Perceiving and Performing Radiation Safety:

A Mixed Methods Study of Radiation Protection Officers in Danish Workplaces

Master's Thesis

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Abstract

Aim: This thesis explores how Radiation Protection Officers (RPOs) in Danish workplaces understand and experience their role. The goal is to examine what helps or hinders them in carrying out their tasks and to understand how the role is supported in everyday working life.

Method: The study uses a two-step method. First, it includes focus group interviews and participatory observations from a radiation protection training course. Second, a survey was distributed to RPOs across various sectors. This combination allowed for both in-depth insights and a broader overview.

Theory: The analysis is based on the concept of affordances, which looks at how people's actions are shaped by the environment they work in. This approach helps explain why some RPOs are able to take an active role, while others feel limited or unsupported.

Conclusion: The study finds that RPOs' ability to engage with their role is closely linked to organisational support, attention from management, and the presence of a safety-oriented work culture. While some workplaces offer clear structures and recognition, others leave RPOs with unclear expectations and limited resources. The findings suggest that strengthening networks, improving access to practical tools, and ensuring clearer communication about the role could help RPOs carry out their responsibilities more effectively.

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1 Introduction

This thesis explores how the role of Radiation Protection Officer (RPO) is perceived and experienced by those who carry it out in Danish workplaces. The aim is to examine whether there are personal, structural or organisational conditions that affect the role and whether there is potential for improving how the role is supported, prioritised, and understood.

My interest in the topic began during an internship with the Danish Health Authority's Radiation Protection (DHARP), where my focus area was related to cosmic radiation exposure. What initially caught my attention was not only the range of contexts in which ionising radiation is used, but also the complexity of keeping track of sources and ensuring proper safety practices. I became particularly interested in the gap between the legal and technical requirements and the people tasked with interpreting and implementing them in practice. During my internship, I became aware that some users found the regulations difficult to translate into action, often due to the legal and technical language. These observations suggested that the practical conditions for fulfilling the RPO role may vary widely, and that organisational support and level of expectations may play a central role in shaping how the role is handled.

The purpose of radiation protection is to minimise the harmful effects of ionising radiation on people and the environment (Sundhedsstyrelsen, 2023). This includes ensuring that radiation is used only when justified, that exposure is kept as low as reasonably achievable, and that appropriate safety measures are in place to protect workers, the public, and surroundings.

For workplaces that use radiation sources, having a qualified RPO is a legal requirement, but how the role is integrated into daily operations is less clearly defined. This study is based, among other things, on the assumption that the ability of RPOs to perform their tasks not only depends on individual competencies, but also on how the role is prioritised, supported, and understood in context.

From a techno-anthropological perspective, the RPO can be seen as a boundary role placed between legislation, safety culture, and everyday organisational practice. Focusing on this role offers an opportunity to investigate how formal regulatory expectations are interpreted, negotiated and handled in practice, and how people engage with rules and structures in ways that are shaped by context and practice. This project is based on empirical data from participatory observations and focus group interviews with RPOs participating in a certification course, as well as a survey distributed to RPOs across different sectors. The

study focuses specifically on RPOs' own perceptions of their role. It does not include direct observation of how the role is performed in the workplace or detailed analysis of organisational structures beyond what is described by the participants themselves. The purpose of the study is to provide a practice-oriented understanding of how the RPO role is perceived and enacted, and to identify potential areas where the role could be supported or clarified. In doing so, the study seeks to contribute to ongoing reflections on radiation protection, workplace safety, and professional responsibility.

The following chapter outlines the empirical and institutional context of the RPO role and presents the problem statement and research questions guiding the inquiry.

1.1 Background

Before moving into the organisational and regulatory dimensions of radiation protection, I will briefly introduce the nature of ionising radiation and why protection is necessary.

Ionising radiation occurs when unstable atoms release energy to become more stable. This happens due to an imbalance between protons and neutrons in the nucleus and results in the emission of either particles (such as alpha and beta) or electromagnetic waves (such as gamma radiation) (UNEP, 2016). These forms of radiation are utilised across a wide range of sectors including healthcare, industry, research, and veterinary work, where they contribute to for example diagnostics, treatment, and process control.

Radiation protection is the field that deals with minimising harmful exposure to ionising radiation. While radiation technologies are used under controlled conditions in most settings, and the associated risks are typically low, there is still a need for clear procedures and responsible handling. In the event of accidents or incidents, the potential for acute health effects increases, which makes the preventive aspects of radiation protection crucial (Sabol & Šesták, 2016).

Biological effects from radiation on a cellular level often involve damage to DNA, which can either be repaired, cause mutations, or—if severe enough—result in cell death (UNEP, 2016). The effects of exposure are typically divided into two categories. At lower doses, the effects are stochastic. Meaning that the probability of developing, for example, cancer increases with the dose, but the outcome remains uncertain - for visual exemplification see appendix 1. At higher doses, deterministic effects may occur, where the severity of health damage is directly linked to the size of the dose (Sabol & Šesták, 2016). Such effects can include nausea, tissue

damage, or even death, depending on the level of exposure and the effectiveness of medical treatment.

To assess and manage these risks, radiation dose is measured using the concept of *equivalent dose*, which considers both the type of radiation and its biological effect. The unit of measurement is called Sievert (Sv) (UNEP, 2016).
In Denmark, the average citizen receives approximately 4 millisieverts (1 Sv = 1000 mSv) per year from natural background radiation. About half of this exposure comes from radon gas from the ground, while the remaining is from sources such as food, building materials, and cosmic radiation (Sundhedsstyrelsen, 2024). Beyond this background level, current regulations stipulate that individuals should not be exposed to more than 1 mSv per year unless the exposure is medically justified (Strålebeskyttelsesbekendtgørelsen, 2019). For workers who are occupationally exposed to radiation, In certain professions, such as working with X-ray equipment, the acceptable limit is significantly higher – up to 20 mSv per year (Strålebeskyttelsesbekendtgørelsen, 2019). When exposed by occupational radiation, individuals may be subject to dose monitoring, to detect gaps in safety, protection gear and can be useful, for example, in maintaining appropriate work routines.
With this background, I now turn to the role of Radiation Protection Officers.

2 Field of Inquiry

This chapter introduces the empirical field of the study and outlines the regulatory, institutional and organisational context of which the Radiation Protection Officer (RPO) role is situated. The purpose is to provide an understanding of the environment in which the study takes place and to clarify why this role is of interest from a techno-anthropological perspective. The chapter also describes how I came to define this field of interest and formulate the research question.

2.1 The Radiation Protection Officer

The RPO is a legally required role in all workplaces that use ionising radiation. The role is defined by regulation and includes tasks such as monitoring compliance with radiation safety procedures, maintaining documentation, ensuring personal dose monitoring, and reporting to management and authorities as outlined in the *Executive Order on Ionising Radiation and*

Radiation Protection (Indenrigs- og Sundhedsministeriet, 2019; see appendix 2). To become RPO, one needs to be certified by taking a course. In practice, the role is often added on top of existing job roles and is rarely a full-time position.
The RPO acts as a key actor in the implementation of radiation protection, and is positioned between regulatory expectations and everyday workplace realities. Their responsibilities can include both technical and communicative tasks, such as developing procedures and protocols, advising and training of colleagues and managing compliance.

The study includes data from several sectors where RPOs have a role, such as healthcare, industrial, research institutions, and veterinary clinics. While the role is regulated in the same way across these contexts there are differences in the practical implementations. In hospitals, radiation protection is often embedded in formal structures and supported by an established framework. In contrast, RPOs in industrial settings are more often working alone, with less organisational support or professional exchange. In many workplaces, the RPO role resembles other secondary roles, such as health and safety representatives, taken on in addition to the regular responsibilities, and often dependent on the individual's own initiative, motivation, and local conditions. Because of this variability, in how the role is prioritised, recognised and integrated, points to a need for a more detailed understanding of how RPOs experience their role and carry out their tasks in practice.

The Danish Health Authority's Radiation Protection (DHARP) serves as the national regulatory body for radiation protection in Denmark. It is responsible for supervising compliance across sectors, ensuring that radiation sources and practices are properly registered, and handling authorisations where required. The authority also provides guidance, processes incident reports, and works to align national practice with international standards (Sundhedsstyrelsen, 2023).

2.2 Approaching the Field

My interest in the RPO role emerged during an internship at DHARP, where I became aware of the wide variation in how radiation protection is implemented across sectors. In particular, I noticed that the available guidance materials, though comprehensive, were often by the users experienced as difficult to access, especially for professionals without a technical or regulatory background. This raised questions about how well the role is supported, and what

it demands of the individuals who carry it.

These initial impressions were further informed by meetings with the consultancy *Dansk Strålebeskyttelse*, which provides training for new RPOs, particularly in industry. In conversations based on their experience in the field, we discussed common challenges faced by RPOs, such as unclear expectations, limited time allocation, and a lack of support from management. While these insights were not treated as data in themselves, they contributed to shaping the early stages of the project and the focus of my data collection by drawing attention to potential tensions between formal requirements and the practical realities the RPOs may be facing.

2.3 The Techno-Anthropological Scope

The RPO operates at the intersection of regulation, technology, and organisational practice. Their task is to ensure compliance with safety standards. In this role, the RPO must, depending on their situation, navigate both technical systems and social dynamics, often acting as translator between regulatory logic and everyday operations.

From a techno-anthropological perspective, this role is particularly interesting because it reveals how regulatory expectations are enacted (or not) within local contexts. The RPO is not just a formal requirement, but a role that takes shape in relation to its organisational and regulatory context. Viewing the role this way allows the study to look beyond a binary understanding of compliance, to instead investigate how the role is interpreted, negotiated, and embedded in everyday practice.

2.4 Problem Statement and Research Questions

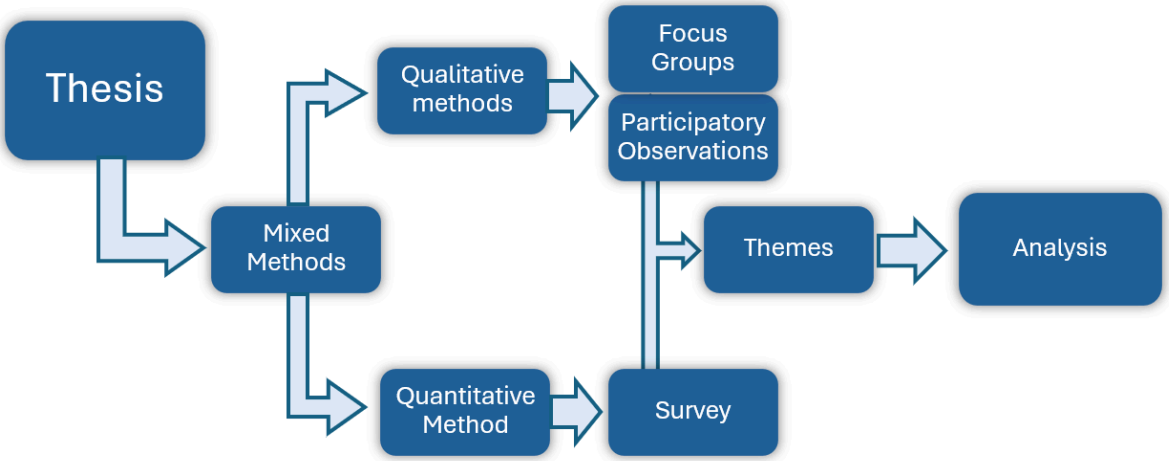
Based on the above, I have formulated the following problem statement and three research questions.

> *How is the role of Radiation Protection Officer perceived, performed, and shaped within the everyday organisational and regulatory contexts of Danish workplaces?*

1. *How do Radiation Protection Officers perceive and engage with their role in practice?*
2. *What organisational and contextual factors influence the Radiation Protection Officers' ability to carry out their role?*
3. *In what ways is the role of the Radiation Protection Officer shaped by structural conditions such as legislation, training, and recognition?*

3 Methodology

This study applies a mixed methods design that can be divided into two phases see figure 1. In the first phase, qualitative methods, which include participatory observations and focus group interviews, are used to develop an in‑depth understanding of how Radiation Protection Officers (RPOs) perceive and perform their role. This qualitative phase enables identifying significant themes and contextual nuances that support the experiences and challenges of RPOs within diverse organisational settings. These findings not only guide the development of the quantitative methods, but also contribute to enhancing the relevance and validity and by grounding the findings in empirical insights (Pickard, 2013).



(*Flowchart of thesis)*

In the next phase, data are collected using a quantitative survey method. The purpose of this phase is to test the generalisability of the qualitative findings within a larger sample of RPOs across Danish companies and sectors. By translating the thematic insights into measurable variables, the survey allows for the assessment of the prevalence of key phenomena and the statistical relationships between organisational, structural and individual factors that influence radiation protection practices. This complementary use of methods ensures methodological triangulation, reinforcing the credibility of the research through cross-validation of findings and by potentially highlighting varying trends that calls for further investigation (Pickard, 2013).

Designing a research study this way can offer several advantages. Firstly, it allows the initial qualitative phase to uncover complex details and generate themes, which can then be systematically examined using quantitative methods. This not only improves the survey, but also increases its overall validity, as the questions directly reflect the lived experiences of the participants (Pickard, 2013). Secondly, the integration of these approaches makes it possible to achieve both depth and breadth in understanding how RPOs perceive their role. However, this is not without drawbacks. The success of the design depends heavily on the strictness in which the qualitative phase is conducted and translated into quantitative measures, and the nature of the process means that any delays or issues in the initial phase may impact the timing of the entire study (Pickard, 2013).

Overall, the mixed methods strategy in this study is designed not only to facilitate a thorough exploration of the RPO role but also to generate findings that are both richly contextualised and empirically robust. The triangulation of data collected from observations, focus groups and the survey provides a comprehensive picture, thereby supporting a more nuanced interpretation of the factors influencing radiation protection conditions.

Results from respectively qualitative og quantitative findings are then analysed against relevant theory to detect correlations and to share light on the problem statement and its research questions.

3.1 Participatory Observations

I have participated in a two-day course in radiation protection, hosted by Dansk Strålebeskyttelse. The course is primarily offered to workers within the industrial use of radiation sources and is aimed at individuals who are, or are to become, RPOs within their organisation or company.

Field observation plays an important role in this study, as it allows me to gain insight into how RPOs are trained and how knowledge about radiation safety is communicated and absorbed by the participants. By observing the course setting directly, I aimed to capture interactions, behaviors, and learning processes that might not be fully conveyed through interviews alone.

The method of field observation is widely used in qualitative research, particularly within ethnographic and anthropological studies, as it enables the researcher to immerse themselves in the environment being studied (Szulevicz, 2020). Unlike interviews, which rely on participants' reflections and self-reporting, observations allow for the study of actual behaviors and social interactions as they unfold. This provides valuable insight into how knowledge is applied in practice and how participants navigate their roles within the training context (Szulevicz, 2020). One of the primary benefits of this method is that it allows for a contextual understanding of how participants engage with the training setting. While the course did not take place in the participants' actual work environments, it still provides a relevant context in which they begin to position themselves in their upcoming role as RPO. Observing the participants during the course provided insight into how they respond to the content, interact among each other and the teacher, and reflect on their responsibilities. Although observing RPOs in their workplaces could offer insights into how radiation

protection is practiced in real-life settings, such an approach would require significantly more time and access to individual participants.

Additionally, participatory observation has allowed me to capture non-verbal cues and tacit knowledge, elements that might not be explicitly expressed in conversations but are significant to understanding professional practice.

The approach is also time-efficient, as it enables the gathering of substantial data within a relatively short period (Szulevicz, 2020). However, field observation also presents certain challenges. The insights gained will depend on the specific events that take place during the observation period, meaning that if key moments do not occur, the material available for analysis may be limited. As an observer, my own biases and background shape how I interpret the events unfolding before me, making reflexivity a key consideration throughout the process.

