Decommissioning the UKCS: increasing flexibility of approach through proportionate regulation and evidence based practice.

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2018

DECOMMISSIONING THE UKCS: INCREASING FLEXIBILITY OF APPROACH THROUGH PROPORTIONATE REGULATION AND EVIDENCE BASED PRACTICE

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A thesis submitted in partial fulfilment of the requirements of the Robert Gordon University for the degree of Doctor of Business Administration

October 2018

ABSTRACT

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Title: Decommissioning the UKCS: Increasing flexibility of approach through proportionate regulation and evidence-based practice.

The purpose of this research is to investigate how industry and Government can strategically align to improve the efficiency and gain environmental benefit from the challenge of decommissioning redundant offshore oil and gas infrastructure through an alternative evidence-based practice and proportionate regulatory approach. Despite nearly thirty years of periodic decommissioning activity, the regulatory drivers and programme design dynamics continue to be politically driven and not evidence based (Penner, 2001, Bellamy and Wilkinson, 2001 and Pulsipher and Daniel, 2000), projects are not deliverable as originally agreed in the approved programmes (BEIS close out reports), and not maximising the potential benefits to the marine environment of the North Sea (Jorgensen 2013, Van Der Stap et al, Macreadie et al 2011, Love et al, 2003, and Soldal et al, 2002). Much of the knowledge and experience gained over the past thirty years has not been recorded or archived in any form that would benefit future programmes and approved decommissioning programmes continue to be audited historically rather than in real time. All stakeholders have a genuine interest and an opportunity to benefit from a regulatory approach that is both evidence-based and proportionate by design.

An adopted mixed methods approach, combining quantitative, qualitative and case study approaches were used to investigate the current regulatory framework and the resulting decommissioning methods that are employed to achieve compliance. The development and impact of the current decommissioning framework was investigated from both the published literature and the research participant's perspectives. The emerging recommendations for change are based on evidence from this research.

This research adds to the body of knowledge on three fronts, theoretical, method and practise. Gaps between theoretical compliance demands and deliverability

are identified, several evidence-based recommendations are made and an alternative, more flexible framework is proposed. The audit methodology and audit template are significant contributions to practice. The research concludes with key recommendations. The primary recommendation of this research is that the United Kingdom Government should implement a fundamental review of the current regulatory framework for offshore decommissioning and consider the evidence base for proposing changes to OSPAR Decision 98/3. The supporting recommendations are: that the derogation limit of 10,000 tonnes should be removed and each project should be assessed on an individual case basis; the UK Government should initiate through a broad stakeholder consultation the introduction of a rigs to reefs programme on the UKCS; the current baseline, of a clear seabed, one size fits all approach is not sustainable and a more flexible, proportionate approach should be adopted; specific changes are proposed to the current regulatory framework to increase its proportionality; the audit process needs to be strengthened and focus on invasive audits to increase stakeholder confidence; guidelines provided to industry need to be revised; and the regulator in partnership with industry should develop a decommissioning knowledge bank at the heart of a knowledge transfer system.

Taken together the research and the resulting recommendations have generated a conceptual framework combining strategic evidence based decommissioning options with proportionate regulatory practices to provide both policy makers and industry with a developmental envelope for an alternative framework for future decommissioning in the United Kingdom and further afield.

Key words: oil and gas; decommissioning; offshore, proportionate regulation; marine environment, evidence-based practice.

Acknowledgements

The thesis produced by this research has been achieved with the support of several individuals. I am extremely grateful for the long-term support and valuable advice provided by my principal supervisor Professor Peter Strachan who, despite our differing viewpoints on the subject matter provided robust challenge and debate during the research period. Similarly, Professor Strachan provided firm, invaluable direction and substantive comments during the latter stages of the thesis.

I am also grateful to Professor Heather Fulford who provided constructive advice on structure and design during the drafting stage, and Dr. Leon Muller who provided additional advice and guidance during this project. I am also like to thank Dr. David Jones who provided encouragement and direction during my annual reviews.

It would be remiss not to record my thanks and appreciation of the contributions of knowledge, experience and personal time provided by the many industry and regulatory professionals both in the UK and around the world who participated in this research. Without their contributions the resulting thesis would not have been possible.

Finally, I would like to thank my family, friends and work colleagues who for the most part did not understand what I was up to but put up with my early mornings, late evenings, missed weekends and outwardly odd diary entries and random periods of out of office email responses.

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LIST OF ABBREVIATIONS AND ACRONYMS

Asia Pacific Economic Cooperation group (APEC)

Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE).

Best Available Techniques (BAT)

Best Environmental Practice (BEP)

Best Practical Environmental Option (BPEO)

Catenary Anchor Leg Mooring (CALM)

Cessation of production (COP)

Centre for International Earth Science Information Network (CIESIN)

Consent to Locate (CTL)

Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)

Decom North Sea (DNS)

Decommissioning Relief Deed (DRD)

Decommissioning Working Group (DWG)

Department of Business, Energy and Industrial Strategy (BEIS)

Department of Energy and Climate Change (DECC)

Department of Mineral Fuels (DMF).

Environmental Emissions Monitoring System (EEMS)

EU Emissions Trading Scheme (EU-ETS)

Fluorinated gases (F-Gas)

Floating Production, Facility (FPF)

Gravity Based Systems (GBS)

Greenhouse Gas (GHG)

Health and Safety Executive (HSE)

Heavy Lift Vessel (HLV)

International Convention for the Prevention of Pollution from Ships (MARPOL)

International Maritime Organisation (IMO)

London Dumping Convention (LDC)

Maritime and Coastguard Agency (MCA)

Ministry of Petroleum and Energy (MPE)

Offshore Chemical Regulations (OCR)

Offshore Environmental Inspectorate (OEI)

Offshore Petroleum Activities Oil Pollution Prevention and Control (OPPC)

Offshore Petroleum regulator for Environment and Decommissioning (OPRED)

Oil Pollution Preparedness, Response and Co-operation Convention Regulations (OPRC)

Oil and Gas Authority (OGA)

Oil and Gas UK (OGUK)

Offshore Petroleum Regulator for Environment and Decommissioning (OPRED)

Petroleum revenue tax (PRT)

Pollution Prevention and Control (PPC)

Produced Water (PW)

Ring-fence corporation tax (RFCT),

Supplementary charge (SC) and petroleum revenue tax (PRT)

United Nations Convention on The Law of The Sea (UNCLOS)

United Kingdom (UK)

Chapter 1: Introduction

1.1 Chapter introduction

Chapter 1 states the research problem and the goal of the research. The chapter outlines the research methodology that will be employed and the scope of the research, together with its limitations and explains the layout of the thesis.

1.2 The background of the research and research problem

Decommissioning of redundant offshore oil and gas infrastructure is not a new scenario on the United Kingdom Continental Shelf (UKCS). The decommissioning of offshore oil and gas infrastructure have been taking place in the United Kingdom (UK) since 1991 when the Crawford Floating Production Facility (FPF), Catenary Anchor Leg Mooring (CALM) buoy and associated subsea infrastructure was decommissioned (BEIS 2016), the current regulatory framework has been in place largely unchanged for two decades (Techera and Chandler, 2015) since Decision 98/3 was adopted (OSPAR, 1998). Both globally and in the UK the pace of decommissioning is now rapidly increasing as many more platforms head towards uneconomic production status (Fowler et al, 2014).

The significant cost of decommissioning currently estimated at £58 billion by the Oil and Gas Authority (OGA) (2017) is only now beginning to be understood by the stakeholder community. The range and scale of stakeholders can be illustrated by the evidence in the Murchison stakeholder engagement report by Canadian Natural Resources (2013) which listed 80 external organisations that were identified and contacted during their stakeholder engagement activities, and Shell (2008) who engaged with around 180 organisations during their stakeholder engagement activities. Stakeholders range from statutory consultees such as the Scottish Fishermen's Federation (SFF), to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) who are the principle regulator for decommissioning, and other regulators for example the Department of Environment, Fisheries and Rural Affairs (DEFRA) and the Health and Safety Executive (HSE). Other Government Departments such as the Ministry of Defence (MOD), and associated agencies including the Joint Nature Conservation Committee (JNCC), Natural England (NE), and Scottish Natural Heritage (SNH). Stakeholders also include other oil and gas operators,

environmental organisations such as Greenpeace and Friends of the Earth, and more broadly UK residents in their role as taxpayers. The fact that the general public are stakeholders in decommissioning stems from their role as taxpayers and the link with the tax relief that is given to the industry against the costs of decommissioning. The tax relief is in effect an opportunity cost lost to the exchequer/general public in that the tax that otherwise would have been received and could be utilised for the public good is in effect written off.

The significant costs of decommissioning are driven by an inflexible regulatory framework that it will be argued is not evidence based and it will also be argued that there is a growing body of evidence that the current regulatory framework is not necessarily providing the optimum outcomes for the marine environment. Equally the current audit inspection process adopted by the regulator, OPRED, does not reflect the environmental risk nor indeed the scale of public money involved through the provision of tax relief on decommissioning costs.

This research takes the view that the status quo is not sustainable and that there is an opportunity to challenge the current constraints and redraw the decommissioning regulatory envelope. This research is an attempt to address the challenges of balancing the requirement for regulations that are both flexible and proportionate with evidence based decommissioning practices that manage costs whilst providing optimal results for the marine environment. The goal of the research is to develop an alternative decommissioning framework based on academic rigour, evidence-based practice and guided by proportionate, flexible regulations. Academic rigour is achieved through a combination of a thorough review of the available academic literature, and a robust research methodology. The evidence-based practice and proportionate regulatory envelope are identified through the application of the research methodology. Figure 1-1 illustrates the goal of the research.

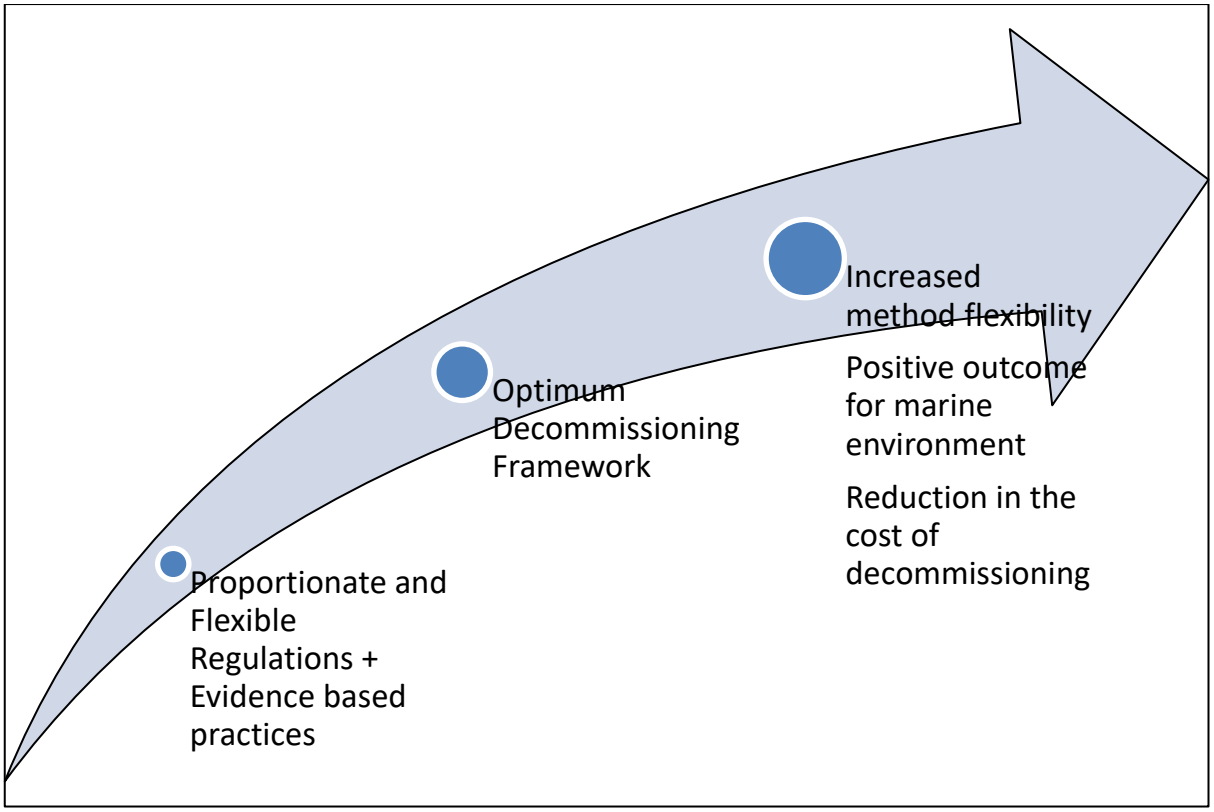

Figure 1-1: Research Goal. Source: Author

Despite the increasing volumes of the physical infrastructure necessary to extract the oil and gas that are heading towards the end of their economic lifecycle and will require decommissioning (Parente et al, 2006), the UK oil and gas industry remains an important industry in the UK. This view is supported by Hough (2017) who summarises that the UK offshore oil and gas industry contributed some 0.8% of GDP in second quarter of 2015 and supported around 370,000 jobs. According to OGUK (2017) since 2014, production has increased by 16 per cent following a decade of continuous decline and, by the end of the 2017, one-third of production will come from new fields that have started up since 2016.

Decommissioning is not a straightforward case of reversing the process for installing the infrastructure and will, for both industry and Government become a major challenge in terms of developing the solutions required for the myriad issues ahead which include technical complexity, physical scale of the structures, cost, safety and environmental protection. The challenges ahead are likely to dwarf those encountered during the exploration and production phase of exploiting the hydrocarbon deposits of the North Sea (World Bank, 2010).

The challenge of decommissioning is not restricted to the UKCS. Globally the majority of crude oil producing countries are beginning to experience production declines. According to the International Energy Agency (IEA, 2013) the average production-weighted decline rate worldwide was approximately 6.0% in 2012 for fields that were beyond their peak production period. Additionally, (S&P Global Platts, 2016) projections indicate that the production decline rate for non-OPEC producers was approximately 5% in 2016 and that an even higher decline rate for OPEC producers was evidenced. Across many oil and gas basins in the world, including Australia noted in Barrymore (2017), China noted in Naa (2017), and Holland noted in EBN (2016a) concerns over the scale of decommissioning are increasing and it is likely that those countries and others will face similar issues to the UK. Indeed, the above scenario is reflected across the globe with thousands of the world's offshore oil and gas platforms aging to the point where they will require to be decommissioned (Doyle et al 2008).

The UK should not be undertaking decommissioning in isolation, it is a global challenge and there are potential lessons to be learned from understanding the approaches being taken elsewhere around the world within the boundaries set by international conventions such as United Nations Convention on the Law of the Sea (UNCLOS) and the Guidelines set by the International Maritime Organisation (IMO). Individual countries and regions are tackling decommissioning differently and even just across the median lines, the approach taken by Norway is similar but not the same as the UK. For example, according to Jorgensen (2012) Norway has not adopted the OSPAR guidelines that prohibit the use of redundant oil and gas infrastructure as material suitable for artificial reefs, whereas the UK has adopted the OSPAR guidelines. A further example is Holland where according to EBN (2016b) recent pilot studies have shown that platform jackets in the North Sea support the marine ecosystem of a rich and biodiverse habitat, and they are considering a trial of the rigs to reef approach which is an option that has not been adopted in the UK.

Additionally, considering the eventual scale of the opportunity cost lost to the UK exchequer and by default the taxpayer through the provision of significant levels of tax relief which are currently estimated to be in the region of 50%-70% of the £58 billion total cost of decommissioning estimated by the OGA (2017), it is argued that the Government should have in place a suitable audit system to

provide confidence to stakeholders that the decommissioning work scopes have been executed in line with the approved programme and with a proportionate level of impact on the environment.

To compound the long-term challenges that industry and Government face, the evolution of significant elements of the current UK regulations are not wholly science or evidence based and according to Pulsipher and Daniel (2000) and some aspects are more a reflection of political expediency (Bellamy and Wilkinson, 2001). From a global perspective this lack of evidence based decommissioning UK legislation as argued by Jorgensen (2012) could be considered a concern as other countries including Australia (Techera and Chandler 2015) are looking at the current UK system as a potential model to consider during the development of their own decommissioning regulations and guidelines.

Within the context outlined, the regulator (OPRED) faces two important challenges. Firstly as the rate of decommissioning increases according to OGUK (2017), with £17 billion forecast to be spent on UKCS decommissioning between now and 2025, how appropriate is the current decommissioning regulatory framework which has not been reviewed for two decades and considering the decommissioning knowledge and experience that has been gained during this period does it remain a valid foundation for the significant volumes of decommissioning that will be happening in the decades to come? Secondly as the public profile and awareness of the decommissioning in general together with the implications of the impact of tax relief given to the industry becomes more apparent, BEIS needs to generate an audit process that would demonstrate to stakeholders including taxpayers that the approved decommissioning programmes are being executed with due consideration of the environment and in line with the approved decommissioning programmes.

The first issue of what in essence is an analysis of the fitness for purpose of the current UK decommissioning regulations, it could be argued is a timely debate considering that the drivers influencing the approaches to dealing with redundant offshore installations today are different in comparison with the drivers in 1998 when significant decisions were taken regarding the regulatory framework underpinning the decommissioning regime for the UKCS. Since 1998 technology

has moved on, for example the Pioneering Spirit, a state-of-the-art multi-purpose twin hull vessel with a topside lift system with the capability to a weight of 48,000 tonnes (Den Haan, 2016), was used to remove the Brent Delta topside in one single lift. Decommissioning knowledge and experience in the UK is growing with (BEIS, 2016) records listing more than 30 decommissioning programmes that have been executed since 1998, and issues such as the environment as well as societal needs and public expectations are growing in importance according to Yakovleva (2016) and Rasche et al (2017). The significant scale of the costs involved in decommissioning under the current regulatory framework are only now beginning to be recognised but the increase in cost estimates from year to year suggest that the true costs of decommissioning the UKCS have historically been under-estimated and question the sustainability of the current approach which was set two decades ago. When OSPAR contracting parties including the UK, agreed Decision 98/3, the cost estimate for decommissioning the UKCS was estimated by Wood-McKenzie (1998) at £8.5 billion. More recently, several cost estimates for decommissioning from Government, Trade Associations and industry respected academics such as Professor Alex Kemp have been published over the past two decades and the common factor is that the estimates continue to increase. For example from the 1998 estimate of £8.5 Billion (Wood-McKenzie, 1998) through the £31.9 billion 2011 estimate by Kemp and Stephen (2011) to the latest Oil and Gas Authority (OGA) (2017) estimate of £58 billion, with according to Oil and Gas UK (2017) decommissioning survey estimating that total forecast expenditure on decommissioning from 2017 to 2025 alone will be in the region of £17 billion.

There is, based on the context outlined in this chapter an opportunity to generate a distinct contribution to the body of knowledge of decommissioning from the regulatory perspective to inform the future development of the UK regulatory regime and to generate a physical audit methodology for the decommissioning of offshore infrastructure. The outcomes from this research project will be unique and will add value to the decommissioning regulatory framework on the UKCS.

1.3 Research aim and questions

The research aims firstly, to critically review the existing UK decommissioning policy, regulatory environment and structure with the intention of developing an in-depth critique of the current UK decommissioning model. Secondly to identify any weaknesses in the current status quo, and thirdly, to identify and consider alternative evidence based decommissioning approaches being deployed in other countries that have the potential to add value and provide flexibility to the current regulatory regime in the UK. The research aims to combine evidence-based practice with proportionate regulations to create a new framework for future UKCS decommissioning. Additionally, this work could underpin the basis for the UK/OPRED position at future OSPAR reviews. In parallel the research will also aim to develop a practical invasive audit procedure and toolkit for OPRED personnel to deploy which will strengthen the audit process of decommissioning. To achieve the above aim a set of research questions have been formulated. The research questions have been designed in the following format which is illustrated in figure 1-2:

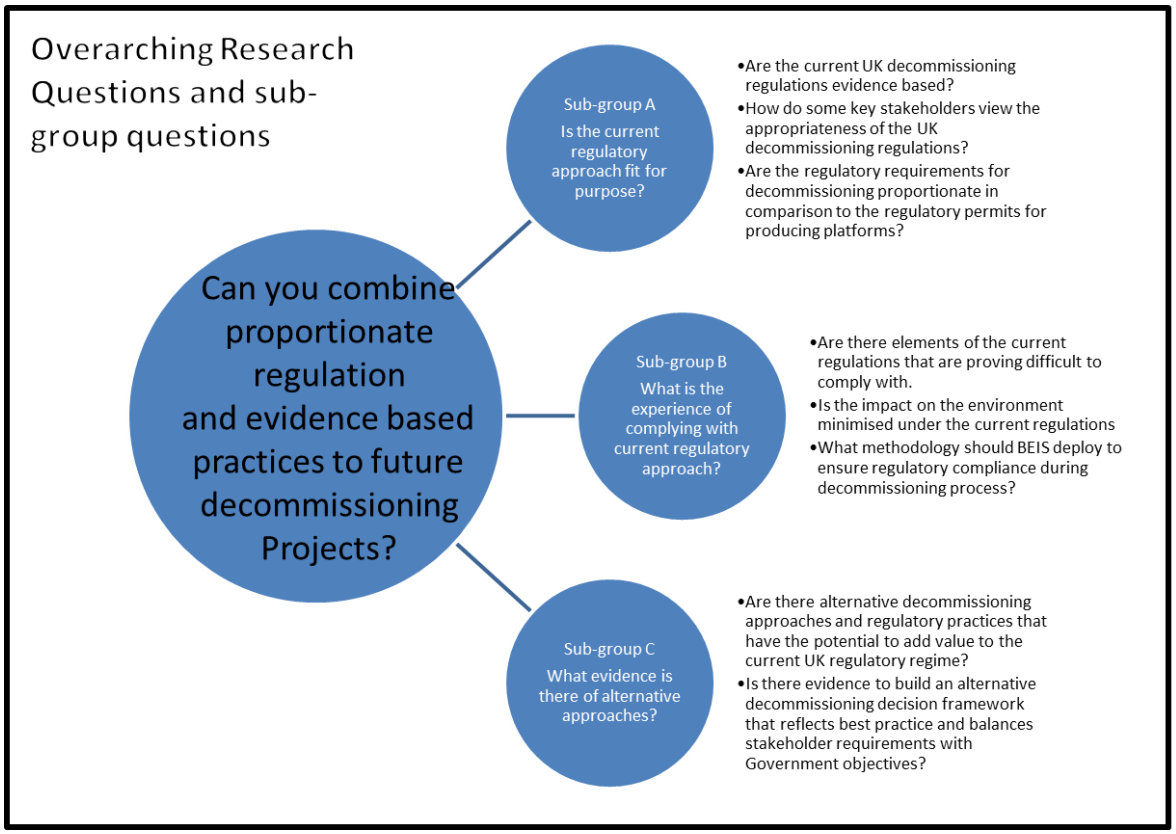

Figure 1-2: Research Questions Design. Source: Author

The research question design indicates that there is an overarching research question which considers whether you can combine and apply proportionate regulation and evidence-based practices to future decommissioning projects? To support the overarching question several sub questions have been designed and these are grouped under three headings. Firstly, questions around whether the current regulatory approach is fit for purpose. Secondly, questions to investigate the practical experience of complying with the current regulatory approach and thirdly questions aimed at identifying alternative approaches. Table 1-1 on the following page summarises the research questions and their related objectives and clearly illustrates their sub-groupings.

Table 1-1: Research questions, sub groups and related objectives

Overarching research question: Can you combine proportionate regulation and evidence based practices for future decommissioning projects?		
GroupA	Questions	Related Objectives
A1	Are the current UK decommissioning regulations evidence based?	To determine whether regulations are based on best practice or political decisions
A2	How do key stakeholders view the appropriateness of the UK decommissioning regulations?	To determine the views of stakeholders experience of implementing the regulations.
A3	Are the regulatory requirements for decommissioning proportionate in comparison to the regulatory permits for producing platforms?	To analyse from an environmental perspective the significance of the differences between the permit requirements for decommissioning and production platforms.
GroupB		
B4	Are there elements of the current regulations that are difficult to comply with.	To determine from practitioners experience where the practical problems exist.
B5	Is the impact on the environment minimised under the current regulations	To determine from practitioners experience whether the current regulations are impacting on the environment.
B6	What methodology should BEIS deploy to ensure regulatory compliance during decommissioning process?	To determine an approach that delivers confidence to stakeholders in the UK approach to decommissioning
GroupC		
C7	Are there alternative decommissioning approaches and regulatory practices that have potential to add value to the UK regulatory regime?	To determine whether other sectors or basins can bring new ideas or processes to our current regime
C8	Is there evidence to build an alternative decommissioning decision framework reflecting best practice and balances stakeholder expectations with Government objectives?	To determine whether it is possible to construct a new collaborative approach to decommissioning on the UKCS

1.4 Methodology overview

Borrego et al (2009) suggest that the research approach adopted should be been driven by the research questions. The research will follow a process of a literature review of the historical development of the UK decommissioning regulations to understand the context and drivers that underpin the current status quo together with an analysis of the regulatory standards adopted in other regions around the world from a comparative viewpoint. The research involves an adopted mixed methods, three pronged approach utilising semi-structured interviews with a number of experienced decommissioning personnel from both the operators and the consultancy contractor groups to provide data for quantitative and qualitative analysis and practical case studies will be undertaken to develop the decommissioning inspection audit procedure and toolkit, provide additional valuable insights within the research process and deliver a contribution to practice.

In terms of research participants, the focus was on recruiting a group of individuals with deep knowledge and experience of delivering and executing actual decommissioning programmes whilst recognising in an ideal world the selection of participants could have included additional representatives from the wider stakeholder community beyond the industry experts group, such as regulators from the UK and other countries, and environmental groups for example. The primary barrier is that these stakeholders do not fit the principle participant selection criteria of having knowledge and experience of delivering decommissioning programmes first hand. Having had initial discussions with other regulators, the Norwegian Ministry of Petroleum and Energy (MPE), the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) in the United States and the Department of Mineral Fuels (DMF) in Thailand at decommissioning conferences in those countries or regions, it became clear that their views on decommissioning regulatory frameworks are both limited and constrained by their inherent requirement to support and standby the regulations that determine the decommissioning approaches in the regions for which they are responsible. Indeed, this was one of the primary reasons that initiated the decision to remove myself from my previous role as Head of Offshore Decommissioning Unit at DECC as the Department was called at the time in order

that I could undertake this research free from the constraints of the role of regulator in terms of advocating and supporting the current UK approach to decommissioning. In terms of environmental stakeholder groups such as Friends of the Earth, World Wildlife Fund (WWF) and in particular, Greenpeace whose protest according to Jorgensen (2012) about Brent Spar and the subsequent international reactions fundamentally influenced the development of OSPAR's artificial reef policy, and other users of the sea, such as Scottish Fishermen's Federation, their views on decommissioning are well documented online and in the media, and captured through the public consultation process of each decommissioning programme as they are developed and approved. For example, commenting on the arrival of the world's largest construction vessel Pioneering Spirit in Hartlepool as part of Shell's decommissioning work in the Brent oilfield, Greenpeace UK's chief scientist Dr Doug Parr stated:

> "The basic principle that our seas cannot be used as the junkyard of the oil industry has prevailed. These international regulations now need to be defended and enforced. Shell is asking the UK government for permission to leave behind the rig's huge concrete legs, and the oil residues they contain, to cut costs. Under the OSPAR regulations, oil firms can only dump this infrastructure if they can prove that's more environmentally sound than attempting to remove it. Shell haven't produced any useful evidence to this effect and seem instead anxious to wriggle out of the proper process. The UK government should not bend the rules for the sake of Shell's profits but should uphold hard-won international laws." (Greenpeace, 2017).

Whilst John Hocevar, Greenpeace's head of ocean campaigns, concedes that reefed platforms, if non-toxic, may increase marine life, but to reinforce their publicised views he stated that reefed platforms:

> "should be banned anyway, because they save the oil firms money and therefore encourage them to drill more." (Economist, 2017).

Rothbach (2007) summarises that the environmental organisations stance does not derive from a desire to preserve fish habitat, but instead from a desire to limit further oil exploration. Ultimately for this research as stated above the actual involvement and experience of environmental groups in decommissioning

projects is limited to the consultation process rather than the execution of the projects and therefore the decision was taken not to involve these stakeholders at this point and take a position that if post the research, an alternative framework was deemed to have sufficient evidence and support from BEIS to take forward then it would be appropriate to undertake that work involving other broader stakeholders at that time.

Most importantly in terms of participant selection the primary focus was to capture the knowledge and practical experience of individuals undertaking decommissioning projects within the current regulatory framework and this by default merits a selection of participants from within the offshore oil and gas decommissioning industry. The participants were selected through a process of non-probability sampling known as expert sampling. By combining the two methods of quantitative and qualitative analysis within the mixed method approach there is the opportunity to produce statistical data on the participants views on the emerging themes from the literature and to combine this with more detailed underpinning experiences and opinions of the participants to deliver a more developed and defendable argument to the concluding discussion and recommendations to be taken forward. The incorporation of the case studies into the mixed methods equation adds an additional level of data to the overall analysis and provides practical insights which add value to the overall analysis, the alternative framework and the development of a practical inspection audit package. The collaboration of the results through the concurrent triangulation procedure where all types of information and data are collected in parallel and subsequently integrated in the interpretation of the overall results (Creswell 2003) provides further support to the analysis and resulting conclusions to be drawn.

The case study approach to developing the audit process was selected to reflect the practical hands on approach that was required and reflects the complex nature of the problem to be addressed. Fry et al (1999) suggests that case studies provide a better comprehension of the circumstances of the problem being studied together with emphasising the main issues and Mann (2006) notes that case studies allow the examination of a situation of unique interest. The case study element of the adopted mixed methods will in addition to delivering an appropriate audit system for OPRED also provide an additional level of

environmental scrutiny that will give confidence to stakeholders that their expectations are being met by the companies involved in the decommissioning of offshore oil and gas infrastructure.

The questionnaire contains both qualitative and quantitative questions and is designed to capture responses to enable both qualitative opinions which fits with the constructivist/interpretivism theoretical perspective and the opportunity to undertake a quantitative analysis of responses in line with the positivist theoretical perspective which balances the fact that the quantitative and qualitative approaches have both strengths and weaknesses according to Draper (2004).

Figure 1-3 provides an overview of the overall research methodology. It illustrates the direction and context of the research, the associated research questions which lead to emerging themes that are taken forward through the quantitative, qualitative and case study elements of the mixed methods approach. From this, the data analysis leads to a set of conclusions, recommendations, and contributions to both knowledge and practice.

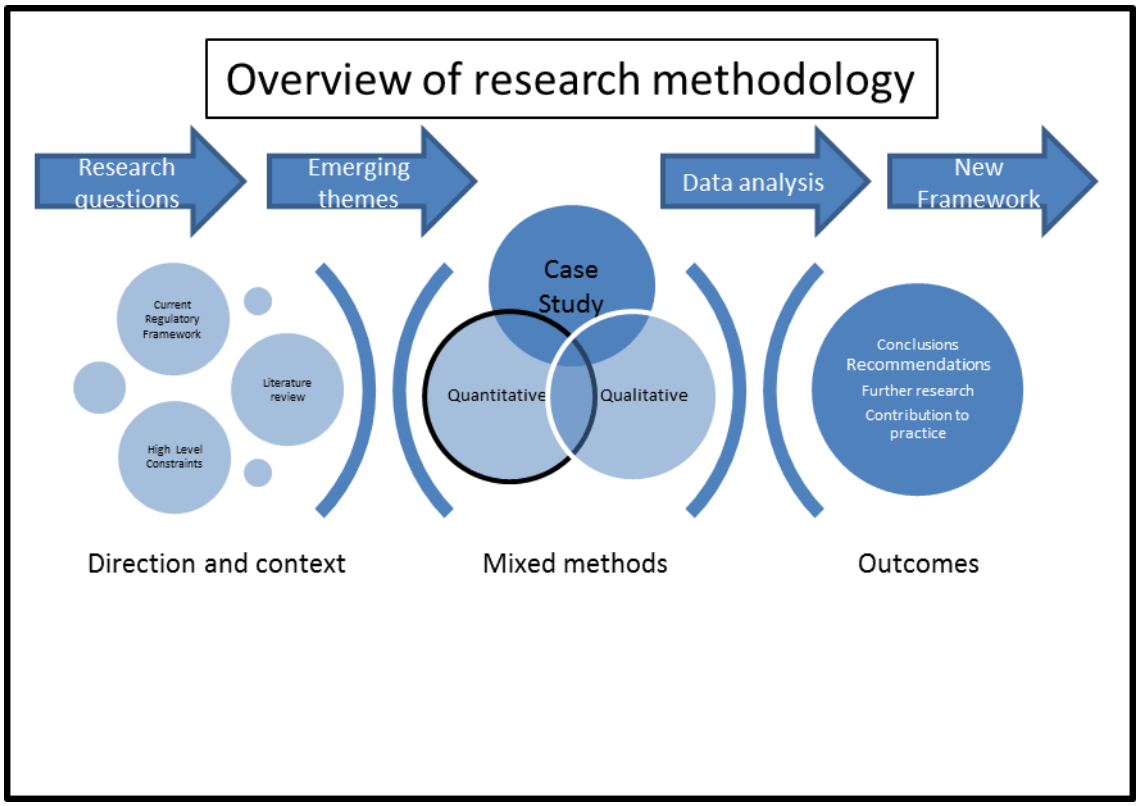

Figure 1-3: Overview of research methodology. Source: Author

1.5 Scope of the research

The scope of this research is to demonstrate that the current regulatory framework for decommissioning on the UKCS is not evidence based, that they are borne out of political reaction and that they as currently deployed do not facilitate an efficient system that balances the needs of all stakeholders whether they are knowledgeable about their involvement such as operators, environmental organisations, other users of the sea or whether they are unaware stakeholders such as the general public in their role as taxpayers. The lack of an evidence-based approach is argued from the perspective that the current arrangements result in an overly complicated system that results in completed programmes that are of extended duration, more expensive than necessary and do not always result in the minimisation of impact on the environment.

