias in selection of participants. Instead of focusing only on timing of involvement, one should ensure **flexibility** of the process so that issues that emerge in discussions with stakeholders could be taken aboard. In addition, we think it is important to consider adding some **continuity** to the engagement process, whether it is done by organizing it in stages or by acknowledging and picking up on what was done before in the area/topic. Authentic engagement cannot be achieved if it is assumed that it is founded in one-off events only. Previous and expected future social interactions matter far more than normally recognised. Since evaluation of genuine impact stakeholders had on the outcomes of the process is hard when it is not connected to a specific policy-making, one should evaluate **influence** based on the possibilities stakeholders had to co-frame and choose issues, question the underlying assumptions of those organizing the engagement. The engagement process should be **transparent** in terms of not only *how* the process is conducted, but also *why* it is being organized, what is going to happen with results and who will benefit from it. We also proposed an additional criterion - '**accountability and learning**' to stress that the essence of stakeholder engagement is mutual learning for all sides and should not merely educate stakeholders about various issues of a project or policy.

To conclude we argue that these criteria will ensure a more critical and reflective contextual evaluation of stakeholder involvement, and that addressing these should be a formal requirement to anyone who is organising it. More attention should be paid to the quality of the involvement processes and what role they actually play in the decision-

making (if they play any role at all). In this way the more lasting and important dimension of social relationships is included. I suggest this is needed not only on theoretical grounds, but also on pragmatic ones, to help make emergency responses more effective.

Even though the stakeholder engagement activities that we analysed were stand-alone events, they did highlight for research and decision making, the general problems that exist in participation and engagement. These findings are novel and relevant because although many excellent scholars have been raising the question of democratic deficits in stakeholder involvement, little of these concerns have been put into practice. Also, although we were aware of these discussions and were actively involved in organization of both cases, we found it hard to meet quality criteria. There is little understanding on the part of sponsors and organizers of predominantly technical projects of what does it actually mean to involve stakeholders and why those more demanding and ambitious criteria need to be followed.

In practice, institutions are being applauded merely for doing any involvement, while I believe by now we should have progressed further. It is not about just doing it, it is about constant reflection, re-evaluation of current procedures and processes in order to learn and improve.

5 Discussion

The overall goal of this thesis was to offer a more holistic view of risk communication in emergency preparedness that goes beyond analysis of the message and messenger, and also addresses the relationships between publics and responsible institutions. In this chapter I discuss the theoretical contributions made by this research to risk communication, stakeholder involvement and emergency preparedness by showing the relevance of this research to these fields. I also highlight the practical implications of this research to academic and managerial discussions about emergency preparedness to nuclear or radiological accidents.

5.1 Linking the papers

The papers in this thesis share a common topic as they all address communication aspects in relation to a real or hypothetical nuclear accident. They are primarily linked together by their contributions towards gaining a better understanding of the different components within communication in nuclear emergency preparedness:

- Who are the communicators in emergency and emergency preparedness and their roles in the communication process;
- What should communication content be in terms of message and expectations; and
- How this should be done – process of communication.

Moreover, the papers highlight the multiple directions of social relationships that exist between the key communication actors (Figure 3) and indicate at least some of the factors that affect these relationships.

5.2 Theoretical contribution to the research field

The papers are linked together by their interrelated contribution towards a more holistic understanding of risk communication, but the individual papers also contribute to the theoretical frameworks they are grounded within.

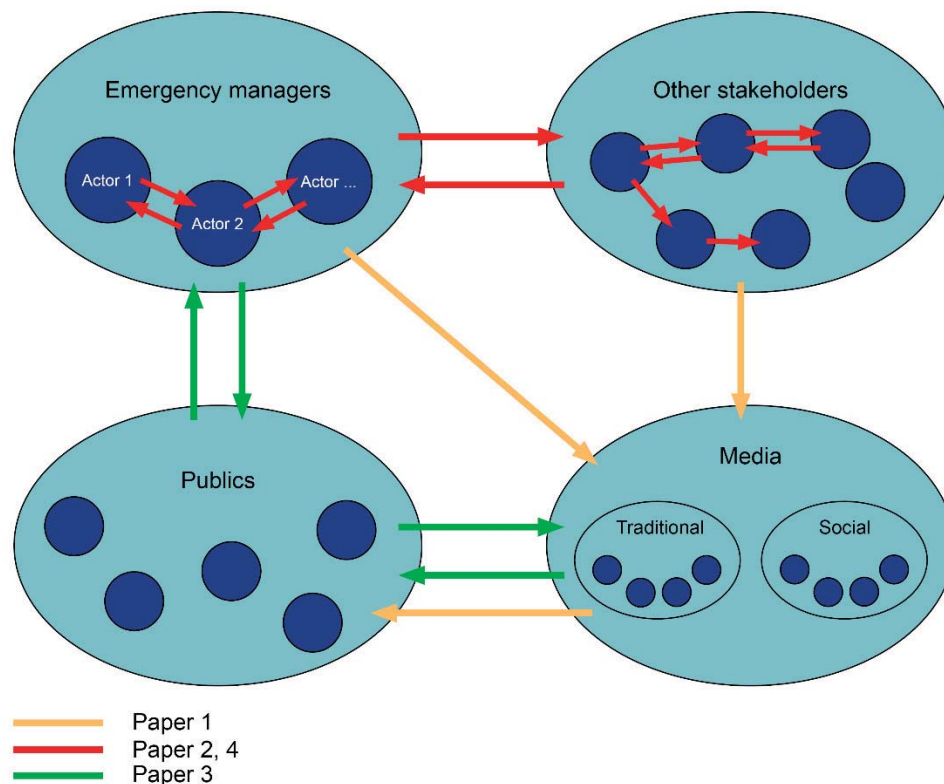


Figure 3 The interactions between the different actors of emergency preparedness and response addressed by the individual papers

Paper 3 demonstrated that publics were basing their perception of nuclear risk on their knowledge, values and experiences of those who control this risk. These findings support the research within the socio-cultural theory of risk, which argues that risk is inseparable from the wider societal and political context and both expert and public approaches to risk are logical and rational, but merely based on consideration of different factors than results of technical assessments (Douglas 1982, Plough and Krinsky 1987, Tansey and Rayner 2009).

Another theoretical contribution of Paper 3 was made to the pluralist theory in the interpretation of Thompson and Rayner, whose cultural theory of risk approach follows their anthropologist teacher Mary Douglas. This approach is based on the way dynamic social constructions affect risk perception, resulting in plurality of rationalities in the sense that *“each of these sets of social constructions provides those whose form of social solidarity it supports and makes viable, with the criteria for deciding what counts as*

rational and what as irrational." (Thompson and Rayner 1998, Thompson, Rayner et al. 1998). The findings of Paper 3, in particular, demonstrated this multiplicity of publics (Irwin 1995, Wynne 2005), and how these publics construct their perception of radiological risk and institutions managing it, based on their knowledge, values, experiences, and their whole web of social relationships. In addition, stakeholder engagement seminar analysed in Paper 2 highlights the plurality of actors within the emergency preparedness system and their perspectives and challenges with regard to emergency response. Thompson and Rayner (1998) also argue that by embracing the plurality, improved flexibility and resilience of institutions could be achieved to respond in a more robust way to ever-changing and unpredictable circumstances of emergencies. The research findings from Papers 2 and 4 contribute to the ongoing discussion on the democratic theory that focuses on the need to shift from representative to deliberative democracy (Benhabib 1996, Biegelbauer and Hansen 2011). The basis of legitimacy in democratic institutions is that their decisions represent "*an impartial standpoint in the interest of all.*" (Benhabib 1996, p.69). This can only be true if such decisions "*are in principle open to appropriate public processes of deliberation by free and equal citizens.*" (Benhabib 1996, p.69) It is important to give citizens legitimate voices in the technical policy processes and steer these processes away from the technocratic mode of decision making towards democratisation (Chilvers 2005). However, there is still a long way to go before this democratization can be fully achieved (Chilvers 2005, Chilvers and Kearnes 2016, Tomkiv, Liland et al. 2019). There is need for more attention to wider social and political contexts that participatory processes are organised within, with focus on the ways democratic principles are respected (Goven 2006, Goven 2006, Chilvers and Kearnes 2016). We respond to this need by proposing extended quality evaluation criteria for stakeholder engagement in Paper 4. These criteria go beyond the more common methodological evaluations and address democratic issues.

5.3 Communication in emergency preparedness: a step towards holistic approach

Based on the research findings from the papers, I have defined four factors that would contribute to improved communication for nuclear emergency preparedness. These are

“listening to people”, “embracing the complexities”, “communication as a relationship” and “need for institutional change”.

5.3.1 Listening to people

A first step towards better communication processes would be listening to (and hearing) the audiences. Listening to public is not only a “normative” requirement of being ‘the right thing to do’ in a truly two-way communication. Understanding the publics, their perspectives, concerns and values, their understanding of concepts and systems can provide valuable input to both research and practice. The importance of audience research has been known and stressed for decades (Fischhoff 1995), however, evidence shows that both research and practice often work with assumptions of what we think public concerns and needs are (Marris, Wynne et al. 2001, Marris 2015, Mays, Valuch et al. 2016). The reasons for such an approach are many, from a devotion to deficit model (Simis, Madden et al. 2016), disregard of social research (Van Oudheusden, Turcanu et al. 2018) or a paternalistic “we-know-it-better” belief (Sundqvist and Elam 2010, Kultgen 2015).

Starting with the basic level of communication related to content and format, the first question we must ask our audience is: Are our messages appropriate? Are our communication channels adequate – are people using them the way we assume they do? Is an article on a webpage a good communication format or should we go for something more interactive? Are the recommendations and other communication content understood the way we intended? Are we speaking the same language with people? Are we answering the questions they are asking? Are we responding to the concerns they are having? Do we know the factors that will influence their response? - these are just few examples of the questions any communicating institution will need to know answers to. There is of course a vast amount of scientific literature internationally, addressing all of these different aspects (see e.g. (Lipkus and Hollands 1999, Lipkus, Samsa et al. 2001, Fagerlin, Ubel et al. 2007, Perko, van Gorp et al. 2013, Bodemer, Meder et al. 2014, Perko, Thijssen et al. 2014, Perko, Adam et al. 2015, Vyncke, Perko et al. 2016). However, the point I would like to make here is that every responsible actor in each country needs to know their particular audience. Generic research needs to be applied and put into

practice in each country, and to date little has been carried out in Norway. The results of studies need to be tested in different countries, since the answers are unlikely to be the same for all the people in the world, as there are political and social contexts that are specific to each country, which would require different communication approaches (Aerts, Impens et al. 2014).

Another important sphere where audience research is very useful and important is to investigate the connection between media coverage and public risk perception. The influence of media on public risk perception is a popular assumption especially promoted by the Social Amplification of Risk Framework. There is a lot of research on the influence of different media types on risk perception, but this only provides limited support for the hypothesis that media sources can have influence on risk perception (Coleman 1993, Sugimoto, Nomura et al. 2013, Utz, Schultz et al. 2013, Vyncke, Perko et al. 2016). However, this influence cannot be taken for granted, as media might have more influence on risk perception via availability of information (more information – stronger effect) rather than being a strong causal factor (Wählberg and Sjöberg 2000). As Urquhart and colleagues have noted, decision-makers may look for media as a proxy of public concerns, however, while media certainly has a role of informing public and impact their degree of awareness (on a particular issue), it cannot be equated to public concerns (Urquhart, Potter et al. 2017). I am not trying to deny the potential effect of media coverage, I only want to stress that, however interesting the results of media coverage analysis are, if we don't actually investigate how people would – or did - respond to the information they received through media, we cannot assume what kind of effect it had. Although in Paper 1 we demonstrated a number of mistakes and lack of context for radiological information found in the newspaper articles, we cannot say how those impacted on the opinions people formed about radiological risks. We also lack understanding of how they actually use media in the constantly changing media landscape and how do they treat it as a source - all of these aspects can only be studied by asking or observing, or both, the potential readers. For example, the participants of our paper 3 study considered online newspapers to be a good source of fast information updates. But at the same time, they differentiated between the tabloid and more serious papers and acknowledged existence of sensationalism, click-baiting, lack of quality

coverage and money interests in media world – demonstrating that they are not merely passive receivers of information.