There are different degrees of participation that a researcher can undertake during field observations, ranging from non-participant to complete participant (Ciesielska et al., 2018). In this study, I took on a role as participant observer, with a level in the range between partial and complete participant. I took part in the course in the same way as the other participants, however, I was introduced as a master's student conducting fieldwork for my thesis, which may have influenced how I was perceived and how others interacted with me. While I was involved in the course activities, my primary aim was to observe interactions, responses, and practices. I also engaged in conversations with participants to gain clarification and contextual understanding. I was particularly interested in how the participants expressed their expectations, concerns, or reflections related to their upcoming role as RPO. For instance, how they expressed potential challenges or uncertainties regarding their future role.

As mentioned, I participated actively in the course on the same terms as the other participants. Still, it is relevant to point out that my role was different in some aspects, as I was the only one who didn’t attend the course to obtain a certificate, and I did not have any current or upcoming responsibilities related to radiation protection in a professional setting. This may have influenced both how I experienced the course and how I was perceived by the others.

The observations were taking place at a conference hotel. Lectures were taking place in a conference room. The collected data is mainly from these lectures and personal conversations with the participants during this time or breaks.

3.2 Focus group interviews

At the course, I was able to conduct two focus group interviews with the participants.
The focus group interview can contribute with many of the benefits as a regular one-to-one interview, such as the ability to gain deep insights and understanding on the subject of investigation, but in a focus group the participants build on each other's statements, which can create deeper reflections and new insights. It is flexible in the sense that it can be used in a variety of settings and easily be combined with other methods, for example observations simultaneously (Barbour, 2007; Halkier, 2020).
Focus groups interviews are a great way of having multiple people participating in reflexive conversations on a subject, making it time efficient for data collecting, compared to interviews, even though I must expect to have fewer questions answered than I could have for a one-to-one interview (Barbour, 2007; Halkier, 2020). The participants can complement each other and bring different experiences into play. A participant with more experience can contribute deeper reflections, while a novice can raise questions that might not otherwise have been discussed.
This can lead to a more nuanced conversation, where the participants challenge each other's views and reflect together on how their workplaces handle radiation protection differently. With their different backgrounds, the conversation can help uncover patterns and common challenges across companies and industries. It can make your results more general and useful in a wider context(Barbour, 2007; Halkier, 2020).

Some of the challenges associated with using this method relate to the practicalities of conducting a focus group. For instance, it is often recommended to have two or more moderators, so that one can focus on asking questions and steering the conversations on the track, while the other is observing and taking notes (Barbour, 2007). To compensate for the lack of an extra moderator, I recorded video and audio of the focus groups. Thus, in that way I am able to distinguish the participants talking, from each other. The video recording also made it possible to supplement my memory, allowing me to accurately distinguish who was speaking and remain faithful to the data during the analysis process.
When recording video and audio, one must be aware that some people do not feel relaxed when being video recorded, and might not behave as they normally would. It can change the behaviour of people and make them more self-aware. It is therefore important that one presents the purpose of the video, and to have consent before recording.

Another challenge is that conducting a focus group is difficult and requires both skill and, preferably, prior experience (Barbour, 2007). I had not engaged in this type of research before; my only previous experience was with conducting interviews. This made it especially important for me to be as well-prepared as possible, in order to ensure that the focus group would be as productive and insightful as possible.

Conducting a focus group often requires extensive planning regarding, finding participants, an appropriate location, time scheduling to accommodate it all. This process is often time consuming (Barbour, 2007); however, I was fortunate that my potential participants were already gathered as part of the course I was observing. As a result, my primary challenge was to gain their willingness to participate in the focus group, despite an already dense program of course activities.
To increase motivation for participation, an invitation was sent to the course participants, along with the course's introductory material.

The interviews were guided by an interview guide developed on the basis of my research questions (see Appendix 3), with the aim of conducting semi-structured focus group sessions.
I aimed to keep the conversations aligned with my problem statement, while still asking open-ended questions that encouraged interaction based on the participants' own experiences and reflections, allowing them to contribute to and build on each other's input (Halkier, 2020). The questions were designed not to lead participants toward predetermined answers .

As the moderator, it was my responsibility to create a relaxed and inclusive atmosphere that encouraged participation from all attendees. This included choosing a suitable physical setting, beginning the session with a light, introductory question to ease participants into the discussion, and being mindful of my own role and behaviour (Barbour, 2007).
I aimed to remain discreet and non-judgemental, allowing participants to express their opinions freely without interference (Barbour, 2007). Conducting a focus group always involves certain risks: the discussion may stray too far from the topic, a single participant may dominate the conversation, disagreements can arise, or personal dynamics may hinder open dialogue (Barbour, 2007). Managing such challenges requires skill and sensitivity to guide the discussion in a constructive direction.

3.3 Qualitative analysis

The qualitative data from participatory observations and focus group interviews were analysed using an inductive thematic approach. The purpose was to identify patterns and themes that emerged directly from the empirical material, rather than being based on predefined categories (Sharp et al., 2019). The analysis was conducted iteratively by coding the material line by line, grouping related codes, and refining them through repeated comparison across the dataset. The coding was carried out manually using Word and Excel, and initial categories were developed and adjusted continuously during the process to ensure consistency.

This approach is well-suited to the exploratory aim of the project, as it allows for a data-driven understanding of how RPOs perceive and carry out their role in different organisational settings (Sharp et al., 2019). Themes formed by the analysis create the basis of the design in the subsequent survey.

3.4 Survey

The survey aims to examine whether patterns identified through participatory observations and focus group interviews were reflected more broadly among RPOs in Denmark. This allowed for the triangulation of findings and contributed to the validation of the qualitative results (Adams & Cox, 2008, p. 25).

A survey is a research method used to investigate relationships between variables and describe characteristics of a population by analysing data collected from a representative sample (Pickard, 2013). While surveys are typically associated with either descriptive or explanatory purposes, this study primarily applied a descriptive approach. The questionnaire was based on empirically grounded themes developed inductively during fieldwork.

3.4.1 Questionnaire design

The questionnaire was developed as the primary data collection tool for the survey. It consisted of a structured set of questions (see appendix 4 and was distributed electronically to RPOs. The use of a questionnaire enabled a structured and consistent form of data collection (Adams & Cox, 2008).

The questionnaire was created and administered using Google Forms. A unique survey link was generated and distributed via email and social media channels. No login or identification

was required to complete the questionnaire, and completed responses were automatically saved and stored for analysis.

The design of the questionnaire was based on the principles of validity and reliability. Validity refers to the degree to which the questionnaire measures what it is intended to, while reliability concerns the consistency of responses under similar conditions (Adams & Cox, 2008). To support both, the questionnaire included concise, thematically organised questions and avoided ambiguous or leading formulations. Efforts were made to ensure that all respondents would interpret the questions in a similar way.

The questionnaire primarily contained closed questions, such as Likert scale items (1–5) and multiple-choice options, with a few open-ended items allowing respondents to elaborate. The questionnaire was kept short and clearly structured to make it manageable for respondents and reduce the risk of misinterpretation (Pickard, 2013). It was anticipated that participants would be motivated by the relevance of the study, as findings may contribute to the future development of the RPO role.

Participation was voluntary and anonymous. The questionnaire included an introduction explaining the aim of the study.

3.5 Quantitative Analysis

The quantitative data were analysed using basic descriptive statistics, including frequencies and percentages, depending on the type of question. The aim was not to perform statistical hypothesis testing, but to describe general trends in the data and to examine whether the themes found in the qualitative phase were reflected in the survey responses (Sharp et al., 2019).

The data were processed in Microsoft Excel, where responses were organised and categorised in accordance with the six qualitative themes. The same tool was used to generate visual representations of the findings in the form of bar charts and frequency distributions. This facilitated comparison between the qualitative and quantitative results and helped highlight patterns, consistencies, and variations across the dataset.

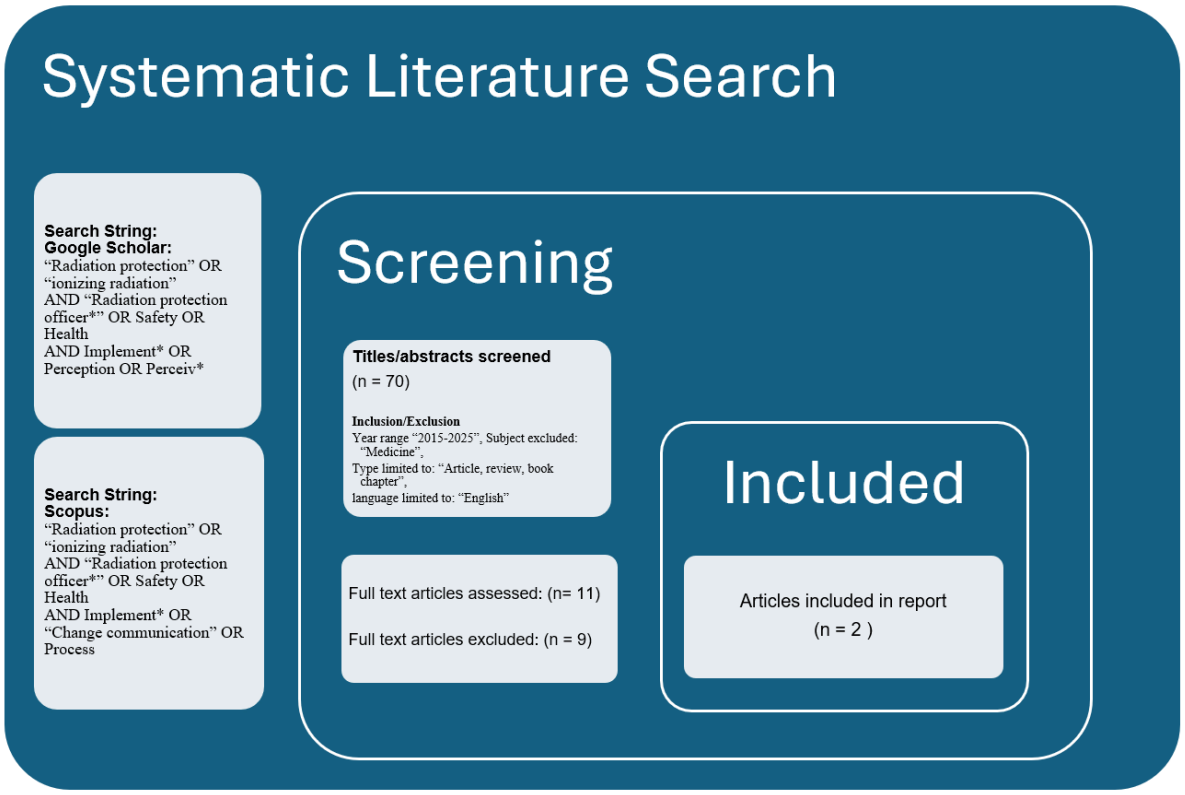
The quantitative analysis thus served to broaden the empirical foundation of the study and complement the exploratory insights gained through observation and interviews.

3.6 Literature Search

In the initial phase of the project, I conducted a structured literature search (see details in Table 3.1.1 and Appendix 5). I applied a Boolean search method, which involves combining keywords using logical operators such as AND, OR, and NOT to refine and focus the search results. This technique enhances the precision of database searches by including or excluding specific concepts (Aalborg Universitetsbibliotek, n.d.).

The search was carried out using Scopus and Google Scholar, as both platforms provide access to a wide range of academic publications across disciplines.

The search did not generate any studies directly comparable to this project. However, a few articles were identified that contributed useful background knowledge regarding the use of radiation, principles of radiation protection, and the risks associated with radiation exposure.



(*Table 3.1.1 - Systematic Literature Search*)

3.7 Use of AI and GPTs

AI-driven tools such as Google Translate, ChatGPT, and Co-Pilot have been utilised during this thesis for translation purposes, grammatical assistance, and sparring.

Furthermore the transcription tool Good Tape has been utilised as assistance for the transcriptions of focus group interviews.

4 Results

This chapter presents the empirical results of the study in a clear and structured manner. The findings presented in this chapter are based on the empirical data collected through observation, focus group interviews, and the survey.

4.1 Focus Group Interviews

The participants represented a range of professional backgrounds and demographics see table 4.1.1. A total of 10 individuals took part in the focus group interviews.

Two focus groups were conducted, each consisting of five participants. Prior to the focus groups interviews, I had handed out a short survey of demographic questions in order to save time in the interview. Themes deducted from the interviews are as listed in table 4.2.

Participants' demographics	(total n=10)
Gender	(n=)
Male	9
Female	1
Age	Years
Min	33
Max	60
Mean	46,5
Experience as RPO	(n=)
0 (not yet started)	8
2 years	1
10-15 years	1
Has become RPO by:	(n=)
Applying for it	0
Being assigned	10

(*Table 4.1.1 - Participants' demographics*)

Focus Group Interviews	
Theme	Results
Motivation	Participants varied in their commitment to the RPO role. Some see it primarily as a formal obligation, while others value the opportunity to gain knowledge and contribute to safety. Level of engagement is often related to work context.
Safety culture & working environment	Radiation protection priorities vary depending on work context. Those handling radioactive materials on a daily basis seem to place greater awareness, compared to the ones who see the role as a formality. While some participants stress the need for clear procedures, others see them as an administrative burden. Radiation safety culture also differs across participants' perceptions. Some have strong management support and established practices, while others treat it as a lower priority or are only now beginning to implement standards.
Communication	Some have established routines, while others experience a lack of systematic approaches. Difficulties concerning creation of procedures.
Legislation & compliance	Several mention that they find it difficult to navigate the legislation, but that it is an essential part of the role. Tension between following legal requirements and finding practical ways to implement them in everyday life. Some companies already have established procedures, while others are starting from scratch.
Risk perception & emergencies	Some participants emphasised caution and preparedness, while others felt that basic common sense was sufficient. Several were surprised by the risk scenarios presented in the course. Most agreed on the need for clear emergency procedures
Networking & knowledge-sharing	There was general interest in more knowledge sharing between RPOs, especially in smaller companies where the role is carried out alone. Suggestions included professional networks or collaboration groups. Some valued informal exchanges with others who had taken the course.

(*Table 4.1.2 Focus group findings)*

The data resulted in six themes *Motivation, Safety culture & working environment, Communication, Legislation & compliance, Risk perception & emergencies,* and *Networking & knowledge-sharing*, which reflect recurring or particularly significant aspects of the participants' experiences. The six themes create the base for the following survey themes and the analysis.

4.2 Participatory Observations

This section outlines the key findings from my participatory observations conducted during the two-day Radiation Protection Officer course. The insights derived from these observations are structured according to the main themes identified during the coding of the data.

Participatory Observations	
Theme	Results
Motivation	Participants have different prerequisites and objectives for taking the radiation protection officers' course. Some are in the startup phase and need to go through all aspects of establishing radiation protection and applications, etc., some have fully established radiation protection but take the course as a brush-up.
Competencies	Participants mention what competencies they find important. *The making of safety protocols, communication towards their colleagues, including reassuring.*
Concerns	Some are concerned with *if* or *how* they will find the necessary time within their work hours to be able to fulfill the role of RPO. Others show no concern at all, since they are used to having all kinds of necessary certificates and safety measures in their line of work.
Support from management	Some of the larger companies put a lot of resources into RPO's sending multiple participants to become certified. Smaller companies are just making sure to have one certified at all times, as it is the minimum.
Knowledge on radiation and radiation safety	The course teaches the basics of radiation, in lessons and experiments. All seemed to find it interesting to learn. Yet some commented on and joked among the participants on the relevance and applicability in their own work. Some participants came with prepared questions regarding specific issues they had trouble finding answers to on their own.