Similarly it is argued that the current audit process of a single close out report from the operator is not sufficient considering the scale of public money involved and that a stronger, invasive evidence based audit process is required to be developed in order that all stakeholders can have confidence that the programmes are being carried out in line with the approved programmes and reflects the interests of all stakeholders.

The main outcomes of the research will be the proposition of an alternative regulatory framework for decommissioning underpinned by new evidence originating from this research and the adoption of evidence based practices from other regions that together will influence and provide opportunities for the future development of the UK regulatory framework and the development of a practical evidence based physical audit process for BEIS to deploy on future decommissioning projects.

1.6 Limitations of the research

The limitations to this research are the limited amounts of available targeted literature and the focus on the UKCS. Whilst global literature comparisons are introduced to offset the level of literature specific to the UKCS, there is the acknowledgement that more UK specific environmental research would further strengthen the arguments presented in this research. The arguments presented whilst they are UK focussed, may well be templates that could be utilised in other

geographic locations who similarly face the challenges of cost, complexity and environmental protection in the years ahead.

1.7 Layout of the thesis

The thesis is divided into nine chapters. The first chapter is this introductory chapter which covers the background to the research, the aim of the research, the associated research questions, overview of the methodology, the scope of the research, its limitations and the layout of the thesis.

Chapters two and three develop the issues raised in chapter one and develop the case for change within the current regulatory framework interpreting the historical regulatory development and providing the supporting evidence from the available literature together with the growing body of evidence underpinning the need for greater flexibility

Chapter four provides the research methodology employed and the following chapters five and six present the results of the quantitative and qualitative results.

Chapter seven outlines the criteria, the regulatory envelope and development of the audit process, the case studies undertaken and presents the final decommissioning inspection template.

Chapter eight presents, discusses, interprets, and triangulates the research data and the responses to the research questions and chapter nine concludes the research findings and recommendations going forward together with suggestions for further research.

1.8 Summary of Chapter 1

Chapter 1 states the research problem and the goal of the research. The chapter then outlines the research methodology that will be employed and the scope of the research together with its limitations and explains the layout of the thesis. Chapter 2 and 3 will set the context for the mixed methods research.

CHAPTER 2: THE DEVELOPMENT OF UK DECOMMISSIONING REGULATIONS WITHIN AN INTERNATIONAL PERSPECTIVE

2.1 Introduction

The main objective of this chapter is to present a case for reviewing the UK decommissioning regulations in light of the academic literature that has been published and the knowledge and experience of the industry that has been gained from decommissioning projects over the last two/three decades since the regulations were put in place.

Chapter 2 will review the development of decommissioning regulations within a UK context and importantly draw comparisons from a global perspective to investigate how the challenge of decommissioning is being addressed in other regions across the world. This is particularly important as other regions would also be subject to the same international conventions as the UK. The opportunity exists to identify alternative approaches that may have been adopted elsewhere and that could add value to tackling the research problem identified in chapter 1.

It is important for this research to review the development of the international regulatory building blocks that provide the primary tier of the UK decommissioning regulatory envelope. The scope of the UK decommissioning regulatory envelope is defined in Section 2.4 and illustrated in Figure 2.4. In parallel it is also important therefore to investigate how international obligations have been interpreted and applied in different countries to identify decommissioning options that might provide greater flexibility of options within the UK regulatory framework.

It argues in section 2.4 that the regulations in the first instance were politically driven rather than evidence based. Section 2.5 argues that the restrictive nature of the regulations limit operator flexibility and have impacted on innovation, cost, and overall efficiency of the decommissioning process. Section 2.6 argues that the sheer scale and cost of decommissioning was not fully understood when the original regulations were set and only now are both Government and industry beginning to truly understand the enormity of the task ahead. Section 2.7 presents the argument for increasing knowledge transfer within the sector to maximise the benefits to be gained from learning from previous and current

projects. The conclusion to this chapter suggests that based on the arguments presented in the chapter, there is now a relatively solid base of decommissioning knowledge and experience from projects on the UKCS and that should be used to inform a review of the current regulations.

2.2 Development of the global regulatory framework

As introduced in chapter 1, decommissioning is not a challenge simply for the UKCS. Decommissioning is a global business and there are around 7,000 installations (Parante, 2006) that will at some point in their lifecycle reach the stage where they will need to be decommissioned. Figure 2-1 on summarises the approximate distribution of installations across the major offshore oil and gas regions across the world. (Wan et al, 2012), (NOPSEMA, 2015), (BSEE, 2018), (OSPAR, 2018), (Scottish Enterprise, 2013), and (Liu et al, 2016). Considering that the North Sea accounts for less than 6% of the total number of offshore platforms underlines the scale of the global challenge that the oil and gas industry and relevant Governments will face in the decades ahead.

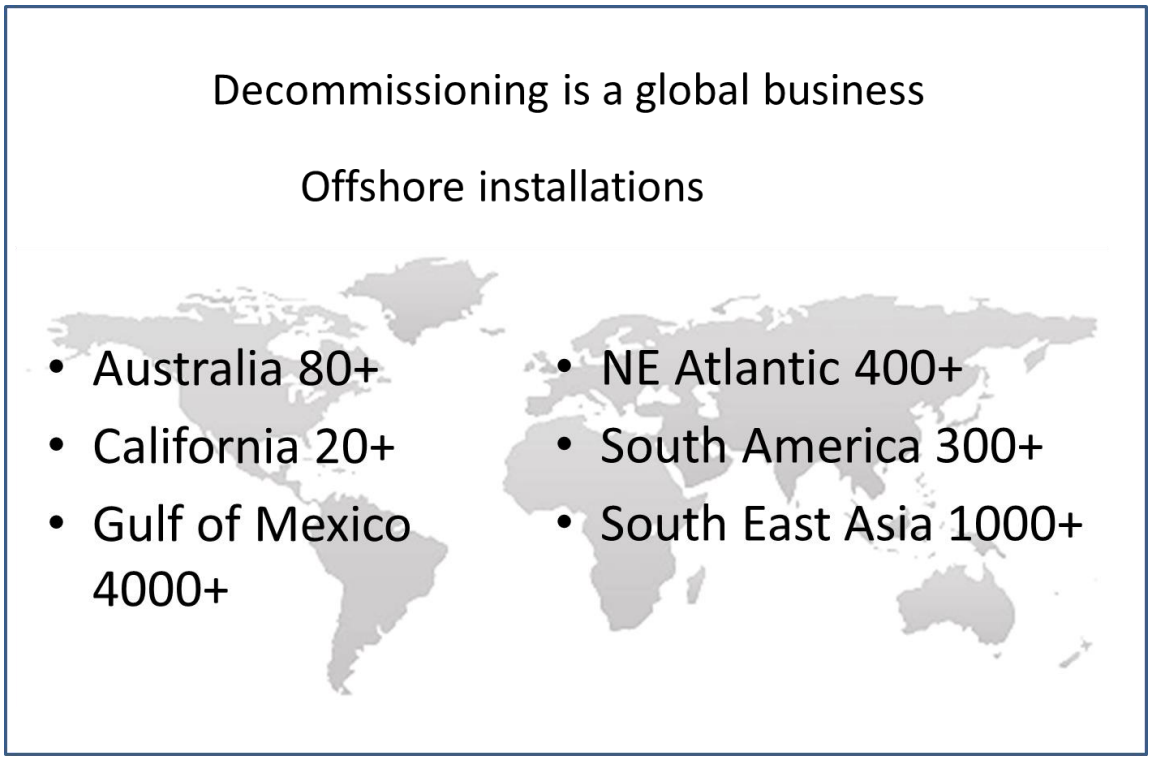

Figure 2-1: Global distribution of offshore oil and gas platforms. Source: Author

Around the world the offshore oil and gas sector has been operating for many decades with some regions that are more mature than others. Different regions of the world have entered this market at different times as illustrated in figure 2-2 and as such reflect different levels of market maturity. For example, offshore oil and gas production began in the Gulf of Mexico in 1955 in 30 metres of water (Max et al 2006) and according to Herbst (2009) by 2009, 70% of US platforms were in waters greater than 300m. In Australia (AGDRET 2008) and Indonesia (Harsokoesoemo et al, 1990) offshore oil and gas began in the 1960's and the North Sea in the 1970's (Ferrier and Bamberg, 1982). China began recovering offshore oil and gas in the 1990's (Zuan et al, 2013) and more recently Ghana entered the offshore market in 2010 (Acheamponga and Akumperigyab, 2018). By contrast there still countries about to embark on the production of oil and gas offshore such as Cambodia who are reportedly (DW 2017) entering the market in 2019. The date of entry into the offshore market may also reflect the maturity and sophistication of their approach to managing environmental risk offshore. In Ghana who entered the offshore market in 2010, currently there is no codified health, safety and environment regulations, and therefore self-regulation by the industry itself will determine what health, safety and environment standards to use. Acheamponga and Akumperigyab (2018) in their study of safety and environmental regulations in Ghana conclude that Ghana has much to learn from the experience and practice of the regulatory approach in the UK and Norway.

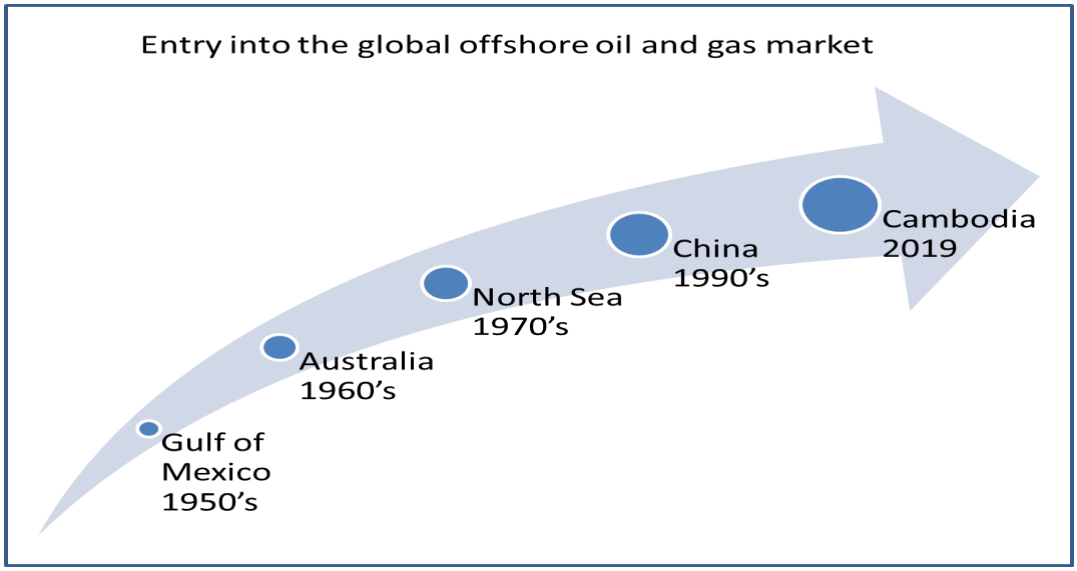

Figure 2-2 Entry into the global offshore oil and gas market

Source: Author

Past events in the UK such as Piper Alpha, (Swuste et al 2017) and Torrey Canyon (Hawkins et al 2017), have influenced regulation and raised awareness of the environmental and safety risks involved in this industry. It is broadly recognised that historical events such as Brent Spar in the North Sea (Robinson 2014) and other significant events across the world such as the Deepwater Horizon in the Gulf of Mexico which generated the largest worldwide oil spill to date (White et al 2012) have shaped legislation, increased public awareness of the environmental risks involved and together with knowledge and experience of both industry and regulators, shaped the current operational and regulatory frameworks for decommissioning. Each country has taken an individual approach to assessing and responding to the environmental risks involved and this together with available technology, knowledge and past experience have all influenced the approaches to decommissioning taken by nations. That said it is important to note that decommissioning remains in its embryonic stage for many countries around the world.

In the offshore petroleum industry, the decommissioning process is governed by a broad spectrum of regulatory frameworks that provide international, national and regional requirements and the potential impact of decommissioning on the environment has had a strong influence on the shaping of the regulations. Whilst it is important to note that the word decommissioning does not appear in the major international regulations according to Hamzah (2003), it is equally important to consider each of these instruments to understand their influence on the development of the UK decommissioning regulatory framework and to discuss that in some aspects they directly contrast with each other in terms of what is and what is not allowed during decommissioning activities. These key international instruments are listed in table 2-1.

Table 2-1: Key International regulatory Instruments

Key international regulatory instruments	
1.	The Geneva Convention 1958 on the Continental Shelf
2.	United Nations Convention on The Law of The Sea (UNCLOS) 1982
3.	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), 1972
4.	International Maritime Organisation Guidelines and Standards for The Removal of Offshore Installations and Structures on The Continental Shelf and In the Exclusive Economic Zone 1989
5.	OSPAR Convention for the Protection of the Marine Environment of the North East Atlantic 1992
6.	OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations; Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles
7.	The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989 and the Bamako Convention 1991 on the ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa

Source: Author

2.2.1 The Geneva Convention 1958

Prior to the Geneva Convention, countries traditionally claimed jurisdiction over the sea adjacent to their nation's coasts with International waters being deemed as any area beyond that point. On ratification of the Geneva Convention, this enabled the definitions of national sovereignty to consider a water depth of two hundred metres or a depth where the exploitation of natural resources can continue to be undertaken according to Shaw (2003).

Importantly from a decommissioning perspective, the convention also brought into being the requirement for a 500m safety zone around installations, and it specifically states in Article 5 that:

> "any installations which are abandoned or disused must be entirely removed". (P.3, Geneva Convention 1958)

Although the UK was party to this convention, the accepted view according to Moller (2013) is that this provision should be interpreted in a way that is consistent with the purpose of the convention, which is the exploitation of a nation's natural resources without interference. The primary function, therefore, is not to prohibit "abandonment" at sea, but to allow member states the freedom to exploit natural resources within their continental shelf without unjustified interference. Moller (2013) observes, additionally, that it is not entirely certain whether the non-observance of Article 5(5) would give rise to a breach of international law.

Article 5 is a strong statement according to Igiehorn and Park (2001) which sets a preference for total removal of infrastructure at a time when the practical experience of offshore decommissioning was in its infancy. This convention for the first time did set an internationally recognised benchmark of expectations for dealing with obsolete offshore installations. That said it is important to note that in 1958 according to Griffin (1998) the United States was the only country with offshore oil and gas production and this was confined to small platforms in relatively shallow water in the Gulf of Mexico and were comparatively less complicated to remove in comparison with installations in the North Sea where the constraints such as depth of water, physical scale of platforms, and the weather conditions faced in the North Sea significantly increases the challenges faced for decommissioning. Martin (2003) makes the point that the Geneva Convention does not identify pipelines as part of the infrastructure to be removed. Therefore, it can be argued that this Convention did not place a strict obligation to remove pipelines. Following due process and negotiation, the Geneva Convention came into force and was ratified in the UK in June 1964.

2.2.2 The United Nations Convention on The Law of The Sea (UNCLOS) 1982

In many countries the Geneva Convention was superseded by UNCLOS (1982) which defined the rights and responsibilities of nations in their use of the world's oceans through establishing guidelines for businesses, the environment, and the management of marine natural resources. To date, many countries and the European Community have committed to the Convention.

According to Nordquist (2011) early drafts of the Convention took a similar stance and language with respect to the removal of infrastructure as that of the 1958 Convention. The first drafts encompassed a statement to the effect that obsolete oil and gas infrastructure must be completely removed. The discussion on the extent of removal was debated over several sessions with a number of countries putting forward proposals. The oil and gas industry proposed during the ninth session that removal of redundant structures should only be necessary when they presented a danger to the environment or other legitimate stakeholders. The argument put forward by the industry to support this proposal was driven by economics involved in generating a clear sea bed. UNCLOS like the Geneva Convention does not explicitly address pipelines or subsea infrastructure, and prevailing practice is that such infrastructure could be decommissioned in situ, usually buried or involving the use of rock loading the pipeline ends.

The final provision is contained in article 60(3) UNCLOS (1982), and reads as follows:

> "Due notice must be given of the construction of such artificial islands, installations or structures, and permanent means for giving warning of their presence must be maintained. Any installations or structures which are abandoned or disused shall be removed to ensure safety of navigation, taking into account any generally accepted international standards established in this regard by the competent international organization. Such removal shall also have due regard to fishing, the protection of the marine environment and the rights and duties of other States. Appropriate publicity shall be given to the depth,

> position and dimensions of any installations or structures not entirely removed." (P.41, UNCLOS 1982)

The important point to note from this quoted text from the 1982 Convention is the significant difference from the 1958 Geneva Convention whereby complete removal of installations was the benchmark expected internationally, to the final line in article 60(3) of UNCLOS which envisages that there is now scope for partial removal. It is difficult to find evidence that supports the position that this may well be a concession that was necessary to gain buy in from stakeholders, but the concept of partial removal remains a foundation block of decommissioning legislation for OSPAR contracting countries today. Hamzah (2003) attributes this concession on the part of the UK was because of the potential hydrocarbon reserves to be found in deeper waters of the UKCS and pressure from the oil companies to consider the decommissioning of installations in deeper waters differently from the installations on the UKCS which until that time had been located in shallower waters.

Article 196 (P.99, UNCLOS 1982) and Article 210 (P.103, UNCLOS 1982) both focus on the requirements for countries to protect the marine environment by requiring that all states that have ratified the Convention to control and minimise pollution from either technologies that they have control over such as oil and gas infrastructure. Article 196 states that:

> "States shall take all measures necessary to prevent, reduce and control pollution of the marine environment resulting from the use of technologies under their jurisdiction or control, or the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto." (UNCLOS P.99, 1982)

Article 210 (P.99, UNCLOS 1982) covers in the case of decommissioning leaving infrastructure in the sea once production operations have ceased. More broadly it covers a wide range of non-oil and gas activities under the banner of "dumping". Importantly, it does not prohibit dumping but that it can only be undertaken with

approval from the state that has jurisdiction over the territorial sea or continental shelf in question.

> "Dumping within the territorial sea and the exclusive economic zone or onto the continental shelf shall not be carried out without the express prior approval of the coastal State, which has the right to permit, regulate and control such dumping after due consideration of the matter with other States which by reason of their geographical situation may be adversely affected thereby." (UNCLOS P103, 1982)

Guidelines are available for the assessment of what sorts of material that could be considered for dumping and in relation to decommissioning there are specific guidelines. Article 210 requires that consultation is undertaken with other states that might be affected by another state's marine activities. Within the current decommissioning legislation in the UK Article 210 is reflected in the current requirement to undertake a consultation with OSPAR contracting parties when the UK is considering approving the partial removal of an installation. Finally, it is important to register that in accordance with Article 311(P.140, UNCLOS 1982) of the Convention, it prevails over the Geneva Convention 1958 by the countries which have ratified it and removes the obligations previously acknowledged and accepted.

> "This Convention shall prevail, as between States Parties, over the Geneva Conventions on the Law of the Sea of 29 April 1958." (UNCLOS P140, 1982)

2.2.3 International Maritime Organisation (IMO) Guidelines and Standards for The Removal of Offshore Installations and Structures on The Continental Shelf and in the Exclusive Economic Zone 1989

IMO's Guidelines and Standards for the Removal of Offshore Installations and Structures on The Continental Shelf and in the Exclusive Economic Zone were adopted in 1989. They stem from Article 60 of UNCLOS 1982, which to date interestingly the USA has not ratified. The guidelines indicate that there is a requirement that obsolete oil and gas infrastructure offshore effectively

anywhere should be removed to shore except where leaving in situ or partially in situ is in line with standards and guidelines set by the IMO. Importantly from a decommissioning perspective and for this research, the guidelines also state that the any decisions for non-removal must be made on an individual case by case basis. In determining the correct approach there are a set of factors that are required to be considered and they are listed in Table 2-2 for ease of explanation and interpretation.

Table 2-2: IMO guidelines for decommissioning

IMO Guidelines for decommissioning	
1	Complete removal of all structures in less than 75m of water and less than 4,000 tonnes in air, excluding the deck and superstructure
2	Complete removal of all structures emplaced on the sea-bed after 1998, in less than 100 m of water and weighing less than 4,000 tonnes in air, excluding the deck and superstructure
3	Removal should cause no significant adverse effects on navigation or the marine environment
4	Any structure projecting above the surface of the sea should be adequately maintained to prevent structural failure. In cases of partial removal, an unobstructed water column sufficient to ensure safety of navigation, but not less than 55 m, should be provided above any partially removed installation or structure which does not project above the surface of the sea
5	Where living resources can be enhanced by the placement on the sea-bed of material from removed installations or structures (e.g. to create an artificial reef), such material should be located well away from customary traffic lanes, taking into account relevant standards
6	After 1998, no Installation should be installed unless the design and construction are such that entire removal upon abandonment would be feasible

Source: adapted from IMO (1989); section guidelines pp 3-5

Whilst the 1982 UNCLOS introduced the concept of partial removal, the IMO guidelines take a more detailed step in introducing measurable limits of 4000 tonnes for partial removal which interestingly from the perspective of this research are much lower than the current limit set by OSPAR of 10,000 tonnes. If OSPAR had adopted the IMO guidelines of 4000 tonnes rather than the more stringent figure of 10,000 tonnes, then there would be significantly more installations that would be provided with a more flexible set of decommissioning options to consider. If OSPAR had adopted the IMO guidelines, then the number of jacket structures on the UKCS that could consider partial removal as an option would double as shown in figure 2-3 below.

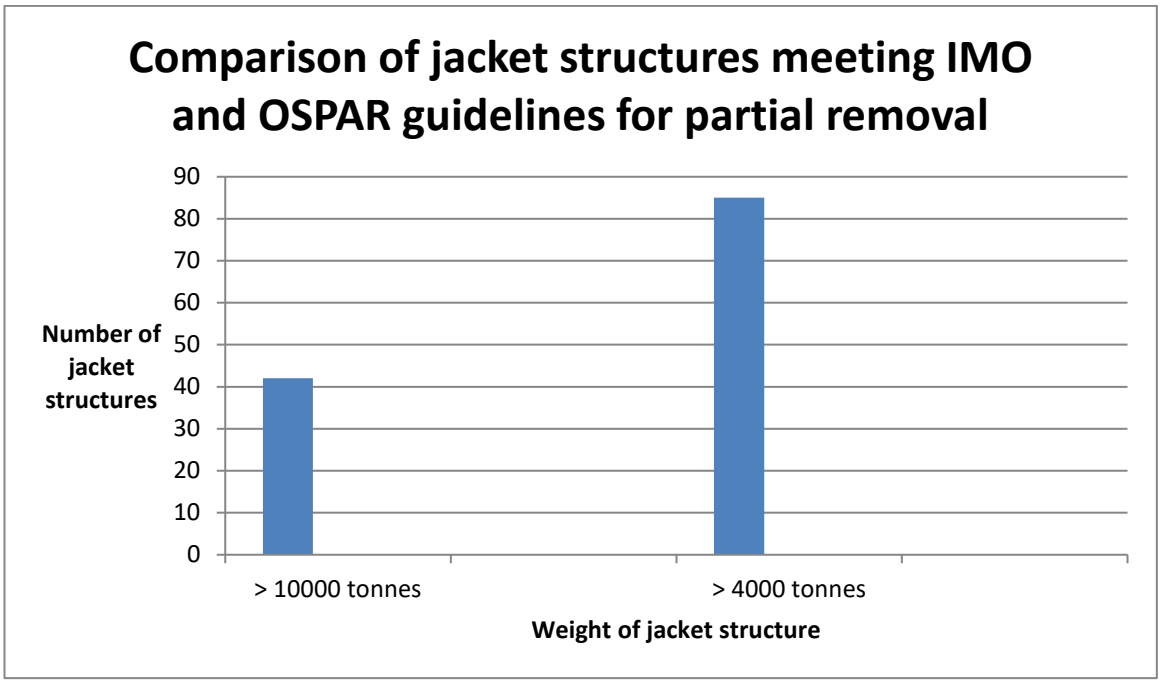

Figure 2-3: Comparison of jacket structures meeting IMO and OSPAR guidelines for partial removal. Source: Author

Continuing with the theme of increasing decommissioning option flexibility, the IMO guidelines also introduce the concept of the use of man-made objects as a source of artificial reefs with the aim of benefitting the marine environment. Today there is a substantial and increasing body of academic literature including (Jorgensen, 2013), (Macreadie et al (2011), (Gass and Roberts 2006), (Claisse et al 2014) and Bouma and Lengkeek (2013) providing the evidence base of the

environmental benefits of utilising redundant oil and gas infrastructure as material for the creation of artificial reefs and this subject is discussed in detail in Chapter 3, which involves a proportionality review of the current regulatory framework underpinning an argument for the introduction of a future rigs to reefs programme on the UKCS.

The IMO guidelines also introduce the concept that if removal of infrastructure is undertaken then it must not be done in a manner that should result in any substantial negative impacts on the offshore environment. The main issues raised are the potential to cause significant damage to the seabed and the associated marine life when disturbance of the seabed is necessary to remove pipelines, associated infrastructure or when gaining access to cut foundation piles. Pulsipher and Daniel (2000) suggest that removal of an installation creates the worst negative impacts, by eliminating habitats that had supported marine ecosystems for decades and this is particularly the case for the UKCS where the loss of habitat from a normally featureless seabed increases the impact on the marine environment. Similarly, much of the oil infrastructure on the UKCS has been in place for many years and significant volumes of marine growth have accumulated creating artificial reefs by default rather than design. Removal of the infrastructure would result in the destruction of these marine environments which runs contrary to the IMO guidelines on protecting the environment in the North Sea. This issue is discussed in detail in Chapter 3, which is a proportionality review of the current regulatory framework which provides the argument for removing the limits on derogation applications and argues that a more rational approach is to consider each situation using an individual case decision framework for the UKCS.

2.2.4 London Convention 1972 and Protocol 1996

The dumping into oceans of wastes such as oil, untreated sewage and heavy metals by industrialized countries was one of the primary issues underpinning concerns for marine environment pollution in the 1970s. These concerns lead to the signing of the London Dumping Convention (LDC) in 1972, during the Intergovernmental Conference on the Convention on the Dumping of Wastes at Sea. This convention considered that the abandonment of obsolete installations or indeed the toppling of platforms in situ as dumping. However, importantly

according to Griffin (1998) the conventions do not prevent the use of redundant oil and gas infrastructure as artificial reefs. The important elements of the convention regarding this are Article III (ii) (b) which provides that dumping does not include:

> "placement of matter for a purpose other than the disposal thereof, provided that such placement is not contrary to the aims of this convention". (P.2, IMO 1972)

It is through Article III (ii) (b) that a Rigs to Reef program is achievable according to (P.2, IMO 1972). The use of redundant platforms to be toppled to form artificial reefs would fall under this convention but that individual states would be able to take their own decisions. Under the 1996 Protocol all dumping is prohibited with the exception of a list of wastes in Annex 1 that may be dumped subject to a permit from the host State. Annex 1 of the 1996 Protocol lists seven specific materials that can be considered for marine disposal (P.17, IMO 1996).

From a decommissioning perspective the London Convention 1972 and Protocol 1996 focus on minimising the impact of decommissioning activities on the environment offshore again utilising the provocative wording of "dumping" and included the leaving behind of redundant offshore oil and gas infrastructure as "dumping" but as argued before you cannot dump something that is already in situ. Importantly, the 1996 protocol does not prohibit the creation of artificial reefs from offshore infrastructure or the leaving behind the foundations of infrastructure but leaves the decisions on this type of activity to individual countries.

2.2.5 The Basel Convention (1989)

Most international waste legislation is aimed at preventing environmental and other hazards from the movement of hazardous wastes, particularly to countries which may be less well equipped with laws or infrastructure to manage those hazards. In the late 1980s, environmental regulations in industrialised nations were made stricter and this resulted in a large increase in terms of the costs of

dealing with hazardous material, and exports to less developed countries increased. International concern resulted in the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. Since 2007, non-hazardous waste transfers from the EU have become more regulated and enacted in the UK via the Trans-frontier Shipment of Waste Regulations 2007. Whilst the Bonn Convention is an important building block in minimising the risk of environmental impact from the shipment of waste during decommissioning activities, from the perspective of this research the Basel Convention is not particularly relevant to the areas under investigation and review.

2.2.6 OSPAR

The role of OSPAR is to manage, protect and improve the environment in the North Sea through a system that the officials representing 15 countries who are known as contracting parties in partnership with the European Union work together to achieve this aim. OSPAR began in 1972 on a foundation of the Oslo Convention on Dumping and in 1974 increased its coverage to include the offshore industry based on the Paris Convention hence the OSPAR nomenclature which is a combination of the OS and PAR conventions. In 1992 these two conventions were incorporated into the 1992 OSPAR Convention which came into force in 1998.

Overall, the work undertaken by OSPAR is directed by an ecology-based system that manages activity undertaken within the marine environment of the North Sea. To support this system, contracted parties are assumed to acknowledge and apply the complimentary principles of the precautionary approach and the polluter pays. The precautionary principle according to Antonopoulou and Van Meurs (2003) is interpreted as if there is a suspected risk that a policy or action could cause harm to the environment and there is a lack of scientific consensus then the burden of proof falls on those taking the action or decision.

Regulators during decision making can adopt the precautionary principle as a strategy to deal with the potential risks of taking decisions where there is a risk of causing harm when scientific understanding on the subject is lacking and a

finite evidence base is not available. According to Lofsted (2003) the precautionary principle has emerged as one of the main regulatory tools of European Union environmental policy, as opposed to the more traditional use of scientific risk analysis as the main tool for regulation (Charnley and Elliot, 2002). For decommissioning it is important to argue that the plausibility of harm to in this case the environment requires scientific analysis and evidence rather than a precautionary principle which may be flawed in that the approach may have been made on assumptions rather than evidence. Equally it is important that as both the evidence base and scientific analysis reduces the levels of uncertainty, that the current decisions are regularly reviewed on the evidence available. Within OSPAR Decision 98/3 is reviewed every 5 years but to date insufficient evidence has been put forward by any of the contracting parties to warrant change and the status quo has been maintained.

The polluter pays principle with regards to the environment according to Tilton (2016) is an environmental policy principle established to make the entity responsible for introducing a pollutant culpable for the costs of dealing with the pollution and the subsequent damage done to the marine environment.

In effect, the polluter pays principle will internalize the cost of dealing with waste and potential pollution into the overall project cost modelling, which could within the decommissioning context suggest that operators will focus on efficiency of the waste management of their decommissioning programme, thus adopting a more radical approach to the waste management hierarchy thereby decreasing waste and targeting increased reuse and recycling.

A strong argument can be made that OSPAR's precautionary approach and polluter pays principles are very much the driving force behind the decisions made by OSPAR regarding the rules of engagement for decommissioning in the North Sea. The current OSPAR position was set back during the 1990's, as a political decision rather than an evidence-based decision as argued by Bellamy and Wilkinson (2001); Penner (2001) and Jorgensen (2013) and very much follows the precautionary principle which may have reflected the absence of decommissioning knowledge and experience at that time. The argument is that the precautionary principle adopted by OSPAR can now be challenged as sufficient evidence is now available to support an evidence-based approach from

OSPAR contracting parties towards the decommissioning of redundant oil and gas infrastructure as opposed to the current status quo. The legal significance of OSPAR 1998/3 with regards to decommissioning the UKCS should not be underestimated as it is legally binding on the party's signatory to the OSPAR Convention which includes the UK.