The past decades have seen an evolution in our understanding of the variety of factors that impact the way people construct their perception of the risks. The issue of risk perception has been addressed in many different disciplines and using different methods, but in the end, the perception triggers that emerged from psychometric research (Slovic 1987, Slovic 1997) or those that emerge from qualitative data based on discussions with people (Short 1999, Tomkiv, Oughton et al. 2019), are very similar. For example, participants of the focus group discussions in Paper 3 revealed that in the case of radiological contamination, their perceptions of radiological risks would be affected by the feeling of disempowerment and having lack of control over exposure, its persistence and effect on future generations. People's response to risk is not phobia or irrationality, it is grounded in their values (societal, moral, ethical) (Wynne 2001, Wynne 2013, Oughton and Engel-Hills 2016). However, emergency actors often lack this understanding of public perception and act upon their assumption of a misunderstanding and hysterical public that has to be reassured and 'sedated' (Hernes 1986, Irwin 2014) – behaviour that also resonates well with my own personal experience. There are few if any studies that would have systematically analysed whether emergency preparedness actors actually use the results of social research for guiding them in the decisions and strategies and if yes, how and to what extent?

Listening to people should not be limited to audience research only. Many scholars have been advocating for inclusion of public as a stakeholder in the decision-making processes (e.g., Wynne 1992, Sundqvist and Elam 2010). There has also been increasing recognition of the importance of public involvement in recovery after the nuclear accidents (Oughton, Forsberg et al. 2004, Liland, Lochard et al. 2009, Ando 2016, Rollinger, Lochard et al. 2016). However, public involvement in emergency preparedness is not so widespread, although involvement of other stakeholders is slowly becoming accepted. The reason for that could be that this field is still dominated by technical experts and arguments against public involvement usually focus on their lack of scientific expertise (Sundqvist and Elam 2010) or secrecy. This prioritization of scientific knowledge and power and control to experts only discourages knowledge exchange and mutual learning. It also limits the

dimensions of issues that are thought to influence public concerns to only scientific ones (Hirakawa and Shirabe 2015). However, we know from Chernobyl experience that the local context and knowledge are crucial for successful implementation of the countermeasures (Skuterud 2006, Liland and Skuterud 2013). The focus group participants (Paper 3) hoped all the people with relevant knowledge are included in the decisions, some said they would like to be included as well.

As important as it is to promote participation, it should be done properly with attention to both method and process. As discussed in Paper 4 a quality stakeholder engagement process should be supported by democratic values and pay attention to the context in which it is organised. It should be inclusive, allow for joint deliberation on framing of the process and mutual learning, be clear about aims and purposes, and flexible to take issues that emerged aboard.

5.3.2 Embracing the complexities

There several dimensions of complexities that emergency preparedness need to be aware of and address. Firstly, responding to a nuclear accident is a complex task – it will affect multiple parts of society and involve a vast variety of actors (Oughton and Howard 2012, PREPARE 2015, Charron, Lafage et al. 2016), and requires mobilization of all institutions and power (Clancey and Chhem 2016). Achieving a coordination of so many actors is very challenging and can only be done if everyone's roles and responsibilities are understood by all of the groups involved (Charron, Lafage et al. 2016). However, as clearly illustrated in Paper 2, reality shows that roles and responsibilities are a big source of confusion for many actors, especially those that are not usually involved in exercises and discussions (Liland, Tomkiv et al. 2017). In the actors' opinion, only the common deliberation on issues made them realize the full picture of potential consequences of a nuclear emergency and challenges it was going to bring to the various sectors (Liland, Tomkiv et al. 2017).

Moreover, as several scholars have already pointed out, there are not only multiple actors, but also multiple publics (Irwin 1995, Wynne, Scoones et al. 2005, Kerr, Cunningham-Burley et al. 2007). These publics will apply a variety of rationalities in the construction of their attitudes towards risk and actors managing this risk. Each time they

make a judgement about risk or actor, they will weigh the evidence presented, their background knowledge and experience with similar situations and actors, etc. The focus group discussions (Paper 3) gave a good illustration of this plurality: some of the participants that had personal experience with emergency exercises, and knew about weaknesses that exist in preparedness systems expressed less confidence in the ability of Norwegian emergency preparedness. Other participants, whose experience with emergency preparedness and response was limited to the knowledge about post-Chernobyl recovery, were more positive towards the competence of the authorities.

Another dimension of complexity I would like to mention is the difference between the theoretical (i.e. emergency plans) and the actual emergency response. Countermeasures tend to be planned by the responsible actors centrally, but will need to be implemented locally. The differences in local context will have an impact on the implementation, but it is often unclear how, or whether, these are considered in this type of planning. The Rogaland seminars discussed in paper 2 and 4 were a one-of-a-kind activity, with invited participation from all levels of decision-making, as the involvement does not usually go further than the regional, county level, while implementation of the countermeasures would fall onto municipalities' table. If we also add here the dimension that every emergency is going to be different, it seems only logical that response systems should aim for flexibility and resilience rather than fixed rigid solutions, emphasising on the ability of the system to adapt (Britton and Clark 2000, Clancey and Chhem 2016). For achieving flexibility and resistance, strong healthy relationships between all the actors in the preparedness system will be beneficial.

The final complexity has paradox right through it. A clear requirement for much of the above-discussed improvements in emergency response, and preparedness, is that regular rehearsals take place involving the various actors in their distinct roles and functional relationships. A problem with such rehearsals for many authorities is that they risk provoking the very public anxiety and exaggeration of the risks of the accident scenarios rehearsed, which are the officials' greatest lament – and fear. Focus group participants (Paper 3) acknowledged this as one of the challenges with making emergency preparedness more visible. At the same time, some of them acknowledged that knowing what to do and who to contact in an emergency would make them feel safer.

So some sort of middle ground solution that would attend to the concerns of the different publics should be possible.

5.3.3 Communication as a relationship

The topics discussed above stress the importance of listening to the public and embracing the variety of complexities that are inherent in an emergency preparedness and response. These arguments lead towards a necessary change in the way we think about the communication process. Here I will present the argument for why we should move away from understanding communication in terms of single events, campaigns and emergencies, and view and develop risk communication as a dynamic network of social relationships (following (Otway 1992) involving all salient actors including publics who may be uninterested and unwilling.

There is a lot of guidance on how to set up emergency communication in response to an accident, but there is still lack of understanding with regard to the impossibility of just pushing a button to get communication going once an emergency occurs. This does not just refer to practical arrangements like activating an emergency webpage, call line or SMS warnings, but the challenges of reaching out to actors and publics that have never been engaged in emergency response and do not have the trust with which to credit emergency managers. Emergency preparedness needs to develop in line with societal changes and changes in nuclear threat assessments – there is a need for regularity and continuity of communication and involvement.

Starting with the issue of trust, which is of crucial importance for risk perception and successful communication and engagement. Many scholars have pointed out that trust needs to be built a long time before it's actually needed (Slovic 1993, Slovic 1999, Siegrist, Cvetkovich et al. 2000, Larson and Heymann 2010) and it is something responsible institutions should always keep in mind. We need to keep in mind that *no* communication is in fact communication, as it is a form of institutional body language, actions and lack of actions (Otway and Wynne 1989). Focus group discussions (paper 3) showed that people do not judge any emergency in a vacuum; they use their experiences from other instances, other accidents, other decisions, and the previous behaviour of those in power. Therefore,

all the experiences they have – and have had over a long time past - with experts and institutions that engage in the emergency response will be having an impact on trust.

To continue the discussion on experiences with institutions – **transparency, openness and accountability** should be the guiding principles of any communication and involvement. These principles were highlighted as important both by participants of the focus group discussions (Paper 3) and by evaluations of the stakeholder engagement activities (Paper 4). However, inclusion of transparency and openness into modern policies is currently grounded in a utilitarian argument that it will help in convincing sceptical publics and restore trust (Irwin 2006, Löfstedt and Boudier 2013). At the same time, the *“possibility that openness might create further grounds for criticism and concern is not considered.”* (Irwin 2006). A recent study confirmed this possibility when transparent communication was tested in Canada during the H1N1 pandemic and found to create more public confusion and provoke negative opinions on the abilities of public health authorities (Driedger, Maier et al. 2018). As we argued in Paper 4, transparency should focus less on how the communication or engagement process is conducted, and more on why and in what context. A fundamental reappraisal of the relationships is needed (Irwin 2006).

The mistakes and misrepresentations of radiological risks in media that were revealed in the Paper 1 led us to suggest that there is a need to build a relationship with media as well. This idea was supported by the journalists present at the RICOMET³ conference, where the results of the study were presented (Perko, Tomkiv et al. 2016). The pro-active approaches bringing together journalists and scientists help improve quality of scientific debate in society (Tanaka 2015).

Every stakeholder engagement process needs to continue beyond the particular lifetime of the issue or decision. This means that organisations responsible for the decision need to maintain their existing relationships with the various other organisations which exist and act in the social or policy environment in question, and this includes interactions with others who may be ‘stakeholders’ in the specific issue as well as stakeholders in more

³ First International Conference on Risk Perception, Communication and Ethics of Exposures to Ionising Radiation (RICOMET 2015), which was held from 15th to 17th of June 2015 in Brdo Castle, Slovenia.
<http://ricomet2015.sckcen.be/>

general and broader-ranging issues. This idea is supported by the findings of Paper 2. Stakeholders that participated in the emergency preparedness seminar said that they felt it would be easier for them to reach out to organisations in an emergency situation, now that they had actually met people (Liland, Tomkiv et al. 2017). The positive effect of continuous involvement has also been demonstrated in the Swedish nuclear waste discussion (Sundqvist and Elam 2010).

We attempted to address stakeholder involvement as a process in the nuclear preparedness seminars described in Paper 2 and Paper 4. The two seminars were deliberately held 6 weeks apart to allow for participants to reflect upon the knowledge they received, their roles and responsibilities. This endeavour had limited success as difficult to achieve a relationship and stimulate collaboration as an exercise, there has to be a focused purposeful process. The seminars, however, had an impact on the responsible emergency preparedness authorities, who gained an understanding of how important stakeholder involvement is for their work⁴. We developed this argument further in paper 4 where we highlighted continuity and flexibility of stakeholder processes as one of the criteria of quality involvement.

A first step towards continuity would be creating a database of all the stakeholder involvement experiences available so far – a suggestion that was originally made by (French and Bayley 2010). Although a technical solution, it would enable actors to learn from previous activities and processes and build on them, particularly if the database contained quality evaluations of those activities. There have already been attempts to create such a database within the NERIS-platform and currently the work continues in the ENGAGE project, however, it will be carried out only to a limited extent due to lack of funding (e.g. the physical development of database is not included as a part of the project). The last argument for developing communication as a relationship is the dynamic and cyclic nature of perceptions already mentioned. People have ambivalent attitudes to risks and institutions. These attitudes will be constantly renegotiated based on the information

⁴ Personal communication the authorities also decided to rethink the way they conducted stakeholder engagement

they receive, their knowledge, previous experiences and current social and political context of the events.