(Table 4.2.1, Participatory observation findings)

The themes identified through participant observation were somewhat different from those found in the focus group interviews. Although they do not align directly with the six analytical themes, the observations contributed valuable contextual insight, especially in relation to participants' engagement during the course and their informal interactions. These insights helped to nuance the interpretation of the data from the focus groups.

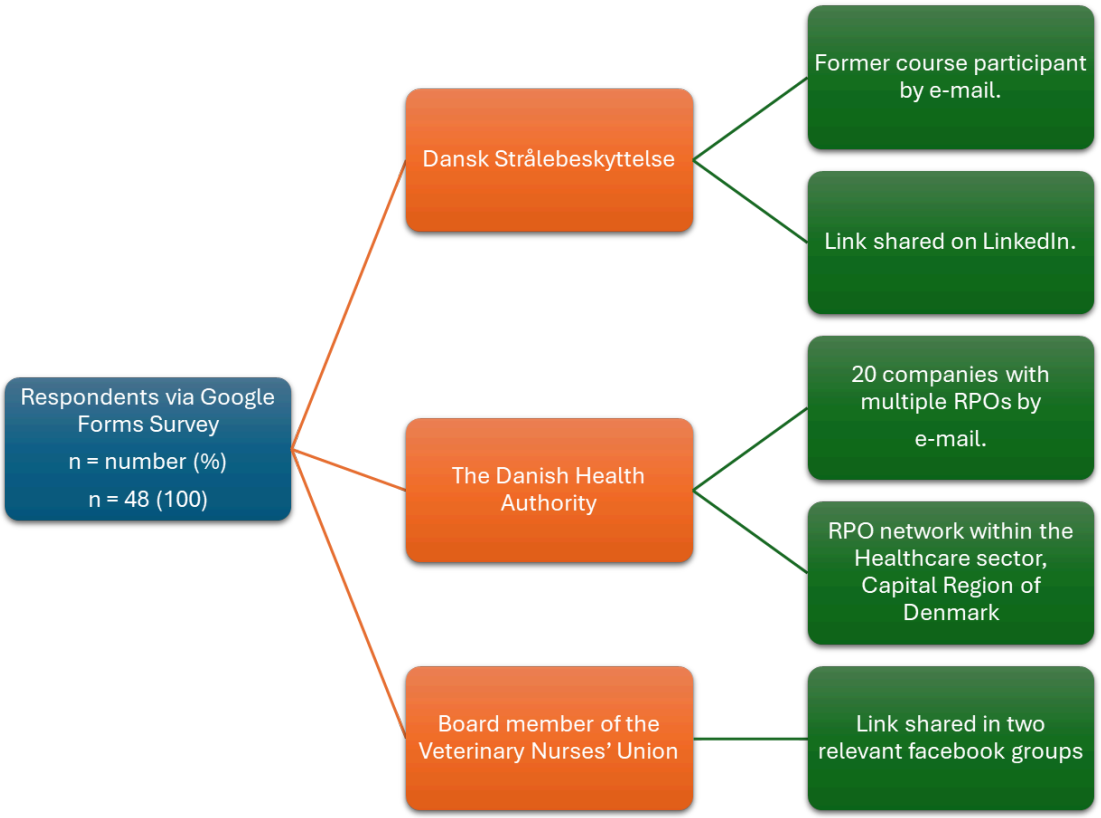
4.3 Survey

Participants were invited to take part in the survey through several distribution channels (Figure 4.3.1). Dansk Strålebeskyttelse shared the survey link with approximately 100 former course participants. The Danish Health Authority's Radiation Protection distributed the link via email to Radiation Protection Officers from around 20 larger companies and institutions having multiple RPOs. Additionally, the link was shared in two Facebook groups for veterinary nurses – one focusing on hands-free X-ray usage, and another for health and safety representatives. Finally, it was shared with RPOs working in the healthcare sector of the Capital Region of Denmark.

The total number of individuals who had access to the survey remains unknown, as it is not possible to determine how many potential participants were reached through these various channels. In particular, the Facebook groups were not limited to certified RPOs, which makes it difficult to estimate the size or relevance of the audience. As a result, no response rate could be calculated.

The survey was open for participation from April 3rd to April 25th, 2025. During this period, a total of 48 complete responses were collected, and their demographics are presented in table 4.3.1.

Before the survey was launched, it was piloted with two independent testers who were not involved in the study. Their feedback was used to revise the phrasing and structure of selected items to improve clarity and usability.



(*Figure 4.3.1 - flow chart of distribution.*)

Demographics		
Age	**Total of Participants n (%)**	**n=48 (100%)**
25-35 years	2 (4,2%)	
36-45 years	16 (33,3%)	
46-55 years	17 (35,4%)	
56-65 years	13 (27,1%)	
Level of education		
Upper secondary education / Vocational education	4 (8,3%)	
Short-cycle higher education/Academy Profession Degree	11 (22,9%)	
Bachelor's degree	24 (50%)	
Master's degree	3 (6,3%)	
PhD	6 (12,5%)	
Length of employment at current workplace		

Demographics	
0-4 years	16 (33,3%)
5-9 years	6 (12,5%)
10-14 years	7 (14,5%)
15-19 years	5 (10,4%)
20-24 years	5 (10,4%)
25-29 years	3 (6,3%)
30-34 years	3 (6,3%)
35< years	3 (6.3%)
Size of workplace (employees)	
0-9	3 (6,3%)
10-49	14 (29,2%)
50-99	7 (14,5%)
100-249	12 (25%)
250<	12 (25%)
Time as Radiation Protection Officer	
< 1 year	9 (18,8%)
1-3 years	25 (52%)
4-6 years	9 (18,8%)
> 6 years	5 (10,4%)
Sector	
Healthcare (hospitals, clinics, radiology)	23 (47,9%)
Industrial (production, reparation, transport, offshore)	9 (18,8%)
Research (universities, laboratories)	6 (12,5%)
Veterinary (animal clinics)	6 (12,5%)
Other	4 (8,3%)

(Table 4.3.1, Demographics of questionnaire respondents)

The dataset consists of 48 complete responses. For the purpose of comparison, participants have been grouped by sector of employment, based on their responses to a multiple-choice question regarding their professional field. The distribution is illustrated below:

Sector	Participants
Healthcare (hospitals, clinics, radiology)	23
Industrial (production, reparation, transport, offshore)	9
Research (universities, laboratories)	6
Veterinary (animal clinics)	6
Other	4
Total	48

(*Table XX, Distribution of respondents and sectors*)

The options "Healthcare sector," "Industrial sector," "Research sector," and "Veterinary sector" were pre-defined in the questionnaire. An additional "Other" option was available with the possibility to specify a sector manually. A few responses initially entered under "Other" were re-categorised into the predefined groups where appropriate. The remaining four responses represent distinct sectors that do not fit into the existing categories and are therefore retained as "Other" to protect participant anonymity.

5 Theory

In this thesis, the concept of Affordance is applied as a theoretical framework to analyse how Radiation Protection Officers (RPOs) perceive and act in their roles in practice. The analysis aims to uncover what possibilities for action become available to RPOs in context, and how these are influenced or constrained by internal and external factors. Affordance theory is used to explore how RPOs experience and respond to opportunities and limitations in their work. It allows for an understanding of the RPO role not just as a fixed set of responsibilities, but as something dynamically shaped in practice by the conditions and situations they face.

The concept of Affordance originates from perceptual psychology, which includes both conscious and unconscious aspects of perception. It has since been further developed by, among others, anthropologist Tim Ingold, whose work I also draw on to emphasise the relational and dynamic nature of affordances (Ingold, 2011).

The empirical analysis is based on a thematic analysis of qualitative data derived from participatory observation and focus group interviews. The identified themes — *Motivation, Safety Culture and Working Environment, Communication, Legislation and Compliance, Risk Perception and Emergencies,* and *Networking and Knowledge-sharing* — emerged inductively from the data.

5.1 Origin of the Affordance Theory

The theory of Affordance was first introduced by James J. Gibson during the 1970s within the field of ecological psychology. Gibson argued that affordances represent the possible actions that the environment offers an actor (human or animals), depending on the actor's capabilities. These are not solely subjective interpretations or objective properties, but they emerge from the relationship between the actors' capabilities and the features of the environment (Gibson, 1979).

"*The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. (...) It implies the complementarity of the animal and the environment*." (Gibson, 1979)

Affordance refers to an action that an object or environment offers to an actor; how the environment or the object invites certain actions. It can be both actions that are perceived, meaning they are being conscious, and potential (unknown) actions. These can be described respectively as perceived affordances and actual affordances.
Perception is not about constructing an internal model of the world, but about perceiving what the environment "offers" us as actors.
There are two sides of affordances. One consists of the properties of things, the other the capabilities of actors. Affordances emerge when the two overlap, namely, when we can see the potential of a thing and when that thing is useful to us in some way (Chemero, 2011). When we perceive an object we observe the object's affordances and not its particular qualities. Gibson believed that perceiving affordances of an object is easier than perceiving the many different qualities an object may have (Gibson, 1979).

5.2 Theoretical Developments: From Gibson to Ingold

While Gibson created the foundation for thinking relationally about action and perception, his model has been criticised for its relative functionalism and lack of cultural nuance. Tim Ingold builds on Gibson's concept of affordances but challenges the idea that human beings can be separated into two domains – as biological organisms adapting to their environment, and as social persons shaped through cultural relations. Instead, he proposes a relational ontology where humans are not divided, but understood as whole beings whose engagement with the world is continuous and dynamic. In this view, affordances are not fixed features of either nature or culture, but emerge through practice and through how people move, sense, and act in the world. What we usually think of as social relations is, according to Ingold, just one part of a broader field of environmental relations. Social affordances, then, are not mediated by culture, but arise directly through interaction with others and with the material world (Ingold, 2011).

For Ingold, the ability to perceive and act upon affordances is not simply a matter of cognitive processing or physical ability, but is deeply grounded in practical, experiential know-how. It is through lived bodily engagement—through the skilled routines of daily activity—that individuals come to sense and utilise the affordances around them. This embodied know-how conditions both what is perceptible and what is actionable in any given situation.

Ingold also brings attention to what he calls anthropological affordances which emphasises the cultural and social dimensions of affordances. Rather than seeing affordances as merely biological or individual properties, he highlights how collective practices, social norms, and shared understandings fundamentally shape what counts as meaningful affordances. Affordances thus are not merely environmental possibilities but deeply intertwined with cultural traditions, relationships, and ways of life (Ingold, 2011).

5.3 Application of Affordances

By integrating both Gibson's and Ingold's perspectives, this framework allows for a nuanced analysis of how RPOs navigate their professional environment.

Instead of focusing exclusively on formal requirements, legislation and procedures, the Affordance perspective enables an investigation of what is actually possible to do, and how opportunities for action are experienced, discovered and realised in concrete situations. Affordances are understood here as opportunities for action that do not simply lie in the environment or in the individual's abilities, but which emerge in the meeting between the two

in the tension between technology, organisational structures and the situated experience of the individual. What warrants action for one RPO may be invisible or unattainable to another, depending on that person's experience, social position, or access to resources.
In the analysis, affordances are identified through the participants' (the actors') descriptions of when they feel empowered, constrained, supported or isolated in their role as RPOs. Statements that indicate perceived possibilities or limitations in action, especially in relation to specific organisational or technological conditions, are treated as expressions of affordances. Affordance theory can in this case provide a dynamic lens for analysing the practices of RPOs. By taking into account the relational emergence of opportunities for action, the analysis can move beyond formal role definitions and explore how radiation protection is implemented in real contexts.

5.4 Alternative Theoretical Perspectives

In this section I will briefly summarize my reflections on alternative theoretical frameworks which could have been applied instead, to study how RPOs navigate their roles in organisational and technological environments. My thoughts and considerations have mainly been the Actor-Network Theory (ANT) and Boundary Object theory.

Actor-Network Theory (ANT), as presented by Latour, Callon and Law (Olesen & Kroustrup, 2008), suggests that roles, practices, and systems are continuously constructed through networks of both human and non-human actors. The RPO role is not seen as something a person simply "has", but as something that emerges through relationships. That is, through the interplay of people, technologies (e.g. measuring equipment), documents (e.g. guidelines), and regulations in practice. The role is a product of these connections and interactions, not merely of the individual's knowledge or formal function.

Boundary Object theory, originally developed by Star and Griesemer (1989), focuses on how artefacts or concepts enable collaboration across different social worlds without requiring consensus. Boundary Objects maintain a flexible identity, they are sufficiently adaptable to local use, yet robust enough to facilitate shared work. In this study, concepts such as radiation protection, standardised documentation, or training materials could be seen as boundary objects. Mediating between inspectors, practitioners, and managers while being interpreted differently by each group. Importantly, Star (2010) emphasises that boundary objects are not

just abstract bridging tools, but are shaped by informatic needs, work arrangements, and power relations.

Even with the relevance of both ANT and Boundary Objects, Affordance theory is chosen in this study because it places emphasis on perceptual involvement in situations as they happen and the way action possibilities emerge dynamically within specific contexts. While ANT and Boundary Objects are well suited for analysing coordination and mediation, Affordance theory provides a more action-oriented framework for exploring how RPOs perceive, interpret, and realise possibilities in their daily practice, especially when these possibilities are ambiguous, constrained, or shifting.

6 Qualitative Analysis

In this chapter, I will present the qualitative empirical data collected through participatory observations and focus group interviews, using a thematic analysis. Through thematic analysis, I will identify key themes, supported by quotes and observations, to illustrate how Radiation Protection Officers (RPOs) perceive their role. I will apply the theory of Affordance to assist interpretation of the data.

The identified themes have been named as: 1 *Motivation*, 2 *Safetyculture and Working Environment*, 3 *Communication*, 4 *Legislation and Compliance*, 5 *Risk Perception and Emergencies*, 6 *Networking and Knowledge-Sharing*.

6.1 Motivation

The data suggests a variety of levels of motivation regarding the role of RPO, and to perform the tasks that come with it, which vary across individuals. These motivations are shaped by both internal and external drivers, and they play a significant role in influencing how the role is carried out.

The Oxford English Dictionary defines *motivation* as:

> *"The (conscious or unconscious) stimulus for action towards a desired goal, esp. as resulting from psychological or social factors; the factors giving purpose or direction to human or animal behaviour. Also more generally (as a count noun): the reason a person has for acting in a particular way, a motive."* (Oxford English Dictionary, n.d.)

This definition highlights both internal and external drivers of motivation, which are important when trying to understand how RPOs engage with their role in practice.

The motivation factor was already at play when the course participants had the initial round of introducing themselves in plenum. They were asked to tell their name, work occupation and company, and why they were attending the course. Most of the participants were objective in their answers, and told their reason in relation to their work or specific work tasks. Although, a few added comments such as;

"*Well, my management told me I have to be RPO, and to take this course*" (Participatory Observation)

or "*If it wasn't for the need of it, I wouldn't be here", said in a way that could be considered 'half jokingly'*. (Participatory Observation)

Some of the participants in the focus groups described their motivation as influenced by an external driver, such as an upcoming or newly obtained device, their management or legislative requirements.

"I'm here because we have to." (FG1)

Others describe the role and course more as a formality or administrative task, rather than professionally motivating.

"It is more of an administrative function that handles contact with SIS. (...) I was asked if I wanted to, and then I politely said yes, thank you." (FG1)

"On a daily basis, it will take up absolutely not very much (time/attention), because(...)" (FG2)

The latter quote is explained further by the praxis of the company, who ships containers which in some cases contain radioactive material, they only handle when loading on and off the ship.

On the contrary some express a positive motivation on a personal level, driven by an interest for safety and professional development.

