Influencing improvements in safety culture using qualitative research methods: a regulatory perspective

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The Office for Nuclear Regulation (ONR) has developed guidance for its specialist inspectors when undertaking targeted assessments of safety culture, assessments of culture change, or when diagnosing organisational problems. Inspectors applied the methods outlined in this guidance and were successful in identifying several factors affecting a dutyholder's safety performance which were used by the inspectors to aid decision making and to re-focus regulatory interventions, and by the dutyholder to inform its improvement plans. This paper provides an overview of the research process outlined in the guidance and describes a case study where ONR inspectors applied the methods to influence improvements to nuclear safety.

Introduction

ONR independently regulates nuclear safety and security at 36 nuclear licensed sites in the UK. ONR also regulates transport and ensures that safeguards obligations for the UK are met. Its duty is to ensure that the nuclear industry controls its hazards effectively, has a culture of continuous improvement, and maintains high standards.

The role of organisational culture in maintaining nuclear safety is well established. Reports of investigations into notable events such as Three Mile Island (Kemeny, 1979), Chernobyl (IAEA, 1992), Davis Besse (NRC, 2002) and Fukushima (Kurokawa, 2013) provide compelling evidence of the importance of establishing an effective nuclear safety culture. Much academic and business research over the past 40 years has also established the critical role of organisational culture in achieving good business and safety performance (Deal and Kennedy, 1982; Kotter, 2008; Lee & Yu, 2004; Morrow et al, 2014; Sackmann, 2011; Stemn et al, 2019).

ONR acknowledges the importance of its role as an independent statutory regulator in promoting and enhancing an effective nuclear safety culture. One recent addition to ONR's regulatory toolkit to assist with this is a suite of qualitative research methods to enable its specialist inspectors to undertake targeted assessments of safety culture, assessments of culture change, or to diagnose problems which may be affecting safety performance (ONR, 2020a). This new guidance document provides a flexible framework of qualitative research methods including interviews, focus groups, observations, and document analysis. These methods are well suited to describing and understanding phenomena such as safety culture, are aligned to existing regulatory approaches, and have been successfully piloted by ONR inspectors within a dutyholder organisation where they were effective in diagnosing cultural factors that were affecting safety performance.

The research process

The research process outlined in this new guidance is shown is figure 1. The first step in the research process is to **determine the research focus**: an important consideration which influences the research design decisions. As an independent statutory regulator, ONR would not normally undertake a full independent safety culture assessment of a dutyholder as "the prime responsibility for nuclear safety rests with the organisation responsible for facilities and activities that give rise to radiation risks" (IAEA, 2006, p.6), and therefore ONR expects dutyholders to periodically assess their own safety culture. ONR may however undertake a targeted assessment where it has identified shortfalls that may indicate a problem with aspects of the safety culture. Such an assessment would normally focus upon one or more typical cultural traits such as 'questioning attitude' or 'raising concerns', as outlined in a safety culture model.
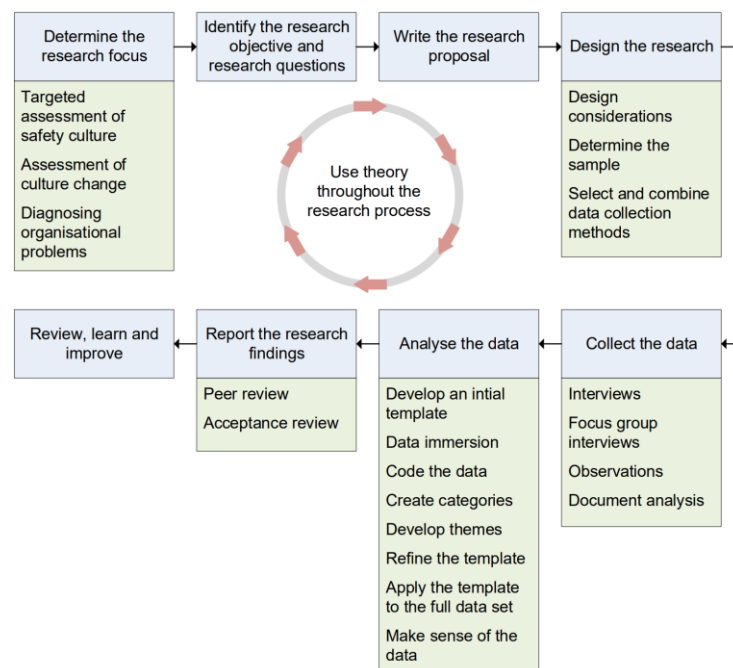

Figure 1: The research process

ONR may also want to assess culture change. Here ONR would undertake a longitudinal assessment, typically 12 to 36 months apart, so that comparisons can be made between the results of the two assessments. Culture change is challenging to assess: if an organisation improves its housekeeping, improves the quality of its written instructions, and develops a new set of organisational values, is this evidence of culture change or has the organisation simply made improvements in

three discrete areas of its business? To assess culture change, ONR advocates use of the iceberg model based upon Schein's (1990) model of organisational culture.