5.3.4 Need for institutional change

Despite the extensive research in fields of communication and participation, the same mistakes were repeated after Fukushima (Ng and Lean 2012, Prezeli, Perko et al. 2016). If one looks back at the old communication manuals (e.g., Covello, Sandman et al. 1988), the points raised there were already good: accept and involve the public as a legitimate partner, listen to your audience etc. But it seems that policy-makers continue to simply apply the deficit model, attribute all the problems to public ignorance and assume that all problems can be eliminated with education and information (Simis, Madden et al. 2016). According to Hadden (1989), dialogue-based approaches are often disrupted by institutional barriers. This section proposes that the problem is that these things cannot be addressed in the way institutional frameworks are currently set and there is need for more global changes (as already noted by Wynne 2006). So while the previous subchapters focused on *what* should be done and *why*, this section addresses *how* the proposed changes should be implemented at the higher level of preparedness systems, which is after all where continuity and continual readiness to deal collectively with what will be by-definition unpredicted but drastic events, are all paramount.

The first step towards an institutional change would be an acknowledgement on the part of responsible institutions and experts that societal aspects are as important and should receive attention on the same line as technical and economic aspects, which would also mean that social science research should be included into the radiological protection to the same extent as natural science. The importance of the social dimension and public involvement in radiation protection and emergency preparedness has been stressed since the Chernobyl accident (Bay and Oughton 2005, Liland, Oughton et al. 2010), but although SSH researchers are getting more and more involved as partners in the research projects on nuclear emergency preparedness (Van Oudheusden, Turcanu et al. 2018) there is still room for improvement. Take, for instance an example of the new Norway's challenge of decommission of the Halden nuclear research reactor and construction of a

nuclear waste disposal. A recent presentation of this project⁵ went into a great detail about all the technical and safety challenges and potential costs of this process. Social aspect was mentioned on one slide towards the end, where presenter explained that they are expecting challenges with regard to sitting of the nuclear waste disposal (Johannesen 2018). That only confirms, unfortunately, that social aspects are often mentioned in relation to issues of potential public opposition with an aim to overcome it. Institutions need to come to terms with the fact that neither communication nor involvement is quick and easy fix for whatever problems they have with public. Communication and involvement are not tools for achieving acceptance – they are key components that should be at the core of the emergency preparedness and response, and if the social aspects took their rightful place in the institutional structures, this idea would not be so uncomfortable to the institutional actors anymore.

We have left behind us the time, when electing representatives that would debate our interests and make decisions on our behalf was enough, and the only accountability they would face was the election for the next term. Public engagement is a new norm and institutions need to learn to live with it. However, as we learned from nuclear preparedness seminars in Paper 2 – many participants needed an obvious benefit and economic support to be willing to participate in such events - do institutions value involving and being involved? Reviews of institutional practices in stakeholder involvement reveal that it is rarely done using the normative motivation, because it is ‘the right thing to do’ (Abelshausen, Perko et al. 2018). Inviting stakeholders simply to provide (silent) approval for a decision (Di Nucci, Brunnengräber et al. 2017) or to achieve a ‘better’ decision are more common motivations. And if the first one is absolutely unacceptable (Hansson and Oughton 2013), the second one is a common trade-off. Given that participatory processes take a lot of time and resources it is hard to ‘sell’ it to the funders if you can’t at least promise them a ‘better’ decision. The utilitarian approach common in policy making almost requires a sort of measurement that would demonstrate the value. But what is a definition of ‘better decision’, really? Wouldn’t a decision that includes or at least acknowledges the perspectives of the widest variety of stakeholders

⁵ The presentation was given at the meeting of the Norwegian Academy of Science and letters that discussed nuclear challenges in Norway

be a better decision? If we adopt this definition, doing stakeholder involvement because it is 'the right thing to do' would be a natural choice. A change of attitude is in order – stakeholder involvement *is* decision-making.

Another important, even crucial change is that institutions need to critically reflect upon their activities, procedures and practices. Everybody is talking about importance of two-way communication and dialogue, but what do they really mean? What should they be doing for it to be a dialogue and what are they actually doing? The majority of the participants in the focus groups (Paper 3) had no idea there was any nuclear emergency preparedness in Norway, let alone who would be responsible for informing them if anything was to happen. This indicates that current communication practices are not working and need to be improved. Everybody is talking about importance of involvement, but how is it carried out? Paper 4 highlights multiple limitations in current involvement practices and argues that there is a need for proper quality evaluation of the involvement processes focusing on context and how the democratic values are addressed. This evaluation has to be imposed by higher authority until we reach the point the institutions accept the value of it and stop treating it as another bureaucratic event.

Any communication and involvement will have effects beyond that particular activity and process as every one of these instances will have impact on the peoples' perception and trust. It is up to the institutions whether it will be positive or negative.

6. Limitations

There were several limitations of the work performed within this thesis.

A clear limitation of Paper 1 was the lack of audience research that would make results of the media analysis more meaningful, namely by examining the links between the media presentation of radiological risk and public responses towards that presentation. This type of study was developed during the course of this thesis, but was postponed due to the lack of time. Another limitation of the Paper 1 is that we can only speculate on the reasons for the highlighted problems with the media presentation of radiological risks. Did it result from ignorance or time pressure? Was information not available or not researched? A follow-up study with journalists and responsible organisations would help to shed light on the reasons for these communication problems.

The seminars in Rogaland, presented and discussed in Papers 2 and 4, had several objectives and had to satisfy wishes of research projects and institutions involved in the organisation while at the same increasing competence of the participants and demonstrating the value of stakeholder engagement. Managing these various objectives took some attention away from ensuring the quality of the engagement process. The purpose and concrete aims of the seminar were not clear for the participants. The topics of the discussions were to certain extent pre-framed because some of the organisers insisted on including a lot of technical and scientific information. They also neglected the aspect of mutual learning. These are just some few examples, but every organiser faces similar issues.

A limitation of the Paper 3 is lack of triangulation with other methods to see if responses received would be similar. A survey with a representative sample of the Norwegian population could be used here. This would allow us to investigate whether citizens in general support the concerns raised by focus groups. Performing a survey would also address the other limitation – the lack of representativeness. Alternatively, a data triangulation could be performed at different time, place and with different participants.

The review of the communication practices in Norway and other European countries presented in Chapter 2, was hampered by the fact that much of the literature on emergency management practice was grey literature and reports, often only available in the language of the country, and very little has been published in peer reviewed

Some of these limitations should be addressed in the future research

7. Future research

The results of this thesis suggest several directions for further multidisciplinary research within risk communication and participation in emergency preparedness. First, there is need for more audience research in Norway that follows from both paper 1 and 3. This work would focus on several aspects: investigating how publics respond to existing emergency communication content; exploring appropriate formats and channels for risk messages; performing a joint reflection on whether nuclear emergency preparedness should be more visible. It will build on the existing literature and examples from media analysis (paper 1) and focus groups discussions (paper 3). The DSA has already showed interest for such research project and it will begin in autumn of 2019.

The results of Paper 1, 2 and 3 indicate that there is a need to perform a systematic review of the Norwegian emergency preparedness focusing on the existing communication and engagement practices and activities. What are the existing communication plans, how are they developed, how are they tested? What are the conditions for communication as a continuous relationship and can they be improved? This could be part of a wider international evaluation of communication in emergency preparedness.

Research in other fields has demonstrated how actors often work with mythological public concerns rather than the real ones (Marris, Wynne et al. 2001). Future research could investigate how the responsible institutions in Norway and other countries perceive public concerns, what that knowledge is based on (empirical evidence or assumptions), and the way they operationalise public perceptions about radiological risks in their work. Paper 3 demonstrated the complex ways in which publics construct their attitude to risks and their ambivalent trust towards the institutions that manage this risk. The paper also showed that despite the lack of knowledge on certain things related to radiation and radiological protection (i.e., its effects and protective measures), the public showed a good understanding of uncertainties and risk management practices, demonstrated their ability to judge complex situations and expressed a wish to be involved in the decisions. Comparing these insights to those of the responsible institutions, and highlighting the discrepancies if and where they exist, would give concrete indications of where improvements of the social relationships are needed. It

could also stimulate a more critical reflection by institutions about their responsibilities and relationships with publics.

Finally, Paper 4 developed extended quality criteria for stakeholder engagement activities. Future work on this topic should focus on application of these criteria in more cases in order to demonstrate how they can be applied in practice during organisation of various stakeholder activities. Such applied research is important to promote a more critical and reflective evaluation in the field of participation and work towards making it a part of formal practices.

8. Conclusions

This PhD research investigated risk communication within nuclear emergency preparedness by addressing several factors: media representation of radiological risks and compliance with recommendations; public needs and concerns in radiological emergencies; and the value and quality of stakeholder involvement. The overall goal of the thesis was to offer a more holistic understanding of risk communication that goes beyond evaluation of the message and messenger, and considers the complex relationships between publics and responsible institutions.

The studies revealed that recommendations for communication of radiological risk by the media were not followed and there is need for improvement in this field. Assessment of stakeholder engagement activities demonstrated the value of the dialogue, but also identified a number of limitations. A series of quality criteria were proposed that could contribute to improving the overall quality of stakeholder engagement. Finally, audience research indicated that some problems exist in the current emergency preparedness system in Norway, and that several factors influence the way people build their relationships with emergency preparedness actors, and form their attitudes to risk and protective actions. The findings highlight the need for further systematic and multidisciplinary research in the field.

The thesis defined several factors that would contribute to improvement of risk communication within emergency preparedness. These factors include reiterating the importance of listening to people and including them in the decision-making processes. In doing this, we need to embrace the many dimensions of complexities, and change the way we think about communication to focus more on the dynamic social networks it should create and support. Above all, these factors stress the need for institutional change that would lead institutions to recognize importance of the social aspects, adopt stakeholder involvement as a legitimate decision-making process and perform a critical reflection of their activities and procedures.

To conclude, there is a need to assess any risk communication practice based on the way they contribute to the overall quality of the relationships between the multiple actors in

emergency preparedness. Improving the quality of these relationships should foster societal resilience to potential future nuclear emergencies.

References

- Aarhus Convention (1998). "Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, June 1998, <http://www.unece.org/fileadmin/DAM/env/pp/documents/cep43e.pdf>."
- Abbott, P., C. Wallace and M. Beck (2006). "Chernobyl: Living with risk and uncertainty." *Health, Risk & Society* **8**(2): 105-121.
- Abelshausen, B., T. Perko and C. Turcanu (2018). Stakeholder Engagement in Emergency Preparedness and Response. *NERIS Workshop 2018, 25-27 April 2018*. Dublin, Ireland.
- Aerts, A. M., N. R. E. N. Impens, S. Baatout, M. A. Benotmane, J. Camps, J. M. Dabin, H. Derradji, B. Grosche, N. Horemans, J. R. Jourdain, M. Moreels, T. Perko, R. Quintens, J. Repussard, W. Rühm, T. Schneider, L. Struelens and F. Hardeman (2014). "Joint research towards a better radiation protection—highlights of the Fifth MELODI Workshop." *Journal of Radiological Protection* **34**(4): 931.
- An, S. K. and K. K. Gower (2009). "How do the news media frame crises? A content analysis of crisis news coverage." *Public Relations Review* **35**(2): 107-112.
- Ando, R. (2016). "Ethos in Fukushima and the ICRP dialogue seminars." *Annals of the ICRP* **45**(2_suppl): 135-140.
- Arnstein, S. R. (1969). "A Ladder Of Citizen Participation." *Journal of the American Institute of Planners* **35**(4): 216-224.
- Árvai, J. (2014). "The end of risk communication as we know it." *Journal of Risk Research* **17**(10): 1245-1249.
- Attar, A. and A. Genus (2014). "Framing public engagement: A critical discourse analysis of GM Nation?" *Technological Forecasting and Social Change* **88**: 241-250.
- Barbour, R. S. and D. L. Morgan (2017). *A New Era In Focus Group Research*, Palgrave Macmillan.
- Baudé, S., G. Hériard-Dubreuil and C. Mays (2013). Decision making for the future: Applying the Aarhus Convention in Radioactive Waste Management. IPPA Deliverable 3.8.