UNCLOS according to Hamzah (2003) for example provides a more flexible approach to decommissioning compared with the prescriptive approach adopted by OSPAR. This can be illustrated in that internationally, there remains today an ongoing debate on whether any obsolete offshore structures and installations which are no longer required for hydrocarbon production must be totally removed as promoted by Article 5.5 of the Geneva Convention which states that:

> "any installations which are abandoned or disused must be entirely removed". (P.3, Geneva Convention 1958)

and the OSPAR Convention which states:

> "The dumping, and the leaving wholly or partly in place, of disused offshore installations within the maritime area is prohibited." (P.3, OSPAR 1998)

or whether the leaving some elements of infrastructure in situ is allowed as promoted by Article 60.3 of the UNCLOS Convention that according to Chandler et al (2017) is now considered to be the dominant instrument in the area of marine governance. The final provision is contained in article 60(3) UNCLOS (1982), and the final sentence reads as follow:

> "Appropriate publicity shall be given to the depth, position and dimensions of any installations or structures not entirely removed." (P.41, UNCLOS 1982)

Putting to one side the different opinions on the interpretation of the wording of article 5.5 and 60.3 this research takes the view that there is an evidence based argument that this supports the adoption of a more flexible approach to the regulation of decommissioning on the UKCS but that this approach should be taken in line with the non-binding guidelines for the removing offshore infrastructure drafted by the IMO (1989). Within the IMO guidelines there is a

requirement for an individual case by case analysis and assessment prior to a decision being taken not to remove elements of an offshore installation which takes into account, a range of criteria including safety, impact on the environmental, safety of personnel, technical feasibility and the views of additional stakeholders.

2.3 The interpretation of international obligations into practice

Having discussed the development of the regulatory framework and the underpinning international conventions that regulate the decommissioning of redundant infrastructure on the UKCS, it is important to understand and contrast the regulatory regimes in other basins around the world to identify the most relevant practices that may influence future UK regulation. This part of the research was undertaken through a period of desk research in parallel with a programme of conference participation across three continents detailed in appendix B. I have summarised the complexity of the global regulatory framework in Table 2-3:

Table 2-3: Structure of the global regulatory framework. Source: Author

International	Regional	National	Sub-National	Non-Governmental
Geneva Convention on the Continental Shelf	OSPAR	Petroleum Act 1998	Marine Act (Scotland)	Industry Guidelines
UNCLOS	UNEP Regional Seas Convention	Marine Acts	Marine and Coastal Access Act (England & Wales)	Operator standards
IMO	Basel, Barnako, etc Conventions	National Fishing Enhancement Act	US Artificial reef programmes	World Bank Standards
London Convention	EU Marine Strategy Directive			

Whilst there is evidence that most countries are treaty members of the main international regulations, the interpretation and conversion of these fundamental principles into national regulations varies from one country to another.

Within the Asia Pacific region, whilst the countries for the most part are treaty members of the main international regulations that underpin the decommissioning of redundant oil and gas offshore structures, they have not taken the clear sea bed approach adopted by the countries in the North Sea such as the UK and Norway. They very much take a case by case approach to each decommissioning project and there is lack of consistency which from a positive perspective means a greater degree of flexibility in decommissioning approach from one country to another.

In the North West Pacific, where the main oil and gas producing countries in this region are China and Japan there is no Regional Seas Convention, but there is an Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Northwest Pacific Region (NOWPAP, 2018). This was adopted in 1994 and is relevant to the offshore oil and gas operations in the geographic area but specific decommissioning legislation has not been developed. In Chinese national law there is no specific decommissioning legislation but there is a Marine Environmental Protection Law relating to submerged or abandoned structures (Chen and Hicks, 1999). In Japan there is clear evidence of a decommissioning in situ policy as demonstrated by the recent decommissioning of the Iwaki platform. According to Twomey (2010), the Iwaki topside was removed, and the top section of the jacket cut. The top half of the jacket was placed on the seabed alongside the remainder of the jacket. It is understood that this was a permitted disposal rather than an artificial reef project but in essence the resulting end case is one and the same.

The Asia-Pacific region in comparison with the UK or Gulf of Mexico has undertaken relatively few offshore oil and gas decommissioning projects. The early projects in the Asia-pacific area were undertaken with little international regulatory control because they took place prior to the ratification of UNCLOS 1982 and the introduction of the 1989 IMO guidelines. In 1997 the Asia Pacific Economic Cooperation group (APEC) considered the challenges facing the region with regards to decommissioning. In 1998 a workshop was held on the basis that

decommissioning and the creation of artificial reefs raised questions that needed to be addressed from an environmental, economic and safety perspective (APEC, 1998). The conclusions openly raised the potential conflict between the desire to protect and minimise the environmental impact of oil and gas operations and the need to minimise the cost implications of decommissioning. APEC (1998) concluded that decommissioning regulations must be sufficiently flexible to take account of local conditions; as complete decommissioning and onshore disposal would likely harm the region's oil sector. They also concluded that most economic and technical arguments would favour an individual case by case decision process for the disposal of redundant infrastructure.

Many of the one thousand-plus oil platforms in the waters of Southeast Asia are heading towards the late life stage of the production period, yet only a handful of decommissioning projects have been completed in the region. The lack of decommissioning activity may reflect the lack of specific decommissioning regulations. For example, in Malaysia, there is no governing legislation for decommissioning according to Zawawi et al (2012) and therefore it is likely to take place within a confusing set of non-decommissioning specific laws according to Ibanez (2011). Thailand is in the process of finalising its regulations. In Thailand the decommissioning authority is the Department of Mineral Fuels (DMF). Draft guidelines for decommissioning are in place in Thailand, and the government expects to publish a final version by the end of 2018. The guidelines will cover re-use, re-purposing, rigs-to-reef and disposal. Financial constraints have also posed a barrier in this region. The question of how to cover decommissioning costs is a difficult one for operators around the world, but for some in the developing countries of Southeast Asia it is seen as outright prohibitive (Zawawi et al 2012). Although Asia lags behind the North Sea and especially the Gulf of Mexico for decommissioning experience, it has seen its share of innovative thinking about what to do after cessation of production. For example, there is an initiative developed at Malaysia's Universiti Teknologi Petronas, which is aiming to actively involve multiple industries in the decommissioning process. The significant costs of decommissioning led to this initiative, a three-year roadmap which seeks to involve related industries including architecture and construction in thinking about potential solutions to cut costs for oil and gas companies. One successful example according to Sessor

(2010) of repurposing can be found at the Sea Ventures Dive Resort near Sipadan island off the east coast of Sabah, where an old rig was towed in and now houses a boutique hotel with 25 rooms. In Malaysia, the Baram-8 structure, was toppled and turned into an artificial reef off the shore of Sarawak, making it the country's first rigs-to-reef project. A series of marine surveys showed that the sunken BARAM-8 platform was housing soft corals and that fish were using the rig for migratory purposes. (Chin and Mohd-Khairi; 2011).

In summary countries in the Asia Pacific region are at a relatively early phase of developing their approaches to decommissioning. What is clear from the evidence available is that they are in favour of a case by case approach to optimise decommissioning solutions and that they consider rigs to reefs as a legitimate option amongst a range of options. Their approach supports the argument of providing the most flexible regulatory framework that would allow decommissioning solutions that come within the broadest range of parameters within the re-use, re-purposing, rigs-to-reef and disposal envelope.

In contrast, Nigeria where decommissioning and abandonment requirements are not prescriptively stated in Nigerian laws and guidelines, there does exist according to (Ibebuike, 2013; Salawu, 2014), an aspiration to remove facilities at the end of their economic life and in line with international best practices. Nigeria therefore follows a similar approach to both Norway and the UK from the perspective of a total removal policy but unlike the Norway and the UK there is no specific decommissioning legislation. The Federal Government Harmful Waste Act 1988 prevents the disposal of harmful waste offshore and a framework for the abandonment of structures is provided in the Nigerian Environmental Guidelines and Standards for the Petroleum Industry issued by the Department of Petroleum Resources. According to Ekhator (2016), the expectation in Nigeria is that best practice environmental stewardship will create a requirement for all redundant oil production facilities to be removed and the environment restored to its original condition prior to the installation of the platform.

There is a divergence with the UK policy when it comes to decommissioning liability. In the UK, every operator that have been linked with an asset at any time in its economic life and had been issued with a legally binding section 29

notice are held jointly and severally liable for the decommissioning liabilities of the infrastructure listed in the notice (West, 2014; Wetmore, 2014). In Nigeria the concept of joint and several liability for any operator who currently is or had been associated with an installation does not currently exist, however according to Dawodu (2016), a forthcoming Petroleum Industry Bill is intended to incorporate a similar objective. However, enforcing it on foreign multinational oil companies will be difficult, especially after they have divested their assets to local companies and left Nigeria. According to Schaps and George (2017), a court in the UK has held that Shell in Nigeria cannot be taken to a UK court in a dispute over environmental liabilities from its operations in Nigeria.

The Norwegian approach to decommissioning is similar to the UK. They are parties to OSPAR and The International Convention for the Prevention of Pollution from Ships (MARPOL), and as such have international obligations when decommissioning redundant installations. The Norwegian Petroleum Act 1996 governs the decommissioning of offshore installations and pipelines in the Norwegian sector of the North Sea. Chapter 5 of the Act deals with the termination of petroleum activities. The Act is administered by the Norwegian Ministry of Petroleum and Energy (MPE) who make decisions on the acceptable disposal method based on each individual case. A Decommissioning Plan must be submitted by the licensee 2 to 5 years prior to the shutdown of the facility. Similarly, to the UK, decisions are made based on technical, safety, environmental and economic factors as well as regard for other users of the sea.

In terms of the UK, the decommissioning of offshore infrastructure and pipelines in the UKCS, is regulated by the Petroleum Act 1998 Part IV – Abandonment of Offshore Installations which provides the Secretary of State with the power to

> "by written notice require—
>
> (a)the person to whom the notice is given; or
>
> (b)where notices are given to more than one person, those persons jointly,
>
> to submit to the Secretary of State a programme setting out the measures proposed to be taken in connection with the abandonment of an offshore installation or submarine pipeline (an "abandonment programme"). "

The term "decommissioning" according to 1998 Petroleum Act, section 29,

> "is the activity undertaken in executing the abandonment programme"

This regulation sets out the requirements for undertaking decommissioning including the requirement to prepare and submit a substantial and detailed decommissioning programme. In the UK since that time (1998) there has been a significant increase in decommissioning activity, however very little of the experience and knowledge gained has been reflected in changes to the UK regulations other than those related to financial security in response to the Energy Act (2008) and an OSPAR decision in 2006 with regards to the treatment of drill cuttings OSPAR (2009a). OSPAR is the mechanism by which regulators from 15 countries & the European Union work together to protect the marine environment of the North-East Atlantic. The decommissioning regime in the UK is based principally on the OSPAR decision 98/3, one of the fundamental pillars underpinning UK decommissioning legislation. In 1994, the decommissioning of Shell's Brent Spar storage buoy received significant media coverage when Greenpeace boarded the buoy as it was being towed for deep water disposal. Following this episode, the OSPAR Commission despite reservations from contracting parties France, Norway and the UK voted through a moratorium on disposing of offshore installations at sea. The OSPAR Environment Ministers, at their Ministerial Conference (1998) agreed on what was to become the OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations. The 98/3 Decision has been reviewed to take account of scientific and technological advances and the review period is 5 years. During the reviews in 2003, 2008 and 2013 no new or additional scientific evidence or technological breakthroughs have been presented that would require any changes to the decision and therefore OSPAR contracting parties have maintained the status quo.

This decision effectively rules out the options of leaving decommissioned installations or parts of installations in the sea within the geographical areas covered by the OSPAR agreements. However, all is not as it first appears as there are permitted exceptions based on the principle of partial removal allowing some elements of the infrastructure to be left behind for installations in place before the 1999. It could therefore be argued that both the UK and Norway do

not therefore have a completely clean sea bed approach and that these derogated structures are in fact similar to the reefing or decommissioning in situ approach of other regions.

The joint and severally liable nature of the decommissioning liability regime in the UK provides a key focus and incentive for operators to ensure that their contractual arrangements between partners fully takes into account the financial securities requirement should one of the partners default. The joint and several nature of the liabilities is also targeted at protecting the UK taxpayer from incurring any additional costs above and beyond the levels agreed by Government through the provision of tax relief.

It has become clear during this research that the most active decommissioning market has been the Gulf of Mexico. This has generated significant volumes of knowledge and experience that has been gained in the Gulf of Mexico by both the regulators and the industry and this is a region which has become of particular interest during this research. USA policy stems from the Geneva Convention rather than the UNCLOS and IMO MARPOL approach. Both federal and state regulations have an impact on decommissioning and taken together the regulatory landscape can be confusing to navigate.
The administration of the offshore oil and gas industry is shared between both State and Federal administrations in coastal waters. Beyond 3 miles from the coast, responsibility for installations rests with BOEMRE. The location of an installation therefore dictates which jurisdiction takes precedence on decommissioning decisions. That said, the final decisions and required approvals follow a similar path to the UK, involving consultation with a broader range of stakeholders.

Whilst the USA parallels the UK approach by favouring a complete removal base case, the USA unlike the UK has also established several artificial reef programmes. The basis for the Gulf of Mexico artificial reef programmes has been their contribution to the biological productivity of fish populations in an ecosystem largely devoid of solid surfaces, which is a similar position to the North Sea where the seabed is largely devoid of solid surfaces to act as the nucleus of natural reef development. The socioeconomic demand for sustainable fisheries also has a substantial influence. The US position is that artificial reefs

contribute to the biological productivity of the ecosystem. As an alternative to complete removal, approval can be obtained to convert an installation to an artificial reef as part of a State reef programme and any navigational requirements are satisfied. A large number of the offshore platforms that have been decommissioned in the Gulf of Mexico have been donated to the various state Artificial Reef programmes in the States of Louisiana, Alabama, and Florida an all future liability passes to the State (Macreadie et al, 2011). Contrastingly in the UK the liability for decommissioning remains with the operator in perpetuity. Texas and Louisiana require 50% of the cost saving versus taking ashore to be transferred to the Artificial Reef Program.

In summary the interpretation of the international conventions by regional areas and individual countries leads to the translation of international obligations into specific practices and sets the boundaries within which regional areas and/or individual countries are channelled to develop decommissioning programmes. It is these boundaries that dictate the degree of options and flexibility that can be used to optimise decommissioning solutions. The more options there are, the more flexibility there is, increasing the probability of achieving an optimised approved decommissioning programme. Table 2-4 provides a summary, from a flexibility perspective, of the impact of the international regulations and regional instruments on some of the major decommissioning routes.

Table 2-4: Impact of regional regulation on decommissioning flexibility

Impact of regional regulation on decommissioning flexibility				
Decommissioning option	International regulations	Regional regulation		OSPAR impact on Flexibility of options
		Non OSPAR	OSPAR	
Artificial reefs	Allowed	Allowed	Not allowed	Negative
Clear seabed	Allowed	Optional	Mandatory	Negative
Total removal	Optional	Not required	Mandatory except for caveat below	Negative
Partial removal	Allowed	IMO guidelines suggest >4,000 tonnes	GBS and >10,000 tonnes on application	Positive but restricted to only 10% of installations

Source: Author

From the table above it can be seen that for the UK, the impact on the flexibility for decommissioning options is significant. International regulations such as the IMO guidelines and Standards For The Removal Of Offshore Installations And Structures, UNCLOS 1982, and London Convention 1972 and Protocol 1996 do not rule out the options of utilising redundant oil and gas infrastructure as material for artificial reefs or do they insist on total removal or a clear seabed baseline whereas the OSPAR decisions in the late 1990's has effectively ignored all of these options deemed acceptable through the international regulations and imposed their own set of requirements that are not in line with the current practices in the rest of the world and it can be argued that these decisions are political rather than evidence based decisions.

2.4 Politically driven regulatory framework

The removal of offshore platforms is governed by regulations. There are regulations that are international in setting regulatory obligations, such as the United Nations Law of the Sea (UNCLOS), regionally based regulations such as OSPAR, and more increasingly, indeed more influentially from a practical perspective, regulations at the national level such as the 1998 Petroleum Act in the UK. Whilst past events and public perception have shaped legislation particularly in the UK it can be argued and evidenced that the knowledge, and experience gained to date has not been given the opportunity to influence or contribute to the regulatory envelope within which the decommissioning industry operates.

The regulatory envelope in the UK can be defined as a linked two-tier system. The primary tier consists of the overarching regulations which govern the envelope for the decommissioning of offshore oil and gas installations and pipelines on the United Kingdom Continental Shelf (UKCS) which is controlled through the Petroleum Act 1998 together with the UK's international obligations on decommissioning which are governed principally by the regionally focussed 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention). Agreement on the regime to be applied to the decommissioning of offshore installations in the Convention area was reached at a meeting of the OSPAR Commission in July 1998. The secondary tier of the envelope consists of the national environmental regulations that both govern and provide guidance on a practical day to day level in terms of regulating offshore oil and gas activities which whilst they are predominately targeted at the exploration, development and production elements of the offshore installation lifecycle, many of these regulations remain in force and therefore valid during the decommissioning phase and these are the regulations that OPRED would issue permits against, inspect against and enforce during the decommissioning phase. Figure 2-4 overleaf illustrates the current regulatory framework.

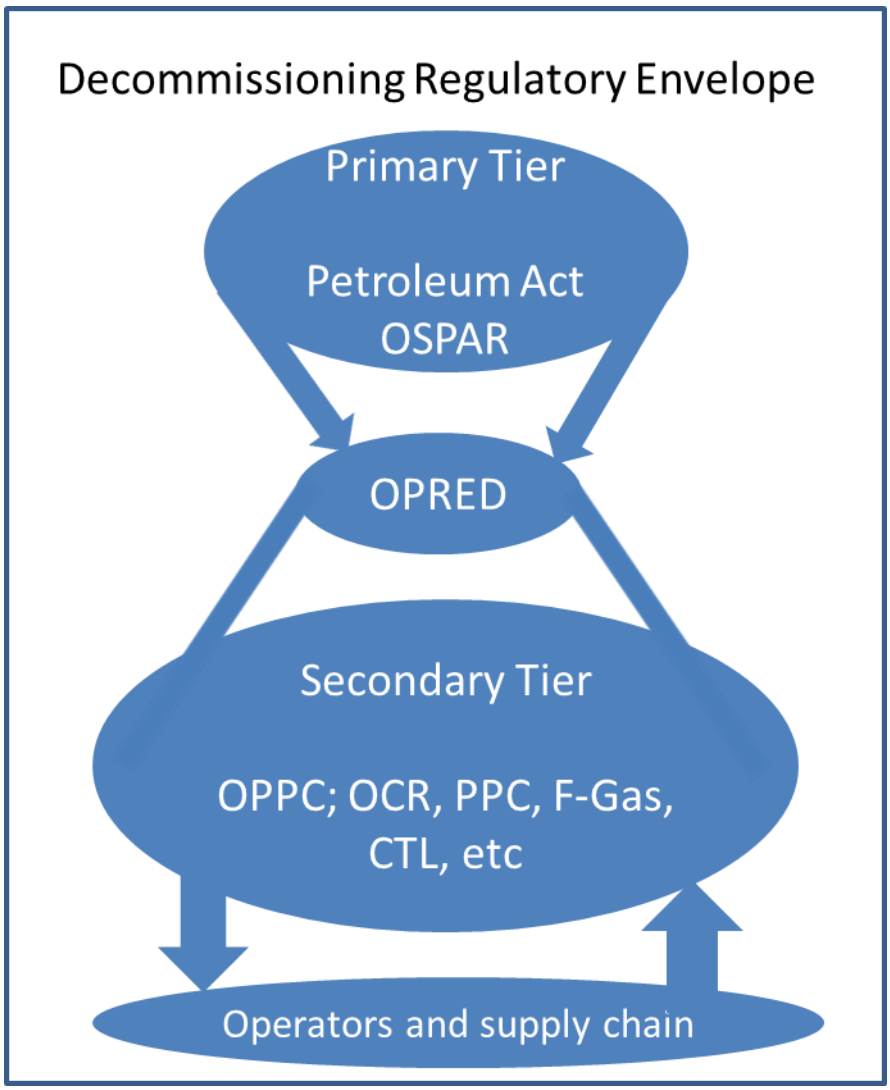

Figure 2-4: Decommissioning Regulatory Envelope for UKCS

Source: Author

Fundamentally, the UK decommissioning regime is steered and directed principally by the OSPAR 98/3 decision. This overarching principle according to Bellamy and Wilkinson (2001), Penner (2001) and Jorgensen (2013) is based not on the evidence of scientific study but principally on political reaction to the widely reported concerns with respect to the initial approach taken by Shell for dealing with the Brent Spar, a redundant offloading buoy in the mid to late nineties and this is an important element to detail. Penner (2001) argues that the environmental lobby, stimulated by their success over Shell's abrupt change of policy towards disposal, caused what is essentially a political decision that has neither a proven basis on grounds of environmental best case nor benefits to society. Wilkinson and Bellamy (2001) argued that despite a lack of evidence to

identify the environmental impact redundant installations generate, or scientific support to demonstrate that removal is the best practicable environmental option the decision taken was political.

Firstly, in setting out the context, it is argued that significant elements of UK decommissioning regulation are driven by the decisions of the Commission for the Protection of the Marine Environment of the North East Atlantic (OSPAR). This statement is supported by Techera and Chandler (2015), who additionally indicate that Decision 98/3 limits the decommissioning options available in the UK. Decision 98/3 is particularly important to decommissioning in the UK according to Jorgensen (2012), Hamzah (2009) and Osmundsen and Tveteras (2003) and it is essential to understand the impact and the background to this historical decision on the current regulatory regime today, and potentially for the future if the status quo remains.

In February 1995 the UK Government approved a decommissioning plan submitted by Shell for the Brent Spar buoy which had been used for oil export via tanker from the Brent field, which following the introduction of an export pipeline to Sullom Voe rendered the buoy surplus to requirements. According to Osmundsen and Tveteras (2003) following independent assessments that established that deepwater disposal of the Brent Spar was the Best Practical Environmental Option (BPEO). The assessments concluded that deepwater disposal would have negligible impact on the marine environment, which was confirmed by independent scientists (Osmundsen and Tveteras, 2003). According to Shell (1998) in summary deepwater disposal was the preferred option as it provided a decommissioning solution that had six times lower safety risks, four times less cost and minimal environmental impact when compared with the onshore disposal option.

The approved decommissioning programme included disposing of the buoy at sea in a deep trench on the UKCS at a site known as the North Feni Ridge in the deep Northern Atlantic (Greenpeace 2016). Up to this point all the previously approved decommissioning programmes involved removal from the sea for onshore disposal (BEIS, 2016). What was fundamentally different about this approved programme was that this was the first programme that would result in the disposing of infrastructure at sea. The decommissioning of oil and gas

infrastructure in the UKCS hit the media headlines in April 1995, when several protesters representing the environmental organisation Greenpeace managed to board the Brent Spar buoy. There was substantial media coverage and the Greenpeace objection gained the support of thousands of people, and of several governments. The opposition was extreme; Shell petrol stations in Germany were attacked and the UK embassy in Bonn was stoned (Rice and Owen, 1999).

Pulsipher and Daniel (2000) identify this period as a game changing event in terms of decommissioning on the UKCS. For example, during this period of conflict between Greenpeace and Shell, the Environment Ministers of a number of the countries bordering the North Sea stated, notwithstanding reservations from the UK and Norway that they were

> "aware that an increasing number of offshore installations in the North Sea are approaching the time of their decommissioning. Even if the offshore installations are emptied of noxious and hazardous materials, they might still if dumped or left at sea, pose a threat to the marine environment." (P.24, Danish Environmental Protection Agency 1995).
> In the same Esbjerg statement, the North Sea Environment Ministers agreed "that decommissioned offshore installations shall either be reused or be disposed of on land", and they invited OSPAR to implement this agreement. (P. 24, Danish Environmental Protection Agency 1995).

Norway was unable to accept this provision on the grounds that they believed that disposal on land is not necessarily the best solution from an environmental point of view for all installations, and the UK did not accept this proposal, since the UK delegation believed that the environment will be better protected by adoption in each case of the best practicable environmental option identified by a thorough case-by-case examination, as provided for in Annex III of the OSPAR Convention 1992 (Jorgensen, 2012).

Figure 2-5 overleaf provides a timeline for the Brent Spar decommissioning summarising the key events that took place between 1995 and 1999.

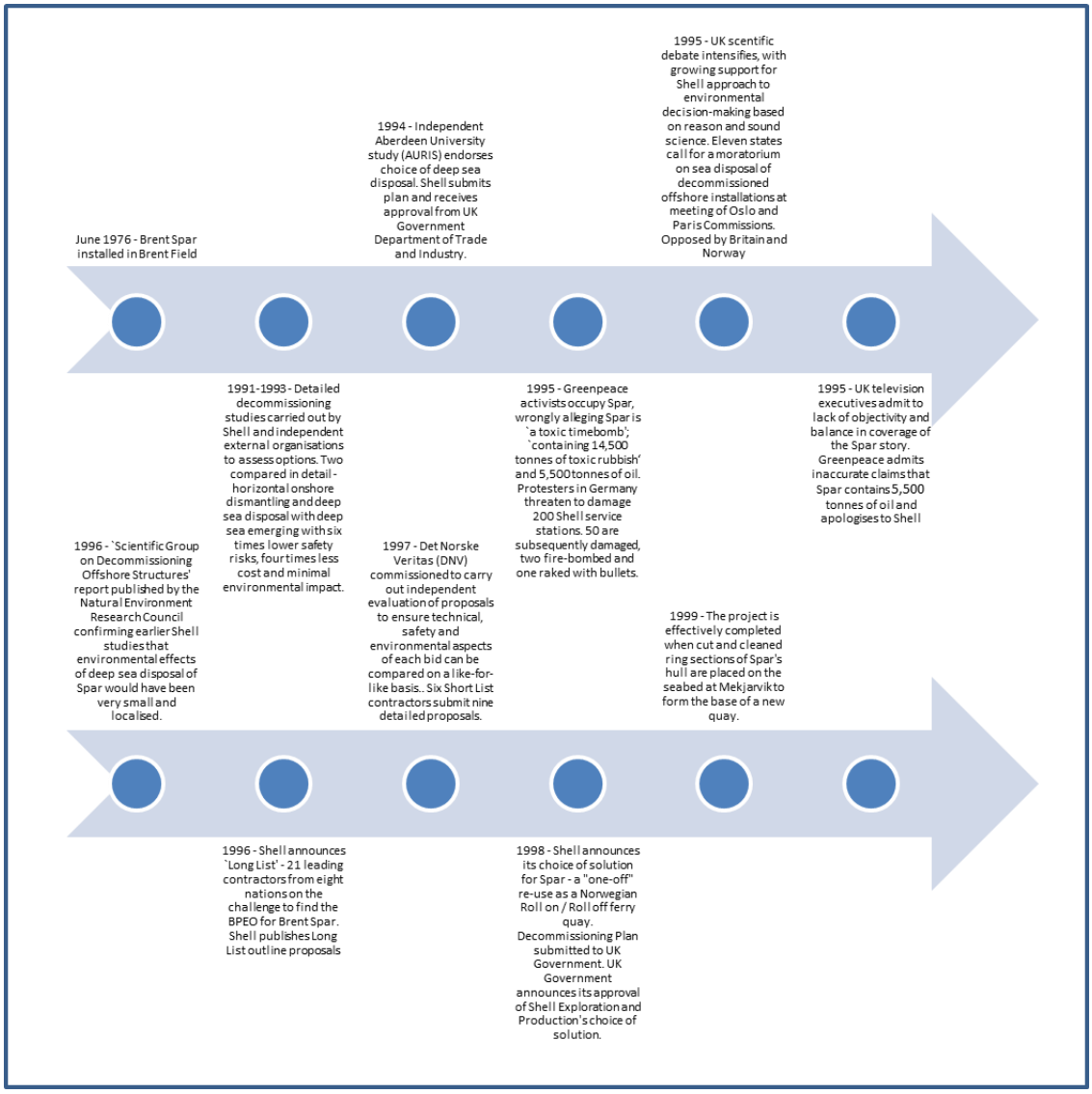

Figure 2-5: Brent Spar timeline

Source: Constructed using data from Brent Spar Dossier, Shell (2008)

Greenpeace had argued that dumping of hazardous waste at sea was not acceptable, claiming that the Spar contained large quantities of hazardous waste oil in excess of 5000 tonnes compared with the 50 tonnes estimated by Shell (Rice, 1996) and it should not be left in the sea. In addition, Greenpeace declared that;

> "the Brent spar, is laden with substances dangerous to the marine environment," Greenpeace adding, "The aging oil installation contains over 100 metric tons of hazardous materials, including PCBs, and

> heavy metals such as cadmium and arsenic, together with over 30 metric tons of radioactive scale." (Oil and Gas Journal 1995).

Shell's argument was also straight forward. It would be safer and cheaper to sink the Spar in deep water rather than to bring it ashore for disposal. According to Barclay (1995) consultations with fishermen and environmentalists before the deepwater disposal was approved indicated support for the Shell approach, and additionally Barclay (1995) suggests that none of the European governments notified by HMG under the Oslo Convention queried the plan before the Greenpeace action.

Over a period of three months, and against a backdrop of both national and international protest, Shell took the decision not to dispose at sea despite the continued support of the UK Government for the original decision. The then Prime Minister John Major reiterated the Governments support when he stated in the House of Commons that

> "I understand that many people seem deeply upset about the decision to dispose of Brent Spar in deep water. I believe that it is the right way to dispose of it. It will be disposed of in the Atlantic, in 6,000 ft of water. It is 150 yards tall and 30 yards wide, and the proposition that it could have been taken inshore to be disposed of is incredible. Shell has my full support to dispose of it in deep water." (P 2, Barclay 1995).

In a statement Shell UK denied that Greenpeace's actions had forced the about turn but conceded that the company had found itself in an untenable position due to widespread objections from international governments. The statement said:

> "Shell UK has decided to abandon deepwater disposal and seek from the UK authorities a licence for onshore disposal. Shell UK Ltd still believes that deep water disposal of the Brent Spar is the best practicable environmental option, which was supported by independent studies." (BBC 1995).

The UK Government retained their support for Shell's original stance with Michael Heseltine, President of the Board of Trade, criticising Shell for relenting when he said:

> "I think they should have kept their nerve and done what they believed was right." (BBC, 1995).

After the decision was made to recover rather than sink the buoy, it was subsequently proved according to Rice (1996) that Greenpeace's claims regarding significant volumes of hazardous waste were shown to be misleading resulting in a loss of trust and integrity for the organisation and the submission of a written apology from Greenpeace to Shell (Side 1997). Once the decision had been taken by Shell to explore alternative disposal options Eric Faulds, Shell's decommissioning manager at the time recalled in an interview in 2008 that;

> "after the 1995 decision to halt the sinking, one of the first things we (Shell) had to do was understand what really happened. We had considered the options in detail, made scrupulous analyses, and identified a disposal plan with the least technical risk, lowest exposure of the workforce to accidents, an insignificant impact on the environment and lowest cost. Why couldn't we carry it out?" (Shell 2008). Faulds went on to say that "There was a lack of appreciation (within Shell) that other countries would be interested in our plans and that they would see the issue quite differently. Although in the UK we had carried out statutory public consultation, neither we (Shell) nor the rest of the industry had explained decommissioning widely enough, early enough. When we encountered low initial public interest, we mistakenly assumed that this meant people would not be concerned." (Shell 2008, P.17).

From a Greenpeace perspective the change in policy by Shell was received positively by Greenpeace who announced that;

> "it is a victory for us but more importantly it is a victory for all the people who campaigned against the dumping" (BBC 1995).

Shell began a process to select an alternative disposal route for the Brent Spar in late 1995 and following a series of reviews to narrow the options announced in January 1998 its choice of solution which would entail an onshore disposal of the topside and the storage tank re-used as a Norwegian roll on / roll off ferry quay.

The revised decommissioning Plan submitted to UK Government who announced its approval of Shell's choice of solution in August 1998 and the project was completed in June 1999 when cut and cleaned ring cut sections of Spar's hull are placed on the seabed at Mekjarvik to form the base of a new quay.

Following the initial media frenzy surrounding the decommissioning of Brent Spar, media and environmental stakeholder interest remained intense and this influenced debate amongst the contracting parties to OSPAR. In July 1998 at the first ministerial meeting of OSPAR in 1998, the 15 contracting parties agreed a set of rules for the disposal at sea of offshore installations. Under the 1998 decision by OSPAR, the abandonment and leaving wholly or partly in place of offshore installations is prohibited. This was known as Decision 98/3 (OSPAR 1998) which whilst it banned dumping at sea, it recognised the difficulties involved in attempting to remove the footings of large steel jackets weighing more than 10,000 tonnes and concrete installations (P4, Annex 1, OSPAR 1998). It agreed therefore that in exceptional circumstances and if supported by sufficient evidence, derogations for these categories of installations could be achieved if the internationally agreed assessment and consultation process shows leaving them in place is justifiable. This 10,000 tonnes caveat is interesting in that there is no evidence in the OSPAR records that indicate where the figure originated from, it runs contrary to the original argument of a clean sea bed and it effectively creates an artificial reef by default.