Consider an iceberg observed from a nearby ship; what is observable above the water is only a small amount of the mass that makes up the iceberg. Upon closer inspection more of the iceberg can be seen just underneath the surface of the water however the bulk of the mass is too deep to be seen with the nak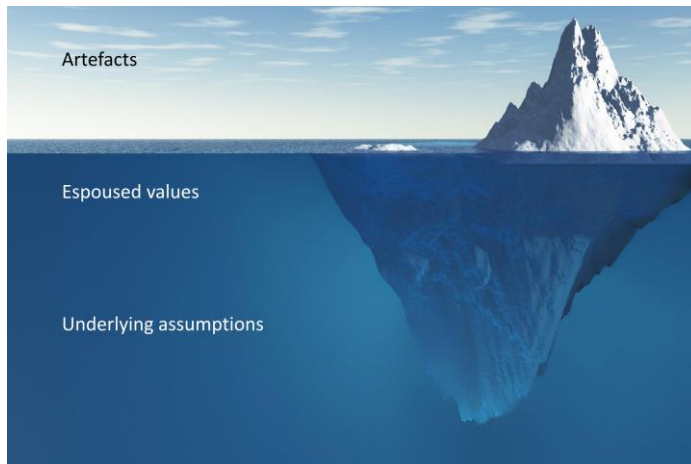ed eye. On the surface of the iceberg model are artefacts: the observable physical and social environment of the organisation. These include behaviours, architecture, physical layout, signage and symbols, slogans and expressions, technology, rituals and routines, control systems, and organisational structures.

Figure 2: Iceberg model of organisational culture

Just below the surface, less visible than artefacts are espoused values: the underlying meanings which explain patterns of behaviour and artefacts. Sometimes these are found to be documented in a 'value statement' which comprise of both deeply held values (those which are congruent with the underlying assumptions) and aspirational values (those which the organisation hopes to one day possess and which set a cultural direction).

Hidden deep below the surface, and usually invisible, are underlying assumptions. These are the taken for granted ways in which people within the organisation perceive the world. Sometimes described as the paradigm, they are only understood by people who have become accustomed to the way the organisation works. They are not written down, are rarely spoken about, and are difficult to unearth.

For an organisation to change its culture it must unearth and understand the underlying assumptions so that people can reflect upon them and recognise what is unconsciously driving their behaviours. It is only when deeply held assumptions have been modified, that culture change is likely to sustain. Inspectors concerned with assessing culture change develop an understanding of the deeply held assumptions and how they affect the way safety is enacted in the organisation. This requires reflection, analysis, and a degree of immersion in the culture of the organisation.

The research may not always be focussed explicitly on safety culture. Often an inspector may encounter a safety problem and wants to understand the underlying factors so that action can be taken to improve safety outcomes. Examples of safety problems that an inspector may encounter include workers not following safety rules, poor relationships between leaders and the workforce, failures to learn from previous events, or safety conversations that indicate complacency.

An important consideration for an inspector is to determine whether the safety problem they are initially presented with is the real problem or whether it is a symptom of a deeper systemic problem. Inspectors address this by considering whether the problem, as presented, is an 'antecedent' or a 'consequence'. Consider the example of an organisation whose leaders have been unsuccessful in their attempts to increase incident reporting. Following an exploratory study an inspector finds that the real problem may be the low safety motivation of employees who feel that safety is not a priority for the organisation. Here the low incident reporting rate is a symptom of a systemic safety motivation problem and if these conditions were to remain, setting reporting targets may not improve reporting. The inspector carries out a further exploration of the problem and reviews the academic literature; in doing this they identify that safety motivation mediates the effect of safety climate on individual behaviour (Griffin & Neal, 2000) and so they re-frame the original problem from one which started out as 'low incident reporting' to one concerned with 'safety climate'. To frame problems accurately, inspectors draw upon academic literature and models to understand the psychological processes which may be affecting safety outcomes. This differs from typical regulatory approaches which rely upon sources of relevant good practice as standards against which to judge compliance.