- Baumont, G. (2018). Nuclear Crisis Preparedness Lessons Learned from Fukushima Daiichi. Risk Communication for the Future Towards Smart Risk Governance and Safety Management. M. Bourrier and C. Bieder, Springer Open.
- Bay, I. and D. Oughton (2005). Social and Economic Effects. Chernobyl. Catastrophe and Consequences. J. Smith and N. A. Beresford, Springer-Verlag Berlin Heidelberg.
- Benhabib, S. (1996). Towards a deliberative model of democratic legitimacy. Democracy and difference: contesting the boundaries. S. Benhabib: 67-94.
- Bieder, C. (2018). Societal Risk Communication—Towards Smart Risk Governance and Safety Management. Risk Communication for the Future: Towards Smart Risk Governance and Safety Management. M. Bourrier and C. Bieder. Cham, Springer International Publishing: 155-175.
- Biegelbauer, P. and J. Hansen (2011). "Democratic theory and citizen participation: democracy models in the evaluation of public participation in science and technology." Science and Public Policy **38**(8): 589-597.
- Bodemer, N., B. Meder and G. Gigerenzer (2014). "Communicating Relative Risk Changes with Baseline Risk: Presentation Format and Numeracy Matter." Medical Decision Making **34**(5): 615-626.
- Bourguignon, M., P. Bérard, J. M. Bertho, J. Farah, C. Mercat and R. E. Board (2017). "What's next in Radioprotection?" Radioprotection **52**(1): 21-28.
- Bourrier, M. (2018). Risk Communication 101: A Few Benchmarks. Risk Communication for the Future. Towards Smart Risk Governance and Safety Management. M. Bourrier and C. Bieder, Springer Open.
- Britton, N. R. and G. J. Clark (2000). "From Response to Resilience: Emergency Management Reform in New Zealand." **1**(3): 145-150.
- Brown, A., P. Franken, S. Bonner, N. Dolezal and J. Moross (2016). "Safecast: successful citizen-science for radiation measurement and communication after Fukushima." J Radiol Prot **36**(2): S82-s101.
- Callen, J. and T. McKenna (2018). "Saving Lives and Preventing Injuries From Unjustified Protective Actions-Method for Developing a Comprehensive Public Protective Action Strategy for a Severe NPP Emergency." Health Phys **114**(5): 511-526.
- Callon, M., P. Lascoumes and Y. Barthe (2009). Acting in an Uncertain World: An Essay on Technical Democracy. Cambridge, Mass., MIT Press.

- Carr, Z., M. Maeda, D. Oughton and W. Weiss (2018). "Non-radiological impact of a nuclear emergency: Preparedness and response with the focus on health." Radiation Protection Dosimetry: ncy163-ncy163.
- Charron, S., S. Lafage, E. van Asselt, M. Baptista, M. van Bourgondiën, P. Brandhoff, T. Cabianca, J. Camps, B. Cessac, P. Crouail, V. Durand, E. Gallego, O. Gil, S. Holmes, C. Hourdakakis, K. Jones, V. Kamenopoulou, J. F. Lecomte, A. Liland, I. Lopes, M. J. Madruga, J. O. Martins, C. Mc Mahon, M. Montero, C. Murith, G. Olyslaegers, C. Organo, I. Paiva, T. Peltonen, L. Portugal, C. Potiriadis, A. Prades, M. Reis, N. Rossignol, T. Schneider, R. Sala, V. Smith, V. Tafili, P. Teles, Y. Tomkiv, C. Trueba, C. Turcanu, T. Turtiainen, C. Twenhöfel and P. Vaz (2016). "Overview of the PREPARE WP3: management of contaminated goods in post-accidental situation – Synthesis of European stakeholders' panels." Radioprotection **51**: S83-S91.
- Chilvers, J. (2005). Democratizing science in the UK: the case of radioactive waste management. Science and citizens: Globalization and the Challenge of Engagement. B. Wynne, I. Scoones and B. Leach.
- Chilvers, J. (2007). "Towards Analytic-deliberative Forms of Risk Governance in the UK? Reflecting on Learning in Radioactive Waste." Journal of Risk Research **10**(2): 197-222.
- Chilvers, J. and M. Kearnes (2016). Remaking Participation: Science, Environment and Emergent Publics. Abingdon, Oxon; New York, NY, Routledge.
- Chilvers, J. and M. Kearnes (2016). Science, democracy and emergent publics. Remaking Participation: Science, Environment and Emergent Publics. J. Chilvers and M. Kearnes. Abingdon, Oxon; New York, NY, Routledge.
- Chung, J. B. and G. W. Yun (2013). "Media and social amplification of risk: BSE and H1N1 cases in South Korea." Disaster Prevention and Management: An International Journal **22**(2): 148-159.
- Clancey, G. and R. K. Chhem (2016). INTRODUCTION. Health in Disasters. A Science and Technology Studies Practicum for Medical Students and Healthcare Professionals. R. K. Chhem and G. Clancey. Fukushima, Japan, Fukushima Medical University.
- Clarke, L. and J. F. J. Short (1993). "Social Organization and Risk: Some Current Controversies." Annual Review of Sociology **19**(1): 375-399.

- Clarke, R. and J. Valentin (2009). "ICRP publication 109. Application of the Commission's Recommendations for the protection of people in emergency exposure situations." Ann ICRP **39**(1): 1-110.
- Coates, R., G. Webb and T. Lazo (2012). "The world comes to Glasgow—the IRPA 13 Congress." Journal of Radiological Protection **32**(1): E1-E2.
- Cole, F. L. (1988). "Content analysis: process and application." Clin Nurse Spec **2**(1): 53-57.
- Coleman, C. L. (1993). "The influence of mass-media and interpersonal-communication on societal and personal risk judgments." Communication Research **20**(4): 611-628.
- Cooke, B. and U. Kothari (2001). The case for participation as tyranny. Participation: The New Tyranny. B. Cooke and U. Kothari: 1 - 15.
- Coombs, W. T. (2009). Conceptualizing crisis communication. Handbook of Risk and Crisis Communication. L. H. Heath and D. H. O'Hair. New York, Routledge: 99-118.
- Council decision 67/600/Euratom (1987). "Council Decision on Community arrangements for the early exchange of information in the event of a radiological emergency, 67/600/Euratom."
- Council directive 2013/59/EURATOM (2013). Council directive 2013/59/EURATOM laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom. Available from <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2014:013:0001:0073:EN:PDF>.
- Council Regulation 2218/89/EURATOM (1989). Council Regulation laying down maximum permitted levels of radioactive contamination of foodstuffs and of feeding-stuffs following a nuclear accident or any other case of radiological emergency, 3954/87/Euratom, 1987, as amended by Council Regulation 2218/89/Euratom, 1989.
- Covello, V. T. (2011). "Risk communication, radiation, and radiological emergencies." Health Physics **101**(5): 511-530.

- Covello, V. T. and P. M. Sandman (2001). Risk communication: Evolution and Revolution. Solutions to an Environment in Peril. A. Wolbarst. Baltimore: John Hopkins University Press: 164–178.
- Covello, V. T., P. M. Sandman and P. Slovic (1988). Risk Communication, Risk Statistics, and Risk Comparisons: A Manual for Plant Managers. Washington, D. c., Chemical Manufacturers Association.
- CSN. (2010). "What a radiological emergency is. Spanish Nuclear Safety Council (CSN). Available at <https://www.csn.es/en/emergencias/que-es-una-emergencia-radiologica>."
- Daglish, J. (1988). "Radiophobia and radiation protection." Atom (London) **383**: 14-17.
- Daris, I., M. Kralj, N. Železnik, M. Marega, G. Zakrzewska and D. Diaconu (2015). Analyses of education, training and information (ETI) materials and activities regarding ionizing radiation EAGLE Deliverable Report 1.1 (78 p) (<http://eagle.sckcen.be/en/Deliverables>).
- Di Nucci, M. R., A. Brunnengräber and A. M. Isidoro Losada (2017). "From the “right to know” to the “right to object” and “decide”. A comparative perspective on participation in siting procedures for high level radioactive waste repositories." Progress in Nuclear Energy **100**: 316-325.
- Douglas, M., Wildavsky, A. (1982). Risk and Culture, University of California Press, Berkeley.
- Driedger, S. M., R. Maier and C. Jardine (2018). "“Damned if you do, and damned if you don’t’: communicating about uncertainty and evolving science during the H1N1 influenza pandemic " Journal of Risk Research: 1-20.
- Drottz-Sjoberg, B. M. and L. Persson (1993). "Public reaction to radiation - fear, anxiety, or phobia." Health Physics **64**(3): 223-231.
- DuPont, R. L. (1982). Nuclear phobia, phobic thinking about nuclear power. Washington, Media Inst.
- Earle, T. C. and M. Siegrist (2006). "Morality information, performance information and the distinction between trust and confidence." Journal of Applied Social Psychology **36**(2): 383-416.
- Ehold, V., T. Perko and M. Martell (2018). Analysis of national legislative provisions and review of standards and guidance supporting the implementation of EU legislation

in Member States. Deliverable D1.1 of the “Study on good practices in implementing the requirements on public information in the event of an emergency, under the Euratom Basic Safety Standards Directive and Nuclear Safety Directive.”.

- Eiser, J. R., A. Bostrom, I. Burton, D. M. Johnston, J. McClure, D. Paton, J. Van Der Pligt and M. P. White (2012). "Risk interpretation and action: A conceptual framework for responses to natural hazards." International Journal of Disaster Risk Reduction **1**: 5-16.
- Elo, S. and H. Kyngas (2008). "The qualitative content analysis process." J Adv Nurs **62**(1): 107-115.
- EPA. (2019). "Risk communication. Available at <https://www.epa.gov/risk/risk-communication>."
- Fagerlin, A., P. A. Ubel, D. M. Smith and B. J. Zikmund-Fisher (2007). "Making Numbers Matter: Present and Future Research in Risk Communication." American Journal of Health Behavior **31**: S47-56.
- Felt, U. and R. K. Chhem (2016). Techno-natural disaster and the role of expertise. Health in Disasters. A Science and Technology Studies Practicum for Medical Students and Healthcare Professionals. R. K. Chhem and G. Clancey. Fukushima, Japan, Fukushima Medical University.
- Figuroa, P. M. (2013). "Risk communication surrounding the Fukushima nuclear disaster: an anthropological approach." Asia Europe Journal **11**(1): 53-64.
- Finucane, M. L., A. Alhakami, P. Slovic and S. M. Johnson (2000). "The affect heuristic in judgments of risks and benefits." **13**(1): 1-17.
- Fiorino, D. J. (1989). "Environmental Risk and Democratic Process: A Critical Review " Columbia Journal of Environmental Law **501**.
- Fischer, F. (2005). Are scientists irrational? Risk assessment in practical reason. Claiming Citizenship: Rights, Participation and Accountability. B. Wynne, I. Scoones and M. Leach. London, Zed Books.
- Fischhoff, B. (1995). "Risk perception and communication unplugged - 20 years of process." Risk Analysis **15**(2): 137-145.