A further but less well-known casualty of the Brent Spar incident was the Odin platform operated by Esso in Norwegian waters (Jorgensen 2013). In 1995 Esso had been planning after several years of study to remove the topside to shore and place the jacket substructure on the seabed as a pilot project to test if obsolete oil and gas infrastructure could be used as reefing material. Two Government Departments, and two independent research institutes were involved in developing the plan and Esso were to invest $2.5 million for 5 years of scientific research and the project would have saved the Norwegian taxpayer $25 million but according to Jorgensen (2013) the Norwegian Parliament rejected the plan with the press release setting out that their decision was intrinsically linked to the activities of Greenpeace with regards to their Brent Spar actions and the negative international publicity that was generated.

Whilst the Brent Spar incident did result in a political driven set of regulations it also brought home to the industry that decommissioning is more than just an engineering project. It is a process and according to Griffin (1998) preparing a decommissioning programme that is compliant with the regulatory framework in place at the time of execution and one that is both technically and scientifically acceptable may not be enough in their own right to warrant public support and that the Brent Spar incident underlines the importance of communications and engagement with a broad band of stakeholders. This lesson learned by Shell is illustrated in that for the Brent decommissioning programme, consultation involved interaction with more than over 180 organisations, involving more than 400 individuals in the UK and mainland Europe (Shell, 2017).

Every five years Government representatives of member countries of OSPAR gather evidence related to the current regulations and debate whether they remain fit for purpose and since 1998, decision 98/3 and the limits on derogations have not been challenged during this period. It could be suggested that the reason for the lack of challenge each 5 years has been primarily due to the lack of activity in decommissioning in the early 2000s and subsequently a lack of collected evidence. More recently the pace of decommissioning activity has accelerated, and it can be argued that the corresponding levels of decommissioning experience and the associated knowledge gained has increased significantly. Decommissioning is global in nature and over time, the global knowledge and experience envelope will have inevitably gained from exposure to the varying regulatory and practical approaches taken towards decommissioning. It can be argued that these increases in both experience and knowledge are generating an evidence base that supports the proposal to critically re-evaluate the UK policy and regulatory environment of decommissioning and to draw on this growing knowledge base both domestic and international in order to develop an alternative decision framework for decommissioning the United Kingdom Continental Shelf (UKCS).

The legal significance of OSPAR 1998/3 with regards to decommissioning the UKCS should not be underestimated and implementing the recommendations from this thesis that impact on 1998/3 would be challenging to implement. For example, Decision 98/3 which is reviewed every 5 years by the contracting

parties is legally binding on the party's signatory to the OSPAR Convention which includes the UK.

2.5 Constraints of an inflexible regulatory framework

There are currently approximately 302 manned, unmanned or floating oil and gas installations on the UKCS according to OGUK (2015). Many of these installations are now well beyond their original design lives of 20 to 25 years and have been in service for up to 40 years or more. Long gone are the heady days of the North Sea producing between 9,000 and 12,000 tonnes of oil per month between the years 1999 and 2003 (Morton, 2003), and many are now more likely to be operating as water filtration plants separating small volumes of oil and gas from huge volumes of produced water which is normally discharged back to sea or in a few cases re-injected into adjacent wells to aid oil recovery. Whilst the oil and gas industry remains vital to the UK economy, the fact remains that a significant proportion of the offshore infrastructure will require decommissioning as the economic realities of mature assets reach a tipping point. In terms of scale and timing, it is estimated that almost 100 platforms are forecast for complete or partial removal from the UKCS over the next ten years. Over 1,400 wells are expected to be plugged and abandoned and some 7,000 kilometres of pipeline are scheduled for decommissioning as suggested by OGUK (2016).

Decommissioning of the UKCS is a major challenge for the oil and gas industry. As discussed in chapter 1, there are major technical challenges to be overcome in parallel with the need to protect the marine environment particularly as a significant proportion of the cost of decommissioning will be passed on to the tax payer through the system of tax relief given to the industry as noted by Ekins et al (2006) and Phillips and Yan (2013).

The decommissioning of O&G infrastructure is heavily regulated (Rouse et al 2018).The current UK decommissioning regulations and accompanying guidelines are prescriptive in terms of what an operator can do and what an operator cannot do but despite this the process of gaining approval for a decommissioning programme is "long and tedious process" according to Hamzah (2003) taking anything from 3 to 6 years. The conundrum for the industry is that the decommissioning approach that they must adopt is dictated by the regulatory framework rather than by the specific technical or environmental challenges of

the individual platform or location. This restriction limits choice and flexibility and impacts on opportunities for innovation, to reduce cost, to save time and increase efficiency and they also have prevented the transfer of knowledge and the process improvements that could have been gained over the last 20 years.

That is not to say that regulation is not important or indeed helpful. Good regulation, regulation that is evidence based and proportionate to the activities it underpins can be an enabler that helps industry understand both Government and other stakeholder expectations. According to a literature review by Brevignon-Dodin (P 5. 2009) a consensus has emerged amongst regulators and in academia that "a supportive regulatory environment" is one of the factors which are more likely to positively impact on an industries capacity to innovate. Clear regulation helps to protect the reputation of both industry and Government by giving guidance and agreed parameters within which to operate and ensures stakeholders have a voice and have an opportunity to contribute to the decommissioning programme. Through evidence based proportionate regulation Government and industry can look to streamline processes and provide opportunity to standardise solutions and to identify opportunities for cost reduction. (Peel and Lloyd, 2008) and (Wright, 2014) argue that the regulation has to be both proportionate to the activity taking place and the impact that the activity would have on the environment. Additionally, the regulations should also be sufficiently flexible to reflect the breadth and complexity of the UKCS infrastructure that has to be decommissioned. Prescriptive regulation that assumes a one size fits all approach will not lead to optimised decommissioning solutions. The concept of Decommissioning Regulatory Proportionality is introduced and discussed in Chapter 3, section 3.3.

Traditionally there have been opposing schools of thought regarding the impact of prescriptive regulations on business productivity. On one hand there is a school of thought that suggests that prescriptive regulation can add cost to a business model through the need for a company to invest capital to meet regulatory standards and increased operating costs due to the inability to utilise the most efficient processes if they do not meet the regulatory requirements. Empirical studies by Jaffe, Peterson, Portney and Stavins (1995) suggest that prescriptive regulations can lead to increased business cost and reduced productivity. The alternative view proposed by Porter (1991) is that prescriptive

regulations may drive a business to come up with alternative operational processes that actually improve productivity but within the decommissioning envelope the lack of regulatory flexibility limits the range of operational processes deemed acceptable and has been shown to add significant cost and time to projects Hamzah (2003). This view is supported by Rana (2010) who argues that striking a balance between environmental impact and cost of compliance needs the implementation of regulations with offer greater flexibility and efficiency to achieve optimised levels of environmental protection and lower costs.

There are numerous variables within the decommissioning envelope when it comes to assessing and determining the most suitable method for decommissioning an individual installation. These include the scale of the installation, how long the installation had been in location, the distance from land, depth of the water column and the condition of the sea floor, the make-up of sea floor, scale, position and length of pipelines and other installation dependencies etc, etc. The broad nature of these variables by default would mean that a single solution would not be the best outcome for all installations and therefore the more choices that are available the more likely that each installation will be decommissioned with the most appropriate, efficient and balanced methodology. This point is supported by Marcus (1998) who argues that within a system of constraints the more choices that are available the better the overall results are likely to be. Similarly, when individuals and companies are constrained by prescriptive regulations without flexibility, leading to limited decommissioning options, both the incentive and the envelope for innovation are limited. Regulators may argue an opposing view that this would encourage innovation which would align with the views of Porter and Van Der Linde (1995) who suggest that more regulatory constrained environments would encourage innovation from the perspective of finding a way round the regulation, or at least minimising the requirements of compliance with the regulations, but it could argued that the greater the flexibility that is built into regulations, the greater the opportunity and breadth of scope there is to drive innovation and identify alternative decommissioning solutions. This argument is supported by the work of Eisenhardt (1989) who argues that innovation is suppressed by

disproportionate procedures and by Strebel (1987) who shows that providing regulatory flexibility improves performance and encourages innovation.

Additionally, with prescriptive regulation we see that operators have minimal flexibility in terms of meeting current regulations resulting in the same approaches to decommissioning being employed project after project with no evidence of new or different innovative alternatives being employed. Regulators may argue that taking similar approaches project after project would lead to more efficient programmes and associated cost reductions as the lessons learned from one project are taken forward and implemented to the benefit of subsequent projects. Unfortunately, there is no evidence to support this view and the reality is that unless the learnings, both good and bad are reflected in changes to the regulatory framework, it is unlikely that real change and improvements can be realised in practice. There is evidence (BEIS 2017) in both the published approved decommissioning programmes and close out reports submitted by operators that similar decommissioning approaches are being employed from one project to the next and cost overruns of up to 40% are still common which illustrates that there have been no discernible improvements in efficiency or evidence of lessons learned being transferred form one project to another. Oil and gas operators are notoriously competitive with each other and the sharing of knowledge and best practice is not a common occurrence which is an area that needs to be improved. There is a need to tackle what I would term as the Competitive Collaborative Conundrum illustrated in figure 2.6 in section 2.7 which considers the issue of how do you motivate competing companies to collaborate for the mutual benefit of the broader industry.

2.6 Cost of decommissioning

There have been a number of cost estimates published over the years and the only common theme between them is that as each new cost estimate is published the number inevitably rises. When OSPAR set its current decommissioning policy the cost estimate for decommissioning the UKCS was £8.5 billion according to Wood- Mackenzie (1998). The reality is that the long-term liability for decommissioning will be substantial under the current regulatory framework, more than 30-35 billion pounds over the next 30 years according to

Kemp and Stephen (2011). The latest estimate from the OGA (2017) is that the cost will be £60 billion. They are very large sums and who would argue against these cost estimates continuing to rise in the decades ahead. Considering that up to 75% of these decommissioning costs are picked up by the taxpayer (or can be described as an opportunity cost lost to the taxpayer) due to the availability of tax relief, there is an argument that decommissioning could be regarded as a public good where transparency and value for money are essential requirements. The cost of decommissioning is driven by the requirements of the regulatory framework and without significant change these costs are only set to rise.

Decommissioning projects necessitate significant expenditure, therefore the amount of tax relief available becomes a critical factor in any financial decision relating to an offshore asset. Tax relief for the costs of decommissioning has long been an issue of concern for the industry. Currently, the costs of decommissioning can be offset by a system of tax relief whereby tax relief is available against ring-fence corporation tax (RFCT), together with the supplementary charge (SC) and where applicable petroleum revenue tax (PRT). It is usually available by way of a combination of reduced tax liabilities for qualifying expenditure and a refund of tax previously paid. Critically, however, decommissioning must be undertaken to qualify for the tax relief, and for many years the long-term certainty of availability of tax relief has been uncertain.

The commitment in the March 2013 budget to introduce Decommissioning Relief Deeds (DRD) later that year came as a long-awaited relief for the UK oil and gas industry. Under the Deeds, if the tax relief currently available for the decommissioning costs linked to UKCS oil and gas infrastructure was reduced in the future, the Government would make a compensating payment. The Deeds, which locks in a Government commitment to effectively a future tax relief guarantee, is viewed within the industry as increasingly important given the age of many UKCS assets and the projected profile of decommissioning timelines. OGUK (2013) have indicated that the Government by providing certainty on tax relief for decommissioning will increase investment in the UKCS by providing a solid foundation on tax relief that can be used for investment decisions and inter-company financial security arrangements. OGUK (2013) further argue that this will extend field life for a number of years through the attraction of new investment. This is likely to be increasingly achieved following statements in the

November 2017 budget which will enable companies selling North Sea oil and gas assets to transfer some of their tax payment history to the purchaser. This is likely to encourage asset transfer and bring new entrants and fresh investment into the UKCS and extend the life of mature late life fields.

The provision of long term certainty of tax relief is of considerable interest to the taxpayer. It could be argued that the majority of taxpayers are unaware of the provision of tax relief for decommissioning costs and from that perspective the opportunity cost that has therefore been accepted by the Government. There is value in terms of the taxpayer stakeholder if a decommissioning solution or regulatory reform that is acceptable to other stakeholders results in reduced costs of decommissioning.

The OGA report (2017) has set the industry a target of reducing decommissioning costs by 35% which it could be argued is an ambitious target to achieve. The evidence to date is that far from achieving project cost reductions, the opposite is the case in that the published data indicates that projects have commonly cost >40% over their original estimate (BEIS, 2016). The OGA believe that a 35% cost reduction (£60 billion down to £39 billion) is achievable. Little detail has been published by the OGA on how they will achieve this target but the OGA report (P. 5, 2017) indicates that it will be "achieved by sharing of lessons learned, development of innovative approaches to contracting strategy and enhance the capability of the supply chain".

Considering that the cost estimate for decommissioning the four Brent platforms was estimated by Shell as a multi-billion pound project when it was first reported by Shell (with industry rumours of a total cost estimate now approaching £10 Billion) and that there are more than 300 other platforms and 300 subsea production systems as well as more than 5000 wells and 25,000 kms of pipelines to decommission, the ambition of doing this with the £39 billion target suggested by the OGA is difficult to imagine within the current regulatory framework. The fact remains that the costs of decommissioning are driven by the requirement to comply with the regulatory framework and unless significant changes are made to the regulatory framework, it could be argued that the level of cost reduction suggested by the OGA will continue to appear ambitious.

According to OGUK (2013) their decommissioning survey estimates that from 2013 to 2022 the forecast expenditure on decommissioning will be in the region of £10.4 billion with £4.6 billion or 44% of these costs reflect the predicted decommissioning activity in the northern North Sea which presents the most challenging environment for undertaking decommissioning activities due primarily to the depth of water and prevailing weather conditions. The annual nature of this study allows it to benchmark activity from year to year to identify trends in the decommissioning market. Over time this should generate a more representative view of the industry for forecasts. However, the survey admits that its forecasts beyond 2019 have a degree of uncertainty due to the changing nature of decommissioning programme start dates.

One of the elements adding to the cost of decommissioning projects is the supply chain constraints which are a combination of other areas of oil and gas sector competing for the same resources and a lack of visibility of the pipeline of decommissioning work and when these projects will come to the market. This has resulted in the supply chain being unable to commit to invest in additional resources. Predicting the exact date of decommissioning for future projects is difficult for a number of reasons. According to Decom North Sea (DNS) (2014) the reasons include the volatility in oil and gas prices which determine the end of field life management and decisions on the economic timeline for keeping a field in operation. Confidence or lack of confidence in both the fiscal and regulatory regimes which will influence the future investment environment, the introduction and acceptance of improved production and reservoir recovery methods, extending the use of the current infrastructure to facilitate smaller satellite fields tied back into existing export systems, and finally the alternative use of the structures for example gas storage or carbon capture and storage.

The OGA through their production licensing regulatory function maintains a data base of expected cessation of production (COP) dates provided by operators but this information is currently not available to the market. It is considered by the operators as commercially sensitive. The operators consider this information commercially sensitive with the argument that premature announcement of COP data could impact negatively on share price. If a solution could be generated to solving this conundrum of providing an accurate calendar reflecting the pipeline

of decommissioning work, then the supply chain could with increasing confidence invest in the areas of infrastructure capacity and reduce the pressure on contracting costs and liabilities.

The regulatory framework determines to a large degree the activities that an operator must undertake in order to develop and execute a decommissioning programme and by default the regulatory framework is a major driver of the costs of decommissioning. The regulatory framework determines what must be done and what is not allowed. As such it is important to consider the value that each element of the regulatory framework is providing in terms of the expectations of all stakeholders. This has not been systematically investigated and it is likely that there are elements of the regulatory framework that add to the cost of decommissioning and add little or no value to the overall delivery of the project from the perspective of the numerous stakeholders involved. From an efficiency perspective, many economists would argue according to Arrow et al (1996) that the measurable gap between identified benefits and calculated costs, should be one of the primary criteria for considering proposed environmental regulations. That said it is fair comment to say according to Stavins (2006) that even when the collated benefits of a regulatory policy outweigh the collated costs there will inevitably be winners and losers.

2.7 Knowledge transfer

When an oil and gas installation transitions from an operational production phase to a decommissioning phase a number of significant changes are taking place. Decommissioning is fundamentally different from the operational production phase. The organisation moves from a process oriented, function defined steady state into a project mode with constant changes to requirements and process with the aim of ultimately removing the installation. The installation changes from a profit centre into a cash consuming entity, the required supply chain support will change, there will be loss of operational personnel and with that their knowledge of the platform and there will be regulatory changes and changes to associated compliance requirements. All of these changes require access to a new set of knowledge and experience to minimise the impact and

maximise the efficiency of the changing dynamics that surround an installation transitioning through the decommissioning phase.

Knowledge transfer is an important mechanism for improving the performance of those with access to it. For example, a study of the introduction of a second shift within a manufacturing plant found that the second shift reached a level of productivity in several weeks that it had taken the first shift many months to achieve (Epple, Argote, & Murphy, 1996). Much of the knowledge the first shift acquired had been embedded in the technology and routines of the plant, and this knowledge was available to the second shift with the obvious benefits accrued.

Knowledge harvesting is common within organisations as they seek to learn from their own experiences to seek to improve on current performance. The oil and gas industry is no different. For example, BP have their Retrospect Process system which following project completion and through discussion and analysis according to Gorelick and April (2004) identifies what were the successes? why did they occur? and importantly how they ensure that the successes can be repeated? In parallel and potentially from a decommissioning perspective, it also identifies what were the disappointments? why did they occur? and how can they be avoided in future?

The difficulty the industry faces is the challenge of encouraging natural competitors to work together, to collaborate for the benefit of each other. I term this issue the Competitive Collaborative Conundrum. Competitor collaborations have occurred in other industries. For example, Hitachi, Toshiba, and Matsushita jointly established a company to manufacture liquid crystal display panels and in the automobile industry, platform sharing across firms has become common practice. By sharing a common platform, they save on development costs according to Ghosh and Morita (2012). According to a recent study comparing innovation within the Norwegian and the UK oil and gas sectors, Hatakenaka et al (2011) suggested that within the supply chain in Norway there is clear evidence of collaboration and coordination supported by local and national governments whereas in the UK it is characterised by being market led with competition seen as the primary driving force.

Decommissioning should be seen not as a phase of the lifecycle where competitive advantage can be gained but more as a common goal for the industry. Each operator would stand to benefit from sharing decommissioning knowledge and experience as they will each be decommissioning individual assets at different points in time over the next 30 years or so. Figure 2-6 below summarises the author's concept of the competitive collaborative conundrum and illustrates the normal competitive forces preventing collaboration between competitors and the idea that through a combination of trust, cooperation and shared values this conundrum can be overcome with the support of Government and industry trade bodies to tackle the common challenge of decommissioning which overshadows the industry.

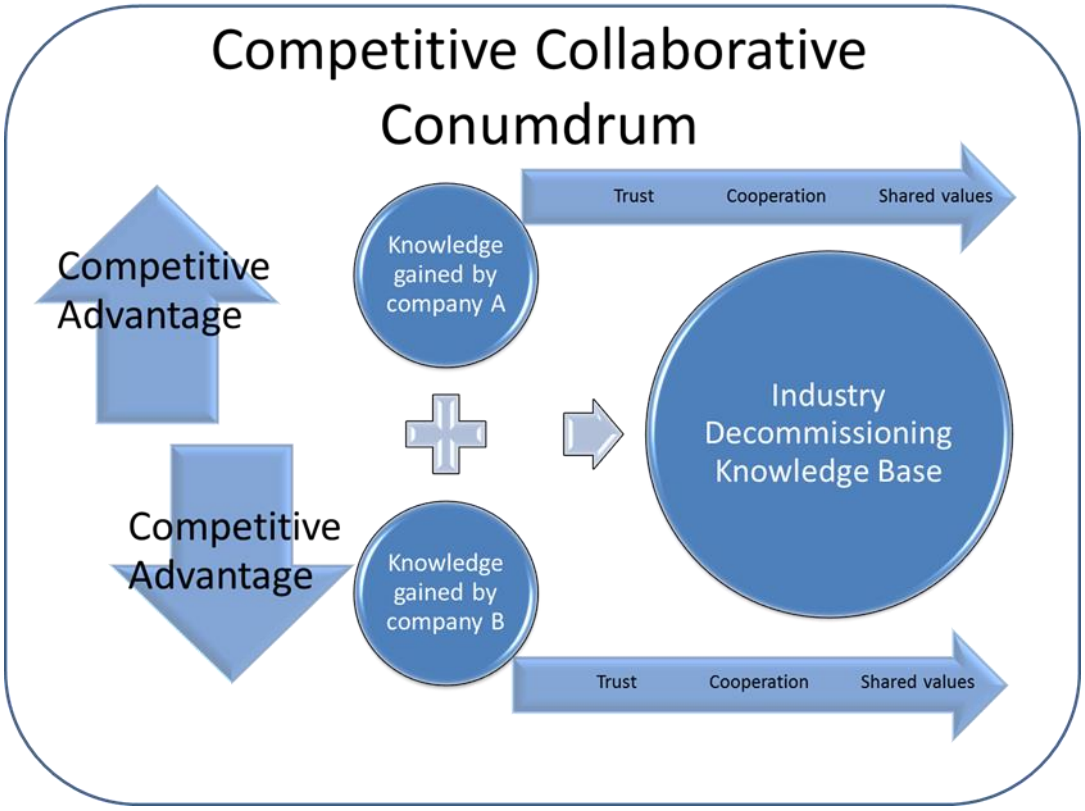

Figure 2-6: The Competitive – Collaborative Conundrum. Source: Author

Easterby-Smith et al (2008) articulate knowledge transfer as a process during which one organisation learns from the experience of the other. One potential approach would be the concept of knowledge transfer through partnering.

Partnering is defined by Black et al (2000) as an approach that aims to remove antagonistic relationships through supporting the participants to work in partnership with communal objectives to reach an end game where all participants achieve successful outcomes. Naoum (2003) considers partnering as a structure for creating shared objectives between participants.

Tackling the Competitive Collaborative Conundrum will be a difficult challenge but there are tangible benefits to be gained over time as the knowledge base builds project by project and improvements in project efficiency, cost and safety are delivered. Erickson (2010) suggests the success of partnering depends on the development of a shared collaborative culture and Bresnen and Marshall (2000) suggests that the foundations of success are the development of trust, cooperation and common objectives between participants.

Considering the considerable tax relief that has been granted to industry for the costs of decommissioning over this period the Government technically "owns" a significant share of that knowledge that could have been recorded, stored and made available to benefit future projects. Due to the significant tax relief available it could be argued that decommissioning projects should be considered to be public procurement projects and that the minimisation of cost should be a prominent core objective to maximise value for money criteria for the use of public money.

There would be significant benefits to projects if access was available to knowledge gained from previous decommissioning projects. Access to for want of a better description, some form of a decommissioning knowledge bank that had captured the knowledge and experience gained from previous decommissioning projects and the people involved in those decommissioning projects. According to the Organisation for Economic Co-Operation And Development (OECD) (1996), knowledge transfer is articulated as providing information to contribute to solving problems, sharing or spreading of knowledge to make it available to others. In organisational theory it is the transfer of knowledge between different parts of the entity. Argot and Ingram (2000) considers that the fact that knowledge resides in people, tasks and networks makes its effective use a complex task. Nonaka and Takeuchi (1995) put forward that much of the valuable knowledge is tacit based such that the individuals may not realise that they have the

knowledge that others could make use of. The goal here is convert the tacit knowledge into explicit knowledge such that it is available to others to use. The guidance offered by the Government of Alberta quoted in Graham et al (P.15, 2006) is that "a systematic approach to capture, collect and share tacit knowledge in order for transfer it to become explicit knowledge. By doing so, this process allows for individuals and/or organizations to access and utilize essential information, which previously was known intrinsically to only one or a small group of people."

The industry and Government have both failed to capture the knowledge that has been gained over the past three decades of decommissioning projects. Decommissioning lessons are being learned by individuals and some companies in terms of the challenges faced but this is not being captured and shared. Even the simplest lessons such as what worked well, what did not work well, what approach would be repeated and what approach should never be repeated. Similarly simple foundation blocks for knowledge transfer in decommissioning could include such details as what are the fundamental things I need to know about a decommissioning project?; where can I get more detail of current and previous projects?; what equipment can I re-use?; and who can I talk to in the industry?

The oil and gas industry is a dynamic industry where there is a constant flow of people between companies, between projects, between countries and between employment and retirement. When people make these changes their experience, knowledge, and lessons learned moves with them unless it has been previously captured in some format.

To illustrate this point whilst presenting a paper at a decommissioning conference in 2013, three slides were presented with lists of decommissioning projects undertaken over the past three decades and the audience of 400 decommissioning specialists were asked to stand if they had been involved in the first list representing projects undertaken from 1983 to 1992. Nobody stood up, nobody in the room at a decommissioning conference in 2013 had been involved in those projects and therefore there was no knowledge in the room from those projects that could be passed on to future projects. For the period 1993 to 2002, only a handful of people stood up. They remained standing and they were joined

by an estimated 30 further individuals who had been or were involved in projects from 2003 to 2013. The point being made to the audience was that the 30 to 40 people out of the 400 in the room constituted the grand total of decommissioning knowledge and experience of actual offshore decommissioning of oil and gas infrastructure. The further point made being that the knowledge and experience was in their heads, tacit knowledge as described earlier by Nonaka and Takeuchi (1995) which individuals may not realise they possess and not in an easily accessible format or repository, and the individuals may well be contracted in a manner where they would not contractually be able to share their knowledge.

The lack of an accessible knowledge base for decommissioning which may have resulted in reduced project efficiency with the associated increase in project length and costs and is a missed opportunity that could be improved upon. There is a more generic knowledge transfer issue between naturally competing companies in that they are generally reluctant to be open about anything that has gone wrong in a project. Examples of this emanate from the same 2013 conference where two operators gave presentations about recently completed decommissioning projects. The overall corporate messages from each presenter were that both projects were successfully delivered with no major concerns. From a knowledge transfer perspective this is less than useful particularly when the final costs of the projects when submitted to the regulator as a requirement of the close out report indicated that both projects were between 30% and 40% over the original cost estimation that was submitted to the regulator for approval (BEIS 2016). From a knowledge transfer perspective and to the benefit of future projects it would be helpful if the issues and decisions that had led to these significant cost overruns had been shared with the decommissioning community to prevent similar issues being repeated in future projects.

Industry, through its trade associations and Government could work together to create a knowledge bank incorporating a knowledge capture and transfer mechanism that is available to industry. Figure 2-7 overleaf illustrates a high level conceptualised illustration of how a knowledge transfer network could look within the decommissioning community.

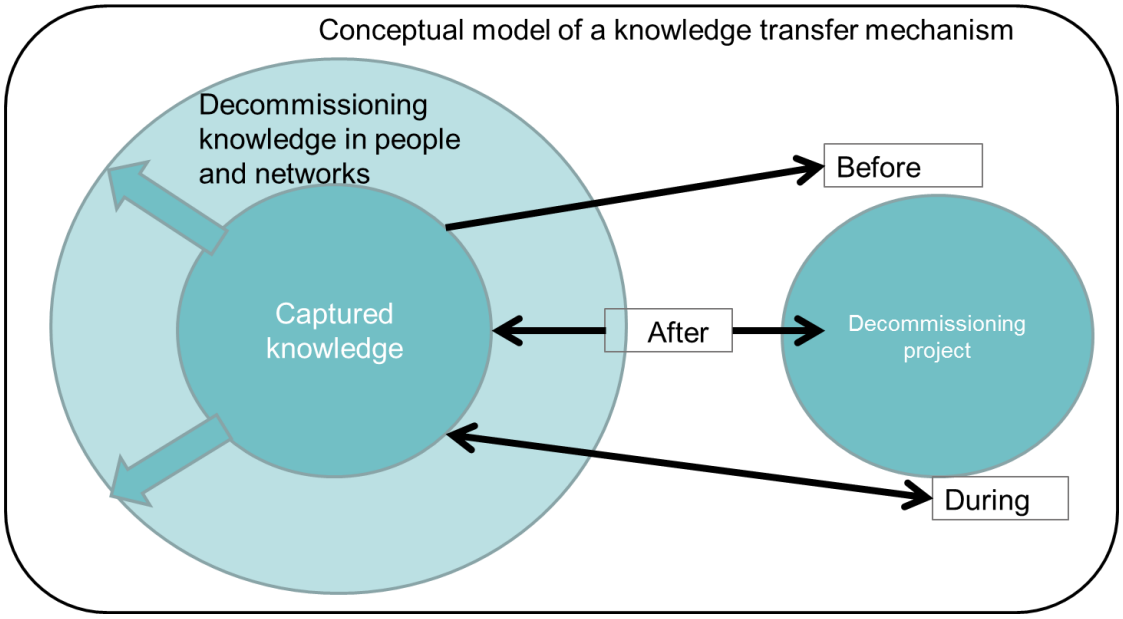

Figure 2-7: Author's conceptual model of a knowledge transfer mechanism for the Oil and Gas Decommissioning sector. Source: Author

Designed to have a central hub of available information, case studies, access to people and professional support both before and during the execution of a decommissioning project. The information gained from each project during programme development, during and after execution could be fed into the knowledge hub to enhance the available data and expertise available to all and acting as a foundation platform for increasing the efficiency of future projects.

2.8 Summary of chapter 2

Chapter 2 lays the foundations of the arguments being made in this research. This chapter discussed the international regulatory defining conventions and the differences between the interpretations of these by regional and national bodies which then determine the limits of the decommissioning envelopes in each country/region.

Supported by the literature reviewed the chapter introduces the identified constraints in terms of inflexibility and prescriptiveness of the current regulatory framework for decommissioning on the UKCS. The analysis of approach around the world indicates that requirements in the UK are more stringent than elsewhere and therefore far less flexible in terms of the decommissioning options that can be considered resulting in decommissioning programmes in the UK that

are not optimised. The one size fits all approach in the UK is also contrary to the approach adopted elsewhere which focuses on dealing with each project individually to realise the optimum solutions from a broader set of available options.

The literature has shown that there is clear evidence that the early decisions taken in setting the current regulatory framework were a political response to a negative event rather than a set of decisions based on scientific evidence. From the perspective of the UK regulatory framework the most critical conclusion to be drawn is that the constraints on flexibility of decommissioning approach governed by the OSPAR regime it can be argued run contrary to the guidance and concepts supported by the various international conventions and obligations.

Additionally, chapter 2 highlights the sheer scale of the costs involved and distinct lack of specific decommissioning knowledge transfer within the industry which runs contrary to the evidence from the literature of the value for all stakeholders that can be gained by adopting successful knowledge transfer mechanisms.

CHAPTER 3: ENVIRONMENTAL REGULATION AND ITS PROPORTIONALITY WITH RESPECT TO DECOMMISSIONING

3.1 Introduction

Chapter 2 concentrated on the current regulatory frameworks that direct decommissioning activities both in UK and in other parts of the world. In addressing the research problem outlined in chapter 1, chapter 2 identified both the constraints of the UK regulatory framework and some of the alternative approaches utilised in other global regions. Together with the resulting impacts on the cost of decommissioning and the lack of knowledge transfer within the decommissioning community. The primary focus of the regulations is targeted at minimising the impact of decommissioning operations on the environment of the North Sea. Therefore, it is a key element of this research that an examination of the both role of the regulator and the impact of oil and gas operations on the marine environment is undertaken and this is the initial objective for chapter 3. The chapter will discuss the main sources of potential environmental impact from oil and gas operations and aims put in context the actual environmental risk from decommissioning activities and the residual risks remaining once decommissioning operations are complete.

This chapter introduces the concept of decommissioning regulatory proportionality with the aim of building on the environmental impact discussions in this chapter. An argument is put forward that decommissioning removes the most significant environmental effects of oil and gas activity and that some of the current regulatory requirements are disproportionate when applied to decommissioning platforms, particularly since they were originally designed to minimise the impact of platforms in their production phase which is when the platforms have most impact on the marine environment. This chapter will also investigate the proportionality aspects of derogations and clean sea bed approaches emerging from chapter 2 and draw on some of the alternative approaches being deployed by other countries also arising from chapter 2.

The chapter argues that the inflexibility of the current regulations may also lead to negative impacts on the marine environment which is in many ways counterproductive to the initial goals of the original regulation. The subject of rigs to reefs is discussed and the chapter develops an evidence-based proposition

to add rigs to reefs as an additional option to the decommissioning options that are currently available to the companies responsible for undertaking decommissioning operations offshore. The chapter sets the historical context, considers the common environmental concerns regarding rigs to reef and provides evidence-based counter arguments to provide a clearer picture of the impact of rigs to reefs.