The second step in the research process is to **identify the research objectives and research questions**. It is important that the problem statement is framed accurately before moving forward with the research process. A well written problem statement comprises a description of the safety problem (the real problem, <u>not</u> its symptoms), the research objective(s) and the research question(s). Inspectors invest time and thought to ensure that a problem statement is written which is both relevant (is aligned to regulatory strategy) and feasible (is achievable given the resources available).

The third step in the research process is to **write the research proposal**. A well written research proposal will comprise a title, a problem statement, the scope of the study, the relevance of the study to ONR's purposes[1], an outline of the research design (pending detailed design), the timeframe and the resources required.

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[1] ONR's five purposes are set out in Part 3 Chapter 1 of the Energy Act 2013. They are nuclear safety, nuclear site health and safety, civil nuclear security, nuclear safeguards, and nuclear transport.

The fourth step in the research process is to **design the research**. The research focus determines much of the research design: a targeted assessment of safety culture normally requires a combination of semi-structured interviews, focus group interviews, observations, and document analysis to gather and triangulate data for subsequent analysis; an assessment of culture change normally requires a longitudinal assessment (two similar assessments normally 12 to 36 months apart); the diagnosis of an organisational issue normally requires an exploratory phase to properly frame the problem before embarking on further data collection.

Sampling is purposeful in qualitative research: inspectors select cases and participants in a strategic way to enhance insight. Inspectors take care not to rely on volunteers as they know that people who choose not to volunteer and therefore do not participate in the research often hold views which are of high research value. To avoid this, targeted invites are sent. Sampling continues until no new findings are generated; known as 'saturation', this indicates that an adequate sample has been undertaken.

Data collection methods are selected and combined to provide the best insights to the given problem. The combining of methods is particularly useful to elaborate on earlier findings, for example document analysis may be followed by observations to explore whether statements written in documents are enacted in practice, or observations may be followed by interviews to confirm understanding of what was observed. Triangulation of methods (using multiple sources of data) provides greater confidence in findings and aids the development of a richer understanding of the social processes being explored.

The fifth step in the research process is to **collect the data**. The four methods used are interviews, focus group interviews, observations, and document analysis. Interviews are the most widely used method for gathering data in qualitative research. Inspectors use two types of interviews: unstructured and semi-structured. In a semi-structured interview, the inspector develops and uses a pre-prepared interview guide to give structure to the interview, whereas in an unstructured interview the inspector may use only a brief aide-memoire coving several topics.

The choice of which interview method to use depends upon the level of understanding of the problem and the degree of comparability required: when the safety problem is not well understood the inspector will use unstructured interviews to gather initial data to frame the problem, whereas semi-structured interviews will be used when the safety problem is well defined; semi-structured interviews are also preferred where several inspectors are carrying out interviews to make it easier to compare the data gathered by each inspector.

Focus group interviews allow inspectors to examine how a group of people interpret and make sense of topics of interest to the research. Inspectors may gain an

Focus Group Interviews	Semi-Structured Interviews
Advantages: • Different perspectives • Voicing of agreements and disagreements • Qualification, justification, and reasons for views • Display of culture and group dynamics • More fully articulated accounts • Diversity of perspectives • Collective sense-making Disadvantages: • The number of questions covered may be limited • Less depth and detail • Careful moderation of the group is required to ensure that views are heard, and conflict is managed • Confidentiality can be a problem in a group of people • Potential for groupthink	Advantages: • Allow sensitive or personal topics to be explored • Greater control over the selection of the participants • Depth and comprehensiveness of responses to questions • Free from group pressures Disadvantages: • Time consuming • Lacks the opportunity to observe interactions with others

Figure 3: A comparison of focus group interviews and semi-structured interviews

appreciation of why people feel the way they do about a topic or scenario, and what people agree and disagree on and why. This group interaction provides rich insights into the culture which cannot be easily attained by other methods. The inspector gives careful thought to the mix of participants in the group to not stifle debate, for example a homogenous group, where all workers are of the same grade, may elicit more honest responses than an heterogenous group with participants of differing grades.