- Fischhoff, B., P. Slovic, S. Lichtenstein, S. Read and B. Combs (1978). "How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits." Policy Sciences **9**(2): 127-152.
- French, S. and C. Bayley (2010). "Public participation: comparing approaches." Journal of Risk Research **14**(2): 241-257.
- Freudenburg, W. R. (2001). "Risky thinking: facts, values and blind spots in societal decisions about risks." Reliability Engineering & System Safety **72**(2): 125-130.
- Freudenburg, W. R. and T. I. K. Youn (1999). Research in Social Problems and Public Policy.
- Frewer, L. J., S. Miles and R. Marsh (2002). "The media and genetically modified foods: evidence in support of social amplification of risk." Risk Anal **22**(4): 701-711.
- Friedman, S. M. (2011). "Three Mile Island, Chernobyl, and Fukushima: An analysis of traditional and new media coverage of nuclear accidents and radiation." Bulletin of the Atomic Scientists **67**(5): 55-65.
- Friedman, S. M., C. M. Gorney and B. P. Egolf (1987). "Reporting on radiation: a content-analysis of Chernobyl coverage." Journal of Communication **37**(3): 58-67.
- Fujigaki, Y. and K. H. Ng (2016). Risk Communication. Health in Disasters. A Science and Technology Studies Practicum for Medical Students and Healthcare Professionals. R. K. Chhem and G. Clancey. Fukushima, Japan, Fukushima Medical University.
- Garcia-Retamero, R., Y. Okan and E. T. Cokely (2012). "Using Visual Aids to Improve Communication of Risks about Health: A Review." The Scientific World Journal **2012**: 10.
- Gardner, G. T. and L. C. Gould (1989). "Public perceptions of the risks and benefits of technology." Risk Analysis **9**(2): 225-242.
- Gaskell, G., K. Hohl and M. M. Gerber (2016). "Do closed survey questions overestimate public perceptions of food risks?" Journal of Risk Research: 1-15.
- Geer, J. G. (1991). "Do Open-Ended Questions Measure "Salient" Issues?" The Public Opinion Quarterly **55**(3): 360-370.
- Gonzalez, A. J., M. Akashi, J. D. Boice, M. Chino, T. Homma, N. Ishigure, M. Kai, S. Kusumi, J. K. Lee, H. G. Menzel, O. Niwa, K. Sakai, W. Weiss, S. Yamashita and Y. Yonekura (2013). "Radiological protection issues arising during and after the Fukushima nuclear reactor accident." Journal of Radiological Protection **33**(3): 497-571.

- Goven, J. (2006). "Dialogue, governance, and biotechnology: acknowledging the context of the conversation." Integrated Assessment **6**(2): 99-116.
- Goven, J. (2006). "Processes of Inclusion, Cultures of Calculation, Structures of Power." Science, Technology, & Human Values **31**(5): 565-598.
- Gray, T. (2004). "For that Healthy Glow, Drink Radiation! Available at <https://www.popsci.com/scitech/article/2004-08/healthy-glow-drink-radiation>."
- Grove-White, R., M. Kearnes, P. Macnaghten and B. Wynne (2006). "Nuclear futures: Assessing public attitudes to new nuclear power." Political Quarterly **77**(2): 238-246.
- Grove-White, R., M. Kearnes, P. Miller, P. Macnaghten, J. Wilsdon and B. Wynne (2004). Bio - to - Nano? Learning the Lessons, Interrogating the Comparison.
- Grove-White, R., P. Macnaghten and B. Wynne (2000). Wising Up: The Public and New Technologies, Centre for the Study of Environmental Change, Lancaster University.
- Hadden, S. (1989). "Institutional Barriers to Risk Communication." Risk Analysis **9**(3).
- Hagendijk, R. and A. Irwin (2006). "Public Deliberation and Governance: Engaging with Science and Technology in Contemporary Europe." Minerva **44**(2): 167-184.
- Hampel, J. (2006). "Different concepts of risk - A challenge for risk communication." International Journal of Medical Microbiology **296**: 5-10.
- Hansson, S. O. and D. Oughton (2013). Public Participation - Potential and Pitfalls. Social and Ethical Aspects of Radiation Risk Management. Burlington, Elsevier Science.
- Held, D. (2013). Democracy and the Global Order : From the Modern State to Cosmopolitan Governance. Hoboken, Wiley.
- Hernes, G. (1986). Informasjonskriser. Oslo, Departementenes servicesenter, Informasjonsforvaltning.
- Hirakawa, H. and M. Shirabe (2015). Rhetorical Marginalization of Science and Democracy: Politics in Risk Discourse on Radioactive Risks in Japan. Lessons From Fukushima : Japanese Case Studies on Science, Technology and Society. Y. Fujigaki. Cham, Springer.
- Hohenemser, C., R. Kasperson and R. Kates (1977). "The distrust of nuclear power." Science **196**(4285): 25-34.

- Horlick-Jones, T., J. Sime and N. Pidgeon (2003). The social dynamics of environmental risk perception: Implications for risk communication research and practice. The social amplification of risk. N. Pidgeon, R. Kasperson and P. Slovic. Cambridge, Cambridge University Press: 262–285.
- Horst, M. (2010). "Collective Closure? Public Debate as the Solution to Controversies about Science and Technology." Acta Sociologica 53(3): 195-211.
- IAEA (1988). The radiological accident in Goiania. Vienna, International Atomic Energy Agency.
- IAEA (2006). Manual for first responders to a radiological emergency. In: I.A.E Agency (Ed.) Emergency Preparedness and Response, Vienna.
- IAEA (2008). INES. The international nuclear and radiological event scale. User's manual.
- IAEA (2012). Communication with the Public in a Nuclear or Radiological Emergency. Emergency Preparedness and Response. Available at <http://www-pub.iaea.org/books/IAEABooks/8889/Communication-with-the-Public-in-a-Nuclear-or-Radiological-Emergency>.
- IAEA (2013). IAEA Report on Preparedness and Response for a Nuclear or Radiological Emergency in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant. Vienna, IAEA.
- IAEA (2015). The Fukushima Daiichi Accident.
- IAEA (2015). Method for Developing a Communication Strategy and Plan for a Nuclear or Radiological Emergency. Vienna, INTERNATIONAL ATOMIC ENERGY AGENCY.
- IAEA (2018). Report on international symposium on communicating nuclear and radiological emergencies to the public. Vienna, International Atomic Energy Agency.
- Irwin, A. (1995). Citizen Science: A Study of People, Expertise, and Sustainable Development, Routledge.
- Irwin, A. (2006). "The Politics of Talk: Coming to Terms with the 'New' Scientific Governance." Social Studies of Science 36(2): 299-320.
- Irwin, A. (2014). Risk, science and public communication: third-order thinking about scientific culture. Handbook of Public Communication of Science and Technology. M. Bucchi and B. Trench, Routledge 199-212.

- Irwin, A., T. E. Jensen and K. E. Jones (2013). "The good, the bad and the perfect: Criticizing engagement practice." *Social Studies of Science* **43**(1): 118-135.
- Irwin, A. and B. Wynne (1996). *Misunderstanding science?: the public reconstruction of science and technology*. Cambridge, Cambridge University Press.
- Jack, F. R. and D. C. W. Sanderson (1995). "Radiophobia: will fear of irradiation impede its future in food processing?" *British Food Journal* **97**(5): 32-35.
- Johannesen, K. G. (2018). "Håndtering av norsk atomavfall og atomanlegg - Statens rolle og ansvar. *Akademimøte "Nukleære utfordringer for Norge"*, 22. november 2018."
- Kamaté, C. (2018). Public Participation in the Debate on Industrial Risk in France: A Success Story? *Risk Communication for the Future. Towards Smart Risk Governance and Safety Management*. M. Bourrier and C. Bieder, Springer Open.
- Kasperson, R. (2014). "Four questions for risk communication." *Journal of Risk Research* **17**(10): 1233-1239.
- Kasperson, R. E., G. Berk, D. Pijawka, A. B. Sharaf and J. Wood (1980). "Public Opposition to Nuclear Energy: Retrospect and Prospect." *Science, Technology, & Human Values* **5**(31): 11-23.
- Kasperson, R. E., N. Jhaveri and J. X. Kasperson (2012). Stigma and the Social Amplification of Risk: Towards a Framework of Analysis. *Social Contours of Risk: Volume I: Publics, Risk Communication and the Social*. R. E. Kasperson and J. X. Kasperson.
- Kasperson, R. E., J. X. Kasperson, N. F. Pidgeon and P. Slovic (2003). The social amplification of risk: assessing fifteen years of research. *The social amplification of risk*. N. F. Pidgeon, R. E. Kasperson and P. Slovic, Cambridge University Press: 13-46.
- Kasperson, R. E., O. Renn, P. Slovic, H. S. Brown, J. Emel, R. Goble, J. X. Kasperson and S. Ratick (1988). "The Social Amplification of Risk: A Conceptual Framework." *Risk Analysis* **8**(2): 177-187.
- Kemp, R. V., D. G. Bennett and M. J. White (2006). "Recent trends and developments in dialogue on radioactive waste management: Experience from the UK." *Environment International* **32**(8): 1021-1032.
- Kerr, A., S. Cunningham-Burley and R. Tutton (2007). "Shifting Subject Positions: Experts and Lay People in Public Dialogue." *Social Studies of Science* **37**(3): 385-411.

- King, A. J. (2015). Visual Messaging and Risk Communication. The SAGE Handbook of Risk Communication. H. Cho, T. Reimer and K. A. McComas, SAGE Publications: 193-205.
- Kothari, U. and B. Cooke (2001). Participation : the new tyranny? London, Zed Books.
- Krimsky, S. (2007). "Risk communication in the internet age: The rise of disorganized skepticism." Environmental Hazards 7(2): 157-164.
- Krimsky, S. and D. Golding (1992). Social theories of risk. Westport, Conn., Praeger.
- Krippendorff, K. (1980). Content analysis: An introduction. Thousand Oaks, CA, Sage.
- Krippendorff, K. (2011). "Agreement and Information in the Reliability of Coding." Communication Methods and Measures 5(2): 93-112.
- Kriseutvalget for atomberedskap (2015). "Plan for Kriseutvalget for atomberedskap. Versjon 1.2."
- Krütli, P., M. Stauffacher, T. Flüeler and R. W. Scholz (2010). "Functional-dynamic public participation in technological decision-making: site selection processes of nuclear waste repositories." Journal of Risk Research 13(7): 861-875.
- Kultgen, J. (2015). Abolition of Nuclear Weapons as a Moral Imperative, Lexington Books.
- Larsen, Ø., S. A. Evensen and C. Gradmann (2011). "Tsjernobylulykken 1986 – hvordan reagerte norske myndigheter og fagmiljøer i dagene og månedene etter 26. april 1986?" Michael 1.
- Larson, H. J. and D. L. Heymann (2010). "Public Health Response to Influenza A(H1N1) as an Opportunity to Build Public Trust." JAMA 303(3): 271-272.
- Latré, E., T. Perko and P. Thijssen (2017). "Does It Matter Who Communicates? The Effect of Source Labels in Nuclear Pre-Crisis Communication in Televised News." Journal of Contingencies and Crisis Management: n/a-n/a.
- Leiss, W. (1996). "Three phrases in the evolution of risk communication practice." Annals AAPSS 545: 85-94.
- Leonard, H. B. and A. M. Howitt (2008). "'Routine' or 'crisis' – the search for excellence." Crisis Response 4(3).
- Lichtenberg, J. and D. MacLean (1991). The role of media in risk communication. Communicating risks to the public: international perspectives. R. E. Kasperson and P. J. M. Stallen. Dordrecht, Kluwer Academic Publishers: vi, 481 s.