"Well, I mean, I actually think this is incredibly interesting and we are, of course, required to have someone in the company who has taken this course, right?" (FG1)

"I actually find it interesting. You learn a lot about safety and procedures, and I like having that responsibility." (FG1)

Viewed through the lens of *Affordance* (Ingold, 2011), the concept of motivation can be seen as the result of what possibilities of action the role of RPO affords, or fails to afford, for the participants. When the participants emphasise that they did not choose to become RPO, but were assigned the role without having much influence, it illustrates limitations in the organisational affordances. Meaning, that the organisation does not actively invite them to perceive the role as a source of personal development or engagement. Instead, participants may experience the role as an administrative obligation or an affordance primarily consisting of formal requirements without a genuine invitation for professional or personal investment.
On the other hand, the participants who perceive the role as motivating and interesting demonstrate that affordances can also be positive. Here, the role offers an opportunity for professional development and responsibility, indicating that organisational and social affordances can actively shape motivation within the role. For these participants, the role is not only a formal task but a genuine opportunity for meaningful action. This highlights the dynamic nature of the concept of affordance, as the same formal requirements (legislation, responsibilities, tasks) do not necessarily afford the same possibilities for action to all participants. Individual experiences, personality, and context play a significant role in how the role is perceived and what possibilities are seen within it.
My observations showed that the participants' upcoming tasks varied significantly in their perceived relevance and integration into the workplace's daily routines. Some had clear, well-defined tasks, such as developing safety procedures, training colleagues or other practical tasks. These tasks were clearly perceived as meaningful, which was reflected in these participants' attitudes toward the role.

The analysis shows that motivation is not just a matter of personal preferences, but is significantly shaped by the affordances that the participants perceive in the role. When the role is primarily seen as a formality, it is because the surrounding context (the organisation, management, and culture) does not offer clear opportunities beyond formal compliance with rules. Conversely, when the role of RPO is perceived as engaging, it is because organisational and social affordances actively support the experience of responsibility, professionalism, and personal development.

6.2 Safety Culture and Working Environment

Safety culture refers to the shared attitudes, values, and practices that shape how employees and management approach safety in their daily work (National Research Centre for the Working Environment, n.d.). The following analysis explores how the RPOs perceive the culture surrounding radiation protection. For example, whether safety related dialogue is supported or facilitated, if their work is acknowledged and how colleagues and management relate to rules and procedures.
Viewed through the lens of Affordance theory, culture and the work environment can be understood as conditions that either enable or limit the possibilities for action that RPOs experience in practice.

Among the participants some are also engaged in the work environment more generally, or work in settings where many safety protocols are already in place, which gives them insight into the cultural and organisational expectations around safety, including norms, routines and support from management. Several participants describe a clear and supportive safety culture with strong backing from management. One participant, for example, highlights.

> *"I think we have really good occupational health and safety management. There's hardly anything we don't get. If there's justification for it, then they're honestly really good in that regard. They really do make an effort when it comes to the work environment." (FG1)*

This points to a culture where safety is taken seriously and where the RPO experiences responsiveness to and from management. Another example supports this, where learning and reflection about safety is linked to direct action.

> *"I've become significantly wiser about some of these things - how they work [...] I'll definitely have to go home and give my boss a little nudge and say that we need to make a few adjustments." (FG1)*

These statements express the role as RPO is not necessarily perceived as isolated, but an integrated part of the safety and working environment, where the RPO feels entitled to and supported in acting. In these cases, the work environment culture generates clear social and

organisational affordances. The RPO meets a culture that encourages reflection, learning, and the ability to influence practice. This makes it possible not just to fulfil the role, but to engage with it in a way that fosters meaning and growth.

During a conversation between three participants, it is described how warning signs and safety labels have become such an integrated part of the work environment that they are no longer actively noticed:

> P 1**:** *"I feel like, at least for me, we just pass by those warning signs—they're just there. You don't really think about them anymore."*
> P 2: *"You mean the labels?"*
> P 1: *"Yeah, the labels. Exactly, you just stop thinking about them."*
> P 3: *"But you're still aware enough not to just go over and dismantle the pipe, right?"*
> P 1: *"Yes, of course—but that's a completely different situation. I know you don't do that."*
> P 3: *"And you've put up those signs for normal operations."*
> P 1: *"Then they don't pose any danger to me."* (FG 2)

This exchange illustrates how visual safety indicators, which initially carry a clear affordance, meaning a signal to act cautiously, will gradually lose their function as cues for action. They become part of the unnoticed background. In terms of Affordance theory, particularly Ingold's relational perspective (Ingold, 2011), this example shows that affordances are not static properties of objects but emerge through ongoing engagement with the environment. A sign or marking that once functioned as a clear warning over time becomes a neutral element without immediate relevance.

At the same time, the conversation demonstrates that safety awareness is not necessarily absent. The participants articulate that they still act responsibly ("*you are still aware enough not to just go over and dismantle the pipe*"), but that this judgment is situated and rooted in practical experience of when warnings are actually relevant. Thus, the safety culture is not only a matter of responding to formal indicators but also an expression of a collective understanding of when and how risks emerge in practice.

It reflects a sense of security and trust in the systems but also highlights the risk that safety may be reduced to something automatic and passive. The material affordances, such as signage and warning labels, serve as effective guides for appropriate behavior. However, they can also reduce the need for reflection or critical attention. The affordance becomes “silently effective”, but perhaps also predictable and disengaged. This may weaken the RPO’s opportunity to act as a communicator or professional in daily practice, as safety appears to be self-evident.

The participants' descriptions show that the work environment and safety culture play a significant role in how the RPOs’ role unfolds in practice. In organisations with strong occupational health and safety management and opportunities for professional development, the RPOs have the perception of the ability to influence practice and act with confidence and engagement. Here, the role is supported by social and organisational affordances.

6.3 Communication

A central aspect of the RPO role concerns how information about radiation protection is communicated and understood internally within the workplace. RPOs are to act as a link between legislation, technical procedures, and colleagues’ everyday practices. This requires both professional insight and the ability to translate knowledge into understandable and relevant information. The analysis examines how participants perceive this part of the role, and how they experience opportunities and barriers in informing, guiding, and creating a sense of safety among colleagues.

From an affordance perspective, the communicative dimension of the RPO role can be understood as dependent on the social and organisational conditions that enable or limit this task.

A quote from one participant illustrates how knowledge and inspiration from the course can give inspiration to concrete action.

> *"I think I’ll go back and update our fire response plan and fire drawings. Maybe make the areas a bit more clearly marked, and even though the markings are good, maybe we could do a little more. [...] It might be that we need to arrange a few more brush-up sessions, so they keep their hands out of those areas, right?"* (FG 1)

This example clearly shows how dialogue and acquiring knowledge can afford reflection and possibly further action. The participant identifies a potential for improvement and links it directly to the wish to communicate more systematically with colleagues. In this case, the RPO role is not simply administrative, but a position with the capacity to shape and share safety practices. This requires both support and confidence in the role, and demonstrates how the RPO can act as an active contributor to creating a safety culture. From this perspective, the RPO can be seen as actively shaping the environment in which colleagues operate, not just by introducing new procedures, but by shifting attention and conditions in ways that make certain actions more available.

Another quote highlights a more emotional and social aspect of the communication role.

> *"We only recently started working with radioactive material, and we already have a Radiation Protection Officer – But our management is extremely concerned about people's worries."* (FG 2)

This statement suggests that the RPO is not only a technical communicator, but also someone who is expected to provide reassurance and clarification. Both in observations and in focus groups, it became clear that colleagues in some settings are uncertain about how to relate to radiation, and that they may feel concerned, even when the actual risk is low. In such situations, the RPO role can be seen as affording a possibility to communicate between knowledge and emotion. The RPO may function as a translator between expert language and everyday understanding. Where knowledge, support and recognition are present, the role may contribute to building trust and a sense of safety. Without this, communication may become weakened and concerns may remain unaddressed.

In addition, the participant illustrates how it can be unclear how to concretely develop procedures.

> *"I'm sometimes unsure about how the procedures should be written, I mean, how they are supposed to be created at this point in time."* (FG 2)

This highlights that communication in the RPO role is not only about sharing information, but about being able to translate technical knowledge and legal requirements into usable and understandable procedures in the local context. This demands both professional and

communicative competences, and it underlines the need for support and guidance in the communicative aspects of the role.

The analysis shows that communication is a central, though often vaguely defined, part of RPOs' work. When RPOs feel that they have room to act and support from their organisation, they want to step forward as active communicators between regulation and practice, between knowledge and concern. Here, strong social affordances emerge. In other cases, the communicative task becomes either invisible or difficult to carry out – for example, if the role is not acknowledged, or if the RPO lacks the platform and competences to communicate effectively. In this way, the RPOs' ability to carry out the communicative task is not only a matter of personal motivation, but shaped by the organisational and relational conditions that either afford or constrain their role in practice.

6.4 Legislation and compliance

A central condition in RPOs' work is the legislation and regulation that frames radiation protection in Denmark.

The RPOs' role is closely tied to regulatory requirements and documentation obligations, but it varies how these requirements are understood, translated, and implemented in practice.

This theme addresses how RPOs experience working with legal compliance, including tasks such as preparing instructions, safety assessments, and procedures and how this affects their ability to act as professionals.

From an affordance theoretical perspective, legislation is not only seen as a set of rules, but as something that, in practice, affords certain types of actions or creates barriers to them. This depends on how the legislation is experienced, communicated, and supported on an organisational level.

One participant describes how receiving examples from another company made a significant difference.

> *"I also stood there like Moses at the Red Sea, staring at the legislation [...] And then I got the material from the other shipping company and I thought: 'Oh, that's all it is.' It doesn't mean it's easy, but the task became more manageable.*"
> (FG 2)

This quote shows that the legislation itself is experienced as complex, opaque, and not particularly action-guiding. It requires either prior experience, strong professional expertise or, as in this case, access to others' solutions and examples from practice.
Legislation does not necessarily afford action directly, it only becomes a real affordance when it is translated, interpreted, and concretised in context. Here, networks and knowledge sharing create social affordances that open up understanding and the possibility for action.
This indicates that in practice, RPOs need more than access to regulations, they need examples and dialogue to perceive the task as achievable.
Another participant, working offshore, describes how the regulations are experienced as troublesome, particularly when they do not match the working conditions:

> "*In my industry, in the North Sea, I think it's important for people who have to work in tanks where they might be exposed to radioactive material. But we think the regulations — especially when materials have to be shipped ashore and are contaminated — are a real hassle.*" (FG 2)

Here, the regulations are not perceived as supportive, but rather as something that obstruct effective work. A participant emphasised especially a challenge when several authorities with different regulations are involved, such as The Danish Health Authority and The Danish Maritime Authority. There arises a sense of inconsistency and lack of applicability, when regulations are not adapted to the specific work context (maritime and offshore environments) a mismatch between actor and environment arises, and thus no real affordance arises. It is an example of how formal requirements can exist without offering meaningful possibilities for action unless they are interpreted and applied in the context.
Legislation and compliance appear as a complex and often challenging part of RPOs' work.
Several participants experience that they are left alone with the responsibility of translating and implementing legal requirements into practice, which is a task that is not necessarily supported or properly grasped by the organisation or clear examples. Here, networks and access to others' materials play an important role in creating manageability and the ability to act.

Their potential as affordances depends on the context they are up against professionally, organisationally, and socially. When regulations are experienced as "*a hassle*," they become a

practical barrier rather than a support. When translated through collegial knowledge-sharing, they become a tool for safe and responsible practice.

6.5 Risk Perception and Emergencies

An important, yet relatively silent aspect of the RPOs' work concerns the perception of risk and the handling of emergency situations. Risk does not always appear the same in practice, it can be perceived as invisible and under control, or as unclear and threatening.
As previously described under the theme of safety culture, when risk is experienced as well-managed, it can reduce the need for active attention and lead to procedures and safety measures being treated as routine. Conversely, when risk appears unclear or unpredictable, it creates a need for clear communication, training, and procedures that RPOs are expected to facilitate.

The data revealed several reflections on how colleagues either underestimate or overestimate risks, which places high demands on the RPOs' communication skills.
One participant highlighted how the ability to foresee and prepare for potential scenarios is a particular challenge.

> "*That something that has not been sufficiently addressed happens — an accident where there was not enough preparation to foresee a scenario or something else*." (FG 1)

This quote emphasises that work with emergency preparation and risk communication is not just about following existing procedures, but about imagining hypothetical situations and creating clear action plans for incidents that, fortunately, rarely occur.
Affordances here emerge both through existing systems that support correct behaviour and through the need for RPOs to actively develop knowledge and procedures in situations where experience is lacking. The ability to anticipate and assess risk thus becomes a, yet often invisible, part of their role.

6.6 Networking and Knowledge-sharing

Networks and knowledge-sharing are crucial in supporting RPOs in their work, particularly because many carry the responsibility for radiation protection alone within their organisation.

This creates a strong need for external sparring, shared experiences, and access to practical solutions. From an affordance perspective, networks can be understood as an important social affordance. It is not only regulations or technology that shape what RPOs can realistically do and dare to attempt, but also access to collegial support and concrete examples that make action possible.

During the focus groups, it became clear that access to others' experiences could be crucial in making one's own tasks manageable. One participant described how collaboration with another shipping company made an otherwise overwhelming task more manageable:

> "*We have been in contact with a counterpart in another shipping company, where we had the opportunity to gain insight into what they are doing. [...] I actually found the task much more manageable after going through this material.*" (FG 2)

This example clearly illustrates that knowledge-sharing between RPOs can transform legislation and requirements from something abstract into something concrete and useful. Without such support, the RPO might have felt stuck or unable to act.

Networks and examples from others create a social affordance that enables action, learning, and the adaptation of complex requirements to practice. They allow for collective, rather than purely individual, interpretation of rules. Conversely, the discussions also revealed that many RPOs felt relatively isolated with their tasks. In particular, in small companies or sectors with few colleagues in equivalent roles. When access to networks is missing, the RPO must navigate complex legislation and technical requirements mainly on their own, which can limit both their ability to act and their motivation.

The absence of networks reduces the social affordances that could otherwise support understanding, problem solving, and development. Instead, it creates a situation where the role affords individual struggle and uncertainty rather than shared learning.

Networks afford not only practical solutions but also psychological support in the role. A factor that can influence whether the RPO feels empowered or isolated in their responsibility for radiation protection.

6.7. Qualitative Summary

In summary, the analysis of the qualitative data shows that RPOs' perception of their role is complex and deeply dependent on the opportunities and limits they will meet in practice. Across the six identified themes, it becomes clear that the RPOs' possibilities for action are

not solely determined by formal requirements but are strongly influenced by social, organisational, and material conditions.

By applying the concept of affordance, it becomes possible to understand how RPOs' practices are shaped by the interaction between individual competencies and the environments in which they work. Motivation is afforded when tasks are perceived as relevant and meaningful. A strong safety culture and support from management create social affordances that foster engagement and open possibilities to influence practice. Conversely, the absence of clear support, complex legislation without practical guidance, and the lack of networks limit the RPOs' perceived possibilities for action.
The analysis also shows that even where material affordances such as signage and procedures are present, routine patterns can develop in which attention to risk is reduced. At the same time, it is highlighted that the work of interpreting risks and developing emergency procedures requires significant judgement and imagination.

Overall, the analysis points to the conclusion that the RPOs' practice cannot be understood solely through legal requirements or formal instructions, but must be seen as a dynamic field where actions are continuously shaped and limited by the affordances that actually become available in their specific working environments.