Structured Observations	Unstructured Observations
Advantages: • Provides a deep understanding of a specific context or issue • Less time and resources required • Can provide quantitative data (number of times something occurs / a behaviour is observed, in the context of interest) Disadvantages: • Narrower descriptions • Less freedom to collect data	Advantages: • Provides a deep understanding of a wider context • Reveals novel aspects of behaviour • Aids the identification of cultural symbols Disadvantages: • Time and resource intensive

Figure 4: A comparison of structured and unstructured observation

Observations involve going into a workplace, watching what people do and describing, analysing, and interpreting what one has seen. Observations can be structured or unstructured. Unstructured observations focus upon what people do, how things get done or don't get done, the work environment, cultural artefacts, relationships, or how people talk and interact. They generate a deep understanding of context, reveal novel behaviours, and aid the identification of cultural symbols.

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Structured observations focus on pre-specified tasks, events, or interactions, such as pre-job briefs or maintenance activities. Inspectors develop and use pre-prepared observation guides to aid data collection when undertaking structured observations.

Normally inspectors will be 'complete observers': this is the most unobtrusive observation as the inspector does not interact with the people being observed (Gold, 1957). There may be occasions where an inspector adopts a 'participant observer' role such as attending a training course where the inspector is open with the trainer and other participants about their research and observes and collects data whilst participating fully in the social setting (Gold, 1957). As an independent statutory regulator, it would not be appropriate for inspectors to adopt a 'complete participant' role as this would require them to immerse themselves in the work of the dutyholder.
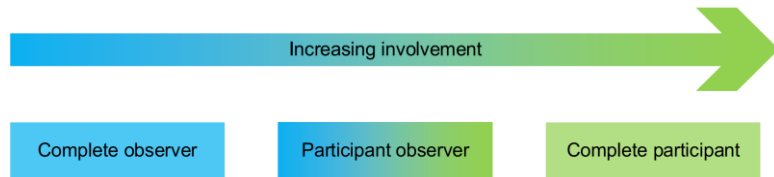

Figure 5: Observer roles

Document analysis is a systematic method for evaluating or reviewing documents that is often carried out early on to help shape the focus and design of the research. Documents to be analysed may be current, historic, private, publicly available, strategic, or tactical. Document analysis may provide insights into hierarchy, power, authority, the degree to which safety controls and formalised, and how people value and prioritise safety.

The sixth step in the research process is to **analyse the data**. ONR advocates the use of template analysis, a form of thematic analysis which is well suited to research carried out in an applied context (King, 2012). Template analysis comprises three phases: preparation, coding and application.
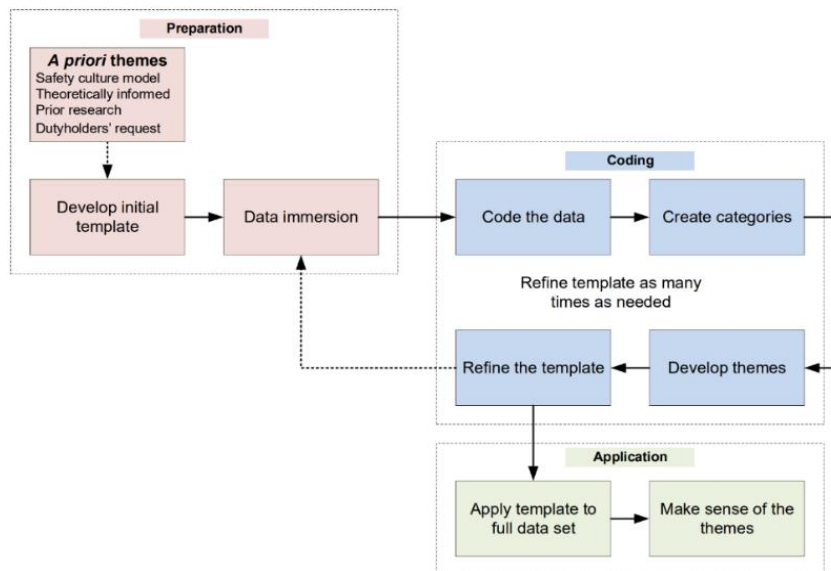

Figure 6: Data analysis method

For the **preparation** phase, the first step is selecting *a priori* themes for the development of the initial template. The selection of *a priori* themes will depend upon the research focus. Normally, if the research focus is a targeted assessment of safety culture or culture change, the *a priori* themes will be structured upon a model of safety culture such as the traits and attributes of the Harmonised Safety Culture Model (IAEA, 2020). When the research focus is concerned with diagnosing a safety problem, the *a priori* themes are likely to be developed from academic literature and models relevant to the social processes being explored. *A priori* themes may also be derived from the findings of previous research carried out by ONR. On occasions the leadership of a dutyholder organisation may request that ONR explores themes that the organisation is interested in knowing more about; the inspector will normally incorporate these themes into the template where they broadly align with the research objective(s).