3.2 Role of the regulator in minimising environmental impact

In terms of UK Government Energy Policy, The Department of Business, Energy and Industrial Strategy (BEIS) is the lead Department and their overarching vision statement clearly indicates that the Government agenda for the Department is broad and not energy industry specific. The focus is on supporting an economy from which everyone can benefit. BEIS states that it has four pillars that will enable it to achieve this goal and one of those pillars is to ensure that the UK has an energy system that can be relied upon at a reasonable cost. This pillar is further refined by the statement that BEIS "will meet our needs for the future by upgrading and diversifying our energy supplies – ensuring they are smarter, cleaner, more secure and affordable for consumers and businesses". BEIS (2016)

Within the Government Department BEIS, the Offshore Petroleum regulator for Environment and decommissioning (OPRED) is responsible for regulating from an environmental perspective the oil and gas industry operating in UK waters. OPRED works in partnership with the Health and Safety Executive (HSE) acting together as the Competent Authority and together with the Maritime and Coastguard Agency (MCA) to enforce regulatory compliance in the industry's activities on the UKCS. OPRED also has responsibility for regulating the decommissioning of redundant oil and gas infrastructure and ensuring that operators have in place sufficient financial security to cover their decommissioning liabilities.

OPRED consists of three teams covering decommissioning, permitting and inspection and who between them cover all regulatory and compliance requirements to ensure that operations are undertaken in compliance with the environmental legislative requirements. The following table 3-1 summarises how

OPRED ensures that offshore operations are undertaken in line with the environmental legislation requirements.

Table 3-1: Summary of OPRED Environmental Management

Role	Delivery method
Cooperation	Developing policies and a regulatory framework, working closely with other Government Departments, external stakeholders and cooperating internationally with appropriate organisations.
Effective regulation	Minimising the environmental impact of oil and gas operations by implementing effective legislation and working closely with international partners and upholding agreed codes of practice.
Knowledge management	Keeping abreast of the latest technological developments and operational trends to ensure that these are mirrored in the Department's risk analysis and environmental monitoring programmes
Ensuring compliance	Undertaking regular inspection of offshore platforms to ensure operator compliance with regulatory requirements
Incident response	Providing a 24/7 response capability to react to offshore environmental incidents
Investigations and enforcement	In cases of suspected regulatory non-compliance, undertaking investigations and methods of enforcement

Source: Author

3.3 Decommissioning Regulatory Proportionality

The concept of regulatory proportionality within the decommissioning envelope is built on the foundation that the environmental regulatory framework should reflect the environmental impact of the activities being regulated. The principle for proportionality according to Craig and Burca (2008) is a basic principle in European Community law which is manifested in a wide range of legal instruments and judicial decisions. Regulations should reflect the principle of proportionality as outlined by Ferran (P2. 2015) such that they

> "do not exceed the limits of what is appropriate and necessary in order to attain the objectives legitimately pursued by the legislation in question; when there is a choice between several appropriate measures, recourse must be had to the least onerous; and the disadvantages caused must not be disproportionate to the aims pursued"

Equally regulatory proportionality should also reflect an attempt to achieve better regulation which according to the European Commission (Chp1. 2015) means

> "designing policies and laws so that they achieve their objectives at minimum cost. Better Regulation is not about regulating or deregulating. It is a way of working to ensure that political decisions are prepared in an open, transparent manner, informed by the best available evidence and backed by the comprehensive involvement of stakeholders".

A common practice for the management of safety risks in the oil and gas sector is based on the principle that risks shall be reduced to a level As Low As Reasonably Practicable (ALARP). The concept of environmental risk is not as unambiguously defined as safety risks according to Jones and Israni (2012) and this is particularly true for planned environmental impacts (e.g. emissions/discharges during decommissioning operations) because the consequence, the environmental impact, is not linked to a likelihood or certain frequency. That said environmental ALARP is contained within the NORSOK Standard Z-103 (NORSOK, 2001) where the risk of accidental harm to the environment is treated in parallel to the risk of harm to people. The use of ALARP within environmental impact would assume that there is a level of risk that is so low that it would not be worth the cost to reduce it further. In essence, Yasseri and Mahani (2009) suggest that ALARP is achieved when a level of risk is reduced to the point where further reduction would not be possible without a disproportionate amount of further investment being required. The use of ALARP reflects both the principles of proportionality and better regulation quoted earlier.

Additionally, and in parallel to the ALARP principle, the principles of Best Available Technology / Best Environmental Practice (BAT / BEP) have been

developed with respect to environmental impacts of activities and the use of BAT/BEP is required by the OSPAR Convention (OSPAR, 1992) to prevent marine pollution. These principles are to a wide extent analogous to the ALARP principle used in health & safety and are considered by Dennis and Shoborin (2009) to take into account the balance between the costs and the environmental benefits. The difference between ALARP and BAT/BEP is that ALARP in the NORSOK standard is usually related to accidental events whereas according to Dennis and Shobirin (2009), BAT/BEP is usually related to planned activities. With all planned activities there remains the risk that something can go wrong and therefore combining both the principles of ALARP and BAT/BEP to decommissioning tackles reduces both the environmental risk and environmental impact whilst underpinning the concept of decommissioning regulatory proportionality.

In essence, it could be argued that decommissioning regulatory proportionality should aim to achieve the regulatory goal whilst striking a balance based on the best available evidence between what is appropriate and what is necessary to achieve the regulatory goal. It should also reflect a balance between difficulty of compliance and cost of compliance as well as difficulty of compliance and measurable benefit of compliance. Equally it should not be designed in isolation but involve stakeholder interaction. Figure 3.1 illustrates the concept of decommissioning regulatory proportionality.

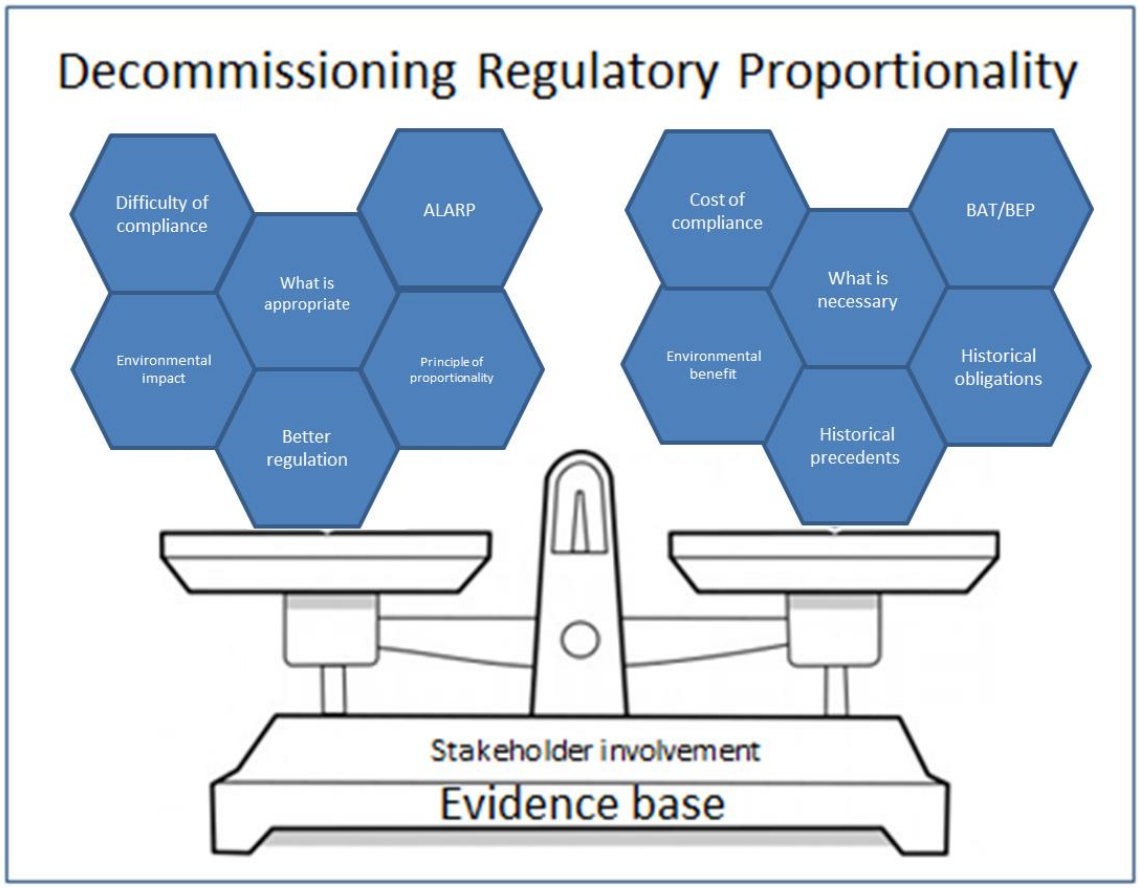

Figure 3.1 Decommissioning Regulatory Proportionality.
Source: Author

Currently the same oil and chemical discharge regulatory framework is applied to platforms in their decommissioning phase as is applied in their production phase and this chapter examines the available evidence and puts forward an argument that the status quo does not reflect proportionate regulation. The chapter will argue for example that applying the current regulatory framework for the production phase is not proportionate to the decommissioning phase of the platform lifecycle and the chapter proposes a number of potential changes to the regulatory framework to reflect a more proportional approach to the current decommissioning regulatory framework.

3.4 Environmental impacts

There are many sources of potential environmental impact from operations involving hydrocarbons. These may include permitted discharges such as oil entrapped in produced water, the degradation of drill cuttings piles and Naturally Occurring Radioactive Materials (NORM). These examples illustrate the range of environmental issues that can raise concerns. These and other environmental issues such as the accidental releases of chemicals and oils during normal operations, atmospheric emissions and indeed operations that disturb the seabed such as pipeline laying, or removal can occur during all of the various elements of the lifecycle from exploration, through the productive period and the end phase of decommissioning. Figure 3-2 illustrates the sources of these environmental concerns.

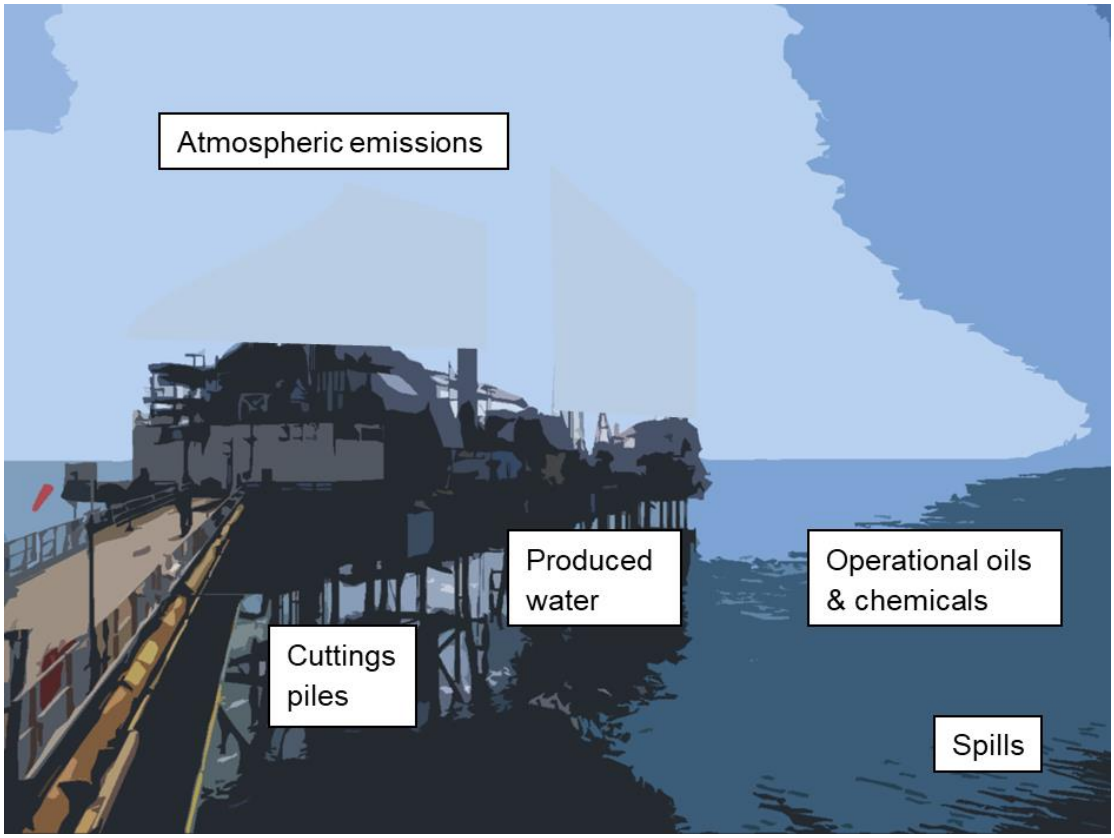

Figure 3-2: Sources of environmental concerns on offshore oil and gas installations. Source: Author

While it is true to state that there was little control over oil and gas operations during the early days of North Sea oil exploration and production phases in the 1960's, 70's and even into the early 1980's, it is also true to state that today the environmental controls in the North Sea are much stricter and the understanding of the impact on the environment is much better understood by the oil and gas operators. For example, up until the late 1990's oil-based drilling mud containing barium and other heavy metals and drill cuttings covered in oil-based mud were routinely discharged to sea accumulating in piles of drill cuttings piles around the platform or the well being drilled. These contaminated drill cuttings were a significant source of pollution to the marine environment according to Pabortsava et al (2011). The intentional discharge of drill cuttings contaminated with oil across the OSPAR region was banned by 2000. In response, operators adopted the use of synthetic and water-based chemicals which significantly reduced the environmental footprint of these activities (Bakke et al., 2013), but of course there remain significant volumes of historical drill cuttings that need to be considered during the decommissioning phase of the oil and gas platform lifecycle.

3.4.1 Oil

Liquids and solids are discharged to sea due to a number of both permitted and non-permitted sources during production, and decommissioning activities and these discharges will generally disperse rapidly and spread over large distances according to Bjorgesaeter (2009). Additionally, liquid from machinery spaces and general drainage systems may also contain measurable amounts of oil. Another known source of oil entering the marine environment is from accidental releases, the general day to day operations of offshore installations and from supply boats particularly during diesel bunkering operations. The majority of the oil that enters the sea during oil and gas operations is commonly through the produced water systems of a production platform. Produced water (PW) is water in underground formations transported to the platform during oil and gas operations. Produced water is contained within the hydrocarbon bearing formations. As such it will be recovered to the surface with the extraction of hydrocarbons and will potentially contain chemicals that were used during drilling

operations, chemicals injected into the well to aid hydrocarbon recovery, production and fluid treatment processes and these chemicals include both corrosion and scale inhibitors as well as oxygen scavengers.

According to Neff et al (2011) it may also contain heavy metals, and naturally occurring radioactive material (NORM). Rabalais et al (2017) suggest the environmental impact offshore is dependent not only on the constituents and concentration of oil but also on the discharge point, physical properties as well as the hydrology of the receiving environment. During normal operations the oil, gas and produced water are separated from each other once the well fluids reach the production platform. The PW is subject to further processing to remove further oil in order that the oil in PW levels is reduced to a level that meets the regulatory requirements before being discharged to sea. Each platform receives approval for their PW discharge by applying for an oil discharge permit from OPRED under the Offshore Petroleum Activities Oil Pollution Prevention and Control (OPPC) Regulations 2005. Discharges are monitored offshore and results recorded in the Environmental Emissions Monitoring System (EEMS) database held by OPRED. On some platforms where technically feasible, PW is reinjected down injection wells primarily to aid oil recovery and maintain reservoir pressure. Selection of the most appropriate technology according to Ahmadun et al (2009) is the result of a mix of variables such as the chemistry of the fluid, economics, available space for equipment packages as well as the durability of the equipment with respect to the weather and operating conditions.

Whilst the standard limits for oil in water discharge concentration provided within an OPPC permit are targeted at platforms in steady state production which are discharging oil to sea 24 hours a day, 7 days a week for many years are both proportionate and achievable, there is an argument that simply applying the same regulatory requirements to decommissioning activities is short sighted and disproportionate since the decommissioning activities are of short duration, and involve much smaller discharges of oil to sea by comparison. The short duration of the activities makes achieving the discharge concentration limits more difficult to achieve resulting in additional time operating equipment and vessels to meet these permit conditions. Additionally, this leads to delays during project execution and increases atmospheric emissions which it could be argued offsets

any potential for environmental gain. This issue is discussed in more detail in section 3.3.

In 2014 according to the EEMs database (2015) some 17% of the total PW was reinjected, but the vast majority of produced water is discharged to sea. The UKCS is a mature basin and over time as reservoirs deplete, oil becomes harder to reach and extract resulting in the percentage of produced water in fluids reaching the platforms increasing. This in turn has increased the volumes of produced water treated and increased oil ending up in the sea. In 2014 according to the EEMS database (2015) 188 million cubic metres of PW containing 2000 tonnes of oil were discharged to sea.

Once cessation of production has occurred the production and discharge of produced water ends and no further oil from the reservoir source is discharged to sea. That does not necessarily mean that the oil in water treatment process is no longer used. Depending on the approved decommissioning programme, and approved OPPC permit, the oil in water treatment facilities may still be used to treat and discharge fluids from vessels on the platform that contain residual hydrocarbon. It may also be used to treat fluids recovered from pigging and flushing pipelines prior to disconnection and the treatment of reservoir sand contaminated with oil prior to the backloading of the sand to shore for disposal.

The risk of release/discharge to sea of hydrocarbons reduces during the decommissioning process but importantly the risk continues and therefore it is important that OPRED develops and introduces a decommissioning specific inspection regime to ensure that operators continue to consider the environment during the decommissioning phase.

3.4.2 Chemicals

Within the oil and gas industry the use and in some cases permitted discharge of chemicals is vital for maximising productivity. The primary discharges of chemicals are likely to occur from drilling including drilling fluids, and cementing chemicals and through the produced water system as they are used for both the production and the processing of the hydrocarbons. There is a perennial issue that many of the chemicals in use offshore are water soluble and once they enter

into the produced water system they will not be recoverable and will be discharged to sea. Chemicals are also used in hydraulic fluids to control valve movements both subsea and at the wellheads. A further use is maintaining flow and integrity of pipelines. Chemicals can result in both short and long term marine environmental effects. Long term chemicals can affect the hormone and reproductive processes of marine organisms and this can impact ecosystem structures and the food chain including seabirds, other predatory fish and by default, humans according to OSPAR (2009)

The discharge of chemicals into the marine environment is controlled by OPRED through the Offshore Chemical Regulations. Between 2012 and in 2014 more than 105,000 tonnes of chemicals were discharged to the marine environment. EEMS database (2015). Whilst the plug and abandonment of wells during decommissioning phases will increase the potential discharge of chemicals used in this process, the environmental impact will be time limited to the duration of the plug and abandonment activity. Overall, decommissioning will provide an environmental benefit from removing any further discharge to sea of chemicals.

3.4.3 Atmospheric emissions

Atmospheric emissions and their associated environmental impact is an area that is not widely reported. Platforms require electrical power generated from the combustion of fuel gas if available or from diesel. The flaring of gas to maximise safety and during well testing creates emissions and unpermitted releases from refrigeration equipment and bulk tank loading are sources of emissions. The resulting emissions include: dioxides of sulphur and carbon, as well as Methane, and Nitrogen Oxide from the combustion and flaring activities; Methane and volatile organic compounds can be released during tank loading and fluorinated gases from leaks in refrigeration and air conditioning systems. The regulatory landscape in the UK for controlling and monitoring atmospheric emissions is extremely complex, difficult to grasp holistically by operators and contractors.

According to OGUK (2015b) there are many atmospherics related European legal instruments applicable to oil and gas activities in the UK. From a regulatory perspective OPRED requires that atmospheric emissions are reported to them

through the EEMS database. OPRED regulate atmospheric emissions through a number of regulations. These include the Greenhouse Gas Regulations 2012; the Energy Savings Opportunity Scheme; the Offshore Combustion Regulations (Prevention and Control of Pollution) Regulations 2013. Greenhouse gas emissions (GHG) are controlled through the EU Emissions Trading Scheme (EU-ETS) where a total limit is put in place for all participants and converted into tradeable emissions allowances. This enables operators to surrender allowances, buy and sell allowances with the aim geared towards encouraging a reduction in emissions.

Decommissioning is an energy intensive process and inevitably leads to a significant increase in atmospheric emissions. The increased use of diesel during the decommissioning operations will generate emissions which cause air pollution according to (Cantle and Bernstein 2015). There will be increased use of diesel powered equipment for long periods on the platform, the increase in transportation journeys between the platform location and the disposal yard and support yard and during the handling of material during recycling will add to the total emissions. Increased numbers of diesel engines will be required, with older heavy lift vessels generating greater levels of atmospheric emissions, and the number of applications for the diesel engines will be significant.

Byrd and Velazquez (2001), suggest that platforms in deeper water of more than 120 metres will present a more difficult challenge from an engineering perspective, and according to Cantle and Bernstein (2015) the associated atmospheric emissions will be proportionate to the depth of water where the installation is located in that the deeper the water, the larger and heavier will be the jacket structure and platform topside that will have to be to be removed. Proportionality will also exist dependant on whether a full or partial removal approach is adopted. Both Sheehan (1997) and Byrd and Velazquez (2001) indicate that it is the extended use of Heavy Lift Vessels (HLV) that contribute significantly to the volumes of atmospheric emissions particularly if full removal is adopted due to the significant additional time on location for HLVs during platform topside and jacket removal where careful preparation and management of lifting and placing large platform and jacket sections which require increased energy usage to successfully execute with the associated increases in atmospheric emissions. Due to the nature of these decommissioning activities

there are less core crew on the platform and a significant increase in short term contractors and temporary combustion equipment and it will become more difficult for the operator to monitor the use of combustion equipment and the associated emissions. It terms of maintaining regulatory compliance this an area which may require additional scrutiny by OPRED. This is reflected in a recent analysis by Cantle and Bernstein (2015) of the decommissioning of platforms off the coast of California. Their analysis indicated that full removal of the jacket and platform will result in an increase in atmospheric emissions which is estimated at approximately 6.75 times more atmospheric emissions than partial removal down to 85 feet below the sea surface.

In terms of minimising atmospheric emissions and their environmental impact during decommissioning there is an opportunity for the UK Government to make improvements to the current regulatory regime. The introduction of a more flexible approach to decommissioning options would also be environmentally beneficial. The current regulatory approach of a one size fits all in terms of a baseline of complete removal maximises the atmospheric emissions from decommissioning, stifles innovation in terms of decommissioning approach and does not allow for methodologies to be deployed that would minimise atmospheric emissions alongside other parallel benefits which are discussed and highlighted in other chapters. There is clear evidence that incorporating partial removal into the available decommissioning options would lead to significantly reduced atmospheric emissions from decommissioning activities and a corresponding reduction in the environmental impacts of decommissioning. In response to the increased use of combustion equipment, in combination with an increase in contractors on the platform, OPRED should incorporate an increased focus on emissions monitoring, running hours efficiency and the maintenance of combustion equipment into the platform inspection template devised as part of this research in chapter 7 to minimise the impact of these additional activities and to ensure regulatory compliance.

3.5 Environmental protection

The current UK regulatory framework default position for a decommissioning programme is that the all infrastructure should be removed to shore with the marine and sea floor environment returned to its natural state with the exception

as highlighted earlier the limited potential derogations for the footings of large jackets and gravity-based structures. It is a very prescriptive regulatory environment that does not consider the technical challenges involved, the Health and Safety issues, and the potential damage to the environment of removing subsea infrastructure and disturbance of the sea bed.

The average age of platforms in the North Sea is 26 years (Decom North Sea, 2014) with many platforms having been in situ for up to 40 years. Over that time significant volumes of marine growth will have developed on the platform foundations, gravity-based structures and jackets creating artificial reefs by default rather than by design.

The surface of the seabed where offshore installations are located on the UKCS consists of soft surfaces such as sand and clay (Bockelmann et al 2018) with limited hard surfaces for marine growth to form due to the normally flat and featureless topography in the North Sea according to Fujii (2015). Offshore platforms add hard substrata to the marine environment (Van Der Stap et al 2016) which in turn attracts marine growth that develops on the hard, vertical surfaces of offshore structures (Guerin 2009). It therefore can be argued that the platforms add complexity and value to the marine environment. For example, research by (Claisse et al 2014) suggest that the platforms have a high ratio of structural surface area to seafloor surface area, resulting in large amounts of habitat for both young and adult fish over a corresponding small footprint of the seafloor. This is supported by Jorgensen et al (2002) in their study of fish residence in the vicinity of a decommissioned platform in the North Sea, and by Bourna and Lengkeek (2013) in their study in Dutch waters of the North Sea. The marine growth on platform foundations consists of both soft bodied organisms such as seaweed and hard bodied organisms such as mussels and importantly Lophelia Pertusa which is a cold-water coral which is listed and protected under the European Habitats Directive (OGUK 2012). A study by Gass and Roberts (2006) found clear evidence of significant colonies of cold water coral on 13 of 14 platforms inspected in the North Sea providing clear evidence that offshore platforms offer safe havens for the threatened cold-water coral. Lophelia Pertusa is a known habitat forming species and OSPAR (2003) in its Bremen Statement and its 2005 / 2006 Report on the Status of the OSPAR Network of Marine Protected Areas called for setting up of more Marine Protected

Areas to prevent the destruction of these important habitats. The evidence suggests that even within the OSPAR organisation there appears to be environmental goals that are not strategically linked and potentially contradictory.

Scientific research undertaken both in the North-East Atlantic such as Soldal et al (2002) whose study identified large aggregations of economically important fish in close proximity to a North Sea platform and around the rest of the world for example Brazil (Jablonski, 2008), Adriatic Sea (Fabi et al, 2004), and California (Love and York, 2005) have affirmed that artificial reefs and by default offshore oil and gas installations acting as artificial reefs have generated positive environmental benefits. Additionally, Gass and Roberts (2006), and Macreadie et al (2011) suggest that these artificial reefs enhance biological productivity, conserve and restore cold water corals by restricting access to fishing trawlers and can help to rebuild declining fish stocks. This positive standpoint that scientists familiar with the North Sea have put forward for a number of years has been overshadowed by the political nature of the current regulatory framework stemming from the Brent Spar incident in the 1990's and has resulted in successive Governments resisting the evidence for a rigs to reefs program. According to Jorgensen (2013) regulators should acknowledge that the twin issues of disposal at sea and the creation of artificial reefs should be separated and future policy decisions should be based on the available evidence rather than as a response to a singular incident as evidenced by the OSPAR decisions that followed in the aftermath of the Brent Spar incident.

Much of the published literature on rigs to reefs to date has focused on the Gulf of Mexico. Whilst the available published literature for the North Sea is not as prolific, the conclusions of the published research for the North Sea mirrors the results from the Gulf of Mexico research. Figure 3-3 summarises some of the main literature under three headings where rigs to reefs adds value to the marine habitat.

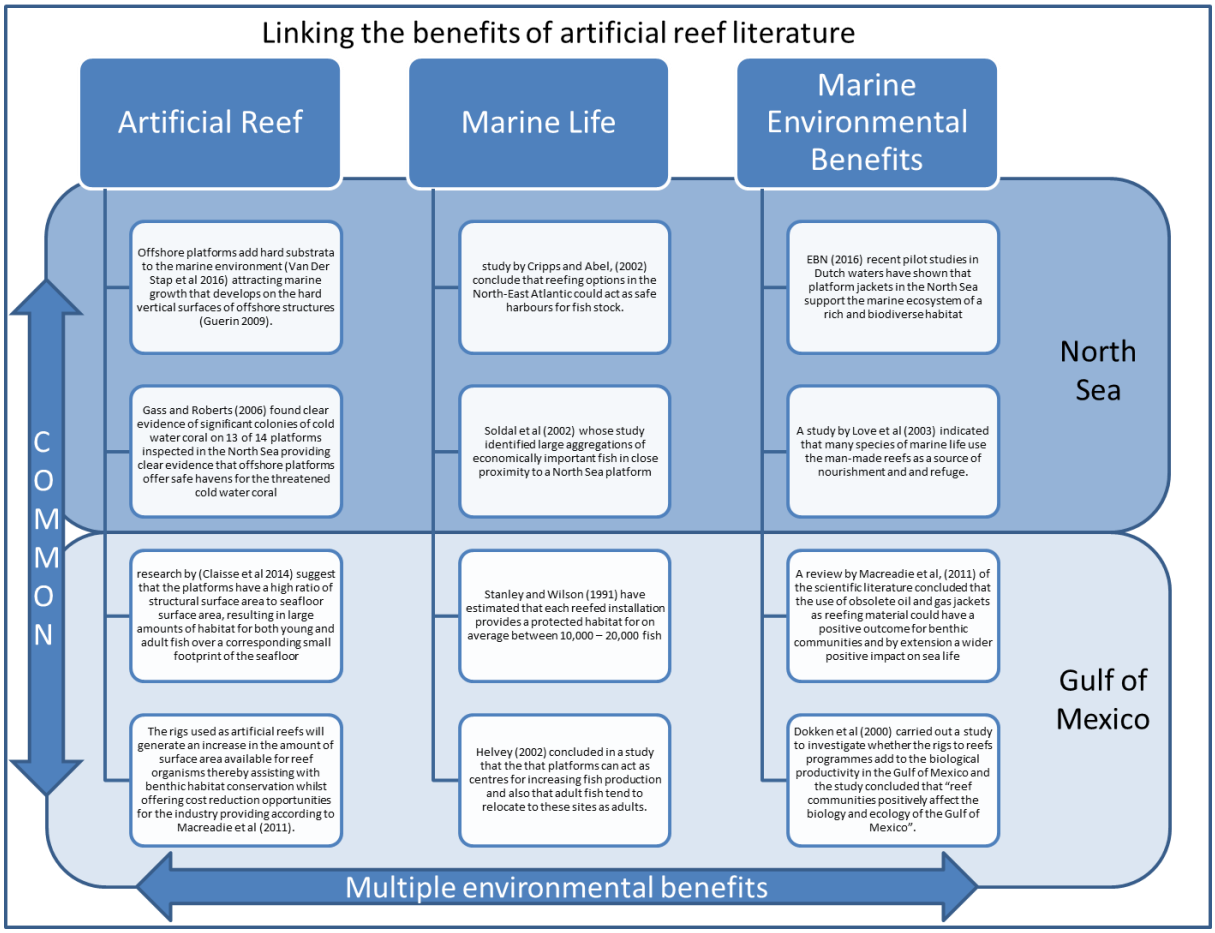

Figure 3-3 Literature summary of environmental value of oil and gas infrastructure acting as artificial reefs. Source: Author

3.6 Derogations and rigs to reefs

Section 3.6 sets out an evidence-based argument that supports rigs to reefs as an additional more proportionate option for decommissioning in the UKCS.
As discussed in chapter 2, in 1998 OSPAR imposed a moratorium on the "dumping" oil and gas infrastructure in the North-East Atlantic with the exception of the footings, the very bottom part of the jacket structures for those jackets that weigh more than 10,000 tonnes but this potential for a derogation from the standard OSPAR approach only applies to a limited number of structures in the North Sea. OSPAR's use of the word "dumping" (OSPAR, 1998) it could be argued is inappropriate and potentially environmentally inflammatory as it is not possible to dump something that is already in place, particularly as in some cases the jackets have been there for more than 40 years. For example, Jonathan

Hughes, the chief executive of the Scottish Wildlife Trust (SWT) in an interview (Guardian 2017) stated;

> "In the past, the natural reaction when you think of dumping a load of metal in the ocean is to throw your hands up in horror but when you look into it, it's much more complicated. You could save money and have good environmental outcomes."

The SWT believes a rethink is now overdue of how the OSPAR rules with regards to redundant oil and gas infrastructure are applied. They raise concerns over the multibillion-pound cost of decommissioning and their belief that in some cases it would be better for the environment to leave platforms to become artificial reefs for marine life (Scottish Wildlife Trust, 2017). The SWT propose an alternative arrangement whereby a percentage of the savings from any derogations are placed in a national Marine Stewardship Fund that supports marine conservation and research, which is a similar approach as taken in the Gulf of Mexico (Kaiser and Kasprzak, 2007) where approximately 50% of the potential cost savings for an operator donating an installation to a state rigs to reefs programme will be donated to the state and this investment utilised for additional marine environmental improvement programmes.

A starting point is to consider the approach to the derogation decision point for jacket structures on the UKCS. There are approximately 300 jacket structures on the UKCS with a weight range of between 200 tonnes for an unmanned platform up to 34,000 tonnes for the largest jacket structure which is the Magnus platform (OSPAR 2017). The removal or partial removal of a jacket structure involves significant technical challenges which will be dependent on the scale of the infrastructure and the water depth involved and dictating a set limit of 10,000 tonnes for derogation sets a one size fits all approach, provides no flexibility and ignores the variation and complexity of the variables involved in decommissioning jacket structures. It also ignores the fact that the actual weight of jacket in situ is considerably more than its original constructed weight due to the additional weight of the steel piles that are used to secure the structure to the seabed which can add 20% to 30% to the total weight of the structure. (DWG, 2018).