- Liland, A. (2015). Societal Consequences of Nuclear Accidents, Dordrecht, Springer Netherlands.
- Liland, A., J. Lochard and L. Skuterud (2009). "How long is long-term? reflections based on over 20 years of post-Chernobyl management in Norway." Journal of Environmental Radioactivity **100**(7): 581-584.
- Liland, A., D. Oughton, I. Bay-Larsen, I. M. Eikermann, H. S. Hansen and L. Skuterud (2010). "Norwegian testing of the EURANOS framework for post-accident rehabilitation preparedness." Radioprotection **45**(05): S215-S224.
- Liland, A. and L. Skuterud (2013). Lessons learned from Chernobyl accident in Norway. Social and Ethical Aspects of Radiation Risk Management. D. Oughton and S. O. Hansson, Elsevier: 159-176.
- Liland, A., Y. Tomkiv, D. Oughton, S. Navrud, E. Romstad and L. Skuterud (2017). "The power of collaborative deliberation in stakeholder dialogue seminars." Journal of Risk Research: 1-25.
- Lipkus, I. M. and J. G. Hollands (1999). "The Visual Communication of Risk." JNCI Monographs **1999**(25): 149-163.
- Lipkus, I. M., G. Samsa and B. K. Rimer (2001). "General performance on a numeracy scale among highly educated samples." Medical Decision Making **21**(1): 37-44.
- Löfstedt, R. (2018). "The communication of radon risk in Sweden: where are we and where are we going? ." Journal of Risk Research: 1-9.
- Löfstedt, R. E. and F. Boudier (2013). New transparency policies. Risk communication's doom? Effective risk communication. J. Árvai and L. Rivers: 73-90.
- Löfstedt, R. E. and P. Six (2008). "What environmental and technological risk communication research and health risk research can learn from each other." Journal of Risk Research **11**(1-2): 141-167.
- Macklis, R. M. (1993). "The Great Radium Scandal." Scientific American **269**(2): 94-99.
- Macnaghten, P. (2017). Focus Groups as Anticipatory Methodology: A Contribution from Science and Technology Studies Towards Socially Resilient Governance. A New Era In Focus Group Research. R. S. Barbour and D. L. Morgan, Palgrave Macmillan.
- Manganello, J. and N. Blake (2010). "A Study of Quantitative Content Analysis of Health Messages in US Media From 1985 to 2005." Health Communication **25**(5): 387-396.

- Marris, C. (2015). "The Construction of Imaginaries of the Public as a Threat to Synthetic Biology." Science as Culture **24**(1): 83-98.
- Marris, C. and N. Rose (2010). "Open engagement: exploring public participation in the biosciences." PLoS Biology **8**(11).
- Marris, C., B. Wynne, P. Simmons and S. Weldon (2001). Public Perceptions of Agricultural Biotechnologies in Europe. Final Report of the PABE research project.
- Mays, C., J. Valuch, T. Perko, I. Daris, C. Condi, A. Miskiewicz, G. Zakrzewska, M. Constantin, D. Diaconu, M. Kralj and N. Zeleznik (2016). "Looking for citizen-centered communication: dialogues between radiological protection or nuclear safety specialists and media professionals." J Radiol Prot **36**(2): S143-s159.
- Mazur, A. (1990). "Nuclear-power, chemical hazards, and the quantity of reporting." Minerva **28**(3): 294-323.
- McGann, C., A. Miaullis and N. Page (2015). "Radiologists: The Unsuspecting Subject Matter Experts." J Am Coll Radiol **12**(7): 745-753.
- Merkelsen, H. (2011). "Institutionalized Ignorance as a Precondition for Rational Risk Expertise." Risk Analysis **31**(7): 1083-1094.
- Mitchell, R. C. (1984). Rationality and irrationality in the public's perception of nuclear power. Public reactions to nuclear power: Are there critical masses?. W. R. Freudenburg and E. A. Rosa. Boulder, CO, Westview Press: 137-179.
- Miyazaki, M. (2016). "Four and a half years of experience of a clinician born and raised in Fukushima: discrepancy found through dialogues and practices." Annals of the ICRP **45**(2_suppl): 23-32.
- Moore, K. (2017). The Radium Girls: The Dark Story of America's Shining Women Sourcebooks.
- Morgan, D. L. (1996). "Focus Groups." Annual Review of Sociology **22**: 129-152.
- Morgan, D. L. (2010). Reconsidering the Role of Interaction in Analyzing and Reporting Focus Groups. **20**: 718-722.
- Morgan, D. L. and J. L. Bottorff (2010). "Advancing Our Craft: Focus Group Methods and Practice." Qualitative Health Research **20**(5): 579-581.
- Murakami, M. (2018). "Importance of risk comparison for individual and societal decision-making after the Fukushima disaster." Journal of Radiation Research.

- Murayama, T. (2012). Social impacts induced by radiation risk in Fukushima. Energy Future The Role of Impact Assessment 32nd Annual Meeting of the International Association for Impact Assessment, Centro de Congresso da Alfândega, Porto - Portugal, IAIA.
- Myslobodsky, M. (2001). "The Origin of Radiophobias." Perspectives in Biology and Medicine **44**(4): 543-555.
- NAIIC (2012). Fukushima Nuclear Accident Independent Investigation Commission Report. Tokio (JP), The National Diet of Japan, The Fukushima Nuclear Accident Independent Investigation Commission: 88.
- National Research Council (2014). Lessons Learned from the Fukushima Nuclear Accident for Improving Safety of U.S. Nuclear Plants. Washington, DC, The National Academies Press.
- NERIS (2017). Strategic Research Agenda of the NERIS Platform. Version 04, November 2017. Available at <https://eu-neris.net/library/sra-1/156-updated-version-of-the-neris-sra.html>.
- NESH (2016). Guidelines for research ethics in the social sciences, law and humanities. Available at <https://www.etikkom.no/forskningsetiske-retningslinjer/Samfunnsvitenskap-jus-og-humaniora/>.
- Ng, K. H. and M. L. Lean (2012). "The Fukushima Nuclear Crisis Reemphasizes The Need For Improved Risk Communication and Better Use of Social Media." Health Physics **103**(3): 307-310.
- Otway, H. (1975). Risk Assessment and Societal Choices. Laxenburg, Austria, IIASA.
- Otway, H. (1980). "A perspective on risk perception: Confessions of a disillusioned analyst," paper prepared for the Risk Perception Workshop, Decision Research, Oregon
- Otway, H. (1987). "Experts, Risk Communication, and Democracy." Risk Analysis **7**(2): 125-129.
- Otway, H. (1992). Public Wisdom, Expert Fallability: Toward a Contextual Theory of Risk. Social theories of risk. S. Krimsky and D. Golding. Westport, Conn., Praeger: 215-228.

- Otway, H. and K. Thomas (1982). "Reflections on Risk Perception and Policy." Risk Analysis **2**(2): 69-82.
- Otway, H. and B. Wynne (1989). "Risk communication - paradigm and paradox." Risk Analysis **9**(2): 141-145.
- Oughton, D. (2004). "The Promises and Pitfalls of Participation." Global Bioethics **17**(1): 181-189.
- Oughton, D. and P. Engel-Hills (2016). Perception of radiation risk: The ethical dimensions of coping with disaster. Health in Disasters. A Science and Technology Studies Practicum for Medical Students and Healthcare Professionals. R. K. Chhem and G. Clancey. Fukushima, Japan, Fukushima Medical University.
- Oughton, D., E.-M. Forsberg, I. Bay, M. Kaiser and B. Howard (2004). "An ethical dimension to sustainable restoration and long-term management of contaminated areas." Journal of Environmental Radioactivity **74**(1-3): 171-183.
- Oughton, D., S. O. Hansson and M. Baxter (2013). Social and Ethical Aspects of Radiation Risk Management. Burlington, Elsevier Science.
- Oughton, D. H. and B. J. Howard (2012). "The Social and Ethical Challenges of Radiation Risk Management." Ethics, Policy & Environment **15**(1): 71-76.
- Pahner, P. D. (1976). A Psychological Perspective of the Nuclear Controversy. IIASA Research Memorandum. Laxenburg, Austria, IIASA.
- Palenchar, M. J. (2009). Historical trends of risk and crisis communication. . Handbook of risk and crisis communication. R. L. Heath and D. H. O'Hair. New York, Taylor and Francis.
- Panteleev, V. A., M. D. Segal' and A. V. J. A. E. Simonov (2019). "Radiation Risk and Features of Its Perception."
- Penta, M. and A. Baban (2014). "Mass Media Coverage of HPV Vaccination in Romania: A Content Analysis." Psychology & Health **27**: 302-303.
- Perko, T., B. Adam and K. R. Stassen (2015). "The differences in perception of radiological risks: lay people versus new and experienced employees in the nuclear sector." Journal of Risk Research **18**(1): 40-54.
- Perko, T. and M. Martell (2019). Study on good practices in implementing the requirements on public information in the event of an emergency, under the Euratom Basic Safety Standards Directive and Nuclear Safety Directive.

- Perko, T., W. Raskob and J. R. Jourdain (2016). "Improved communication, understanding of risk perception and ethics related to ionising radiation." J Radiol Prot **36**(2): E15-e22.
- Perko, T., P. Thijssen, C. Turcanu and B. Van Gorp (2014). "Insights into the reception and acceptance of risk messages: nuclear emergency communication." Journal of Risk Research: 1-26.
- Perko, T., Y. Tomkiv, I. Prezelj, M. C. Cantone, E. Gallego and D. H. Oughton (2016). "Communication with media in nuclear or radiological emergencies: general and practical recommendations for improvement." Radioprotection **51**: S163-S169.
- Perko, T., B. van Gorp, C. Turcanu, P. Thijssen and B. Carle (2013). "Communication in Nuclear Emergency Preparedness: A Closer Look at Information Reception." Risk Analysis **33**(11): 1987-2001.
- Perko, T., M. Van Oudheusden, C. Turcanu, C. Pözl-Voil, D. H. Oughton, C. Schieber, T. Schneider, F. Zölzer, C. Mays, M. Martell, S. Baudé, I. Choffel de Witte, I. Prlic, M. C. Cantone, S. Salomaa, T. Duranova, S. Economides and S. Molyneux-Hodgson (2019). "Towards a strategic research agenda for social sciences and humanities in radiological protection." Journal of Radiological Protection.
- Petak, W. J. (1985). "Emergency Management: A Challenge for Public Administration." Public Administration Review **45**: 3-7.
- Pijawka, D. and A. H. Mushkatel (1991). "Public Opposition To The Sitting Of The High-Level Nuclear Waste Repository: The Importance of Trust." Policy Studies Review **10**(4).
- Plough, A. and S. Krimsky (1987). "THE EMERGENCE OF RISK COMMUNICATION STUDIES - SOCIAL AND POLITICAL CONTEXT." Science Technology & Human Values **12**(3-4): 4-10.
- PREPARE (2015). Deliverable of the PREPARE project D3.2: 10 reports on the national panels.
- Prezelj, I., T. Perko, M. C. Cantone, E. Gallego, Y. Tomkiv and D. H. Oughton (2016). "The limits of public communication coordination in a nuclear emergency: lessons from media reporting on the Fukushima case." J Radiol Prot **36**(2): S45-63.
- Pözl-Viol, C., C. Turcanu, B. Abelshausen, M. Van Oudheusden, G. Meskens, T. Perko, T. Duranova, N. Zeleznik, L. Liutsko, E. Cardis and D. Savu (2018). Report on key

- challenges, best practices and recommendations for stakeholder engagement. ENGAGE Deliverable D9.82.
- Rains, S. A., S. R. Brunner and K. Oman (2015). Social Media and Risk Communication. The SAGE Handbook of Risk Communication. H. Cho, T. Reimer and K. A. McComas, SAGE Publications: 228-239.
- Raitio, K. (2018). "A picture is worth a thousand words. RICOMET 2018, Antwerpen, Belgium."
- Rayner, S. (1988). "Muddling Through Metaphors to Maturity: A Commentary on Kasperson et al., The Social Amplification of Risk." Risk Analysis **8**(2): 201-204.
- Renn, O. (1991). Risk communication and the social amplification of risk. Communicating risks to the public: international perspectives. R. E. Kasperson and P. J. M. Stallen. Dordrecht, Kluwer Academic Publishers: 287-324.
- Renn, O. (2003). Perception of risks. 41st Congress of the European-Societies-of-Toxicology, Florence, Italy, Elsevier Sci Ireland Ltd.
- Renn, O., T. Webler and P. Weidemann (1995). Fairness and competence in citizen participation : evaluating models for environmental discourse. Dordrecht, Kluwer Academic.
- Rojas-Palma, C., A. Liland, A. N. Jerstad, G. Etherington, M. R. Perez, T. Rahola and K. Smith (2009). TMT Handbook; Triage, Monitoring and Treatment of people exposed to ionising radiation following malevolent act. . Lobo Media AS, Norway.
- Rollinger, F., J. Lochard and T. Schneider (2016). "Lessons learnt by IRSN about the involvement of experts towards the population in contaminated areas in Fukushima Prefecture." Annals of the ICRP **45**(2_suppl): 99-104.
- Rosa, E. A. and D. L. Clark (1999). Historical routes to technological gridlock: Nuclear Technology as Prototypical Vehicle. Research in Social Problems and Public Policy. W. R. Freudenburg and T. I. K. Youn. **7**: 21-57.
- Rowe, G. and L. J. Frewer (2005). "A Typology of Public Engagement Mechanisms." Science, Technology & Human Values **30**(2): 251-290.
- Royal Decree (2013). Nuclear Preparedness: Central and Regional Organisation. Royal Decree of 23. August 2013. StrålevernHefte 30. . Østerås, Norwegian Radiation Protection Authority.