Once the initial template has been developed an inspector will immerse themselves in the data set to get a sense of the whole. This involves reading and re-reading the interview transcripts, notes from focus group interviews, observation field notes, and documents selected for document analysis. By doing this the inspector begins to make connections between discrete data sources and develops ideas about the nature of the areas being explored.

For the **coding** phase, the first step is to code a small sample of the data such as one or two interview transcripts. A code is a descriptive label that is assigned to segments of text. The aim of coding is to tag and sort the data. The next step is to create coherent categories by grouping codes which fit well together and share a relationship. Enough categories are developed to explain everything in the data that is relevant to the research questions. Much of the data will be coded and grouped under the *a priori* themes however it is not unusual to develop several additional categories that are relevant to the research questions. Several of these categories may then be grouped together to form a new theme. Themes are more than higher-order categories: they are an explanation or interpretation of what is being explored. The final step of this phase is to refine the template which will now be a product of the *a priori* themes and the newly developed themes.
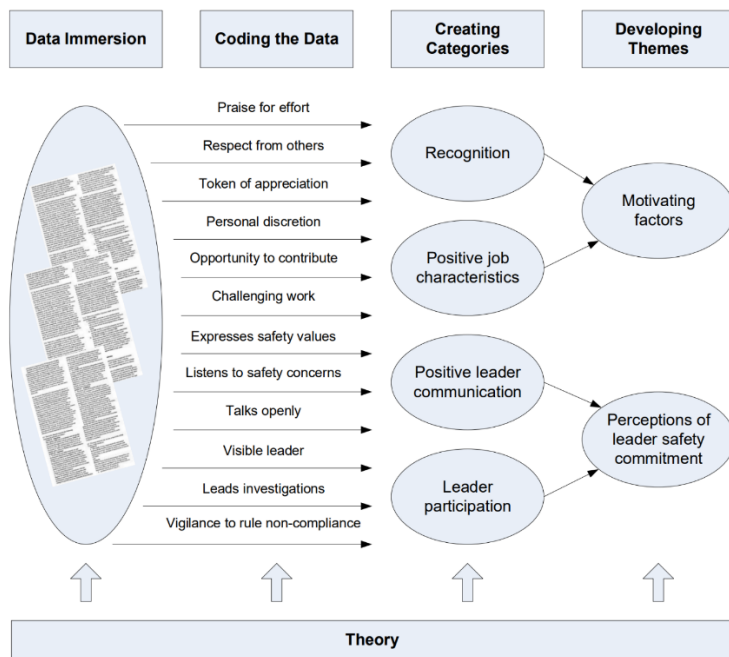
Figure 7: The creation of themes (redrawn, from Green et al, 2007)

As the analysis develops it may become clear that one or more themes seem to cut across many or all the other themes. Known as 'integrative themes' these are: "undercurrents running through participants' accounts; often, perhaps, not addressed explicitly but very apparent to a careful reader" (King, 2012, p.432). These integrative themes often provide deep insights into the non-observable culture (the underlying assumptions) and can be a high value research finding.

For the **application** phase, the first step is to apply the template to the full data set. This involves grouping words, phrases, and segments of text to the hierarchical structure of the template's categories and themes. Significant amounts of data that cannot be grouped to the template's categories and themes yet are of interest to the research question(s) indicates that the template requires further refinement. This data is coded, grouped into categories, and developed into themes to be added to the template.

The final step of data analysis is to make sense of the grouped data: to describe each theme and to draw insights to formulate answers to the research questions. This is often achieved by explaining the story within the data to establish its meaning. Inspectors incorporate quotes from interviews or excerpts from documents which best illustrate the essence of the categories or themes when writing up the research findings using the Setup-Quote-Comment method (Weaver-Hightower, 2018):

Setup: The first sentence or paragraph states the 'thesis' and gives context for the quotation which is to follow, such as who said it (role or pseudonym) and what they were talking about at the time.

Quote: The next element is the quote itself. Pick quotes or data excerpts which best illustrate the point being made.

Comment: The final sentence or paragraph emphasises important parts of the quote or data excerpt.

Setup
The workers were generally positive about the safety commitment of their peers and immediate supervisors however they were less positive about the safety commitment of their more senior management. As is clear in this quote from a front-line worker which they made during a focus group interview, the worker perceived a clear difference in safety commitment across hierarchical grades:

Quote
"I've got no problem with my boss, he's 100% on message with safety. Our safety is number one to him; he's always banging on about it. It's the higher up bosses that cause the problems by putting pressure on. As far as they're concerned programme is everything especially when there's a milestone payment due."