Two of the critical technological areas are lifting and subsea cutting. There are a number of available lifting technologies such as single lift, buoyancy tank assembly and the most commonly used approach of Heavy Lift Vessels (HLV) but they all have constraints in terms of lifting capacity and they cannot be applied to all jacket configurations and the largest structures (Cheng et al 2017). For a vessel-based crane the largest jacket lift successfully achieved to date is 5,200 tonnes during the Frigg decommissioning project in Norwegian waters (Gram et al 2011). Cutting technology does not currently exist to cut the largest diameter footings in the North Sea which exceed the capabilities of current technology. Diameters of up to 3 meters can be cut if access is available and not compromised by other elements of the jacket structure (OGUK, 2012). Other additional variables that should be considered when deciding on what can be removed are the potential for disturbing the drill cuttings, the environmental impact of infrastructure removal, and health and safety of personnel particularly if the work would require diver intervention. (Chandler et al, 2017)

In terms of the current inflexible regulatory position of derogations it is important to note that of the 291 jacket structures on the UKCS, 34 are above the arbitrary figure of 10,000 tonnes in air, but a further 14 weigh more than 7,500 tonnes and 17 additional jackets weigh between 7,500 tonnes and the largest jacket lift to date of 5,200 tonnes. Figure 3-4 illustrates the number of jackets by weight which would currently sit either side of the arbitrary trigger point of 10,000 tones set by OSPAR.

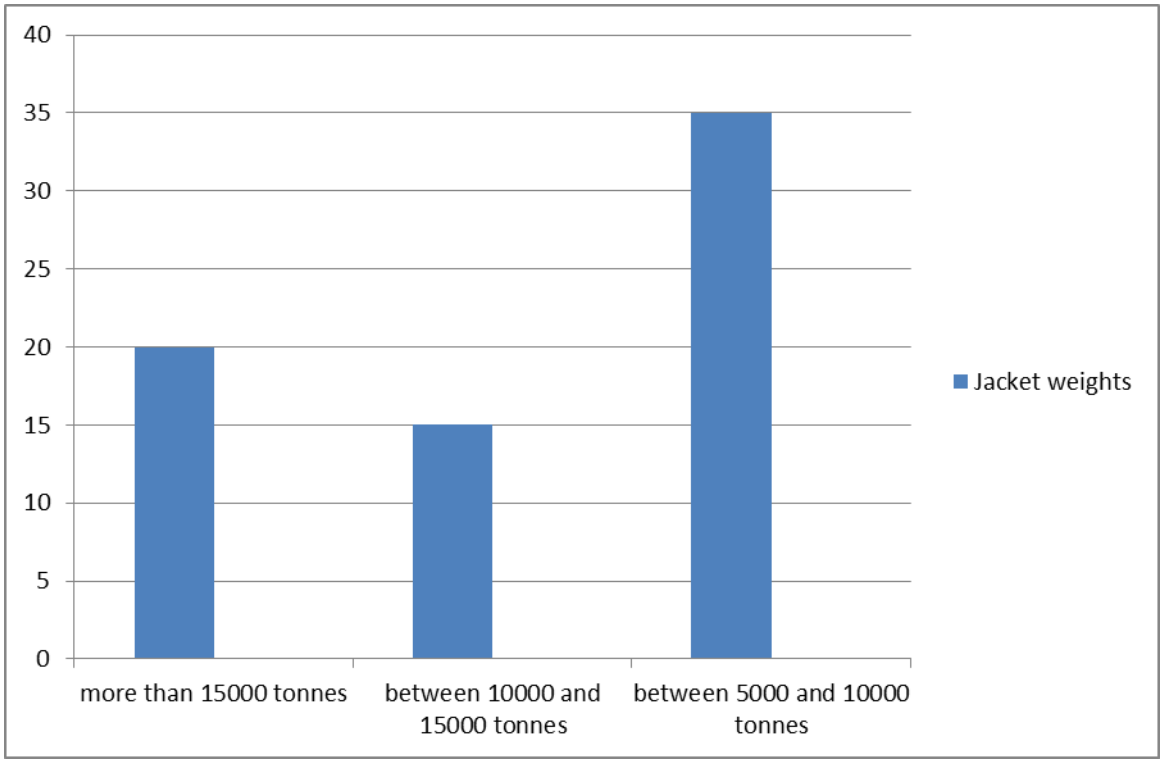

Figure 3-4: Distribution of jackets by weight either side of the OSPAR derogation limit. Source: Author

It is clear from published sources that there is very little international consensus on the best practices for decommissioning obsolete oil and gas platforms according to Macreadie et al (2011). Whereas OSPAR insists on the complete removal of platforms, jackets and associated infrastructure in the North sea, this is not the case in other offshore hydrocarbon basins around the globe. Rigs to Reefs, the transformation of non-producing offshore oil and gas infrastructure into man-made reefs rather than removing them to onshore is an alternative option that is available and has been use in the Gulf of Mexico, California and South East Asia with the first conversion occurring in the late 1970s' off the coast of Florida (Ajemian, 2015). Having stated that there is little consensus on decommissioning best practice, the North Sea is the only offshore oil and gas region that actively does not allow a reefing approach as an option. The absence of a reefing option in the North Sea runs contrary to the practices and options deployed in rest of the world. It decreases flexibility in determining the most appropriate overall decommissioning programme determined on an individual case basis for each installation and it removes an option that would enable a

positive scenario for a range of stakeholders, (stakeholders as defined in chapter 1) based on the published evidence that suggests that reefing has environmental benefits, and that it reduces costs to both the operator and the taxpayer.

For example, the rigs to reefing programme in the Gulf of Mexico was developed by the former Minerals Management Service (MMS) which was renamed the Bureau of Ocean Energy Management, regulation and Enforcement (BOEME) and according to Kaiser and Kasprzak (2007) between 1987 and 2006, 238 redundant installation jackets were utilised as artificial reefs. The National Oceanic and Atmospheric Administration (NOAA) has introduced guidelines in 2007 for rigs to reef in the USA. The criteria indicate that rigs-to-reefs should benefit the marine environment, that contaminated materials must be removed and there is a preference for leaving the structure in its original location to which additional materials be added to develop the resulting artificial reef. As part of the agreement between the operator and the state responsible for a particular area of the Gulf of Mexico where the reefing will occur, half of the projected cost saving for an operator will be donated to the appropriate reef programme. Kaiser and Kasprzak (2007) indicate that the donation is used to fund research, and the monitoring of environmental conditions around the reef site.

In terms of environmental impacts and benefits Stanley and Wilson (1991) have estimated that each reefed installation provides a protected habitat for on average between 10,000 – 20,000 fish. Dokken et al (2000) carried out a study to investigate whether the rigs to reefs programmes add to the biological productivity in the Gulf of Mexico and the study concluded that "reef communities positively affect the biology and ecology of the Gulf of Mexico". Similarly, Gallaway et al (2009) found that the production of some commercial fish populations has increased due to the artificial reefs created from oil and gas infrastructure. A study by Love et al (2003) indicated that many species of marine life use the man-made reefs as a source of nourishment, refuge and some species of fish use them as a nursery. Helvey (2002) concluded in a study that the that platforms can act as centres for increasing fish production.

The contract between the state and the oil and gas operator in which the operator donates half of the cost savings also means that the ongoing liability for

the structure passes from the operator to the state. If rigs to reef were adopted in the North Sea this is an area where some caution should be applied. Whilst the jacket of a decommissioned platform is hydrocarbon free, there would remain some residual risk to other third parties due to the snagging risk, but this should be mitigated so long as a system of marine exclusion zones are developed which would be similar to the 500m exclusion zones surrounding operating platforms. The passing of liability to the Government should be limited to the reefing material and all other infrastructure such as pipelines, plugged and abandoned wells should remain the responsibility of the operator.

The Gulf of Mexico rigs to reefs programme operates under a beneficial scenario for all interest groups including environmentalist organisations believes Jorgensen (2009). The rigs used as artificial reefs will generate an increase in the amount of surface area available for reef organisms thereby assisting with benthic habitat conservation whilst offering cost reduction opportunities for the industry providing according to Macreadie et al (2011). It could also by extension be argued that this approach would essentially reduce the burden on the tax payer through a reduction in tax relief provided to the operator due to the reduction in the overall cost of the decommissioning programme.
There is clear evidence from scientific studies that a reefing programme in the UKCS could be a positive scenario for fish conservation. A review by Macreadie et al, (2011) of the scientific literature concluded that the use of obsolete oil and gas jackets as reefing material could have a positive outcome for benthic communities and by extension a wider positive impact on sea life. Additionally, a study by Cripps and Abel, (2002) conclude that reefing options in the North-East Atlantic could act as safe harbours for fish stock.

Debate regarding the potential for a reefing programme in the North Sea using, manmade and in particular redundant oil and gas infrastructure began more than thirty years ago with the recognition that the decommissioning was very much on the horizon and that the cumulative numbers would be significant and in parallel there had been an increase in the evidence of a significant and successful increase of rigs to reefs programmes in the US. Back in the 1990's, the newly created OSPAR, was considering the development of artificial reef guidelines for the North Sea to cover in terms of building constraints and to decide to what

degree it would be deemed appropriate or not to reuse manmade structures including redundant oil and gas infrastructure. A close empirical study by Jorgensen (2011) provides clear evidence that OSPAR's artificial reef policy in the North Sea was influenced by political reactions to particular events in the late 1990's and that has resulted in long lasting effects on the opportunities for introducing a rigs to reefs programme in the North Sea. Jorgensen's (2011) empirical study indicates for example the degree to which the calls to ban deep water disposal of oil and gas infrastructure arising from the Brent Spar protests influenced the final OSPAR guidelines which placed a moratorium on offshore installations being viewed as valid reef building materials. There is clear evidence that the political pressures and circumstances at the time influenced OSPAR to such an extent that their final guidelines did not actually meet their original mandate which was to create guidelines for the building of artificial reefs with "matter placed in the maritime area for a purpose other than that for which it was originally designed or constructed" (OSPAR 2009b). In 1999 both the Norway and the UK did not agree with the contents of guideline proposals for this very reason that by excluding the re-use of material including offshore infrastructures the proposed guidelines would not meet their original remit. Later in 1999 the UK backed down from this position and adopted the guidelines, but Norway continued to refuse to adopt the guidelines and they are not bound by them. According to (Hopson 1999), John Prescott the then Secretary of State for Environment, Transport and the Regions was instrumental in the UK delegation backing down.

Contrary to the OSPAR guidelines on artificial reefs preventing the use of decommissioned oil and gas infrastructure as reefing material through the rigs to reefs approach, the OSPAR Decision 98/3 on decommissioning does not technically ban a rigs to reefs approach according to (Jorgensen 2011) since the installation would be "serving another legitimate purpose in the maritime area". Additionally, Decision 98/3, the OSPAR agreement amongst contracting parties on decommissioning allows for the leaving behind of concrete installations and the bottom part of the jackets for those jackets that weigh more than 10,000 tonnes. This means that the UK, and other OSPAR contracting parties with offshore oil and gas installations have committed themselves to allow some weight specific derogations after their production period has ceased and these

installations would in effect act as artificial reefs and accrue the added value to the marine environment that is evidence supported.

Closer scrutiny of the OSPAR guidelines and agreements, reveals some areas of debatable interpretations regarding what is allowable and what is not, and it could be argued therefore whether OSPAR descriptions as written would prohibit the use of obsolete offshore infrastructure for building reefs if a Government of a contracting party decides to consider creating a broader range of decommissioning options within its national jurisdiction. The agreement between the contracting parties could be reinterpreted by individual Governments to meet their own requirements. As highlighted by Jorgensen (2011), OSPAR 98/3 states that an offshore installation "serving another legitimate purpose in the maritime area authorized or regulated by the competent authority of the relevant Contracting Party" is not "waste" nor a "disused offshore installation". Taking this interpretation one step further Jorgensen (2011) argues that this would consider that the building of a reef from man-made materials is therefore legitimate, and there would not be any legal barrier against the introduction of a rigs-to-reefs programme if an individual contracting party Government decides that it wants to initiate a programme.

OSPAR Decision 98/3 indicates that if material form an offshore installation is reused for another legitimate purpose then that material is not considered by OSPAR to be waste. If this logic is applied to the OSPAR Guidelines on Artificial Reefs in relation to Living Marine Resources (1999), which states that waste materials cannot be considered for use in the construction of artificial reefs then logic suggests that if material from the decommissioning of offshore infrastructure would meet the guideline requirements as it is being used for another legitimate purpose and in that regard OSPAR itself under Decision 98/3 would not consider the material as waste.

Discussions within OSPAR prior to setting of the guidelines for artificial reefs and Decision 98/3 were held within an environment where the use of environmentally inflammatory language labelling all offshore oil and gas materials as polluted material and the dumping therefore of polluted waste. The experience of rigs to reefs elsewhere has demonstrated that only the jackets are used as reefing

material and in essence jackets are simply a steel matrix construction which has not had any direct contact with oil or other contaminating materials. Anything that could impact the marine environment would have been removed to shore for destruction, clean up and disposal. Experience to date particularly in the Gulf of Mexico according to Macreadie (2011) has demonstrated that the lattice construction of a jacket is excellent environment for providing a safe haven for marine life to shelter, breed and forage for subsidence.

It appears somewhat contradictory for the OSPAR debate over the standards for reefing materials to stop the reuse of materials simply to prevent the use of redundant hydrocarbon structures. This is particularly the case where OSPAR (2009 b) considers the use of steel and concrete materials manufactured onshore to be suitable for creating reefs but steel and concrete already in situ within the marine environment not to be suitable. This point is further supported by studies of offshore oil and gas structures that provide clear evidence of the marine eco systems that have developed on these structures adding value to the marine environment. The current OSPAR position appears even more unsustainable as they already under Decision 98/3 derogation process allow some jacket footings and concrete gravity-based structures to be left behind. This is even the case for example in the Shell Brent concrete gravity-based structures which encompass storage cells which are known to contain large volumes of oil, chemicals and other substances harmful to the marine environment. There is an additional argument that it would be more environmentally sustainable to reuse materials already present offshore because of the reduced energy use required than to manufacture and introduce new constructions into the sea,

According to (Grossman et al 1997), the introduction of an artificial reef is unlikely to damage the marine environment and suggests that contaminant levels remain unchanged within the sediment surrounding offshore structures unless it is disturbed for example when a jacket structure is removed. Removal causes significant disturbance of the surrounding seabed as large amounts of the sea bed need to be moved to allow the jacket piles securing it to the seabed to be cut. There remains a risk of invasive species being attracted to the jackets as an artificial reef according to Page et al, (2006) using the structures as “stepping stones” to promote dispersal. Whilst this a concern, Hewitt et al, (2011) suggest

the addition of additional hard substrates is not the primary element with regards to enabling the spread of invasive species and that the primary culprit is a twin pronged combination of ballast water being discharged from shipping industry and from climate change.

As described above, changes to the legal framework may not be required if the current position is reinterpreted, and what is really required is a change in the political mind-set of decision makers within contracting parties to enable a more open-minded evidence based rather than politically driven discussion about the validity of a reefing programme in the North Sea.

Governments positions on decommissioning are influenced by the views and opinions of a range of stakeholders including environmental organisations, organisations representing other users of the sea and the general public whose perceptions of the industry are generally informed from what they have gathered from media reports. Offshore installations are generally perceived as industrial, dangerous and a source of pollution. As a result, both OSPAR and other stakeholders debate tends to focus on pollution prevention as opposed to broader measures for longer term nature conservation. As a result of this bias, focusing the debate on the potential for pollution from oil and chemicals released to sea from decommissioned platforms rather than on the value added to the marine ecosystems through the marine growth that has developed on the jackets and foundations of the platforms is flawed due to the fact that decommissioning removes the predominant source of pollution which is the release of oil and chemicals through the produced water system. The Brent Spar incident has had a role to play in building this perception. Whilst it is the case that leaving decommissioned offshore structures in place is less costly when compared to taking them to shore for destruction, the events surrounding the Brent Spar disposal and the subsequent political fall-out has coloured the public perception and most probably lead to the belief that the savings achieved by leaving oil and gas infrastructure in situ are very large and it is simply the cost saving that drives oil and gas operators to favour rigs to reefs programmes as undertaken globally. The reality in the Gulf of Mexico according to (Kaiser 2006) is that State Governments often have to persuade oil and gas operators to donate their installations to the various rigs to reefs projects that they operate. Generally, the

rigs to reef programmes in the Gulf of Mexico require that the structures are removed from their current locations and towed to a designated reefing location which in itself reduces the potential cost savings involved. There have been some rigs reefed in the Gulf of Mexico in situ and these have generated greater savings. Additionally, the oil and gas operator is contracted to give half of the cost savings generated to the State Government running the rigs to reefs programme. According to (Kaiser 2006) cost savings published range from $234K to $466K per installation.

In terms of cost savings and who would benefit differs significantly between this country and in America. In America, the oil and gas operators pick up all of the costs decommissioning whereas in the UK due to the tax relief for the costs of decommissioning that is available to oil and gas operators. Tax relief of between 50% and 75% is available to operators in the UK deductible from operator's profits which results in a smaller tax intake for the Government. In essence, a reduction in the cost of decommissioning in the UK directly benefits the UK Government in terms of their share of the costs reduces and by default the taxpayer gains in terms of a reduction in the opportunity cost lost due to tax relief. By comparison with the Gulf of Mexico experience, the potential cost savings in the North Sea are potentially significantly greater particularly if the rigs to reef approach results in obsolete jackets being left in situ. This is because the Gulf of Mexico experience has so far been limited to decommissioning of smaller platforms and shallow water when compared with the decommissioning projects to be undertaken in the UK where the platforms are both significantly larger, in deeper water and more challenging weather and sea state conditions in the Central and Northern North Sea. Potentially decommissioning projects in the southerly areas of the UKCS would be similar to those of the Gulf of Mexico in terms of complexity and opportunity.

3.7 Permitted discharges

This section introduces the topic of regulatory proportionality with the aim of investigating the regulatory framework that minimises the impact of oil and gas operations on the environment applied to discharges to sea from platforms in their production phase and in their decommissioning phase. The same regulatory

framework is applied to platforms in their decommissioning phase as is applied in their production phase and this chapter will examine the available evidence and put forward an argument that the applying the current regulatory framework for the production phase is not proportionate to the decommissioning phase of the platform lifecycle and proposes a number of potential changes to the regulatory framework to reflect a more proportional approach to current decommissioning regulatory framework.

3.7.1 Oil discharge permits

To minimise the impact on the environment, oil discharges from offshore installations are managed through a system of permitting under the OPPC regulations and these prohibit the discharge of oil to sea out with the terms and conditions of a permit. Appropriate permits must be applied for by the offshore installation operators. Similarly, the Offshore Chemicals Regulations (OCR) permit the use and discharge of chemicals on offshore installations.

Permitted discharges under the OPPC regulations are in line with the OSPAR standard that the oil in water concentration of discharges should not exceed 30 milligrams per litre as a monthly flow weighted average. On the UKCS in 2014 there were around 500 installations covered by OSPAR which includes, oil installations, gas installations and subsea installations of which 108 installations were discharging produced water in 2014 (OSPAR 2016). Looking in more detail at the EEMS reporting of permitted oil discharges to BEIS in 2016, a total of 2016 tonnes was permitted to be discharged to sea under the OPPC permitting system from 95 platforms.

From an environmental perspective the discharge of produced water is the primary source of hydrocarbons entering the sea from oil and gas operations and this source is removed once cessation of production is achieved and the platform transitions into the decommissioning phase. The permitted discharge of produced water and their accumulated annual volumes of oil discharged vary from one platform to another for a number of reasons such as depleted wells where the ratio of water to oil that is recovered has increased significantly. Figure 3-5 below indicates the range of permitted discharges of oil in 2016.

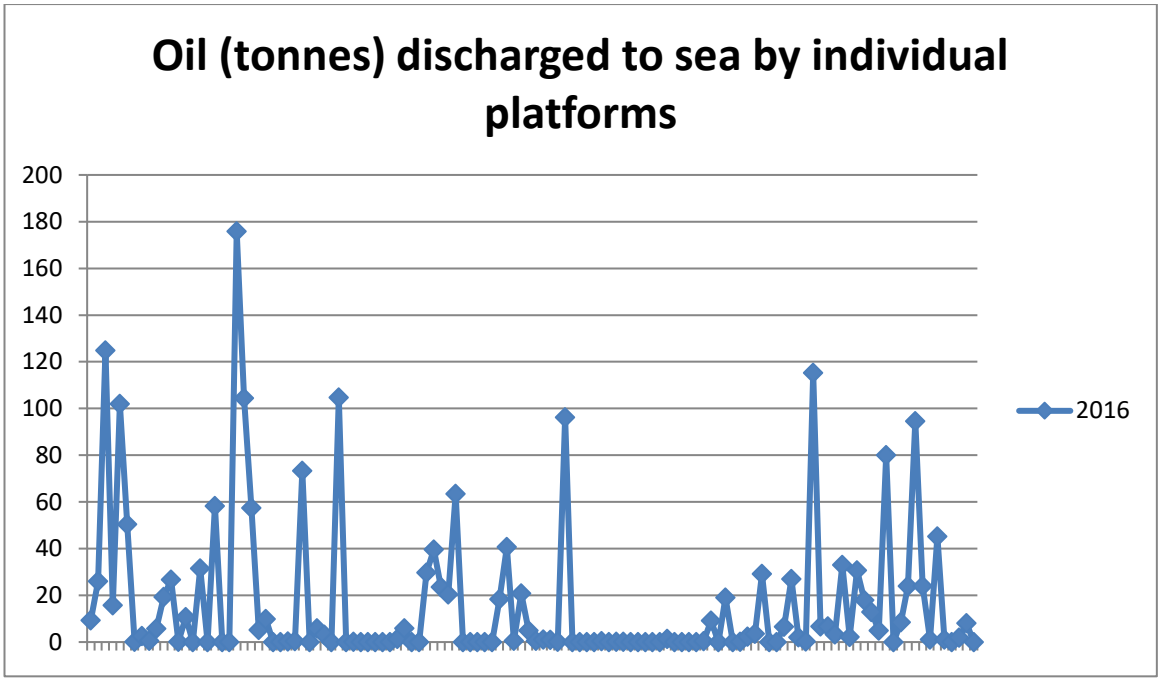

Figure 3-5: Oil volume (in tonnes) discharged to sea under permit by individual platforms. Source: generated by author from data in EEMS database

In 2016 more than 30 platforms discharged more than 20 tonnes of oil with the highest permitted discharge reported at 175 tonnes. These annual permitted discharges of oil from producing platforms are significantly higher than the discharges attributed to the decommissioning phase of a platform which in many cases can be measured in kilogrammes of oil discharged rather than tonnes. For example, the recently decommissioned platform Murchison had a permitted discharge of more than 150 tonnes for many years during its production phase but their approach to dispose of all hydrocarbon contaminated fluids resulting from decommissioning down a disposal well resulted in zero discharge of hydrocarbons to the marine environment during decommissioning and removal of the topside platform and pipeline decommissioning work scopes. Despite the massive differences in actual discharges the permitted concentration of oil and water under the current regulatory framework is the same for both phases of the lifecycle which is not proportionate in terms of the resultant environmental impact of these two different phases of the platform lifecycle.

A further element of this disproportionality is that the processing and discharge of production fluids is a continuous and standard production process whereas the treatment and discharge of decommissioning related fluids is a series of non-standard operations which are much more difficult in terms of meeting the discharge concentrations of a platform in the stable production phase. For a production platform the discharge limit is 30mg/litre which is the same as what is generally applied to decommissioning activities by both industry and regulator, but a significant difference is that for production platforms, the limit of 30mg/litre is a monthly average figure which in practice means that production platforms can discharge up to 99mg/litre for periods each month, so long as the monthly average remains below 30mg/litre and therefore remain in compliance with their permit conditions. Whereas for the decommissioning activities, the time limited nature of each activity does not allow for this degree of flexibility and this is another example of the disproportionate approach applied to OPPC discharge permits for decommissioning activities. The main elements of the decommissioning process that may involve the discharge of treated oil and chemicals include fluids resulting from well abandonment operations, removal of residual hydrocarbons from pipeline flushing, vessels, pipework and any associated oil on sand removal requirements.

For example, the decommissioning of the Ivanhoe and Rob Roy fields by HESS illustrates the difficulties and constraints that occur when the regulatory framework for the production phase of a platform are enforced during the decommissioning phase. Summarising the Hess close report BEIS (2016) it was acutely clear that the treatment process to reduce the oil in water content discharged following well abandonment operations at the first set of wells below the limit set by the OPPC permit was difficult and led to a longer programme time frame than initially planned for. This resulted in an increased level of atmospheric emissions and generated significant volumes of waste containing hydrocarbons. This waste had then to be treated onshore through a waste treatment process resulting in additional environmental issues such as atmospheric emissions and increased use of landfill.

In hindsight, the limited drop in the volume of oil discharged overboard was not judged by Hess to merit the increased environmental impacts onshore. Due to the problems faced by Hess, the regulator approved Hess’s subsequent permit

application to increase the permitted discharge of oil concentration by 50% for their remaining well operations. The argument made by Hess from an environmental perspective and accepted by the environmental regulator OPRED was that the limited volume of oil that would be discharged, would quickly disperse through the water column and that the discharge at this low volume was assessed as not significant and any benefits of maintaining the lower level of oil concentration could not justify the additional environmental impacts such as those experienced during the first set of well abandonments.

3.7.2 Pipeline decommissioning

Pipeline cleaning is an area of decommissioning where experience and evidence suggests that the current regulatory framework is not proportionate. The current regulatory requirement is that any pipeline needs to be cleaned until the residual hydrocarbon is below 30mg/litre of seawater. The standard process to achieve this is to send a series of plugs known as "pigs" through the pipeline with or without a chemical cleaning agent followed by a flushing with inhibited seawater. This process or a variation of this process is repeated until the required standard is achieved. This process will take a significant period of time and a large number of repeat operations to meet the required standard and it is common that this standard cannot be achieved. This decommissioning activity is energy intensive with resultant emissions to atmosphere through the use of temporary diesel generators. Generally, the pipelines would then be disconnected and ends left open to the environment and it is anticipated that some or potentially all of the remaining oil will eventually be released from the pipeline. The residual oil left in the pipeline in terms of volume is dependent on the concentration achieved and the length of the pipeline. The residual oil is once again by producing platform comparison very small in comparison to the annual permitted discharge of oil through the produced water system.

Reservoir fluids entering the processing system on an offshore platform along with oil, gas and water will also in many cases contain solids such as sand from the reservoir. These sands can overtime collect within vessels and pipework. During decommissioning these sands need to be removed. The sands will contain oil and this oil needs to be minimised before it is discharged to sea. This process

is also carried out periodically during the production phase, it is a standard practice and there are specialist third party equipment and service providers who are experienced in this area of work. The current regulatory framework for this activity is therefore not exceptionally difficult to achieve and there is no need to adapt the current standards.

In terms of proportionality for discharges to sea through an OPPC permit for the decommissioning phase the current regulatory framework should be reflective of the overall environmental impact of the decommissioning activities, the short-term duration of the operations, and the long-term benefits of decommissioning. This could be achieved by a number of model options. For example, the simplest model could be to increase the permitted concentration levels for oil on water discharges. An alternative would be to set a maximum volume of oil that could be discharged to sea as part of decommissioning activities. This level could be set as a percentage of the previous permitted levels of annual oil discharged during the final year of an individual platforms production phase. Table 3-2 on the next page sets out the current regulatory requirement for permitted oil discharge and provides two alternative options that would provide a more proportionate regulatory requirement for use during the decommissioning phase of the oil and gas platform lifecycle'

Table 3-2: Permitted discharge options for decommissioning phase

Permitted discharge options for decommissioning phase			
Option	Scope	Advantage	Disadvantage
Status quo	No change to current regulatory framework		Adds, time, cost, increased energy use and associated atmospheric emissions
Increasing the permitted concentration	Could be achieved through variation to permit conditions	Simplify the decommissioning work scope. Shorter decommissioning programme. Less energy intensive. Less cost.	Oil discharged would be increased but would remain significantly below the annual discharge figures for a platform in the production phase. OSPAR

			could be concerned.
Setting a maximum volume of release.	Could be achieved through variation to permit conditions	Simplify the decommissioning work scope. Shorter decommissioning programme. Less energy intensive. Less cost.	Oil discharged would be slightly increased. OSPAR could be concerned.

Source: Author

3.8 Clear seabed requirement

Under the current regulations the baseline requirement is for the operator to return the seabed to the condition it was in prior to the installation of the infrastructure. To comply with this requirement to the letter would entail the removal of every item of infrastructure and associated products. The exception to the rule being the caveat that derogations can be applied for gravity-based structures and the footings of jackets weighing more than 10,000 tonnes.

To fully comply, every pipeline, cable, stabilisation items, rock dump, drill cuttings pile, jacket and foundations would need to be removed. The reality to date has been that the ambition of a clear seabed returned to its original condition is not feasible. The evidence from decommissioning close out reports and from conference presentations by operators and contractors is that this regulatory requirement is not achievable. To date the operator is required to state in their programme that they will achieve a "clear seabed" and in practice attempt to do so. This results in the operator attempting to for example locate and remove every stabilisation mattress that they had to place on the seabed to prevent pipelines or other items from moving due to the action of the tides and currents. One operator for example in their close out report for DECC indicated that they had great difficulty locating mattresses expending considerable time and cost without actually locating many of them. Subsequently when they attempted to remove the mattresses that they did locate, they found that the steel wires connecting the blocks of concrete had deteriorated to the extent that when a lift was attempted the mattress disintegrated. The operators inevitably return to the regulator to agree an alternative but acceptable approach to the

baseline of a "clear seabed" and this adds additional time and cost to the decommissioning programme. Similarly, Hess in their close out report for the decommissioning of Ivanhoe and Rob Roy installations, lodged with BEIS (2016) described that more than ninety percent of their concrete mattresses were made up of single concrete blocks which were connected with metal lengths. During their initial lifting trials, it was discovered that the metal which held these mattresses together had deteriorated leaving the material unsafe for diver assisted recovery. The solution implemented was to rock dump the area rather than recover the material to shore. This again caused delays to the programme and a requirement to revise and have the subsequent revision approved by the regulator. Similar examples can be found in other close out reports concerning grout bags, pipelines etc.

The evidence suggests that the concept of a "clear seabed" is not practical and there is an opportunity to revisit the baseline and that an alternative baseline can be proposed that is practical and based on the evidence and experience to date. The alternative baseline could start from the proposition that mattresses, grout bags, frond mats and pipelines should be left in situ if they pose no danger to other users of the sea, unless there is clear evidence that they can be removed without significant risk to personnel, without significant disturbance of the sea bed or incur significant additional time and cost to remove.