7 Survey Analysis

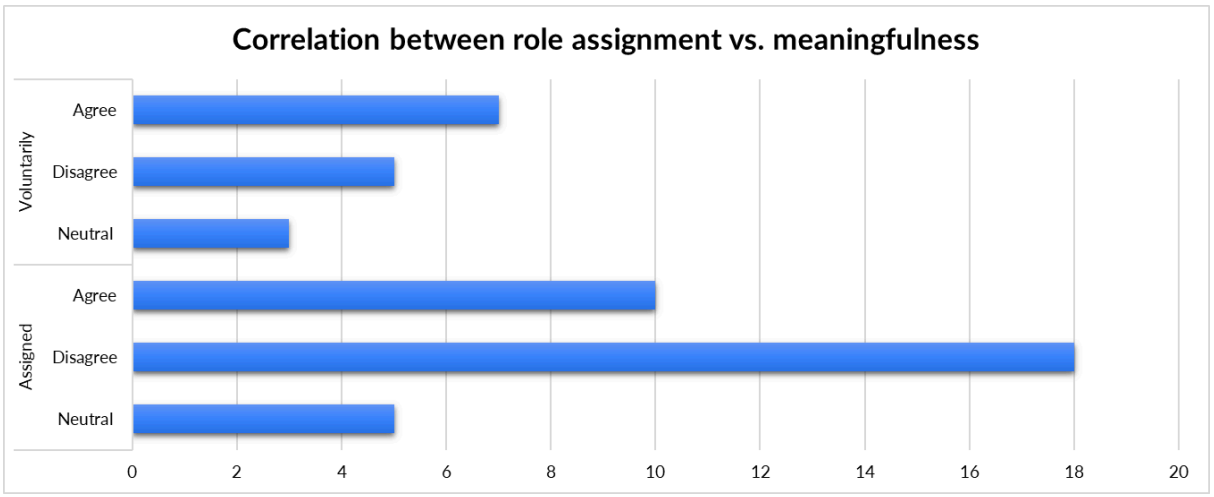
The results from the questionnaire were analysed through the preexisting six themes derived from the qualitative results: *Motivation, Safety culture & working environment, Communication, Legislation & compliance, Risk perception & emergencies,* and *Networking & knowledge-sharing*. Responses were given on a five-point Likert scale from 1 (*Strongly disagree*) to 5 (*Strongly agree*).

7.1 Motivation

This section presents the results related to the theme of Motivation, focusing on what drivers are at play for the RPOs in their role. The data shed light on both internal and external motivation factors, including perceived meaningfulness, role perception, and financial incentives.

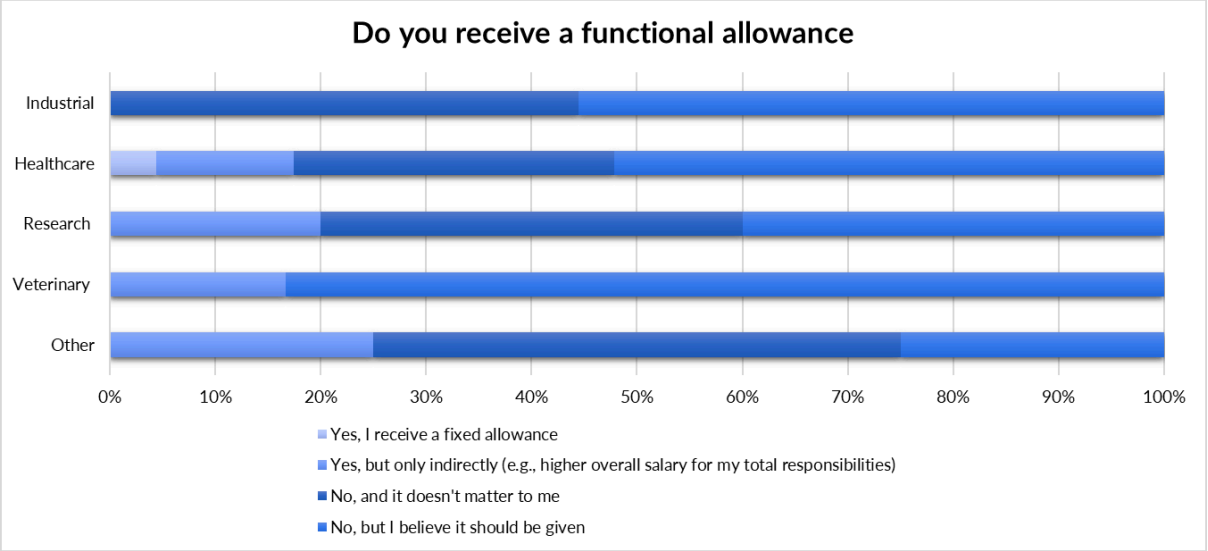
The correlation between role assignment and perceived meaningfulness (figure 7.1.1), shows that the vast majority of respondents were assigned the role of RPO (n=30), while only a smaller group took on the role voluntarily (n=18). When these groups are compared in relation to the statement *"I see my role as engaging and meaningful"*, a clear difference appears. Those who were assigned the role tend to agree less with the statement. Many in this group place themselves at the lower end of the Likert scale (1–2 out of 5).

This suggests a possible connection between voluntariness and perceived motivation. When the role is actively chosen, it more often leads to a sense of meaningfulness.



(*Figure 7.1.1 - Role assignment vs. meaningfulness*)

The survey also investigated whether the RPOs receive a functional allowance for their role and to what extent this affects their motivation (figure 7.1.2 & table 7.1.1). The data show that the vast majority (85%) do not receive such allowance. In the industrial sector, no participants reported receiving additional pay, and in the healthcare sector only a few do.



(*Figure 7.1.2 - functional allowance vs. sector*)

Participants were also asked whether a functional allowance would increase their motivation. Here, we see a clear variation between sectors (Table 7.1.1):

In industry, 4 out of 9 respondents indicated that such an allowance would boost their motivation, while 4 disagreed and 1 was neutral.

In healthcare, 12 out of 23 said that financial compensation would have a positive effect on their motivation.

In both the research and veterinary sectors, the majority agreed that such an allowance would be motivating.

While financial reward does not seem to be the primary driver of motivation, the results suggest that economic compensation is perceived as being able to strengthen motivation, particularly among those who currently receive no allowance. This interpretation is supported by the fact that many respondents stated they do not receive additional pay, but believe it should be provided. At the same time, answers to the statement "*My motivation is independent of financial compensation*" indicate that respondents are divided in their views. While some consider compensation as irrelevant, others might associate it with recognition and responsibility and therefore as part of what motivates them.

Across sectors, it is clear that RPO motivation is not just driven by economic factors. Still, a functional allowance can serve as a form of recognition that may strengthen engagement and a sense of responsibility in the role. This may be particularly important in contexts where

radiation protection is not already embedded as a core element of professional practice, and where compensation may help legitimise the task.

Sector	Question	Yes	No	Neutral
Industrial	Do you receive a functional allowance	0	9	
	Does/would it boost your motivation	4	4	1
	Did you volunteer for RPO	2	7	
Healthcare	Do you receive a functional allowance	4	19	
	Does/would it boost your motivation	12	3	8
	Did you volunteer for RPO	6	17	
Research	Do you receive a functional allowance	1	5	
	Does/would it boost your motivation	5	1	0
	Did you volunteer for RPO	3	3	
Veterinary	Do you receive a functional allowance	1	5	
	Does/would it boost your motivation	5	1	0
	Did you volunteer for RPO	3	3	
Other	Do you receive a functional allowance	1	0	
	Does/would it boost your motivation	1	1	2
	Did you volunteer for RPO	1	3	

(*Table 7.1.1 - Allowance and motivation*)

Participants were asked to indicate what motivates them the most in their role as RPO (Table 7.1.2), based on a predefined set of response options (multiple responses possible). The distribution of answers has shown a clear pattern.

The most frequently selected motivation factor is the "*Opportunity to make a difference in safety*", chosen by 37 out of 48 respondents. This is followed by technical knowledge and development (28 responses). The more external and relational factor, "*Recognition from colleagues and management*" was selected just by 5 respondents. A total of 10 participants indicated that they are not motivated in the role, but perform the tasks because it is required of them.

When looking at the distribution across sectors, the same pattern appears consistently in healthcare, industry, research, and the veterinary sector. For example, 78% of respondents in both the healthcare and industrial sectors cited safety as their main source of motivation. This suggests that internal motivations, linked to responsibility and purpose, is a general theme across professional environments. There are no notable differences between sectors in terms of whether respondents are more driven by safety or professional development.

At the same time, only a small number of respondents selected recognition as their primary driver. This confirms the picture seen in both the qualitative findings and earlier survey results. Namely RPO motivation is primarily rooted in the task itself and its significance, rather than in external rewards. However, a significant group of 10 respondents stated that they perform the role solely because it is required, which may indicate low motivation or a sense of obligation rather than engagement. This group's presence across sectors reflects that the RPO role may, for some, reflect a role shaped more by external assignment than by personal motivation.

What motivates you the most in your role as RPO? (Multiple responses possible)				
Sector	Opportunity to make a difference in safety	Technical knowledge and development	Recognition from colleagues and management	I am not motivated – I do it because it is required
Healthcare (n=23)	18 (78%)	15 (65%)	2 (9%)	4 (17%)
Industrial (n=9)	7 (77%)	6 (67%)	0	1 (11%)
Research (n=6)	4 (67%)	2 (33%)	1 (17%)	2 (33%)
Veterinary (n=6)	4 (67%)	1 (17%)	1 (17%)	2 (17%)
Other (n=4)	4 (100%)	4 (100%)	1 (25%)	0

(Tabel 7.1.2 - Motivational factors vs. sector)

Motivation for taking on the RPO role is generally shaped by internal drivers such as responsibility, safety, and professionalism. External factors like recognition and financial compensation are perceived to play a more limited role. However, the data suggest that a lack of recognition, both symbolic and financial, may have a latent effect on low motivation for some. The findings suggest a role largely driven by a sense of professional responsibility and commitment to safety, though in some cases experienced as assigned and not highly prioritised.

Using affordance theory one can consider which elements one as an organisation can adjust if the motivation for the RPO role is low. Here, data would suggest that greater opportunity to make a difference for safety among colleagues should be mentioned, or that the role be compensated with an allowance.

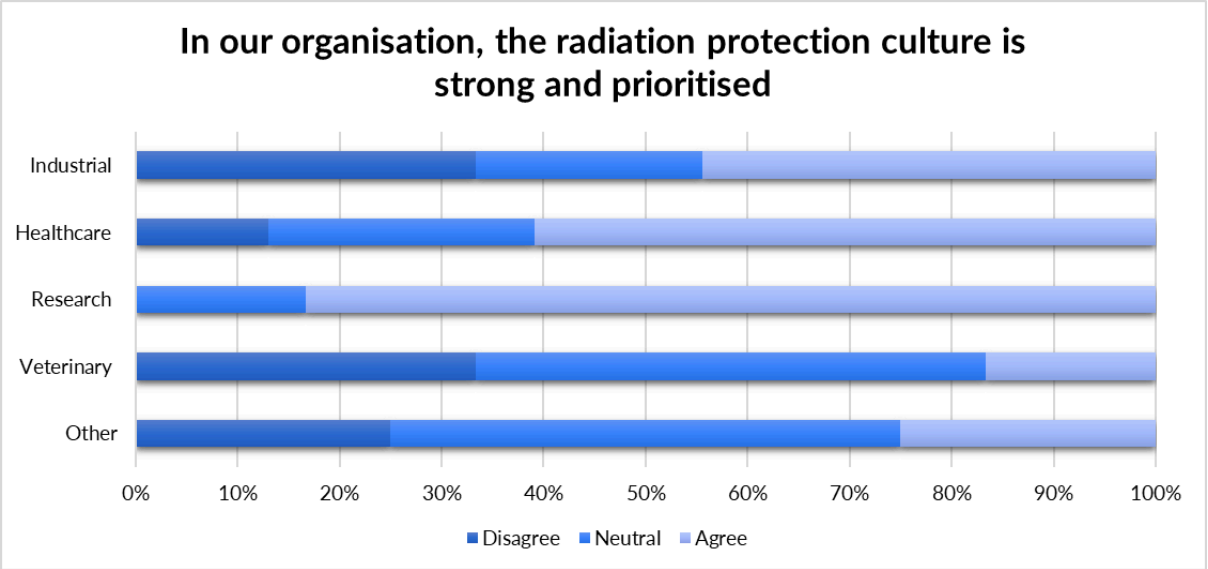
7.2 Safety Culture and Working Environment

This section presents the quantitative findings related to the safety culture and working environment surrounding the RPO role. The questions address whether radiation protection is prioritised in daily work, how often it is discussed, and whether RPOs feel supported and protected when taking action.

Respondents were asked to what extent they agree with the statement: *"The safety culture regarding radiation protection is strong and prioritised."* (figure 7.2.1)

31 (out of 48) respondents selected 4 or 5, expressing agreement. 11 selected 3 (*neutral*), and 6 selected 1 or 2 (*disagreement*).

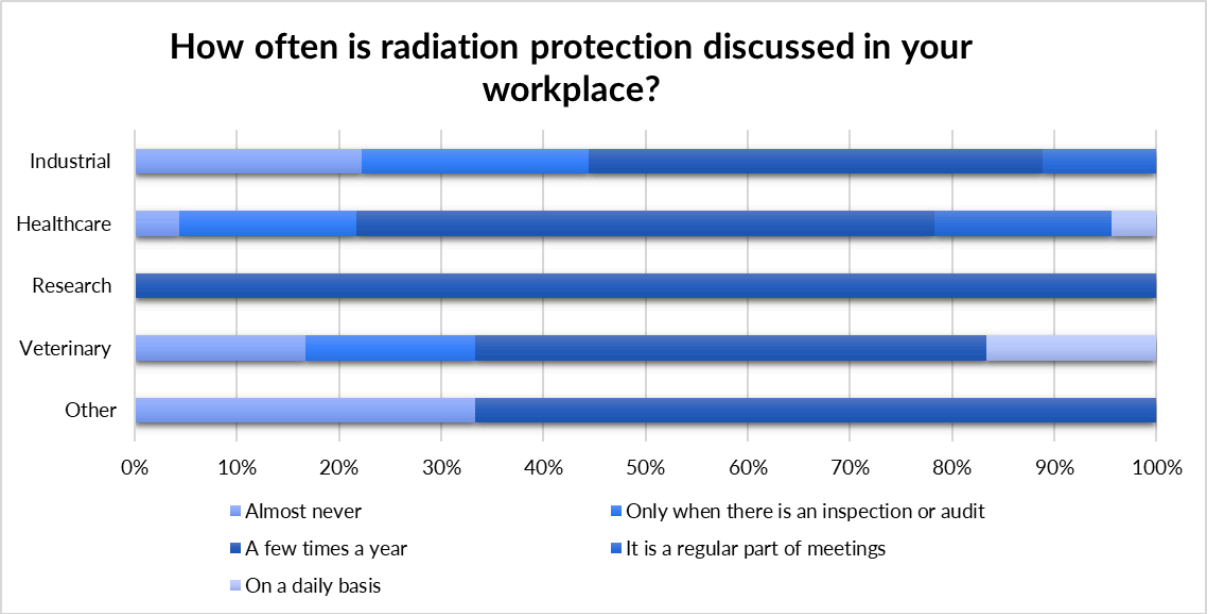
This suggests that while a majority of RPOs perceive a prioritised safety culture, a significant minority remains uncertain or disagrees, pointing to variation across organisations.



(Figure 7.2.1 - Organizational culture vs. sector)

The participants were also asked how often radiation protection is discussed at their workplace (figure 7.2.2). The majority selected "A few times a year". Only a few indicated that radiation protection is discussed frequently. A small number reported "Never".

These findings suggest that although safety may be valued in principle, radiation protection is not consistently part of routine dialogue or reflection in many workplaces.