Comment
This quote highlights that workers perceive the safety commitment of more senior management to be low in contrast to their immediate management and offers insight into factors which the worker considers may be influencing a senior manager's behaviour: the milestone payment. The quote also illuminates that positive safety communications (*"always banging on about it"*) is perceived by the worker as a demonstration of his immediate supervisor's safety commitment.

Figure 8: An illustrative example of the Setup-Quote-Comment method

The final two steps in the research process are to **report the research findings** and undertake a **review, learn, and improve** exercise. The research findings are presented in an ONR document known as an assessment note. Assessment notes which support key regulatory decisions undergo an approval process known as 'acceptance review'. A copy of the report is shared with the dutyholder and the key findings are normally presented at a workshop so that the dutyholder can ask questions and seek clarification of points. Once the feedback has been given a review, learn and improve exercise is undertaken. This exercise considers what went well and why, what didn't go well and why, and identifies key lessons for future research. The output of the exercise is recorded and made accessible to other inspectors embarking on research.

Case study: Using qualitative research methods to influence improvements in nuclear safety

In 2018, a team of ONR inspectors working collaboratively with a dutyholder undertook a series of focus group interviews and unstructured interviews to understand the factors behind a series of non-compliances with safety rules. The inspectors identified two themes which provided insights into the safety challenges the dutyholder was facing at this time. These themes were grounded in perceptions of management safety commitment and employee engagement: the participants held a shared perception that management prioritised meeting programme demands and that safety was an important but

secondary consideration; the inspectors also found there to be low levels of employee engagement with a majority of participants being actively disengaged.

An engaged and motivated workforce, that perceives its management as being committed to safety, is associated with increased safety participation and safety compliance (Cigularov et al., 2013; Flin 2003, Flin et al., 2000; Frazier et al., 2013, Griffin & Neal, 2000; Guldenmund, 2000; Harter et al, 2002; Zohar, 2008). Research has also identified perceptions of the safety commitment of management as one of the most "common and influential components of safety climate" (Fruhen et al., 2019, p.203).

In response to the assessment findings, the dutyholder embarked on a period of improvement activities to increase management safety commitment and employee engagement, and over the same period ONR undertook a series of regulatory interventions to sample progress and influence improvements, culminating with a longitudinal assessment towards the end of 2020 to understand the progress the dutyholder had made with their safety culture improvement efforts. This second assessment utilised the methods outlined in ONR's newly published culture assessment guide and was carried out with a greater degree of methodological rigour than the earlier assessment. All inspectors involved in this later assessment had undergone three days of qualitative research methods training at Alliance Manchester Business School and had some prior experience of assessing safety culture.

The focus of this second assessment was to understand how successful the dutyholder's efforts had been in increasing management safety commitment and employee engagement, and so the inspectors produced a problem statement which outlined the safety problem, the research objective, and the following research questions:

1. How does organisational practice affect employee engagement?
2. How does the workforce perceive the safety commitment of management?
3. How are these affecting safety performance?

The inspectors produced a research proposal which they shared with the dutyholder to ensure that both parties had a common understanding of the purpose of the research and how it would be undertaken. The dutyholder was also invited to nominate a staff member to join ONR's assessment team. This early engagement helped to secure leadership commitment to the research.

The next step was to design the research. The chosen design comprised of each of the four primary methods outlined in this paper: interviews, focus-group interviews, observations, and document analysis. Several semi-structured interviews were to be undertaken with managers in various roles; participants were to be selected purposefully to ensure that the most insight could be gained. Five homogenous (by rank/grade) focus group were to be undertaken: a group of front-line workers; a group of first-line managers; a group of middle managers; a group of Trade Union safety representatives; a group of culture change facilitators.

One of the inspectors was required to undergo two site induction training courses before accessing the site so this provided opportunities for the document analysis of induction training materials and for observation of the training courses to be carried out (as a 'participant-observer'). Observations of operations across several shifts were also planned.

The data collection methods were to be combined as follows:

- The focus group interviews to provide clarification of what was observed out on the plant.
- Observations of operations to look for evidence of assertions made in the focus group interviews.
- Triangulation of data across the focus-group interviews, semi-structured interviews, and observations.