- Sacks, B., G. Meyerson and J. A. Siegel (2016). "Epidemiology Without Biology: False Paradigms, Unfounded Assumptions, and Specious Statistics in Radiation Science (with Commentaries by Inge Schmitz-Feuerhake and Christopher Busby and a Reply by the Authors)." Biological Theory **11**: 69-101.
- Schmid, S. D. (2013). Nuclear emergency response: Atomic priests or an international SWAT team? Nuclear Disaster at Fukushima Daiichi: Social, Political and Environmental Issues: 194-213.
- Schneider, T., S. Lafage, J. Bardelay, T. Duranova, E. Gallego, F. Gering, F. Hardeman, G. Hériard-Dubreuil, C. Murith, D. Oughton and W. J. R. Raskob (2016). "NERIS: European platform on preparedness for nuclear and radiological emergency response and recovery – Activities and perspectives." **51**(HS1): S5-S8.
- Sellnow, T. L. (2015). Crisis Communication. The SAGE Handbook of Risk Communication. H. Cho, T. Reimer and K. A. McComas, SAGE Publications: 288-301.
- Selnæs, Ø. G., I. M. Eikermann and I. Amundsen (2018). Changes in nuclear and radiological threats and hazards. StrålevernRapport. Østerås, Norwegian Radiation Protection Authority. **2018:10**.
- Short, J. F. (1999). Characterizing and managing environmental and technological risks: some requirements for a new paradigm. Research in Social Problems and Public Policy. W. R. Freudenburg and T. I. K. Youn. Bingley, UK, Emerald Group Publishing Limited: 325-.
- Siegrist, M., G. Cvetkovich and C. Roth (2000). "Salient value similarity, social trust, and risk/benefit perception." Risk Analysis **20**(3): 353-362.
- Siegrist, M., C. Keller and H. A. L. Kiers (2005). "A New Look at the Psychometric Paradigm of Perception of Hazards." Risk Analysis **25**(1): 211-222.
- Siegrist, M., C. Keller and H. A. L. Kiers (2006). "Lay people's perception of food hazards: Comparing aggregated data and individual data." Appetite **47**(3): 324-332.
- Simis, M. J., H. Madden, M. A. Cacciatore and S. K. Yeo (2016). "The lure of rationality: Why does the deficit model persist in science communication?" Public Understanding of Science **25**(4): 400-414.
- Sjöberg, L. (1996). "A Discussion of the Limitations of the Psychometric and Cultural Theory Approaches to Risk Perception." Radiation Protection Dosimetry **68**(3-4): 219-225.

- Sjöberg, L. (2001). "Limits of Knowledge and the Limited Importance of Trust." Risk Analysis **21**(1): 189-198.
- Skuterud, L. (2006). Lessons learned from post Chernobyl measures and stakeholder involvement in Norway. 10th European ALARA Network Workshop. Prague.
- Slovic, P. (1987). "Perception of risk." Science **236**(4799): 280-285.
- Slovic, P. (1993). "Perceived risk, trust, and democracy." Risk Analysis **13**(6): 675-682.
- Slovic, P. (1997). "Public perception of risk." Journal of Environmental Health **59**(9): 22-&.
- Slovic, P. (1999). "Trust, Emotion, Sex, Politics, and Science: Surveying the Risk-Assessment Battlefield." Risk Analysis **19**(4): 689-701.
- Slovic, P. (2010). The feeling of Risk: New Perspectives on Risk Perception. London, Earthscan.
- Slovic, P., B. Fischhoff and S. Lichtenstein (1981). "Informing the public about the risks from ionizing radiation." Health Physics **41**(4): 589-598.
- Slovic, P., B. Fischhoff, S. Lichtenstein and F. J. C. Roe (1981). "Perceived Risk: Psychological Factors and Social Implications [and Discussion]." Proceedings of the Royal Society of London. Series A, Mathematical and Physical Sciences **376**(1764): 17-34.
- Smeesters, P. (2013). "Societal issues in a context of radiation protection." Annals of the Belgian Society for Radiation Protection **38**(3): 197-213.
- Statens strålevern (2012). Roller, ansvar, krisehåndtering og utfordringer i norsk atomberedskap. StrålevernRapport 2012:5. Østerås, Statens strålevern.
- Statens strålevern (2014). Scenarier for planlegging av norsk atomberedskap og krisehåndtering. StrålevernInfo 1:14. Statens strålevern, 2014. Available at <https://www.dsa.no/filer/a7fd2c3ca5.pdf>.
- Statens strålevern (2015). Kriseutvalgets kommunikasjonsplaner. Østerås, Norwegian Radiation Protection Authority.
- Stephens, M. and N. G. Edison (1982). "News media coverage of issues during the accident at Three Mile Island." Journalism Quarterly **59**(2): 199-&.
- Stirling, A. (2005). Opening up or closing down? Analysis, participation and power in the social appraisal of technology. Science and citizens: Globalization and the Challenge of Engagement. B. Wynne, I. Scoones and B. Leach.

- Stirling, A. (2008). "'Opening Up" and "Closing Down": Power, Participation, and Pluralism in the Social Appraisal of Technology." Science, Technology & Human Values **33**(2): 262-294.
- Sugimoto, A., S. Nomura, M. Tsubokura, T. Matsumura, K. Muto, M. Sato and S. Gilmour (2013). "The Relationship between Media Consumption and Health-Related Anxieties after the Fukushima Daiichi Nuclear Disaster." PLoS ONE **8**(8): e65331.
- Sundqvist, G. and M. Elam (2010). "Public Involvement Designed to Circumvent Public Concern? The "Participatory Turn" in European Nuclear Activities." **1**(4): 203-229.
- Sweet, W. (1977). "The opposition to nuclear power in Europe." Bulletin of the Atomic Scientists(December 1977): 40-47.
- Tanaka, M. (2015). Agenda Building Intervention of Socio-Scientific Issues: A Science Media Centre of Japan Perspective. Lessons From Fukushima : Japanese Case Studies on Science, Technology and Society. Y. Fujigaki. Cham, Springer.
- Tansey, J. and S. Rayner (2009). Cultural Theory and Risk. Handbook of risk and crisis communication. R. L. Heath and H. D. O'Hair. New York, Routledge.
- Thompson, M. and S. Rayner (1998). "Risk and Governance Part I: The Discourses of Climate Change." **33**(2): 139-166.
- Thompson, M., S. Rayner and S. Ney (1998). "Risk and Governance Part II: Policy in a Complex and Plurally Perceived World." Government and Opposition **33**(3): 330-354.
- Tomkiv, Y., A. Liland, D. H. Oughton and B. Wynne (2019). "Assessing Quality of Stakeholder Engagement: From Bureaucracy to Democracy." Bulletin of Science, Technology & Society **37**(3): 167-178.
- Tomkiv, Y., D. Oughton and B. Wynne (2019). "Embracing the complexities: the value of listening to public in nuclear emergency preparedness." Manuscript to be submitted to Journal of Risk Research.
- Trumbo, C. W. and K. A. McComas (2003). "The function of credibility in information processing for risk perception." Risk Anal **23**(2): 343-353.
- Tversky, A. and D. Kahneman (1973). "Availability: A heuristic for judging frequency and probability." Cognitive Psychology **5**(2): 207-232.

- Tversky, A. and D. Kahneman (1974). "Judgement Under Uncertainty - Heuristics and Biases." Science **185**(4157): 1124-1131.
- Urquhart, J., C. Potter, J. Barnett, J. Fellenor, J. Mumford and C. P. Quine (2017). "Expert risk perceptions and the social amplification of risk: A case study in invasive tree pests and diseases." Environmental Science & Policy **77**: 172-178.
- Utz, S., F. Schultz and S. Glocka (2013). "Crisis Communication online: How medium, crisis type and emotions affected public reactions in the Fukushima Daiichi nuclear disaster." Public Relations Review **39**(1): 40-46.
- Van Oudheusden, M., C. Turcanu and S. Molyneux-Hodgson (2018). "Absent, yet present? Moving with 'Responsible Research and Innovation' in radiation protection research." Journal of Responsible Innovation **5**(2): 241-246.
- Viklund, M. J. (2003). "Trust and risk perception in western Europe: a cross-national study." Risk Anal **23**(4): 727-738.
- Vyncke, B., T. Perko and B. Gorp (2016). "Information Sources as Explanatory Variables for the Belgian Health-Related Risk Perception of the Fukushima Nuclear Accident." Risk Analysis.
- Weart, S. R. (1991). "Images of nuclear energy why people feel the way they do." IAEA Bulletin **3**.
- WHO (2014). "An introduction to risk communication. Available at <https://www.who.int/risk-communication/introduction-to-risk-communication.pdf?ua=1>."
- WHO (2019). "General information on risk communication. Available at <https://www.who.int/risk-communication/background/en/>."
- Woolley, J. P., M. L. McGowan, H. J. Teare, V. Coathup, J. R. Fishman, R. A. Settersten, Jr., S. Sterckx, J. Kaye and E. T. Juengst (2016). "Citizen science or scientific citizenship? Disentangling the uses of public engagement rhetoric in national research initiatives." BMC Med Ethics **17**(1): 33.
- Wray, R., J. Rivers, A. Whitworth, K. Jupka and C. B. (2006). "Public Perceptions About Trust in Emergency Risk Communication: Qualitative Research Findings." International Journal of Mass Emergencies and Disasters **24**(1): 45-75.