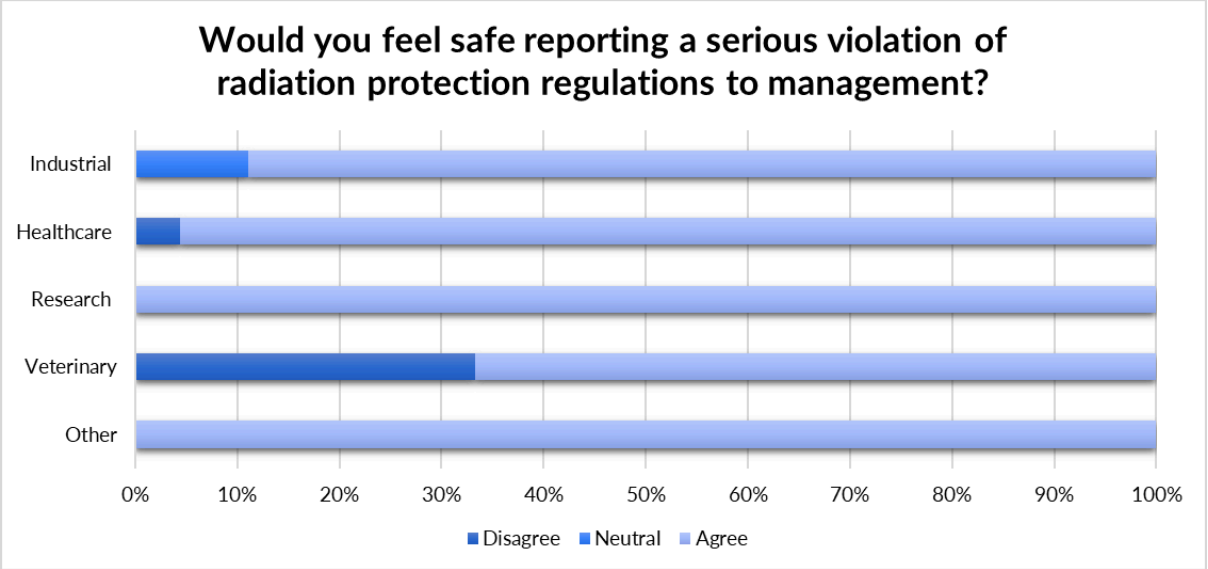
(*Figure 7.2.2 - How often is radiation protection discussed in your workplace*)

Respondents were also asked whether they are familiar with their legal duty to notify authorities in case of safety breaches (Table 7.2.1). To this, 38 out of 48 respondents answered *Yes* and 10 respondents answered *No*. This indicates a generally high awareness of the formal obligation. However, when compared with the earlier data on fear of consequences, it becomes clear that awareness of obligation does not necessarily affect confidence in action.

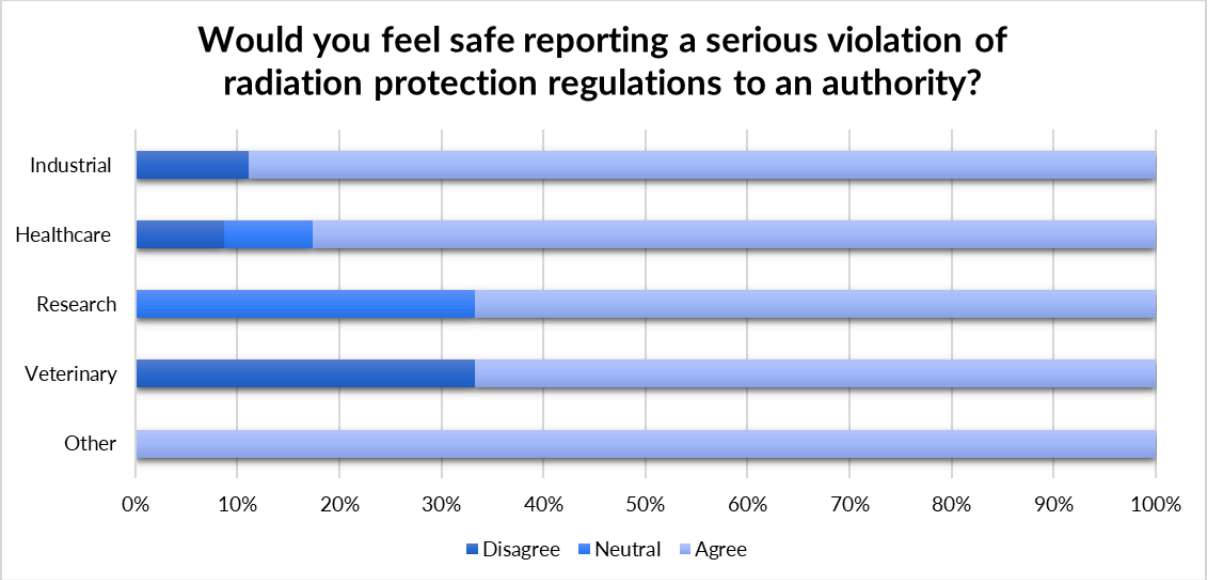
Are you familiar with your obligation to notify as RPO?	
Yes	38 (79,2%)
No	10 (20,8%)
Would you fear employment consequences from reporting to the authorities?	
Yes	6 (12,5%)
No	32 (66,7%)
Don't know	10 (20,8%)

(*Table 7.2.1*)

Respondents were also asked whether they feel safe reporting concerns about radiation protection both internally and to authorities (figure 7.2.3 & 7.2.4). While most do not fear consequences, nearly one third either fear or are unsure, indicating a degree of latent insecurity. This uncertainty may affect whether RPOs act upon concerns in practice.



(*Figure 7.2.3 - Reporting to management*)



(*Figure 7.2.4 - Reporting to an authority*)

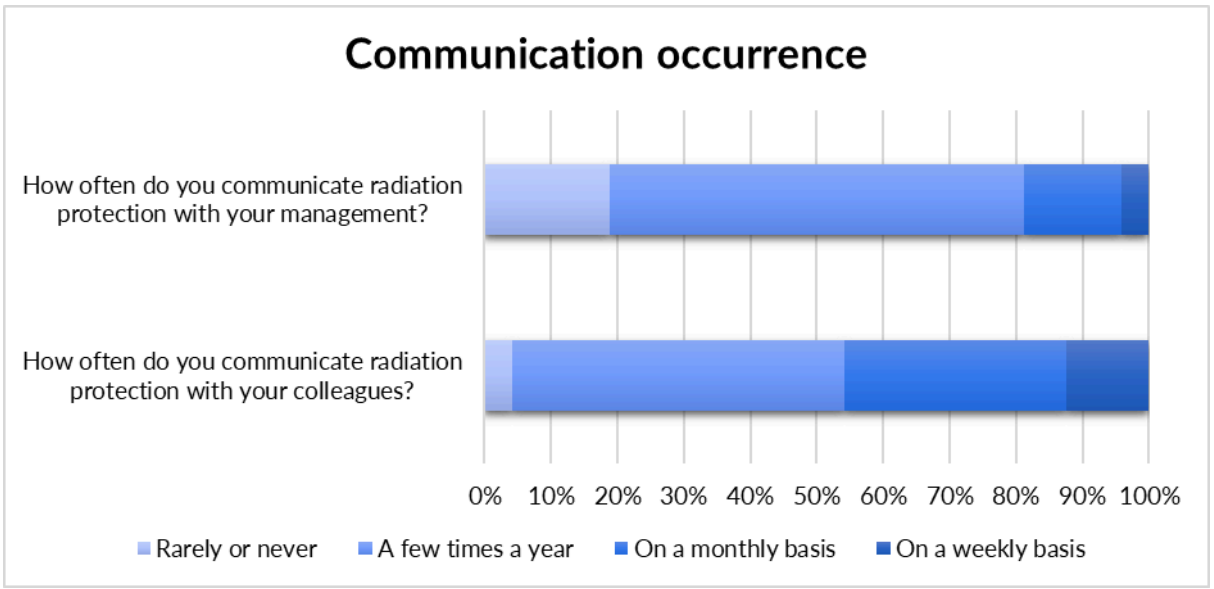
It should be noted that this question may have introduced a negative hypothetical, which could have influenced responses. The elevated share of "Don't know" responses may reflect this ambiguity.

From an affordance theory perspective, the findings suggest that increasing the frequency of safety-related tasks may help strengthen the safety culture within organisations. RPOs often report higher motivation when their work benefits colleagues (figure 7.1.2), which indicates that frequency itself can influence engagement. If the current biannual sessions are poorly executed, increasing their frequency may be necessary to sustain or improve motivation. In addition, low frequency may reduce the RPOs' familiarity with their legal responsibilities over time. Finally, social and organisational affordances appear to be strengthened when the broader impact of the RPO role on colleagues is acknowledged and supported.

7.3 Communication

This section presents quantitative findings on how RPOs perceive their role as communicators, including how frequently they engage with colleagues about radiation protection, and how confident and supported they feel in doing so. These data mirror the qualitative finding that communication is an important, but maybe not clearly defined, part of the RPO role.

Respondents were asked how often they communicate with colleagues and with management about radiation protection (figure 7.3.1).



(*Figure 7.3.1 - Communication occurrence*)

Communication with colleagues takes place on a regular basis for many RPOs. Here 6 respondents indicated weekly, 16 monthly, and 24 a few times a year.

Communication with management is less frequent for most participants. Only 2 reported weekly contact, 7 monthly, and 30 a few times a year, while 9 respondents said they rarely or never communicate with management about radiation protection.

These findings suggest that RPOs are active communicators, especially among their colleagues. However, contact with management appears more limited, which may reflect how the RPO role is positioned within the organisation. It may depend on the RPO's job whether others are involved in the use or handling of radiation sources, so naturally there may be no reason to have that kind of communication. Another explanation could be that radiation protection is integrated into existing occupational safety routines or dialogues, which often takes place quarterly or semi-annually.

It is notable that so many RPOs report rarely or never having conversations with management about radiation protection. This may point to a lack of understanding or acceptance of the role, or at least limited opportunities to discuss priorities and challenges.

From an affordance perspective, this reflects a working environment where communication is more easily realised with colleagues than upwards in the organisational structure. Opportunities for acting, raising concerns or influencing procedures may thus be shaped by how visible and supported the RPO role is in daily management practice. It could also indicate that the task relevant for the RPO does not need clarification from management, and therefore the need for sparring upward is minimal.

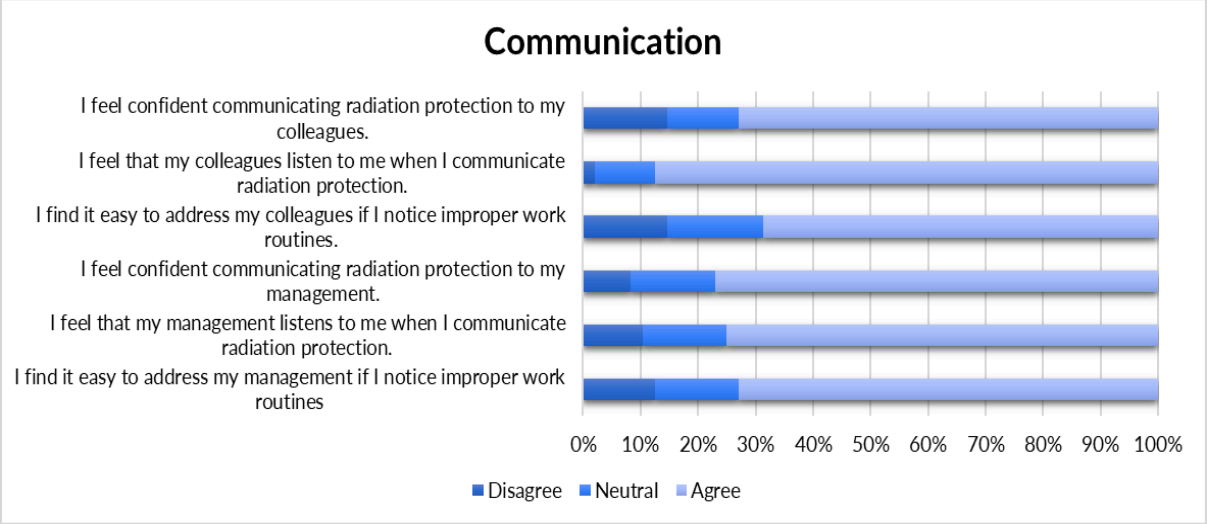
Respondents generally express high confidence in communicating radiation protection, both towards colleagues and management (Figure 7.3.2). Most feel that they are heard, particularly among their colleagues. In this case 35 out of 48 respondents feel confident communicating with colleagues, and even more experience that colleagues listen actively (42 out of 48).

When it comes to addressing improper routines among colleagues, slightly fewer (33 respondents) agree that this is easy. However, the picture is slightly different regarding communication with management. Although a clear majority (37 out of 48) feel confident communicating with management, and (36 out of 48) perceive that management listens, fewer (35 out of 48) find it easy to address management about improper routines, while 6 respondents explicitly disagree, and 7 remain neutral.

This distinction highlights a potential hierarchical or relational barrier, but it may also reflect practical realities. While communication with colleagues appears relatively straightforward and accepted, upward corrective feedback is perceived as more challenging. This could

indicate that organisational hierarchies limit how easily RPOs raise concerns upwards, but it might equally reflect that management generally is less involved in practical tasks where errors in radiation protection could occur. Thus, fewer opportunities or less perceived necessity for correcting management might explain this difference, rather than solely hierarchical barriers.

From an affordance perspective, this suggests that while communication generally appears as a possible and realistic action for RPOs, the organisational environment affords different possibilities depending on direction and type of communication. Horizontal communication among colleagues is easily accessible, whereas upward communication particularly correcting management appears more constrained.



(Figure 7.3.2 Communication)

7.4 Legislation and Compliance

This section explores respondents' perceptions of legislation, compliance requirements, training needs, and specific challenges faced in relation to these areas.

The respondents were asked the following open-ended question:

"What is the biggest challenge in your role as RPO?"

The responses indicate several different recurring challenges from the participants, specifically related to legislation, compliance and regulatory documentation, which I will present (Table 7.4.1)

Respondents frequently cited difficulties with producing risk assessments, safety evaluations, and instructions required by regulatory frameworks. As one participant stated, the biggest challenge was the "*transition to risk assessment-based radiation protection*" (Participants. 34, Q 1.9, table 7.4.1), while others described frustration with "*preparing the safety assessment for the organisation*" or handling "*extensive documentation requirements*" (Participants. 1, 2, 10 & 33, Q 1.9, table 7.4.1).

Several respondents expressed that the biggest challenge is finding the time for the administrative tasks (Participants 10, 13, 17, 28 & 48, Q. 1.9, table 7.4.1). Some participants also mention that their management does not prioritise or have sufficient understanding of the tasks.

Some respondents mentioned challenges related to effectively communicating radiation protection to colleagues or to the colleagues compliance with safety (Participants 5, 9, 20, 24 & 31, Q. 1.9, table 7.4.1) . For instance statements such as "*finding time for mandatory hands-free X-ray training*", and challenges regarding training and ensuring that colleagues follow the established safety-procedures, as one noted, "*It's sometimes quicker just to do it as you always have done.*"

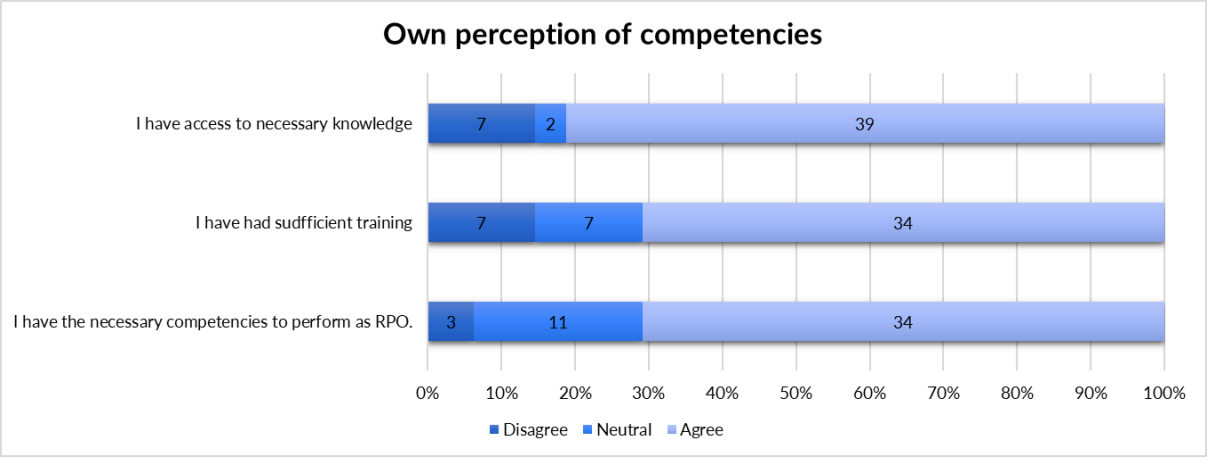
Overall, these insights illustrate that while legislation and compliance are formally clear, they can create significant practical burdens and uncertainties for RPOs. From an affordance theory perspective, the ability to act effectively within these frameworks is not only influenced by the RPOs' personal knowledge but is significantly influenced by organisational support, clarity in regulation, time available, and manageable documentation practices.