Early on, the inspectors identified the need to draw upon the academic literature to inform and shape the research, and so following a literature review the inspectors developed an initial template of *a priori* themes utilising frameworks outlined in academic literature concerned with management safety commitment and employee engagement. For 'safety commitment', the inspectors selected a model of safety commitment demonstrations: communication; managerial participation; support and guidance; allocating resources; policy development, decision making and implementation; involving workers (Fruhen et al., 2019). This model was selected as it outlines "the ways in which leaders view safety and the various things that they do that lead employees to perceive their leaders as committed to safety" (Fruhen et al., 2019, p203). For 'employee engagement', the inspectors selected a model of antecedents of employee engagement: job characteristics; perceived organisational support; perceived supervisor support; rewards and recognition; distributive justice; procedural justice (Saks, 2006). This model was selected as it outlines several factors (the antecedents) which predict both job and organisational engagement (Saks, 2006).

Due to the ongoing pandemic, the inspectors undertook the semi-structured interviews remotely. Video-conferencing software rather than telephone was used as it was felt that being able to both see and hear the interview participants would help with establishing rapport and trust. Participants were provided with information sheets that provided an outline of the purpose of the interviews and how the data would be collected and processed. Each interview was recorded, and written transcripts were prepared. The focus group interviews were carried out at site in a socially distanced setting. Observations of operations were carried out on both the day shift and the back shift.

Once the data collection was complete, the inspectors read and re-read the complete dataset before coding two interview transcripts using a template of *a priori* themes developed from the two academic papers. This initial coding confirmed there was a good fit with the *a priori* themes yet it led to the identification of two additional themes: 'work pressure' and 'challenge culture'. Further coding of the notes from a focus group interview resulted in the template being refined further: the modification of the theme 'challenge culture' to 'raising safety concerns', the removal of the theme 'work pressure',

and the addition of the theme: 'just culture'. A simplified version of the final template is shown in figure 9 (a fuller template with an additional layer of lower order sub-categories was used to help guide the analysis). The final template was then applied to the remaining data.

With the data now grouped by categories and themes, the inspectors took time to make sense of the data. This involved them reading and re-reading the data as a whole and then focussing more intensely upon the data grouped in each category. The inspectors referred to the academic literature throughout this step of the research process to help them understand the social processes described in the data. The inspectors documented their research findings in a report which 'told the story' within the data to establish its meaning. For 'safety commitment' the inspectors discussed: how and what managers communicate about safety and how people perceive this communication; how managers participate in safety activities and how their visibility in the workplace is perceived by others; how people feel about the support and guidance provided by their leaders; how people feel about their involvement in safety activities and how their leaders encourage suggestions and consider their input; how leaders

> **FINAL ANALYSIS TEMPLATE**
> 1. Demonstrations of safety commitment
>   1.1. Communication
>   1.2. Managerial participation
>   1.3. Support and guidance
>   1.4. Allocating resources: finances, equipment & time (indirect)
>   1.5. Policy development, decision making & implementation (indirect)
>   1.6. Involving workers
> 2. Employee engagement
>   2.1. Job characteristics
>   2.2. Perceived organisational support
>   2.3. Perceived supervisor support
>   2.4. Rewards and recognition
>   2.5. Distributive justice (fairness of decision outcomes)
>   2.6. Procedural justice (fairness of procedures to determine outcomes)
> 3. Raising safety concerns
> 4. Just culture

Figure 9: Final analysis template

allocate resources for safety, how leaders set and implement safety policies, and how quickly and decisively leaders act on safety issues. For each category, the inspectors discussed how worker perceptions of safety commitment are affected by these findings.

For 'employee engagement' the inspectors discussed: participants' views on the characteristics of their jobs which provide psychological meaningfulness; perceptions of how both the organisation and supervisors support and care for people; how reward and recognition is enacted and how people feel about this; perceptions of fairness and justice. For each category, the inspectors discussed how employee engagement is affected by these findings. For the additional themes of 'raising safety concerns' and 'just culture', the inspectors discussed factors found to be affecting psychological safety and perceptions of how demands for accountability are satisfied.

The inspectors identified several good practices and behaviours which were positively affecting perceptions of management safety commitment or employee engagement, alongside several practices and behaviours which were negatively affecting these. The inspectors also identified areas for improvement in establishing a just culture and creating an environment where people feel psychologically safe to raise concerns. The inspectors also discussed how the findings may be affecting safety performance thereby addressing the last of the three research questions. The inspectors used the Setup-Quote-Comment method to report the findings, choosing quotes which best illustrated the points being made.