3.9 Emerging themes and the research questions

Four critical themes have emerged from chapters 1 to 3 which each link directly to various combinations of four of the eight research questions that will guide the field work of the research. The first theme emerging is a consideration of the proportionality of the current regulatory framework which link with research questions 1,2,3,8. The second theme emerging is around identifying the complexities and constraints of the current regulatory framework which links with research questions 2, 4, 5 and 8. The third theme emerging is about minimising the impact of decommissioning on the environment and the role of OPRED in monitoring environmental regulatory compliance which links with research questions 2, 5, 6 and 8. The fourth and final theme considers derogations as a foundation for increasing flexibility of the regulatory framework which links with

research questions 1, 2, 7 and 8. Figure 3-6 summarises the links between the emerging themes and the research questions

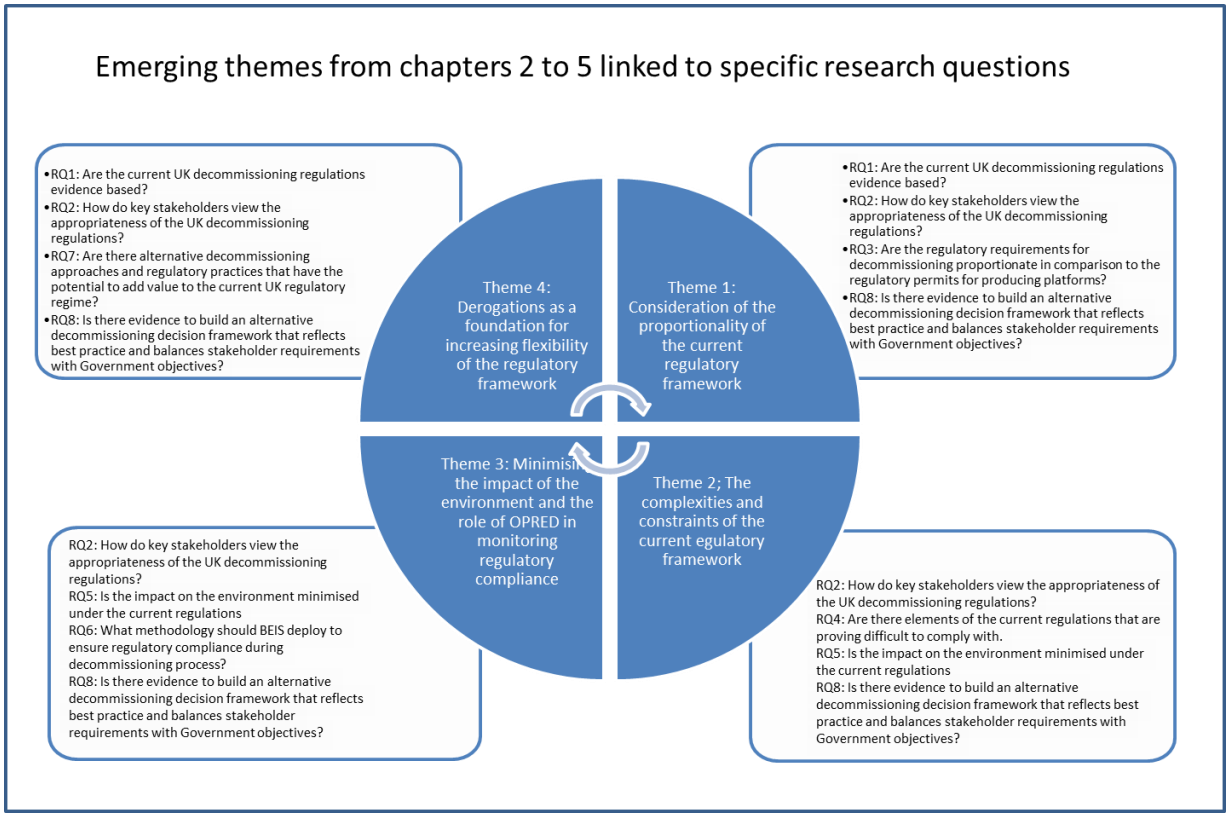

Figure 3-6: Links between emerging themes and research questions. Source: Author

It should be noted that questions 2 and 8 are common to all emerging themes which reflects the goal of the research to identify evidence to build an alternative framework for future decommissioning in chapters 2 to 3 and the importance of gathering data from industry participants which will be captured in chapters 5,6, and 7.

3.10 Summary of chapter 3

Having considered in chapter 2, the decommissioning regulations both in the UK and around the world, chapter 3 builds on this work by considering the environmental impact of decommissioning and introducing the concept of decommissioning regulatory proportionality. From consideration of the literature it is clear, that from an environmental perspective, decommissioning results in a reduction in the volumes of oil and chemicals discharged to sea. Whilst the

literature concludes that there would be an increase in atmospheric emissions during the decommissioning phase as a result of the increased energy requirements particularly from temporary equipment, the net effect on completion of the decommissioning project would be a positive outcome for the environment. The literature also indicates that a reduction in atmospheric emissions can be achieved from reducing or removing the current derogation limits.

A number, of the current regulatory requirements were investigated from the perspective of proportionality. Evidence was presented on the impact on the flexibility of available decommissioning options, the impact on the complexity of the current requirements and negative impact of maintaining the regulatory requirements for an installation during its production phase to an installation during its decommissioning phase.

The evidence presented from the literature provides an evidence base that while there is no clear consensus on decommissioning best practice the UK regulatory framework when compared globally offers less flexibility in terms of available decommissioning options and that for example technology is not available to achieve a truly clear sea bed approach as adopted in the UK. Crucially the literature indicates that the foundations of offshore platforms have developed significant colonies of cold water coral and other marine life and are acting as artificial reefs by default. The chapter provides evidence that there is a case to be made that for a reefing programme if adopted in the UKCS. The historical data regarding permitted discharges suggests that the current approach for decommissioning is not proportional.

Given the overall positive outcome for the environment from decommissioning, the primary conclusion from this chapter is that the regulatory framework should consider the proportionality of the environmental impact of decommissioning and that the regulations should reflect the net benefits through the introduction of a proportional set of revised regulations that foster greater flexibility and increase the range of decommissioning options available to the industry, removing the current one size fits all approach. The evidence from chapter 3 together with the evidence gathered in chapter 2 generates a strong case for a review of the current regulatory framework for decommissioning.

CHAPTER 4 RESEARCH METHODOLOGY

4.1 Chapter introduction

This chapter will outline the research methodology that was used to collect the data that underpins this research, but it also includes a consideration of the concepts and theories which underlie the method selected from the alternatives available and demonstrates the validity of the methods selected for the particular challenges faced through an understanding of the underlying concepts of the methodology employed. The argument for a concurrent mixed methods approach and a thematic analysis strategy is presented and the research questions arising from the literature are also listed for ease of reference and context setting. The overarching research question and the eight research questions across three sub-groupings arising from the literature analysis, which are important drivers of the research design are illustrated in the figure 4-1.

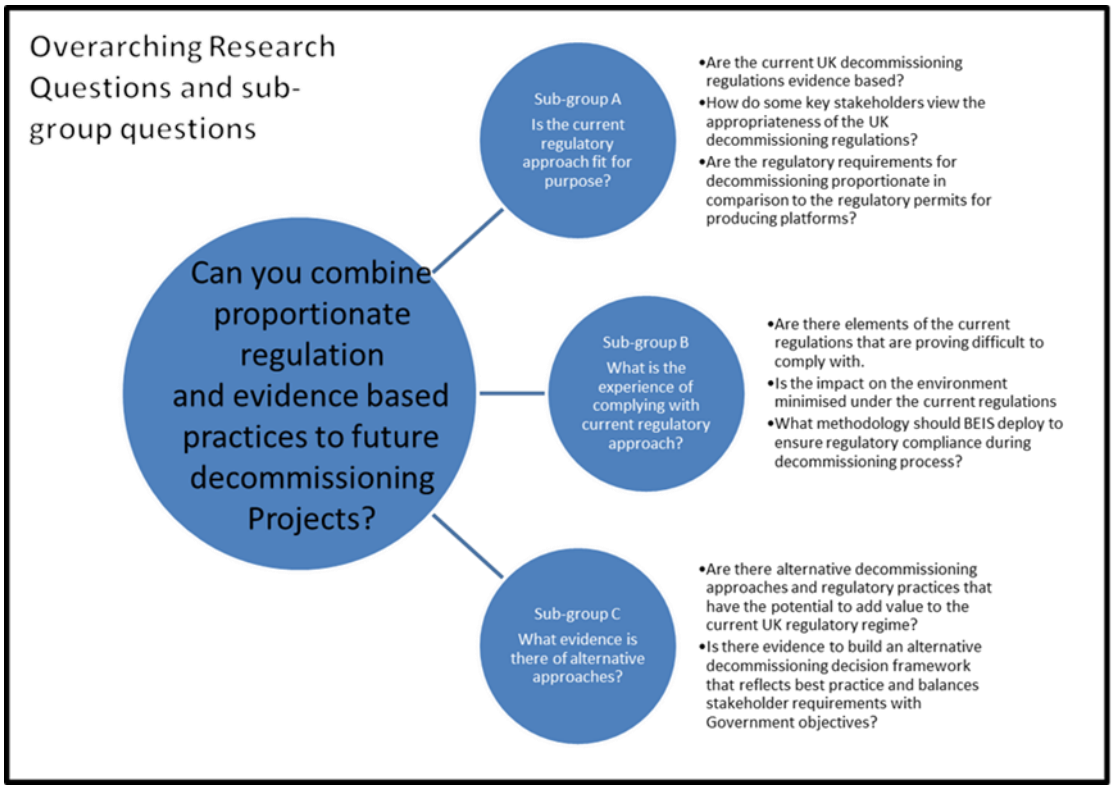

Figure 4-1: Research questions. Source: Author

4.2 Development of the Methodology

The research design according to Creswell (2009) is a plan for research that covers decisions taken across a broad spectrum from assumptions, to the methods used to collect data, and its subsequent analysis. In terms of selecting the most appropriate methodology in the context of this research there were the three recognised approaches of qualitative, quantitative and the mixed method combination of qualitative and quantitative to consider. Albert Einstein provided words of wisdom when he said "Not everything that can be counted counts, and not everything that counts can be counted ", which further reinforces the need to focus on the quality of the data being collected.

Creswell (2009 p.5) considers that when selecting the research method three considerations must be worked through. They are "the philosophical assumptions that they bring to the study, the strategy of inquiry that is related to this worldview, and the specific methods or procedures of research that translate the approach into practice."

4.3 Philosophical assumptions

Given a choice had to be made between qualitative, quantitative, or mixed methods approaches, Creswell (2009) suggests that the nature of the topic being researched, the researchers personal position and the target audience should be additional considerations during the selection of the methodology. These considerations are supported by James and Vinnicombe (2002) who caution that our research designs will be influenced by the fact that we all have inherent preferences.

Therefore, the selected methodology has in hindsight been influenced by both the epistemological stance and the theoretical perspectives that this researcher has adopted. Epistemology, the study of knowledge, delivers a philosophical foundation for taking decisions on what elements of knowledge are valid and meet the required standard. Easterby-Smith et al (2002) indicates that holding an epistemological stance is important as it can aid the clarification of the design of the research with regards to the overall structure, the research tools employed, the kind of evidence that is being sought and importantly how that

evidence will be interpreted. This is supported by Chia (2002) who articulates epistemology as the how and what it is possible to know and the requirement to consider both standards and methods of research used to gather knowledge which are both reliable and can be verified.

Ontology is according to Blaikie (1993) the study of being, that is, the nature of existence and what constitutes reality. For positivists the world is not influenced or controlled by our knowledge of it. For positivists knowledge simply exists while for relativists and others, there are many varying realities and methods of understanding them.

Research should be about uncovering the objective truth. To achieve this aim, researchers will endeavour to exclude their own emotions, values and any bias but of course we are human and therefore this is difficult to achieve but it should no less be the ambition. The selection of a mixed methods approach involving quantitative data and analysis, is subject to the use of participants subjective views and that has to be accepted and to a degree interpreted but as Bunge (1993) points out, objectivism, does not involve rejecting subjectivity. Individual's subjective views can be studied and interpreted but it must be undertaken objectively.

Positivism is another theoretical perspective that is connected to objectivism. Cresswell (2003) suggests that positivism promotes that reality must be studied using the cause and effect process of scientific enquiry. Hatch and Cunliffe (2006) suggest that positivism is based on a foundation of reason, truth and validity. Factual data is collected through experience and observation reflecting the values above.

On the other hand, constructivism takes the stance that many different and potentially contradictory accounts of the world do exist because individuals build their own understanding of the same phenomenon in contrasting ways. This constructivism stance is built on the view that it is the individual's interactions with the world that creates meaning and knowledge rather than it already existing in some external world.

Linked to constructivism there is a theoretical perspective known as interpretivism which according to Crotty (1998 p.67) seeks to find "culturally

derived and historically situated interpretations of the social life-world". In interpretivism the researcher has a focus on interpreting the participant's views of their world or a particular phenomenon. Saunders, et al (2007) suggest that interpretivism is very much dependant on the circumstances that form the setting for their views and is therefore not easily generalisable to other settings.

The research questions listed earlier through the design of the questionnaire and the analysis of available literature should illicit responses that are clearly within the epistemological and ontological envelope of the interpretivism/constructivism and positivist paradigms and support the adoption of a concurrent mixed methods approach. The data that will evolve from the research will be a mix of individuals opinions based on their knowledge and experience fitting squarely within the interpretivism/constructivism paradigm whereas some elements of the factual data emerging from the questionnaire and the integrated case study approach to auditing compliance will fit with the positivist paradigm. The case study approach to developing the audit process was selected to reflect the practical hands on approach that was required and additionally reflects the complex nature of the problem to be addressed. Fry et al (1999) suggests cases studies provide a better comprehension of the circumstances of the problem being studied together with emphasising the main issues and Mann (2006) notes that case studies allow the examination of a situation of unique interest. The integrated case study element of the adopted mixed methods approach will in addition to delivering an appropriate audit system for BEIS provide additional valuable insights within the overall mixed methods research process and deliver a contribution to practice.

Qualitative and quantitative methods of research according to Creswell (2003) vary from one another not just in the methods deployed and the collecting and analysis of data. According to Draper (2004) they both adopt different stances with regards to the inherent features of both the world itself, our knowledge of the world and how this knowledge is brought into being. The following table 4-1 from Draper (2004) has been adapted to further support the case for a mixed methods approach to this study.

Table 4-1: Contrasting aspects of qualitative and quantitative research strategies

Contrasting aspects of qualitative and quantitative research strategies		
	Qualitative	Quantitative
Philosophical basis	Naturalism and interpretivism	Materialism and positivism
Analytical process	Analytical induction	Hypothetico-deductive
Research design	Observational, holistic and flexible	Experimental, reductionist and closed
Methods and data	Interviews and observations yielding textual data	Range of specific data collection techniques yielding numeric data
Approach to analysis	Codes are derived from the data	Coding frames usually predefined
Analysis	Thematic	statistical

Source: adopted from Draper (2004) p.643

The two approaches have both strengths and weaknesses. By combining the two methods within a mixed method approach there is the opportunity to produce some simple statistical data on the participant's views on the emerging themes from the literature. Although the statistical analysis is limited, it will provide additional evidence taken together with insights gathered from the case studies to support and combine this with the more detailed qualitative analysis underpinning experiences and opinions of the participants to deliver a more developed and defendable argument to the concluding discussion and forward recommendations. There is an acknowledged limitation to the statistical analysis that can be carried out due to the limited sample size of 15 participants which is reflective of the relatively small community of experts within the field of offshore oil and gas decommissioning.

4.4 Strategy of inquiry

Having selected a mixed methods approach, a strategy of inquiry or in other words a type of study which will provide a roadmap within a research design needs to be developed.

In terms of this study there are three options available according to Robson (2002). These are the exploratory approach, or alternatively the descriptive approach and the third option is the explanatory approach. Taking them in turn, and as the name implies the exploratory approach aims to explore, question and consider what is happening. If a phenomenon is in just developing or evolving or there is limited information available about a phenomenon then the exploratory studies are seen as a very useful approach. An approach appropriate to this research is suggested by Saunders et al (2007) which is to conduct the research by undertaking a literature review, and interviewing experts from the subject specialism. Once the primary conceptual elements and focus of the research are known, it would be appropriate to undertake explanatory or interpretive research which to a degree mirrors the approach to be taken in this study in terms of a literature review from which emerges themes which are then used to develop the questionnaire which itself is the basis for semi-structured interviews with identified experts in the field of offshore oil and gas decommissioning. Cresswell (2003) notes that equal priority is usually given to each of the methods, but in practical situations, one of the methods can be given priority. In this research, the qualitative data is given priority as this approach will allow a more comprehensive and structured approach to the investigation. The mixed methods approach adopted is therefore by design more qualitative than quantitative, but all are brought together with the case studies to reinforce the findings that emerge. For the quantitative aspect of this mixed methods study the approach taken is through semi structured interview research which will provide a quantitative description of the opinions of the selected sample of the decommissioning population. For contrast the qualitative aspect of the mixed methods approach is addressed through an adaption of phenomenological research which according to Creswell (2009) is a strategy of inquiry founded on a philosophy where the researcher focuses upon a phenomenon and collects information through descriptive experiences of participants with in this case the phenomenon being the decommissioning of redundant offshore infrastructure.

This design is supported Giorgi (2009) and Moustakas (1994) as it has strong philosophical underpinnings and typically involves conducting interviews.

The subjective nature of qualitative data analysis is commonly criticised in that it can reflect the bias and areas of interest of the researcher. Therefore, it is important according to Green & Thorogood (2004) that all analysis and subsequent interpretations made by researchers should be both defendable and open to scrutiny, and that there is a clear explanation of the links between the original data and the research outcomes. Mays & Pope (2000) suggest that within qualitative research researchers should take a stance of 'subtle realism', where the end game is not to attempt to attain absolute truth but should be to represent reality. Fade (2003) sums it up succinctly in suggesting that qualitative research should be credible and authentic and demonstrate criticality and integrity. This also supports the rationale for including both qualitative and quantitative results together with the integrated case studies within the methodology and the use of a mixed methods approach.

Having selected the mixed methods approach and described the quantitative, qualitative and case study elements, the overall strategy of inquiry will be to use concurrent mixed methods procedures which will entail combining all data sets related to the research problem to gain a thorough analysis. The approach will be to gather both the quantitative and qualitative data at the same time through a set of semi-structured interviews and present the interpretation of the integrated data in the overall results. Creswell and Plano Clark (2007) suggest that the concurrent mixed methods approach will provide the opportunity for the qualitative results to support the quantitative results.

4.5 Mixed methods design – translating the approach into practice

Having selected a concurrent mixed methods approach the specific methods or procedures of research that translate the approach into practice need to be developed. Creswell (2009) indicates that the design of the procedures will be influenced by several aspects. These are consideration of the timing of data collection in terms of whether it will be in phases or at the same time. Additionally, the weighting given to the qualitative and quantitative elements and

how the data will be mixed or brought together should be considered. Finally, the extent to which a theoretical perspective guides the entire design should be considered. Creswell (2009) identifies six mixed method strategies that he and his colleagues advanced in (Creswell et al 2003) and these are identified in table 4-2 below.

Table 4-2: Mixed method strategies

Mixed method strategies	Timing	Weighting	Mixing
Sequential explanatory strategy	In series	QUAN	Connected
Sequential exploratory strategy	In series	QUAL	Connected
Sequential transformative strategy	In series	QUAN/qual quan/QUAL Equal	Connected
Concurrent Triangulation strategy	In parallel	Equal	Interpretation discussion stage
Concurrent embedded strategy	In parallel	QUAN/qual quan/QUAL Equal	Embedded
Concurrent transformative Strategy	In parallel	QUAN/qual quan/QUAL Equal	Merging Connected Embedded

Source: adapted from Cresswell (2009 pp 207-216)

Of the six strategies listed in the table above the concurrent triangulation strategy design is selected as the platform for this study. Whilst it will be adapted to fit the research aim and data sources, it is the best fit for this study because in terms of timing the data both quantitative and qualitative will be collected at the same time, and both sets of data will be mixed during the interpretation or discussion phase and the theoretical perspective is explicit.

Although the weighting given to each is not truly balanced with more emphasis placed on qualitative than quantitative analysis due to the limited sample size, as explained earlier, in application the adapted approach remains valid. The addition of research findings from the case studies enhances the overall data set and adds depth and value to the interpretation and discussion phase. Figure 4-2 below illustrates the adapted concurrent triangulation design strategy.

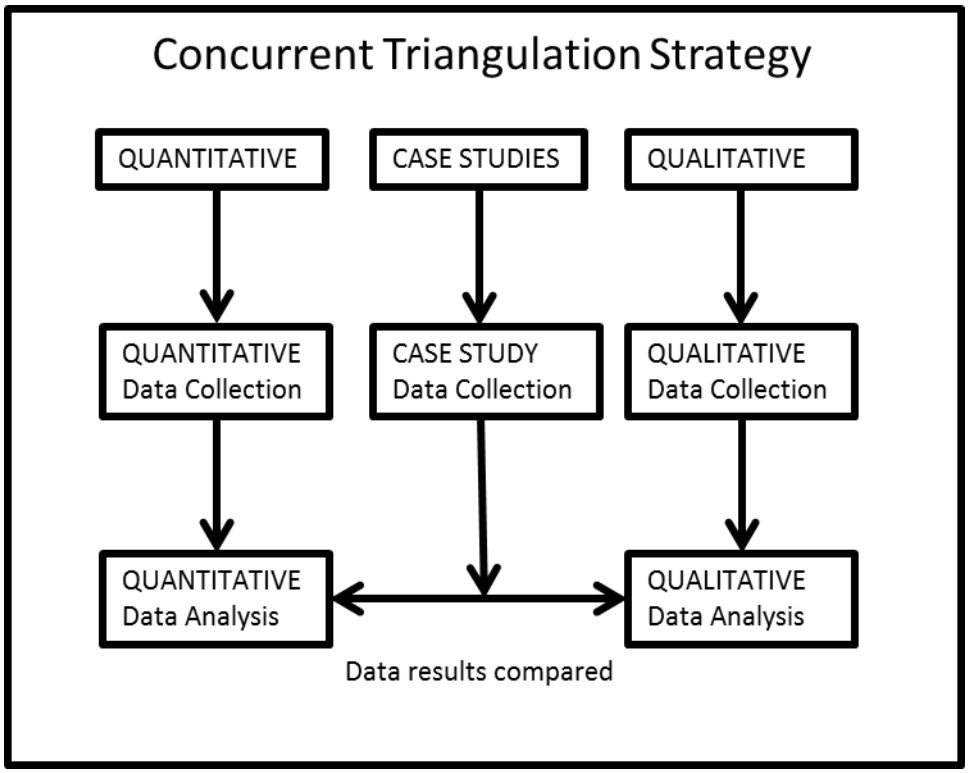

Figure 4-2: Adapted concurrent triangulation design strategy. Source: adapted from Creswell 2009 p.210

The selected sampling approach for the quantitative/qualitative elements was a subset of Non-Probability Sampling known as Expert Sampling where potential participants who are considered to have high levels of knowledge and expertise are selected for taking part in the study. The primary reason for selecting this sampling method was due to the subject matter of this study which is an emerging industry subset and the pool of potential participants is limited.

Therefore, with a sampling method involving randomization, it would not be possible to obtain a sample that would be representative. While it is recognized that participant bias is potentially more of a concern with this type of sampling, additional steps were taken to minimise this concern.

To successfully employ a qualitative approach to this research, targeting and gaining access to the right individuals and organisations was vital to this research. In terms of sampling Ritchie, Lewis and Elam (2003) suggest that there is a point of diminishing return which is when the collection of data does not lead to additional information. In the UK the decommissioning community is not extensive which limits the community from which to sample. In terms of sampling it will be important to identify and seek agreement from those individuals with the most experience of decommissioning and this approach is supported by Jette, Grover and Keck (2003) who suggest that levels of significant expertise in a subject can result in a reduced requirement of the number of individuals required for a study. In order to balance the selection of the participants and to minimise bias, participants were selected who represented the operators who have overall responsibility for the decommissioning programme and sub contracted service providers responsible for delivering the programmes. Similarly, participants were selected whose area of expertise was either focussed on programme management, well services or on the environment once again to minimise bias and to enable the opinions and experience of participants with different and potentially opposing functions to be collected. Table 4-3 overleaf summarises the employer and expertise of each participant.

Table 4-3: List of Research participants

List of Research participants		
Participant	Employer	Area of Expertise
D01	Operator	Project Management
D02	Service Provider	Environment
D03	Operator	Environment
D04	Operator	Well services
D05	Operator	Project management
D06	Service Provider	Project management
D07	Service Provider	Environment
D08	Operator	Environment
D09	Service Provider	Well services
D10	Operator	Project management
D11	Operator	Project Management
D12	Operator	Environment
D13	Service Provider	Well services
D14	Operator	Environment
D15	Service Provider	Project management

Source: Author

The selection of the subjects for the case studies was constrained by the timing of the research and the available decommissioning programmes that had been approved, and that would be executed during the research period and whose operators were willing to participate. The selection was further constrained by the researchers ambition to develop a decommissioning inspection regime that was suitable for all of the UKCS which necessitated that both of the case studies

were in different geographical locations and of different types of installation in terms of overall project scale.

4.5.1 Data Gathering and questionnaire design

The research format was interviews that were semi-structured. The interviews covered a set of themes arising from the literature review. The interviews were designed in such a way that there was the flexibility to record extra information and additional topics from the interview dependent upon the flow and direction of the discussions held with the participants.

The initial section of the questionnaire recorded the levels of experience and knowledge of the participants to validate that they met the criteria for participating in the study. Following the initial section, the main body of the questionnaire was divided into four main sections that reflected the four themes generated in the literature and additionally linked to combinations of the eight research questions. This is summarised in table 4-4.

Table 4-4: Themes generated from the literature

Themes generated from the literature		Research questions targeted
Theme	Description	
Theme 1	Consideration of the proportionality of the current regulatory framework	1,2,3,8
Theme 2	Identifying the complexities and constraints of the current regulatory framework	2,4,5,8
Theme 3	Minimising the impact of decommissioning on the environment and the role of OPRED in monitoring regulatory compliance	2,5,6,8
Theme 4	Derogations as a foundation for increasing flexibility of the regulatory framework	1,2,7,8

Source: Author

Each section of the questionnaire under each theme contained both open and closed questions and both styles of questions are followed by a further discussion to capture further comments that would support their responses. A Likert scale was used for the quantitative questions where respondents specify their level of agreement or disagreement on a symmetric agree-disagree scale for a series of statements. This according to Burns (2008), the range additionally captures the strength of their opinions for a given topic. A five-level Likert scale was selected with the following options provided for the majority of the questions using the Likert Scale.

Strongly disagree

Disagree

Neither agree nor disagree

Agree

Strongly agree

For two questions due to the nature and directness of the questions, different response options were generated that would enable the participants to provide their opinions and strength of their opinions. Both of these questions continued with the use of a five-level response option providing a balanced set of options in line with the other questions in the questionnaire that employed Likert Scales.

Likert scaling is a bipolar scaling method, which is used to measure either positive or negative responses to a statement and the strength of the opinion. The neutral option of "Neither agree or disagree" could be considered as a non-committal option to take when a respondent is unsure of their strength of opinion, and so whether it is in truth a real neutral option remains open to question. The alternative option considered was to use an even-point scale, when the central option is not incorporated. Often this is known as a forced choice method, since you are removing the neutral choice according to Allen and Seaman (2007). It was decided to continue with the 5 level Likert Scale approach because each question that employed the Likert scale was followed by a section to capture further information around the participants opinions.

For the questions under each of the emerging themes in the literature in the questionnaire that were to be subject to qualitative analysis, dichotomous questions were used providing two possible responses, in this case a yes or a no. Whilst this is the easiest form of questionnaire for the respondent in terms of responding, the participants were also asked during the interviews to provide comments on their particular response to each dichotomous question.

For Theme 1: consideration of the proportionality of the current regulatory framework, the questions in this section of the questionnaire were designed to capture information from the participants on their experience and opinions on the degree to which the current regulatory framework is proportional with regards to the impact of decommissioning on the marine environment. For theme 2: identifying the complexities and constraints of the current regulatory framework, the questions in this section of the questionnaire were designed to capture information from the participants on their experience and opinions on working within the current regulatory framework. For theme 3: minimising the impact of decommissioning on the environment, the questions in this section of the questionnaire were designed to capture information from the participants on their experience and opinions on to what extent the current regulatory framework provides a positive environmental outcome for the marine environment. For theme 4: derogations as a foundation for increasing flexibility of the regulatory framework, the questions in this section of the questionnaire were designed to capture information from the participants on their experience and opinions on building a greater degree of flexibility into the decommissioning options envelope.

4.5.2 Data Collection method

The data was gathered from the participants in the research study through semi-structured interviews using the developed questionnaire as the basis for the discussions. Due to the expert sampling method employed to generate the participants in this study, it was decided that face to face interviews based on the questionnaire with the data captured by the interviewer through the taking of notes and recording the information provided by the participants would be the most effective route to gathering the data. The researcher was fortunate through

a previous role within the decommissioning industry to have a high profile within the sector and to have made contact and built working relationships with a large percentage of individuals who would qualify as potential participants in the study.

From this foundation, building of the participant base began with identifying through personal knowledge the potential participants across a range of disciplines. Initial contact was then made by telephone to each identified individual and during these initial discussions it was made clear to the potential participants that their identity and the identity of their employers would remain anonymous in any thesis or reports produced for the academic institution or the researcher's employer OPRED. A number of potential participants declined to participate due to their employer conditions of employment and a number of potential participants declined due to personal choice. From those who agreed to participate fifteen individuals were selected that reflected a balanced group of individuals across both disciplines and employer types. Due to the limited decommissioning population and the limited potential participants available with knowledge and experience of decommissioning, saturation or close to saturation would be achieved by the selection of fifteen participants. Each interview was undertaken at the choice of location of the participants and the duration varied between 45 minutes and 90 minutes. Not all of this time was value adding as the discussions at times would wander off to non-decommissioning specific topics, but it was deemed important to allow participants the time to respond to the questions in a manner with which they were comfortable. Similarly, not all of the data gleaned from participants in a qualitative study can be utilised. During the data analysis phase (Guest, MacQueen, & Namey, 2012) suggest that researchers need to "winnow" the recorded data which involves disregarding some of the data while concentrating on other parts of the data.

4.5.3 Case study approach, data acquisition and analysis methods

The case study has been developed as a two phase approach.The initial phase was desk based research to firstly identify the environmental regulations that applied to offshore oil and gas operations, followed by matching them to the operations ongoing during the execution of a decommissioning programme. Further analysis of the perceived scale of environmental impacts involved under

each regulation was undertaken together with an analysis of the feasibility of inspecting against each regulation offshore in order to generate the initial boundaries of the inspection process for the second phase of the research. From this initial work an initial model framework for the offshore inspection phase was developed.

The second phase of the research was offshore based practical development of the inspection model based on the outcomes of the phase 1 research. Phase 2 involved two consecutive inspections of each of the nominated platforms undertaking decommissioning activities. The first of the inspection visits was to trial the initial inspection model and identify what worked well and what elements of the model required improvement. On completion of the first set of trials and following a further period of reflection and re-design a second set of trials of the final version of the inspection model were undertaken. The second inspections of the platforms also enabled a revisit of the inspection findings from the first visit to identify what remedial actions and improvements had been put in place to validate the usefulness of the model as an audit tool. Figure 4-3 illustrates the development of the case study approach.

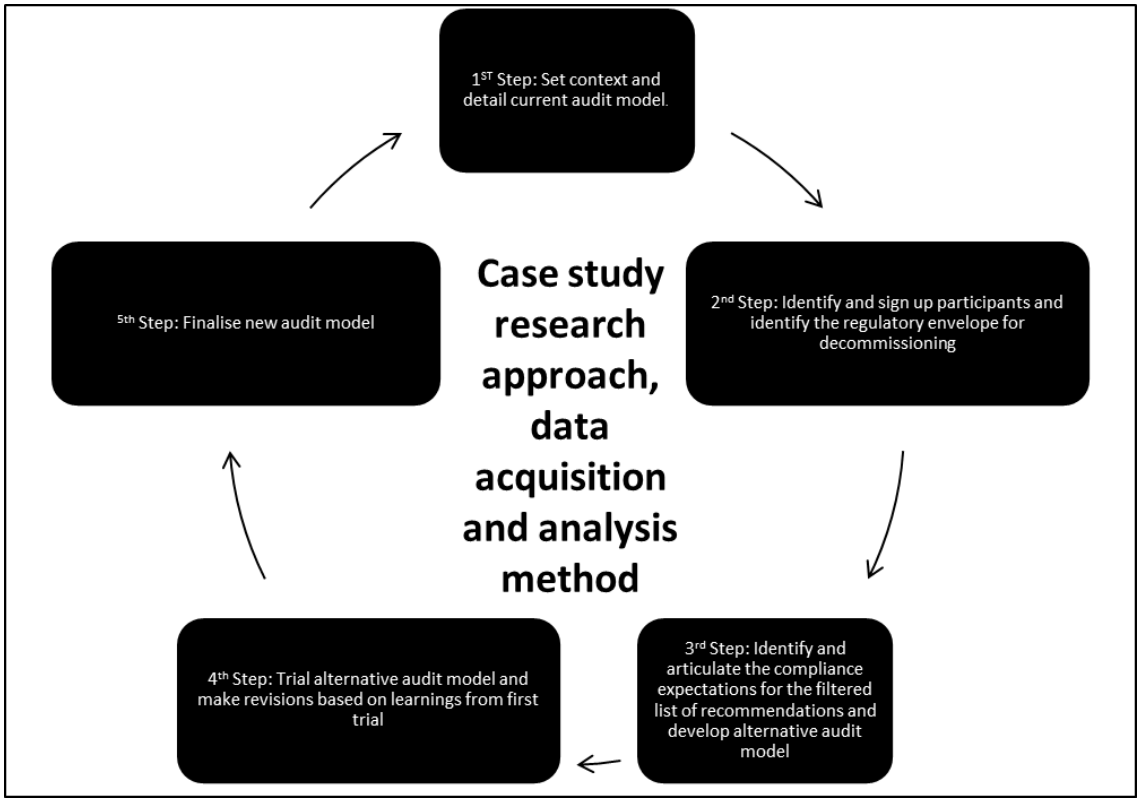

Figure 4-3: Case study approach, data acquisition and analysis.

Source Author

4.5.4 Quantitative and qualitative data analysis and procedures for validation

The data analysis techniques are described in this section. The mixed method approach undertaken, involved gathering both the quantitative and qualitative data at the same time, through the same questionnaire and interviews. The analysis was carried out in series in chapters 5 and 6 and then interpreted in parallel together with the case study data from chapter 7 in chapter 8.