P.	Main Challenge as RPO	P.	Main Challenge as RPO
1	Preparing new risk assessments and instructions in accordance with new regulations	25	Prioritising less interesting tasks and finding answers to questions, especially regarding foreign regulations
2	Writing the safety assessment	26	Lack of technical information from the foreign supplier about the source before receiving and installing it
3	Collaboration with the medical physics expert	28	Getting management to recognise the importance of the tasks
4	Managing personal dosimetry. The current system is outdated and time-consuming.	29	We don't use X-ray equipment daily, so there are few challenges

5	Raising awareness about the RPO role among colleagues	30	Maintaining my knowledge
6	Collaboration with front-line colleagues, some middle managers, and certain senior specialists	31	Communicating procedures and ensuring they are followed – easier to do things the way they've always been done
7	Defining the scope and tasks relative to other RPOs in our department. We have multiple departments/sites, and therefore multiple RPOs	32	Carrying the responsibility for colleagues' safety
9	Finding time to train staff in hands-free X-ray use, which is mandatory	33	Writing the safety assessment for the company
10	Understanding and navigating the rules and requirements in the documentation we must complete	34	Transition to risk-based radiation protection
11	An overwhelming amount of documentation	35	Lack of a clear procedural guide
12	The wide scope of the role â€“ there are MANY things to know and do	36	Understanding what the role actually involves
13	Time and management's understanding of the importance of the administrative work	37	Implementing the new mini C-arm
14	Preparing the safety report and understanding the transport of radioactive materials	38	Not knowing the tasks
16	Our facility differs from others in Denmark, so the RPO training does not always feel relevant or sufficient	40	Defining my role and understanding my responsibilities
17	Finding time to carry out tasks. Getting management to prioritise	41	When personal dosimeters show abnormal readings
18	Communicating correct information to customers/their staff. In my field, there are many misconceptions about radiation risks, driven by years of misinformation and union culture	42	Learning new things about radiation protection that I don't deal with daily
19	The ship is not yet in operation, so the source is not yet in use. Currently, the RPO role concerns permissions to own and purchase the source	44	No system for evaluating new lead protection equipment purchases
20	Getting colleagues out of the X-ray room	45	We use X-ray so rarely
21	My role requires access to C-arms that are used daily, so tasks must be done on evenings or weekends	46	The role is so new that it's difficult to define tasks
22	No major challenges	47	In a small company with few staff, it's difficult to stay updated and maintain focus on the area
24	Communicating risk to colleagues	48	In a busy daily routine, finding time for the RPO role is difficult and often done in between other tasks

(*Table 7.4.1 - Main challenge as RPO*)

To further examine these aspects, participants were asked to rate the following three statements related to their competencies and access to knowledge (figure 7.4.1).



(Figure 7.4.1 - Perception of competences)

The majority of respondents expressed confidence in their access to relevant knowledge and competencies. However, seven disagreed that they have access to the necessary knowledge and an equal number disagreed that they have had sufficient training. This indicates that while the overall level of confidence is high, a notable minority still experience gaps that may affect their ability to act effectively in the role. These concerns mirror some of the qualitative findings about unclear expectations and limited support.

Participants were also asked whether they felt they lacked knowledge in specific areas related to their RPO role (Table 7.4.2). The responses show clear tendencies, nearly half of respondents indicated ‘Legislation and compliance’ as an area where they feel they lack sufficient knowledge, emphasizing that even when formal rules exist, their practical implementation can remain ambiguous or overwhelming. ‘Technical measurement and risk assessment’ and ‘Crisis management’ were also commonly chosen, indicating areas where additional training or guidelines could be beneficial.

Are there any areas within radiation protection where you feel you lack knowledge?	Legislation and compliance	Technical measuring and risk assessment	Communication and training	Crisis management (e.g. in case of accidents)	No
Industrial	3	4	1	5	1
Healthcare	12	9	6	11	2
Research	3	0	0	2	2
Veterinary	4	4	1	0	2
Other	1	0	2	1	1
n (%)	**23 (47,9%)**	**17 (35,4%)**	**10 (20,8%)**	**19 (39,6%)**	**8 (16,7%)**

(*Table 7.4.2 - Perceived knowledge*)

Altogether, the qualitative and quantitative data suggest that although RPOs often feel generally competent, some RPOs experience specific blind spots and structural limitations that make regulatory compliance challenging. These include lack of time, unclear expectations, difficulties in how to make safety-assessments and -protocols, and limited support from management.

The legal demands regarding the RPOs qualification updates are described in Strålebeskyttelsesbekendtgørelsen §34, stk.4,(Indenrigs- og Sundhedsministeriet. (2019); "*The RPOs knowledge, skills and competencies must be updated as necessary."*

However it does not state the interval or clarifies how the RPO and organization determines the sufficient level of knowledge, skills or competencies.

In terms of affordances, the ability to act in line with legislation depends not just on individual capability, but whether the organisation supports action. Whether it is through prioritising time, training, and clear procedures. Without such support, even competent individuals may find their possibilities for action constrained.

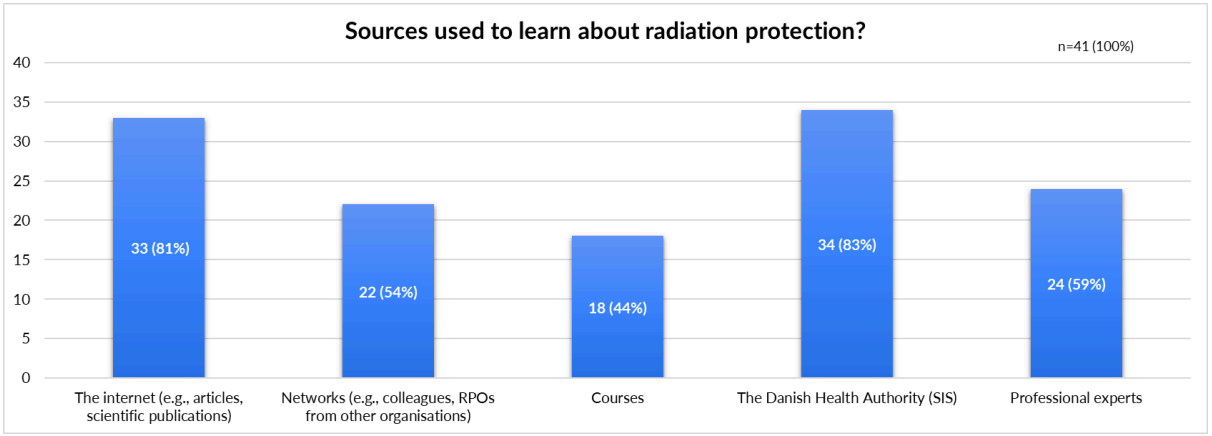
7.5 Risk Perception and Emergencies

The theme of risk perception was present in the qualitative material, where several participants described radiation risk as either being downplayed or difficult to communicate, partly because of its invisibility. This dimension was less present in the quantitative data, as the survey did not include targeted questions on perceived risk or the handling of accidents.

7.6 Networking and Knowledge-sharing

The final theme is in regards to how the RPOs access and share knowledge. Depending on the organisation and context, the role can range from involving completely independent work with limited formalised support options, or in a setting where several RPOs work side by side and where knowledge sharing is part of the practice. The following section examines how participants perceive their access to knowledge, areas where they feel a gap in their knowledge, and how they imagine networking and knowledge-sharing could be carried out successfully in their opinion.

Respondents were asked how they typically access information about radiation protection (Figure 7.6.1). The most frequently used sources were the internet (including scientific publications), The Danish Health Authorities, and professional experts. Many also reported turning to networks, such as colleagues and RPOs in other organisations. Several respondents made use of more than one source, which suggests an active and varied approach to staying informed.



(*Figure 7.6.1 - Sources used to learn about radiation protection*)

From an affordance perspective, the variety of sources used may suggest that RPOs navigate their role by identifying and combining the forms of support that are available to them. In some settings, where formalised support may be limited, contact with colleagues in similar roles and informal exchanges could represent important opportunities for navigating the role. These types of social affordances do not replace institutional frameworks but may supplement them in practice.

Respondents were also asked to indicate specific areas where they feel they lack knowledge (table 7.6.1). The most frequently mentioned categories were legislation and compliance (48%), crisis management (40%), and technical measuring and risk assessment (35%).

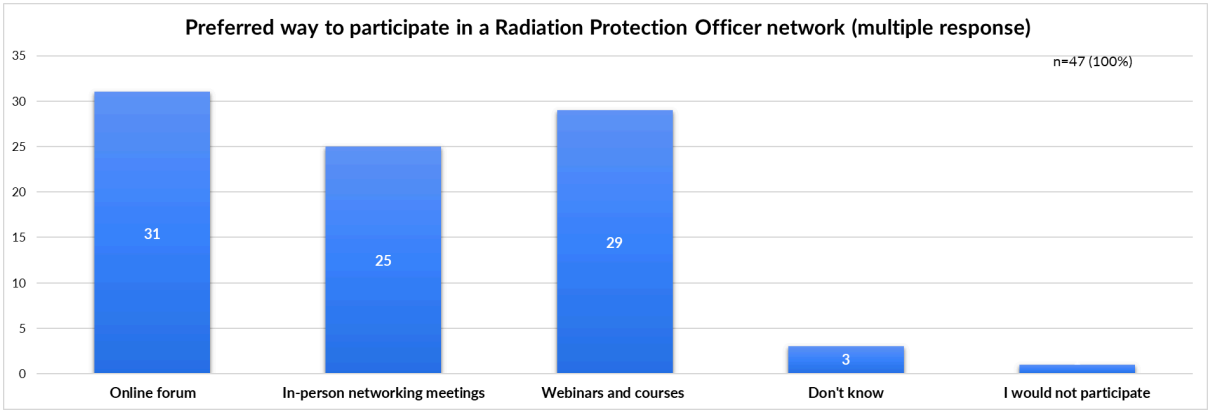
Communication and training is present by a smaller group (21%), while only 17% reported no significant lack of knowledge.

Are there areas of radiation protection where you feel you lack knowledge?					
Sector	**Legislation and compliance**	**Technical measuring and risk assessment**	**Communication and training of colleagues**	**Crisis management (accident)**	**No**
Industrial (n=9)	3	4	1	5	2
Healthcare (n=23)	12	9	6	11	2
Research (n=6)	4	4	1	0	2
Veterinary (n=6)	3	0	0	2	2
Other (n=4)	1	0	2	1	1
Total (n=48)	23	17	10	19	9

(*Table 7.6.1 - Perceived lack of knowledge*)

These findings highlight that while many RPOs report confidence in their general competencies (as also discussed in Section 7.4), there are still perceived knowledge gaps, especially in relation to regulatory interpretation and emergency scenarios. Differences appear across sectors. Respondents from the research and veterinary sectors were more likely to report no significant gaps, while concerns around crisis management were especially common in the industrial and healthcare sectors. This may reflect variations in task scope, institutional routines, or frequency of performing radiation-related work, or size of workplace.

Lastly, the respondents were asked about their preferred way of participating in networks (Figure 7.6.2). The results show broad support for digital and structured learning: 31 respondents were interested in online forums, 29 in webinars and courses, and 25 in physical networking meetings. Only a small number indicated uncertainty (n=3) or a lack of interest (n=1).



(*Figure 7.6.2 - Distribution of Network preferences*)

This suggests that the majority of RPOs are open to more systematic forms of knowledge exchange. There is an expressed willingness to engage in more formalised networks. From an affordance lens, this illustrates a latent potential. Platforms for dialogue, learning, and mutual support are widely desired and could perhaps enable a more confident, informed, and engaged practice, especially among those who otherwise navigate the role alone.

Overall, the data show that RPOs take an active role in seeking out knowledge through various sources. Knowledge gaps remain in core areas, particularly related to legislation and emergency response. The expressed interest in structured networking opportunities suggests a desire for a more stable and predictable form of professional exchange. Supporting these forms of engagement may not only benefit individual RPOs, but also contribute to strengthening the broader culture of radiation protection.

8 Discussion

In this chapter, I critically reflect on my methodological choices and discuss how they have shaped my findings regarding the research questions about how Radiation Protection Officers (RPO) perceive, engage with, and are influenced by their organisational and regulatory contexts. I consider the strengths and limitations of applying techno-anthropology and affordance theory to capture the organisational complexity of the RPO role, while acknowledging theoretical blind spots.

I evaluate the mixed-methods approach, recognising both its strengths and its scope, given the time-frame of the thesis, addressing limitations related to representativeness and questionnaire design. Lastly, I highlight key findings, discussing their implications for improving radiation protection practices.

As a former intern at The Danish Health Authority's Radiation Protection, I had already prior to this Master's thesis gained insights into the regulatory and organisational field of radiation protection, that the RPOs are part of. This background has given me an understanding of the context and has inspired my choice of topic, but it may also have influenced my perspective on the field and my focus during data collection and analysis.

My previous affiliation with the field may have created both trust and expectations in the meeting with participants, which I have been mindful of throughout the process. On the one hand, it has enabled a more nuanced understanding of the subject and fostered recognition and openness in the interactions. On the other hand, I have been critical of how my preconceptions could risk shaping both my observations and the questions I asked. I have aimed to balance this dual position by taking an open and listening role during data collection and by allowing the analysis to be based on the participants' own statements and experiences. Still, it is likely that my prior knowledge and insight into the field has influenced how I approached and interpreted some of the patterns that emerged during analysis. For instance, I may have been more prone to understand certain challenges, such as lack of engagement or uncertainty around responsibilities, as shaped by organisational structures rather than as a matter of individual motivation or capability. This perspective is also aligned with the affordance approach I applied in the analysis, where possibilities for action are seen as something that emerges in the relation between people and their environment. In this sense, my focus on structural and contextual factors is not just a result of my background, but can also be a reflection of the theoretical framework used.

The role of the RPO is located at a complex intersection between technology (radiation sources), legislation (e.g. Strålebeskyttelsesbekendtgørelsen, 2019) and organisational practices. The techno-anthropological approach makes it possible to capture this complexity and uncover how it actually unfolds in practice.

Techno-anthropology is particularly suited to illuminate roles such as Radiation Protection Officers because the field enables a holistic and practical understanding of how technological, legal and organisational elements are intertwined in everyday practice (Børsen, 2016). Instead of analysing the individual parts in isolation (legislation, technology, organisation), the techno-anthropologist looks at the interaction and the diverse meanings and tensions that arise in the intersectional field in which the RPO works.

Thus, techno-anthropology can both uncover the experience of the role and the structural and technological conditions that shape it and point out how roles like this could be improved, strengthened or made more visible in an organisation.