The inspectors identified an integrative theme from analysing the data which they named: "us and them". The dutyholder has both an industrial (workers) and a non-industrial (management) workforce and participants referred to these groups using terms such as "the blue hats" (the colour of the safety helmets worn by workers) and "the white hats" (the colour of the safety helmets worn by managers), or "the industrials" and the "non-industrials". This language, and the context in which it was used, indicated that there were opportunities to improve the relations between the industrial and non-industrial workforces. This finding is of significance to the research objective as workers in high quality relationships with their managers are more likely to engage in safety citizenship behaviours (Hofmann et al., 2003). This integrative theme was discussed in the report as a key finding.

The inspectors also discussed how perceptions of the safety commitment of management and employee engagement had changed when compared to the earlier assessment carried out in 2018. Two of the inspectors and the dutyholder appointed team member had participated in this earlier assessment and were therefore well placed to evaluate the changes. The inspectors found that there had been improvements across all six categories of safety commitment, and overall, this had resulted in a significant improvement in worker perceptions of the prominence of safety relative to programme demands. The inspectors also found that employee engagement had improved, with improvements being most pronounced in the categories of job characteristics, perceived organisational support, perceived supervisor support, and reward and recognition. No notable improvements in perceptions of distributive justice or procedural justice were found and the inspectors discussed why this may be. The themes of 'raising concerns' and 'just culture' were not explored during the earlier assessment, however there were enough examples in the earlier assessment data for useful comparisons to be drawn.

The research findings were presented to the dutyholder's head internal regulator to test the credibility of the findings and received an encouraging response. The research findings were then presented to the dutyholder's leadership and key safety and operational personnel. The dutyholder appointed assessment team member contributed to providing the feedback and this helped to increase the credibility of the findings with those receiving the feedback. The dutyholder personnel received the feedback constructively and at each feedback session a healthy debate ensued about the implications of the feedback

and how the information may be used to make further improvements. The dutyholder has subsequently used several of the research findings to inform its improvement plans

ONR inspectors used the research findings to aid their decision making and to re-focus their strategy for the regulatory oversight of the dutyholder's culture improvement efforts. Once the research was complete the inspectors undertook a review, learn, and improve exercise to capture key lessons so that these may be made available to inspectors carrying out future research.

Discussion

Qualitative research methods provide an effective framework for inspectors concerned with undertaking targeted assessments of safety culture, assessments of culture change, or diagnosing problems which may be affecting safety performance. The application of methodological rigour and the use of academic literature to inform thinking, complements existing regulatory approaches such as inspection, permissioning assessment, and investigation. The qualitative methods outlined in this paper can be effective in aiding regulatory decision making, particularly where decisions relate to the more intangible aspects of nuclear safety such as culture. They can also help inspectors to shape regulatory strategy and to influence improvements within dutyholder organisations.

The application of the methods outlined in the case study was successful in meeting the research objective and answering the research questions. Factors which contributed to this success include:

- Sharing the research proposal early on with the dutyholder to establish trust and build confidence that the research is intended to provide insights which are of benefit to both organisations.
- Inviting dutyholder staff to join the research team. This has several benefits as it helps to enhance credibility of the findings, it assures stakeholders who are suspicious of interventions of this nature, and it develops the dutyholder's own capabilities for undertaking similar assessments.
- Gaining the support of the Trade Unions.
- Taking time to build trust and rapport at the start of each interview and focus group interview.
- the willingness of management to engage constructively with the feedback provide to them on the research findings.

Several factors made the research challenging. The research was carried out during a pandemic with the on-site data collection coinciding with the start of a national lockdown towards the end of 2020. This made it challenging to move freely around the site and led to a lower number of participants than anticipated in some focus group interviews. The inspectors were concerned that saturation had not quite been achieved and whereas under normal circumstances they would ask to undertake more data collection, this was not practicable due to COVID-related site restrictions.

ONR is an independent statutory regulator and there may be occasions when information is uncovered during research which may indicate that formal enforcement action is required. On the rare occasion where this may occur, the research will be halted, and an appropriate regulatory approach will be adopted in line with ONR's enforcement policy statement (ONR, 2020b). Inspectors will handle occurrences of this nature sensitively to not discourage future participants from speaking openly.

ONR's guidance document was formally issued in December 2020 following its successful application as outlined in the case study. Inspectors are now using the document to aid them in planning several culture assessments in line with ONR divisional strategy and plans. ONR has continued to build on the training provided by Alliance Manchester Business School by providing continued professional development opportunities for its specialist inspectors. The guidance is published on ONR's website (ONR, 2020a) and is now available for download.

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