- Wynne, B. (1980). Technology, risk and participation: on the social treatment of uncertainty. Society, technology and risk assessment. J. Conrad. London, Academic Press.
- Wynne, B. (1989). "Sheepfarming after Chernobyl - a case-study in communicating scientific information." Environment **31**(2): 10-&.
- Wynne, B. (1992). "Misunderstood misunderstanding: social identities and public uptake of science." Public Understanding of Science **1**(3): 281-304.
- Wynne, B. (1992). Risk and social learning: reification to engagement.
- Wynne, B. (1992). "Uncertainty and environmental learning - reconceiving science and policy in the preventive paradigm." Global Environmental Change-Human and Policy Dimensions **2**(2): 111-127.
- Wynne, B. (2001). "Creating Public Alienation: Expert Cultures of Risk and Ethics on GMOs." Science as Culture **10**(4): 445-481.
- Wynne, B. (2005). Risk as globalizing 'democratic' discourse? Framing subjects and citizens. Science and citizens: Globalization and the Challenge of Engagement. B. Wynne, I. Scoones and B. Leach.
- Wynne, B. (2006). "Public engagement as a means of restoring public trust in science - Hitting the notes, but missing the music?" Community Genetics **9**(3): 211-220.
- Wynne, B. (2007). "Public Participation in Science and Technology: Performing and Obscuring a Political-Conceptual Category Mistake." East Asian Science, Technology and Society: an International Journal **1**(1): 99-110.
- Wynne, B. (2013). Social Identities and Public Uptake of Science. Chernobyl, Sellafield and Environmental Radioactivity Sciences. Social and Ethical Aspects of Radiation Risk Management. D. Oughton and S. O. Hansson. Burlington, Elsevier Science: 283-309.
- Wynne, B., I. Scoones and M. Leach (2005). Science and Citizens : Globalization and the Challenge of Engagement. London, Zed Books.
- Wynne, B., C. Waterton and R. Grove-White (2007). Public Perceptions and the Nuclear Industry in West Cumbria.
- Wählberg, A. A. and L. Sjöberg (2000). "Risk perception and the media." Journal of Risk Research **3**(1): 31-50.

Železnik, N. and A. Klemenc (2015). Report of NTW Working Group on Emergency Preparedness & Response (EP&R). Available at <https://www.laka.org/docu/boeken/pdf/6-01-3-80-24.pdf#page=2>.

Železnik, N., M. Marega and B. Koron (2014). Report from initial project conference: let's communicate about ionising radiation EAGLE, Deliverable D4.10 ed T Perko (Brussels: European Commission), <http://eagle.sckcen.be/en/Deliverables>.

Атомная энергия 2.0 (2013). "Главная проблема в ядерной энергетике - радиофобия, считают эксперты." [Atomic-energy.ru](http://www.atomic-energy.ru) <http://www.atomic-energy.ru/news/2013/11/26/45264>.

Annex 1 – Other scientific publications

Scientific Articles in International Peer Review Journals

Charron, S., Lafage, S., van Asselt, E., Baptista, M., van Bourgondiën, M., Brandhoff, P., Cabianca, T., Camps, J., Cessac, B., Crouail, P., Durand, V., Gallego, E., Gil, O., Holmes, S., Hourdakis, C., Jones, K., Kamenopoulou, V., Lecomte, J.F., Liland, A., Lopes, I., Madruga, M.J., Martins, J.O., Mc Mahon, C., Montero, M., Murith, C., Olyslaegers, G., Organo, C., Paiva, I., Peltonen, T., Portugal, L., Potiriadis, C., Prades, A., Reis, M., Rossignol, N., Schneider, T., Sala, R., Smith, V., Tafili, V., Teles, P., Tomkiv, Y., Trueba, C., Turcanu, C., Turtiainen, T., Twenhöfel, C., Vaz, P. (2016). Overview of the PREPARE WP3: management of contaminated goods in post-accidental situation – Synthesis of European stakeholders' panels. *Radioprotection*, 51, S83-S91.

Gallego, E., Cantone, M. C., Oughton, D. H., Perko, T., Prezelj, I., & Tomkiv, Y. (2016). Mass media communication of emergency issues and countermeasures in a nuclear accident: Fukushima reporting in European newspapers. *Radiat Prot Dosimetry*. doi:10.1093/rpd/ncw334

Perko, T., Prezelj, I., Cantone, M. C., Oughton, D. H., Tomkiv, Y., & Gallego, E. (2018). Fukushima Through the Prism of Chernobyl: How Newspapers in Europe and Russia Used Past Nuclear Accidents. *Environmental Communication*, 1-19. doi:10.1080/17524032.2018.1444661

Perko, T., Tomkiv, Y., Oughton, D. H., Cantone, M. C., Gallego, E., Prezelj, I., & Byrkina, E. (2015). Units related to radiation exposure and radioactivity in mass media: The Fukushima case study in Europe and Russia. *Radiat Prot Dosimetry*, 164(1-2), 154-159 doi:10.1093/rpd/ncu328

Perko, T., Tomkiv, Y., Prezelj, I., Cantone, M. C., Gallego, E., & Oughton, D. H. (2016). Communication with media in nuclear or radiological emergencies: general and practical recommendations for improvement. *Radioprotection*, 51, S163-S169.

Prezelj, I., Perko, T., Cantone, M. C., Gallego, E., Tomkiv, Y., & Oughton, D. H. (2016). The limits of public communication coordination in a nuclear emergency: lessons from media reporting on the Fukushima case. *J Radiol Prot*, 36(2), S45-63. doi:10.1088/0952-4746/36/2/s45

Project reports

Turcanu, C., Perko, T., Abelshausen, B., Sala, R., Oltra, C., Tomkiv, Y., . . . Zeleznik, N. (2018). *D9.26 Planned behaviour in nuclear emergency situations. Deliverable of the CONFIDENCE project*. Retrieved from <http://www.concert->

h2020.eu/Document.ashx?dt=web&file=/Lists/Deliverables/Attachments/69/D9.26%20Planned%20behaviour%20in%20nuclear%20emergency%20situations_approved_v2_10092018.pdf&guid=01b5ac77-b2ec-4cda-9c98-917dba396f0f

Oughton, D., Perko, T., Abelshausen, B., Kenens, J., Van Oudheusden, M., Turcanu, C., Sala, R., Oltra, C., Tomkiv, Y., Maître, M., Schneider, T., Zeleznik, N. (2018). *D9.25: Case descriptions for characterization and response to uncertainty in past nuclear emergencies. Deliverable for the CONFIDENCE project.* Retrieved from [http://www.concert-h2020.eu/Document.ashx?dt=web&file=/Lists/Deliverables/Attachments/83/D9.25 Case%20descriptions%20for%20characterization%20and%20response%20to%20uncertainty%20in%20past%20nuclear%20emergencies_approved06072018.pdf&guid=01b5ac77-b2ec-4cda-9c98-917dba396f0f](http://www.concert-h2020.eu/Document.ashx?dt=web&file=/Lists/Deliverables/Attachments/83/D9.25%20Case%20descriptions%20for%20characterization%20and%20response%20to%20uncertainty%20in%20past%20nuclear%20emergencies_approved06072018.pdf&guid=01b5ac77-b2ec-4cda-9c98-917dba396f0f)

Oughton, D.H., Albani, V., Barquinero, F., Chumak, V., Clero, E., Crouail, P., Fattibene, P., Kesminiene, A., Laurier, D., Liutsko, L., Ohba, T., Ostroumova, E., Pirard, P., Rogel, A., Sarukhan, A., Schneider, T., Tanigawa, K., Tomkiv, Y., Vale, L., Cardis E. (2017). Recommendations and procedures for preparedness and health surveillance of populations affected by a radiation accident. Shamisen report, pdf available at: [https://issuu.com/isglobal/docs/recommendations booklet](https://issuu.com/isglobal/docs/recommendations_booklet).

Perko, T., Prezelj, I., Tomkiv, Y., Oughton, D., Cantone, M. C., & Gallego, E. (2014). *Final recommendations for improvement of media communication within nuclear/radiological emergency management. Deliverable for the PREPARE project.*

Tomkiv, Y., & Bardos, P. (2014). *SustRem 2014 – NanoRem special session report. Nanoremediation: hopes or fears from the sustainability perspective. Proceedings of 3rd International Conference on Sustainable Remediation, 17 - 19 September 2014, Ferrara (Italy)* <http://sustrem2014.com/APPENDIX%201%20SustRem%202014%20-%20NanoRem%20Special%20Session%20Report.pdf>

Tomkiv, Y., Bardos, P., Bartke, S., Bone, B., & Oughton, D. (2015). *The NanoRem Sustainability and Markets Workshop, Oslo, Norway, December 2014. NanoRem Report.* Available at <http://www.nanorem.eu/Displaynews.aspx?ID=797>

Annex 2 - Consent and information document for the participants of the focus group discussions

Forespørsel om deltakelse i forskningsprosjektet «Publikums bekymringer, forventninger og informasjonsbehov i forhold til atomulykker»

Bakgrunn og formål

Dette prosjektet er en del av en PhD-grad i risikokommunikasjon om stråling ved Norges miljø- og biovitenskapelige universitet (NMBU). Formålet er å utforske folkets bekymringer, forventninger og informasjonsbehov i forbindelse med ulykker som involverer radioaktiv forurensning.

Alle personopplysninger vil bli behandlet konfidensielt. Det vil kun være student og veileder som vil ha tilgang til personopplysningene. Personopplysninger vil ikke lagres sammen med øvrige data for å ivareta konfidensialitet.

Hva innebærer deltakelse i studien?

Datainnsamling skal foregå som gruppeintervjuer med en varighet på ca 2 timer. Spørsmålene skal omhandle synspunkter om myndighetenes kommunikasjon om risiko fra ståling, eksisterende beredskapsplaner og diverse konsekvensereduserende tiltak.

Hva skjer med informasjonen om deg?

Alle personopplysninger vil bli behandlet konfidensielt. Kun prosjektansvarlig vil ha tilgang til personopplysningene.

Analysen av diskusjonene vil publiseres i en PhD avhandling og en vitenskapelig artikkel. Deltakerne vil anonymiseres, men vil kunne kjenne igjen egne sitater.

Prosjektet skal etter planen avsluttes i juni 2019. Alle personopplysninger og opptak vil slettes etter prosjektslutt.

Frivillig deltakelse

Det er frivillig å delta i studien, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn. Dersom du trekker deg, vil alle opplysninger om deg bli anonymisert.

Dersom du har spørsmål til studien, ta kontakt med Yevgeniya Tomkiv, PhD student ved NMBU (46969768).

Studien er meldt til Personvernombudet for forskning, NSD - Norsk senter for forskningsdata AS.

Samtykke til deltakelse i studien

Siden rekrutteringen skal foregå ved hjelp av et rekrutteringsfirma, bare de personen som vil være med på studiet kommer til å stille opp som deltakere. De vil bli informert om at personopplysningene vil bli behandlet konfidensielt og bedt om lov til at diskusjonene blir tatt opp. Etter at gruppeintervjuene tar slutt, får alle deltakerne et dokument som beskriver hva som kommer til å skje med informasjonen fremover og skal inneholde kontaktinformasjonen til prosjektansvarlig.

Paper I

Tomkiv, Y., Perko, T., Oughton, D.H., Prezelj, I., Cantone, M.C. & Gallego, E. 2016. How did media present the radiation risks after the Fukushima accident: a content analysis of newspapers in Europe. - Journal of Radiological Protection 36: S64-S81. DOI: [10.1088/0952-4746/36/2/S64](https://doi.org/10.1088/0952-4746/36/2/S64)

Paper II

Liland, A., Tomkiv, Y., Oughton, D., Navrud, S., Romstad, E. & Skuterud, L. 2019. The power of collaborative deliberation in stakeholder dialogue seminars. - Journal of Risk Research 22: 243-267. DOI: [10.1080/13669877.2017.1378247](https://doi.org/10.1080/13669877.2017.1378247)

Paper III

Tomkiv, Y., Oughton, D. & Wynne, B. Embracing the complexities: the value of listening to public in nuclear emergency preparedness. (Manuscript)

Paper IV

Tomkiv, Y., Liland, A., Oughton, D.H. & Wynne, B. 2017. Assessing Quality of Stakeholder Engagement: From Bureaucracy to Democracy. - Bulletin of Science, Technology & Society 37: 167-178. DOI: [10.1177/0270467618824027](https://doi.org/10.1177/0270467618824027)

ISBN: 978-82-575-1598-0

ISSN: 1894-6402



Norwegian University
of Life Sciences

Postboks 5003
NO-1432 Ås, Norway
+47 67 23 00 00
www.nmbu.no