Techno-anthropology may have difficulty assessing whether a RPO actually makes a difference in terms of safety, because the method does not measure effect, but interprets meaning.

As also mentioned in the theory section, several different theories could have been used to shed light on the RPO role. Affordance theory was chosen because it brings analytical depth to a complex and practice-oriented topic. It makes it possible to look beyond formal job descriptions and instead examine how the role is shaped by organisational and social conditions. This has made it possible to understand variations in how the role is experienced and carried out.

At the same time, the openness of the Affordance concept introduces challenges. There is a risk of applying the term too broadly, and describing all perceived possibilities or barriers as affordances without clearly distinguishing between them. For instance, if all situations of inaction are interpreted as a lack of affordance without considering other possible explanations, the concept risks being diluted. In some cases, lack of action may be due to uncertainty, time pressure, or hesitation from the individual rather than the absence of affordance.

Furthermore, affordance theory does not address structural or institutional factors directly. While it highlights how possibilities for action are shaped in context, it does not explain why an organisation does not prioritise the RPO role, or how power and resource distribution influence the function. These limitations have required supplementary interpretation based on the organisational findings and should be taken into account when assessing the explanatory strength of the theory.

Still, by working with the idea of social and organisational affordances, the analysis has been able to connect individual experience with broader cultural and contextual patterns. In this way, the theory has contributed to identifying not only what RPOs do, but under which conditions their role becomes possible or constrained in practice.

8.1 Method

Conducting a mixed methods study as part of a Master's thesis is a particular strategy. In this case, it was chosen in an attempt to strengthen the findings, but considering the level of

experience required, the time involved, and the overall scope, it must be considered too ambitious for the framework of a thesis project.
Looking back, it might have been more appropriate to focus on a single sector; such as the industrial field and to strengthen the qualitative material through additional interviews, including more experienced RPOs. It could also have been relevant to examine differences based on company size or region. With systematic access to RPOs within one sector, the reliability and validity of the quantitative data could have been significantly improved.
In addition, the data collection period was relatively short. The survey link was not re-sent or followed up on, meaning that data saturation could not be achieved.
For better triangulation, interviews or greater insight from close collaborators would also have been relevant. For instance, how do supervisors from The Danish Health Authority's Radiation Protection perceive their encounters with RPOs, and what perspectives or nuances could they contribute to understanding the role?

The combination of participant observation and focus group interviews, during a course for Radiation Protection Officers' certification, has allowed for both contextual observations and reflexive statements from the participants. The focus groups created a setting for shared interpretations and informal discussions about daily practice. However, group dynamics can have limited some more critical or personal perspectives, if some participants have dominated the conversation. The thematic analysis was utilised to identify patterns across the data. My interpretation has been guided by the theory of affordance, which has led my attention towards what the participants perceive as possible or limiting in their work. This theoretical perspective has sharpened the analysis, but also opened up the possibility that other perspectives may have been overlooked.

Although the survey was mainly based on structured, closed questions, its purpose was not to establish causal relationships, but rather to describe and explore the extent to which patterns identified in the qualitative phase were also present in the broader population of RPOs. In that sense, the design was primarily descriptive, but with exploratory elements. This approach made it possible to investigate variations across organisational settings and roles, and to identify potential associations between themes such as safety culture, communication practices, and perceived responsibilities.
The combination of qualitative and quantitative methods allowed for a more nuanced understanding of the RPO role in practice, and helped to validate the themes developed

inductively during fieldwork. The survey provided a broader empirical grounding for the analysis, although future studies may build on these findings using more explanatory or causal models.

The questionnaire was distributed through available networks across the five sector categories, but there was no way to ensure that the responses were representative of RPOs or the sectors as a whole. It would have been an advantage to access an RPO register or distribute through relevant industry-specific news channels. As a result, the reliability of the data cannot be verified, as it is unclear whether the responses reached the target group in a representative way, for example, in terms of region, age, experience level, or sector.

As already mentioned, 48 responses are not sufficient to constitute a representative sample size of RPOs, nor for the sector categories used in this study. The results should therefore be seen as indicative trends. For broader application, a more systematic approach across sectors would be needed, with wider distribution through formal channels and a larger response rate. Responses from the Danish Radiation Protection Register would be of sufficient quality, but since the data do not indicate how many responses came from that source, the validity of the results must be assessed with caution.

Several demographic questions were deliberately left out of the questionnaire, as the purpose of the study was exploratory, and to avoid making the questionnaire too long. Additionally, the techno-anthropology programme does not include formal training in quantitative data processing, which is why no statistical analysis beyond Excel has been carried out. This increases the risk that the data have not been fully analysed, and that relevant patterns may have been missed. Correlations between qualitative and quantitative findings are interpreted, but no statistical correlation tests have been conducted. Therefore, any conclusions based on these links must be considered provisional.

The questionnaire was peer-reviewed, but it is possible that some relevant themes were not sufficiently included. For example, only a few questions covered risk perception and emergencies, meaning this part of the analysis calls for further study.

Although efforts were made to ensure clarity and internal consistency in the design, a few questions turned out to be ambiguously worded. This may have influenced how some participants interpreted and responded. While these issues were limited, they underline the importance of thorough piloting and iterative refinement in questionnaire development.

These limitations could have been addressed more adequately with additional resources, such as more time, input from a co-author, and stronger methodological support in survey design

and pilot testing. The questionnaire's reliability and validity have not been calculated or formally assessed.

8.2 Perceiving and Engaging the Role

Across the qualitative and quantitative data, a common denominator regarding motivation seems to be linked to a sense of professional responsibility for safety, rather than financial compensation or formal recognition.

This raises a further question about the nature of the reported motivation among those who did not choose the role themselves. If engagement with meaningful safety work is the most common motivational driver, how should this be interpreted in cases where the role was assigned? One possibility is that some participants in retrospective frame their motivation as internal, even if the role was initially unwelcome. In this case, the word *"motivation"* may reflect a way to legitimise an externally imposed obligation, rather than a genuine source of engagement.

In order to gain a more nuanced understanding of motivation I could have included a question in the survey such as: *"Knowing what you know now, would you have volunteered for the RPO role?"* If the majority had answered no, it might suggest that perceived responsibility operates more as compliance than engagement. If many had answered yes, it could imply that meaningfulness can emerge through experience. Either outcome would help clarify the boundaries between acceptance, identification, and motivation in professional safety work.

Another notable aspect concerns recognition from management. Despite the fact that many participants were assigned the RPO role, recognition from colleagues and management scored low as a motivating factor in the survey. This is somewhat counterintuitive. One might expect that when a role is imposed, symbolic or formal recognition would play a larger role in maintaining motivation. One explanation could be that recognition is so limited in practice that it is no longer expected. Alternatively, the strong emphasis on internal motivation, may reflect a normative ideal, where seeking recognition is culturally downplayed or tacit.

These reflections also suggest that motivation in this context should not be treated as a stable personal trait, but as situation dependent and relationally shaped by both organisational framing and professional culture. From an affordance perspective, this means that motivation does not emerge simply from the role itself, but from how the role is afforded meaning through situated interaction.

Communication appears as a central part of the RPO role, but one that is often vaguely defined and unevenly supported. Most respondents report feeling confident when communicating with colleagues, and horizontal communication appears relatively frequently compared to with management, which is far less frequent. This may reflect hierarchical structures, but it may also relate to perceived relevance or that speaking with colleagues is more integrated into daily routines, while communication with management is more difficult or simply not expected. This could indicate that the opportunity or need for upward feedback is simply limited, rather than actively discouraged.

From an affordance perspective, this suggests that communication is shaped not only by authority, but also by relevance and established routines. Overall, communication is not simply about passing on information, but depends on the conditions that allow the RPO to take on this responsibility. Whether RPOs engage actively in communicative work depends not only on their individual capacity or motivation, but on whether the organisation makes the role visible, trusted, and relevant in practice.

This creates a challenge for RPOs, who are expected to be able to guide others through something that may never happen and yet must be planned for. The survey responses support this picture. Crisis management was one of the most frequently mentioned knowledge gaps from respondents. One possible explanation is that procedures for handling radiation in everyday practice are generally well-established and effective. As a result, serious incidents rarely occur. For many RPOs, this means that emergency scenarios make up only a very small part of their role in practice. When something is perceived as unlikely and distant, it does not take up space in their everyday tasks, therefore it receives less attention. Over time, this may contribute to a sense that their knowledge in this area is insufficient, even if it is not a direct problem in practice. Whether it actually is or not remains unclear, but the perception itself matters, as it may influence confidence and preparedness.

8.3 Organisational Factors

The findings show that organisational culture plays a central role in shaping how the RPO role is carried out. In workplaces where occupational health and safety is prioritised, RPOs describe a sense of legitimacy and support. Here, the role is not just about compliance, but about contributing to meaningful practice. In contrast, several participants report that radiation protection is treated as a low priority, and that their function is seen mainly as

administrative. These differences suggest that the RPO role is not experienced as a standardised function, but as something deeply influenced by local organisational context.

This variation points to a broader structural issue. Even though the RPO role is defined by regulation, the ability to act seems to depend more on how the role is embedded in the workplace than on the formal description itself.

These differences raise questions about how the role is introduced and supported across sectors. If engagement with the role is shaped primarily by organisational conditions, it becomes difficult to ensure consistent safety practices through regulation alone. A more general understanding of what the RPO role requires in practice and how organisations can support it may be needed to reduce this variation and strengthen radiation protection more broadly.

Another point of concern is the combination of conditions that may limit how radiation protection is maintained in practice. Several participants describe the RPO role as something they did not choose, which comes with no financial recognition and is rarely discussed or made visible in the organisation. When these factors are present together, the role risks becoming a silent formality rather than a functional safety measure.

While the data do not allow for conclusions about direct consequences, this combination may influence how actively the role is carried out. If RPO tasks are seen as low priority, or left to the individual without support, it could over time lead to gaps in compliance. In that sense, there is a structural vulnerability in the way the RPO role is organised in some settings, which may also be noticed by external authorities during inspections.

8.4 Structural Factors

A consistent theme in both focus group interviews and survey responses is that legislation is often experienced as opaque, overly technical, and difficult to translate into practical procedures. While it is central to the definition of the RPO role, it does not, in itself, provide sufficient guidance for action.

In affordance-theoretical terms, this means that regulations do not afford action directly. They only become actionable through contextualisation, examples, or translation into specific workplace practices.

In some cases, participants expressed frustration that multiple authorities, such as the Danish Health Authority and the Danish Maritime Authorities overlapping areas of responsibilities.

Especially in offshore sectors, where conditions differ substantially from typical industrial settings, the regulations were perceived as ill suited:

> "(...) we think the regulations — especially when materials have to be shipped ashore and are contaminated — are a real hassle." (FG2, (p.38))

This creates a structural mismatch, where the actor's environment (e.g., maritime work conditions) does not align with the assumptions embedded in the regulation. As a result, the affordance disappears – not because the rule is absent, but because it cannot be meaningfully enacted.

Overall, the analysis shows that regulatory structures are not neutral or universally actionable. Their capacity to support or constrain the RPO role depends on how they are experienced, understood, and integrated into practice. Without interpretative support or peer examples, formal structures risk becoming barriers rather than enablers of responsible action.

9 Conclusion

This study has explored how the role of Radiation Protection Officer (RPO) is perceived, enacted, and shaped within Danish workplaces, using a techno-anthropological perspective. Through a sequential exploratory mixed methods approach, based on participatory observations, focus group interviews, and a survey, it has become evident that the RPO role is both complex and highly dependent on the organisational and structural context in which it is embedded.

Drawing on the theory of affordances, the study has examined how possibilities for action do not emerge solely from legislation or individual competencies, but also from the dynamic interaction between actor and environment. RPOs' ability to perform their role meaningfully is therefore shaped by the social, organisational, and material conditions that afford or constrain their capability to act.

The findings indicate that motivation and engagement with the RPO role vary considerably. Whether the role is voluntarily engaged or assigned without influence plays a significant part in how meaningful it is perceived. Those who actively chose to become RPOs often describe a greater sense of professional interest and responsibility, while those who were assigned tend to describe the role as administrative and externally imposed. In particular, when

organisational recognition and support are lacking, the role risks being reduced to a formal obligation rather than an opportunity for professional engagement.

The study also highlights how various organisational factors influence RPOs' ability to carry out their responsibilities. Elements such as management support, established safety culture, available time, and opportunities for professional exchange significantly affect how the role is integrated and prioritised in everyday practice. Where safety is a shared concern and embedded in routines and culture, the RPO role is more likely to be understood and supported, making it easier to navigate. Conversely, where the role is marginalised or unclear, it becomes more difficult to fulfil its purpose.

It is further evident that sector and company size play a considerable role. In larger organisations, particularly within the healthcare sector, the RPO function is often supported by formal structures and professional communities. In contrast, RPOs in smaller companies or within the industrial sector are more often isolated, lack procedural frameworks, and must independently interpret and implement regulations. These differences significantly affect how RPOs experience their role and what opportunities they have to carry it out effectively.

Regulatory frameworks also present a central condition that shapes the RPO's role. The findings show that while legislation is a key reference point, it is often perceived as complex, abstract, and difficult to translate into practice. For many, it does not offer clear guidance unless accompanied by examples, templates, or peer input. In such cases, knowledge sharing becomes an essential support mechanism, enabling RPOs to transform regulatory requirements into locally applicable procedures. The course for certification plays an important role in introducing knowledge and establishing networks, but several participants express a need for more accessible resources and continued guidance.

Moreover, most RPOs do not receive any formal compensation for their responsibilities, and many point out that a functional allowance or formal recognition could significantly increase their motivation.

Together, the findings demonstrate that the RPO role is shaped by a complex interplay between formal requirements and everyday conditions. Affordance theory has made it possible to understand how these roles are enacted not just through compliance, but through the relational dynamics between individuals and their working environments. When organisational, social, and structural conditions afford meaningful engagement, the RPO role becomes more than a legal requirement, it becomes a source of professional responsibility

and safety awareness. When those conditions are absent or limited, the role loses visibility and relevance.

In light of these insights, it is recommended that greater organisational and structural support be provided for RPOs. This includes improving access to practical examples and templates, strengthening opportunities for peer-to-peer learning and experience sharing, and ensuring that the role is not only legally required, but also institutionally recognised and supported as a meaningful function in the workplace.

The findings of this study hold relevance beyond the specific field of radiation protection. They point to broader issues regarding how cross-functional safety roles are embedded in practice, particularly in smaller organisations with limited resources. As such, the results may contribute to the work of regulatory bodies and advisory organisations seeking to improve implementation strategies across sectors. Practical implications include the potential development of national or sector-specific RPO networks, provision of more practice-oriented guidance materials, and a consideration of how such roles are formally grounded in organisational structures.

The study also raise questions that could be explored in further research. Future investigations could examine how other regulatory or safety-related roles experience similar challenges, and to what extent these roles are supported or isolated in different workplace settings. Additionally, ethnographic studies observing RPOs in their actual work environments could provide deeper insight into how the role is enacted in everyday practice and how regulatory expectations are interpreted and translated in real time.

By offering a practice-oriented understanding of how the RPO role is perceived, supported, and enacted, this study aims to contribute to the ongoing development of radiation safety, workplace culture, and professional responsibility in Danish companies.

This thesis has strengthened my skills as a techno-anthropologist by providing hands-on experience with analysing and engaging in complex socio-technical systems. Through my work with radiation protection, I have gained a deeper understanding of how regulation, technology, and organisational practices are interconnected and how these relationships shape the people who are to translate requirements into practice. These insights are relevant in various settings where technological solutions must be implemented in responsible and meaningful ways; for example within healthcare, industry, or public authorities. I therefore consider the methods, analyses, and reflections developed through this project to be relevant

in future employment, especially in roles that require analytical thinking and the ability to navigate the intersection of regulation, technology, and practice.

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