4.5.6 Quantitative Analysis

The quantitative analysis utilises Likert scale questions and responses. Cresswell (2009), describes the main steps for analysing quantitative data, although not all of the steps in this approach were relevant to this research study and this is reflected in adapted approach in figure 4-4

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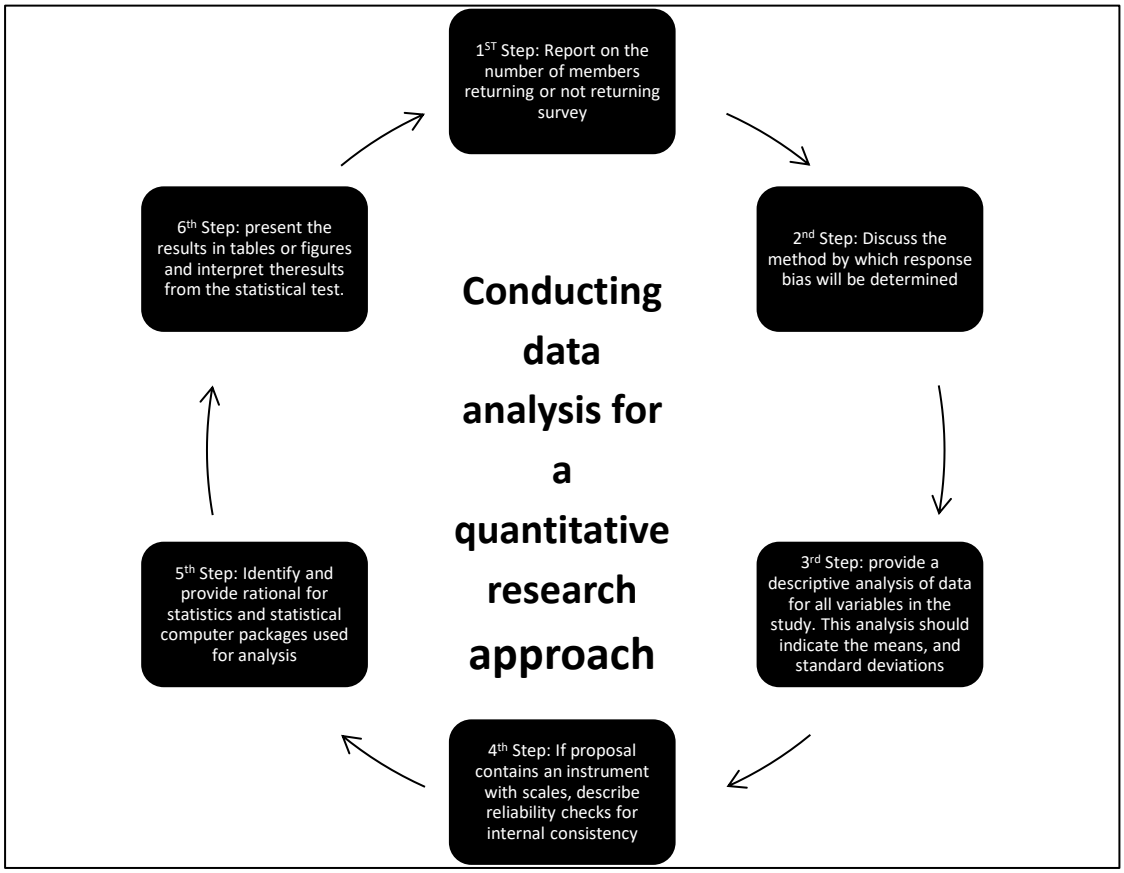

Figure 4-4: Conducting data analysis for a quantitative research approach Source: adopted from Cresswell (2009 pp 166-167)

Looking in more detail at each of the steps as applied to this research study. In terms of step 1, the response rate was 100% which reflected the chosen data gathering method of one to one interviews which followed a period of targeted expert sampling to generate the participants. In terms of step 2, there was potentially some unconscious bias based on participant's disciplines and employer stakeholder interests but an attempt to even this out was made through the range of discipline types and employing organisations types. Step 3 provides a descriptive analysis. In terms of step 4, many of the questions included in the questionnaire used Likert 5-point Scales. In terms of qualitative reliability, the researcher's approach taken in using Likert Scales is consistent across different researchers and different projects according to Gibbs, (2007). Reliability can be assured in that this approach is according to Burns (2008), a common approach in capturing the intensity of participant's feelings for a given

topic. This is also recognized as being a common approach to directly measure attitudes according to Bowling (1997). In terms of step 5, many of the questions included in the questionnaire used Likert scales and therefore a basic statistical approach could be used to analyse the participants responses and identify strength of opinion on the various topics within each theme. These quantitative results could then be analysed in parallel with the qualitative results from the response to the questionnaire to triangulate the results.

4.5.7 Proposed case study audit approach

The development of the content of the audit is detailed in chapter 7 but in essence the proposed audit approach would involve a degree of onshore pre audit work looking at available data previously submitted by the operator to OPRED such as annual chemical use and discharges, reportable incidents, permitted discharges followed by a two day offshore audit which would reflect the bulk of the data gathering, looking at compliance with various permits and visual inspection. Finally the data and other information gathered would be reviewed onshore and any clarifications sought prior to a report being issued. Figure 4-5 illustrates the conceptualised approach to the audit.

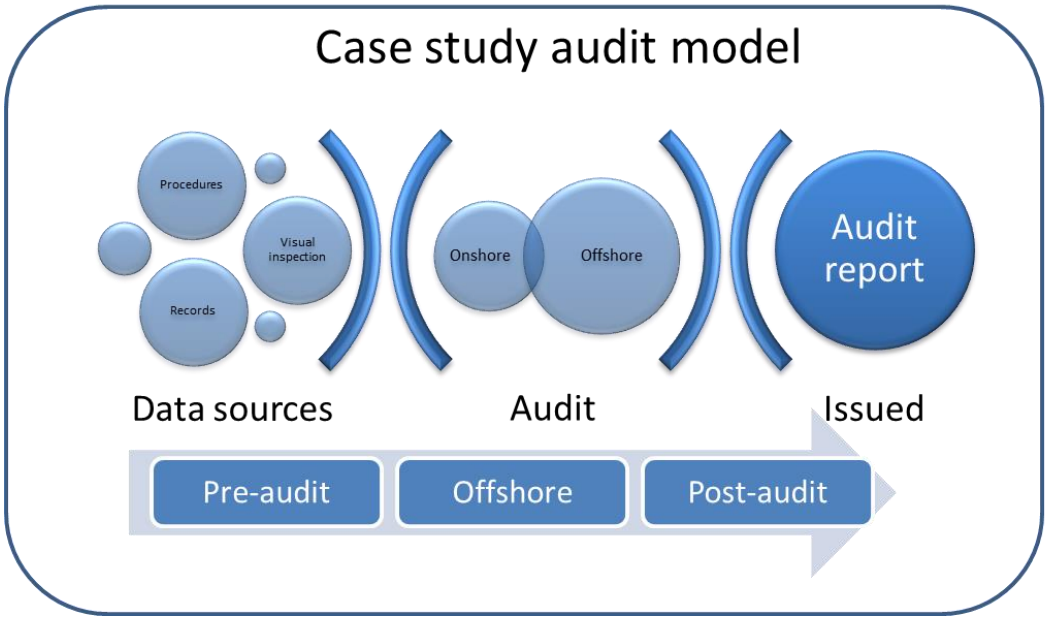

Figure 4-5: Case study audit model. Source: Author

4.5.8 Qualitative analysis

Creswell (2009) provides a step by step model of an approach to analyse and interpret qualitative data. Those steps are adopted and adapted in figure 4-6.

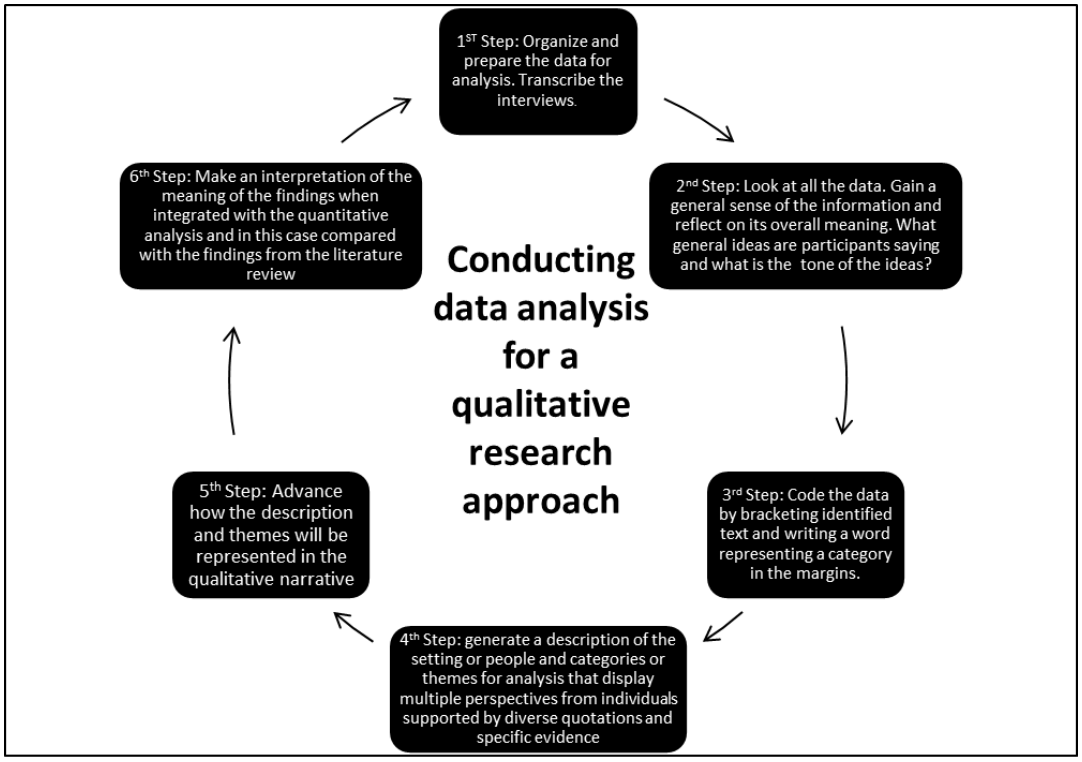

Figure 4-6: Steps for qualitative data analysis and interpretation. Source: adapted from Cresswell (2009 p.186)

In terms of step 1, the semi structured questionnaire format generates a considerable amount of data. Employing the "winnow" approach of Guest, MacQueen, & Namey, (2012) as mentioned earlier in the chapter, the data that is most appropriate for the research is recorded in a spreadsheet. This excludes anything recorded during an interview that is not relevant to the topic under research. For example, any participant's opinions on wider Government Policy or non-decommissioning aspects of the oil and gas industry were not transcribed into the spreadsheet.

In terms of step 2, general themes on participant's views on their consideration of the proportionality of the current regulatory framework; the complexities and constraints of the current regulatory framework, minimising the impact of decommissioning on the environment and their views on derogations as a

foundation for increasing flexibility of the regulatory framework would be of principle concern and interest.

In terms of step 3, the coding of the gathered data is the analytical approach that will be used analyse the qualitative data from the questionnaire. Jacob (1988) suggests that researchers should use as many categories as possible to begin to code their data in order as described by Agar (1980) to understand, articulate, and interpret the identified themes emerging from the participant's perspectives. Bryman and Bell (2003) propose that a coding schedule is created to capture the data from the questionnaire.

In terms of step 4, the themes for analysis are somewhat pre-determined by the design of the research questionnaire that in turn reflects the themes emerging from the earlier literature review. There may emerge themes that are decommissioning based but out with the envelopes of the anticipated themes and these will be captured through the use of inductive analysis as proposed by Bryman and Bell (2003).

In terms of step 5, the themes dictate the presentation of the results of the analysis utilising tables of participant's responses to the questions and the relevant comments made to support their response. Following each table, a descriptive narrative focussing on the evidence of emerging perspectives will be drafted.

In terms of step 6, the basis of the themes from the gathered data and the basis of the themes from the literature review will be compared and interpreted. This also involved a comparison and interpretation of the both the quantitative analysis and the qualitative analysis to combine the results to identify content that would provide the framework for the development of an alternative framework combining strategic evidence based decommissioning options and proportionate regulatory practices.

4.5.9 Comparison of the quantitative, qualitative and case study results

In the study the quantitative and qualitative results and case study data are presented in separate chapters, but the analysis and interpretation of the data

will be presented and combined to look for similarities between the outputs from the data on each of the identified themes.

4.6 Chapter summary

Based on the background of the research being undertaken, this chapter outlined the case for the research and design methodology to be deployed, the data gathering approach and the method used for analysing the collected data. The approach selected was presented as within the epistemological and ontological envelope of the interpretivism/constructivism paradigms and an adapted version of the concurrent triangulation mixed method approach supported and enhanced through case study material utilising elements of thematic triangulation and member checking. The argument for this approach rather than a singular quantitative or qualitative approach was presented and builds on the strengths of each singular method and offsets the weaknesses of these approaches to add value to the study.

In terms of data gathering, a semi-structured interview guided by a questionnaire was the approach taken and subsequent analysis of the data utilised coding techniques.

The basis of the themes from the gathered data, were integrated after the analysis of the data in chapters 5, 6, and 7. The combined data and perspectives emerging were then integrated once more with the themes from the literature review and overall results interpreted, combined and triangulated in chapter 8 to identify content that would provide the framework for the development of an alternative framework combining strategic evidence based decommissioning options and proportionate regulatory practices.

CHAPTER 5: QUANTITATIVE RESULTS AND ANALYSIS

5.1 Chapter introduction

The quantitative results and analysis are presented in this chapter. From a quantitative perspective the results aim to understand the study participant's views on the themes that emerged from the literature review and these are depicted in figure 5-1. Despite the relatively small sample which reflects the expert sampling method employed, and therefore limits the extent of numerical analysis that can be conducted, the analysis will provide a numerical measure of opinion of the themes to be investigated in this chapter.

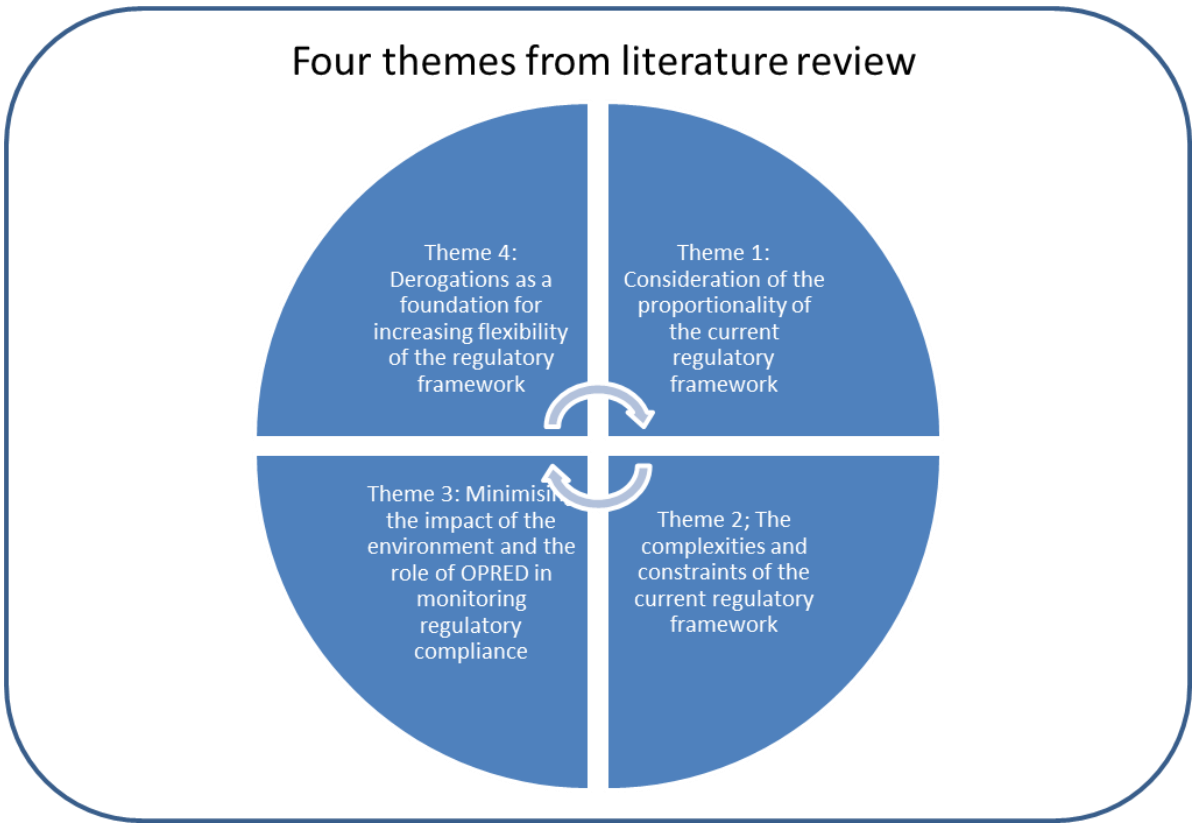

Figure 5-1: Emerging themes from literature review. Source: Author

Those themes on which participants views were taken were their consideration of the proportionality of the current regulatory framework; the complexities and constraints of the current regulatory framework; minimising the impact of decommissioning on the environment and the role of OPRED in monitoring regulatory compliance; and their views on derogations as a foundation for increasing flexibility of the regulatory framework.

5.2 Theme 1: Consideration of the proportionality of the current regulatory framework

The process for collecting the relevant data on this theme was put forward in chapter 4 along with a descriptive coding of the participants who all responded to these questions. The questions were designed to provide data for analysis of theme 1, namely the proportionality of the current regulatory framework and is targeted at providing data in response to research questions 1, 2, 3 and 8 arising from the literature review.

The first set of questions in Section B were designed to gather specific opinions of the participants followed by an open-ended statement asking for comments to support the responses and targeted at capturing more specific details on the participants views which could be further analysed in chapter 6, the Qualitative Results and Analysis. The questions utilised a 5 level Likert scale. Table 5-1 indicates the results received from the four questions posed under section B(ii) of the questionnaire:

Table 5-1: Participants views on the proportionality of the current regulatory framework

Questionnaire section B2(ii) Participants views on the proportionality of the current regulatory framework					
Question	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Q.8	8	7			
Q.9	15				
Q.10	9	6			
Q.11	8	5		2	

The four statements were designed to be overarching statements to gather general opinions of the participants with an open-ended statement asking for comments to support the responses and targeted at capturing more specific detail on the participant's views. Overall the participants disagreed or strongly disagreed with these statements, which supports the original basis of the study in terms of a general unease within the decommissioning community with the current regulatory framework and this was reflected in the responses to three of

the four questions where no participants agreed or strongly agreed that the current regulatory framework was fit for purpose, minimised cost or produced efficient decommissioning strategies. It was interesting to note that two of the fifteen participants (D02 and D07), (13%) agreed that the current regulatory framework was proportionate when compared with the regulatory framework for installations that were in their production phase and this may or may not reflect their personal stance as environmental specialists employed by service providers. Interestingly and for contrast, all of the environmental specialists employed by operators (D03, D08, D12 and D14) (26%) indicated that they did not find the current regulatory framework to be proportionate. The additional comments by two of the environmental specialists (D08 and D12) employed by operators indicated that the potential for permitted discharges from decommissioning activities were minimal when compared with the yearly permitted discharges of oil in produced water or chemicals for platforms in their production phase. Most of the participants, fourteen out of fifteen strongly disagreed that the current regulatory framework minimised the cost of decommissioning with additional comments for example (D01) stating that attempting to remove mattresses was rarely successful as they are usually difficult to locate, disintegrated on initial lifting, and increased both risk and cost of providing diver intervention. A further example from Environmental specialist (D14) was that the requirement for individual environmental impact assessments for different platforms within the same field added significant additional cost for no additional environmental benefit.

The additional comments recorded for the questions in section B(ii) and the questions in section B(i) are considered in Chapter 6, the qualitative results and analysis.

5.3 Theme 2: Identifying the complexities and constraints of the current regulatory framework

The questions in section 3 were designed to provide data for analysis of theme 2 namely identifying the complexities and constraints of the current regulatory framework and is targeted at providing data in response to research question B4 arising from the literature review.

Looking at the questions 14 and 15 under section 3(ii), they are designed to gather data on the opinions of the participants with regards to the complexities of working with the regulations and based on their knowledge and experience, their default preferences for decommissioning the various elements within a programme.

There are many elements within a decommissioning programme that are required under the current regulatory framework, to be comparatively assessed in terms of the appropriate decommissioning option for them. Whilst the base line OSPAR position is that of a "clean seabed", limited guidance is published alongside the regulations and the reality is that not all elements can be removed. Some elements could be removed involving varying degrees of technical difficulty and other considerations such as safety, the environment and other stakeholders should be considered. In order to gather participants views on the helpfulness or otherwise of the regulatory framework is with regards to various elements of a decommissioning programme, the following question was asked, and a 7-level rating scale was provided. "Q14. For the following elements of a decommissioning programme how helpful do you consider the current North Sea Decommissioning regulations to be: Please provide a rating from 1 to 7 where 1 is helpful and 7 is very unhelpful". Table 5-2 presents the cumulative results from the 15 participants for the various elements of a decommissioning programme in terms of the helpfulness or otherwise of the current regulatory framework.

Table 5-2: Cumulative results from 15 participants rating the usefulness of the regulatory framework with each element of a decommissioning programme

Programme Element	**Rating** **Where a rating of 1 indicates that the regulations are very helpful and 7 that the regulations are very unhelpful.**						
	Rating						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Permitting requirements				1	3	5	6
Well P&A	4	4	5			2	
Drill Cuttings		10	2			2	1
Topside making safe and preparation					5	8	2
Topside removal		4	10				1
Substructure removal		8	6				1
Pipeline making safe & decommissioning			1		1	10	3
Subsea infrastructure		1			5	8	1
Seabed remediation		4	6	3			2
Site monitoring					4	7	4

Prior to analysing the above data, it is important to note a couple of points raised by the participants in their subsequent comments with regards to this question. They are that four (66%)(D02, D07, D08, and D12) of the six environmental specialists stated that their exposure to some of the decommissioning elements was limited and whilst they were confident of their assessment for subject areas that they regularly dealt with in terms of environmental assessment and permit applications such as site monitoring, seabed mediation, pipelines and fluid discharge their opinions on other areas were their views based on conversations

that they had with other members of a decommissioning team on their respective projects. It is also worth noting that it was pointed out in discussions that the regulations regarding well plug and abandonment are implemented by the Health and Safety Executive not OPRED although OPRED do assess well notifications as part of their role within the Competent Authority.

By undertaking a simple value system calculation to the results in table 5-2, it is possible to rank the usefulness of the regulatory framework against the various elements of the decommissioning programme and these are presented in table 5-3.

Table 5-3: Cumulative value system results from 15 participants rating the usefulness of the regulatory framework with each element of a decommissioning programme

Programme Element	Rating Where a rating of 1 indicates that the regulations are very helpful and 7 that the regulations are very unhelpful.							Scoring based on multiplying rating by number of participants for each element where lower score indicates helpful and higher score indicates less helpful	Ranking of usefulness where 1 is most useful and 10 is least useful
	Rating								
	1	2	3	4	5	6	7		
Permitting requirements				1	3	5	6	91	10
Well P&A	4	4	5			2		39	1
Drill Cuttings		10	2			2	1	45	3
Topside making safe and preparation					5	8	2	87	7
Topside removal		4	10				1	45	3
Substructure removal		8	6				1	41	2
Pipeline making safe & decommissioning			1		1	10	3	89	8
Subsea infrastructure		1			5	8	1	82	6
Seabed remediation		4	6	3			2	52	5
Site monitoring					4	7	4	90	9

With the exception of drill cuttings, topsides, and substructure removal which according to the supporting comments are clear and unambiguous in terms of overall options, the regulatory framework is considered to be less helpful to the remaining elements. The final question in section 3(ii) is designed to ascertain based on the knowledge and experience of the participants, their default preferences for decommissioning the various elements within a programme.

Question 15 asks "What do you consider should be the default decommissioning option prior to comparative assessment for the following elements?

1. Complete removal
2. Leave in situ
3. Remedial burial/trenching
4. Rock dump/remedial rock dump
5. Partial removal
6. None of these options

Table 5-4 presents the cumulative results from the 15 participants for the various elements of a decommissioning programme in terms of their default decommissioning preference.

Table 5-4: Cumulative results from 15 participants stating their default decommissioning preference.

Decommissioning element	**Decommissioning options**					
	Complete removal	Leave in place	Remedial burial / trenching	Rock dump / remedial rock dump	Partial removal	None of these options
Mattresses		5			10	
Grout bags		15				
Frond mats		15				
Pipelines	2	8	2		3	
Umbilicals	12	2			1	
Drill cutting piles		15				
Pipeline bundles	2	8	2		3	
Gravity Based Structures		15				
Topsides	15					
Steel jackets		3			12	
Subsea installations	15					

There are number of clear messages appearing within this area of questioning and the supporting comments from participants. Across all disciplines and employer organisations it is clear that all participants (100%) believe that all topsides and subsea installations (such as wellhead protection structures) should be completely removed. There are similarly strong preferences that flexible umbilicals should be removed particularly as this is not overly technically challenging. Equally fifteen out of fifteen participants (100%) state that grout bags and frond mats should be left in situ. Interestingly only five out of fifteen participants (33%) have a preference for leaving all mattresses in situ with (67%) opting for partial removal. Participant comments shed additional light on the subject of mattress removal in that they indicate that if mattresses can't be easily located or if they are buried or likely to disintegrate then they should be left in situ. Surprisingly none of the participants favoured rock dumping or partial rock dumping as an option. The additional comments recorded for the questions in section 3(ii) are considered in Chapter 6, the qualitative results and analysis.

5.4 Theme 3: Minimising the impact of decommissioning on the environment and the role of OPRED in monitoring regulatory compliance

The questions in section 4 of the questionnaire were designed to provide data for analysis of theme 3 namely minimising the impact of decommissioning on the environment and the role of OPRED in monitoring regulatory compliance and is targeted at providing data in response to research questions 5 arising from the literature review. Table 5-5 indicates the results received from the five questions posed under section 4(ii) pf the questionnaire:

Table 5-5: Participants views on minimising the impact of decommissioning on the environment and the role of OPRED in monitoring regulatory compliance

Questionnaire section 4(ii) Participants views on minimising the impact of decommissioning on the environment and the role of OPRED in monitoring regulatory compliance					
Question	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Q.20	8	7		3	
Q.21	10	5			
Q.22		1		11	3
Q.23				12	3
Q.24		4		11	

The first two statements were designed to be searching statements to gather opinions from the range of participants regarding the relationship between the regulatory framework and protection of the marine environment. On the whole, participants disagreed or strongly disagreed with these statements indicating that the current regulatory framework is not providing a positive result for the environment. Surprisingly the strongest opinions were not exclusively from environmental specialists with only three out of six (50%) strongly disagreeing with both statements with the rest of the strongest opinions coming from project management specialists. This breadth of response tends to support the findings from the literature review that the current regulatory framework is not delivering the best environmental outcomes from decommissioning activities. The supporting comments point to a lack of choice and flexibility and these along with other supporting comments will be further explored in the next chapter, Qualitative results and analysis.

The participants generally agreed with the statements regarding OPRED compliance interventions reflecting that OPRED involvement is viewed in a relatively positive manner with the majority of participants agreeing or strongly agreeing with the statements. It was noted that there was some hesitancy from

four of the six (66%) project managers who disagreed that OPRED should undertake decommissioning regulatory inspections offshore. When asked to articulate their reasons, a couple of common factors emerged; that preparation for the inspection would impact on schedules; and inspections may result in additional unforeseen work scopes in response to inspection findings.

5.5 Theme 4: Derogations as a foundation for increasing flexibility of the regulatory framework

The questions in section 5 of the questionnaire were designed to provide data for analysis of theme 4, namely derogations as a foundation for increasing flexibility of the regulatory framework and was targeted at providing data in response to research questions 6 and 7 arising from the literature review. Table 5-6 indicates the results received from the three statements and one question posed under section 5(ii) pf the questionnaire:

Table 5-6 Participants views on Derogations as a foundation for increasing flexibility of the regulatory framework

Questionnaire section 5(ii) Participants views on Derogations as a foundation for increasing flexibility of the regulatory framework					
Question	Way too high	Too high	About right	Too low	Way too low
Q.30	4	9	2		
Question	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Q.31			3		12
Q.32			4	3	8
Q.33				5	10

The statements were designed to gather opinions from the range of participants regarding the current derogations caveat to the 'clear seabed' approach promoted by OSPAR as a potential foundation or starting point for increasing the flexibility of the regulatory framework. This section begins with a specific question rather than a statement regarding the current 10,000 tonne limit for derogation applications and therefore the Likert Scale response options have been tailored to match the question with the following statements reverting back to the 5 level Likert Scale options adopted through the rest of the questionnaire. The responses to this question indicate that thirteen of the participants (87%) thought that the current limit of 10,000 tonnes was too high or way too high with only 13% suggesting the limit was about right. The supporting comments tend to focus on a number of issues around as mentioned earlier in the quantitative analysis, the apparently arbitrary nature of the limit and additionally that factors such as location, technical difficulty, environmental impact, safety and value are not being considered as part of the decision process for jacket removal.

The majority, twelve out of fifteen (80%) participants thought that the regulatory frameworks in other basins provided a more flexible approach to decommissioning solutions. Eleven (73%) of the participants thought that a rigs to reef program benefits the marine environment and interestingly the four (27%) participants who neither agreed nor disagreed stated in their comments that although they thought it would benefit the marine environment they had not reviewed any of the academic evidence and therefore preferred to not commit to agreeing with the statement. All of the participants (100%) agreed that they could see no reason why a rigs to reefs programme could not be developed for the North Sea. The additional comments recorded for the questions in both sections E(i) and the question and statements in section E(ii) are considered in Chapter 6.

Summary of Chapter 5

This chapter highlighted the outcomes of the quantitative results and analysis of the fifteen participants responses to the questionnaire that guided the discussions held during the one to one interviews. The questions and statements put to the participants reflected the four themes and the parallel research questions that emerged from the literature review.

During questioning and discussions around the proportionality of the current regulatory framework there emerged a general agreement that the current regulatory framework was not evidence based and that the regulations did not reflect or take account of the experience gained and lessons learned from completed offshore decommissioning projects. The participants highlighted a number of areas of decommissioning where complexities and constraints of the current regulatory framework hindered development of the decommissioning programme and the subsequent execution of the programme content. Secondly under this theme, the participants indicated that the complexities and constraints of the current regulatory framework added additional work and cost for no additional benefit to the stakeholders whether they were operators, Government, NGOs, the marine environment, other stakeholders or indeed the taxpayer.

The research participants were generally agreed that the current regulatory framework is unlikely to minimise the impact of decommissioning on the environment and there was general agreement that the role of OPRED in monitoring regulatory compliance provided additional value to the decommissioning process, although there was a degree of hesitancy from a number of participants regarding the potential introduction of offshore decommissioning inspections by OPRED. There was a general consensus that the current weight limit for derogations was unhelpful and there was agreement that increased flexibility for decommissioning options was necessary. Finally, there was across the board support and agreement that the introduction of a rigs to reefs option for elements of the offshore infrastructure would be a positive step in increasing the flexibility required for optimising future decommissioning programmes.

In conclusion, in chapter 5 the participants responses to the questions was based on their knowledge and practical hands on experience of developing

decommissioning programmes and progressing them through execution and on to completion. In many cases their responses mirrored the themes and concerns arising from the literature review and provided additional evidence to respond to the research questions posed.

CHAPTER 6: QUALITATIVE RESULTS AND ANALYSIS

6.1 Introduction

The qualitative results and analysis are presented in this chapter. Whilst the previous chapter on quantitative results and analysis provided a numerical analysis and measure of the views of the expert sampled participants on the themes emerging from the literature review, the qualitative results and analysis in this chapter provide more detailed underpinning experiences and opinions of the participants on these themes. The themes are illustrated in Figure 6-1.

Investigating the same themes on which participants views were taken in the preceding quantitative results and analysis chapter and will provide a more in-depth perspective on the quantitative findings presented in the previous chapter. For clarity the themes were: the participants views consideration of the proportionality of the current regulatory framework; the complexities and constraints of the current regulatory framework; minimising the impact of decommissioning on the environment and the role of OPRED in monitoring regulatory compliance; and their views on derogations as a foundation for increasing flexibility of the regulatory framework and these are depicted in diagram 14.

As described in the research methodology in chapter 4, the qualitative analysis together with the quantitative analysis and additional data from the case studies delivers a more developed and defendable argument to the concluding discussion and forward recommendations in chapters 8 and 9.

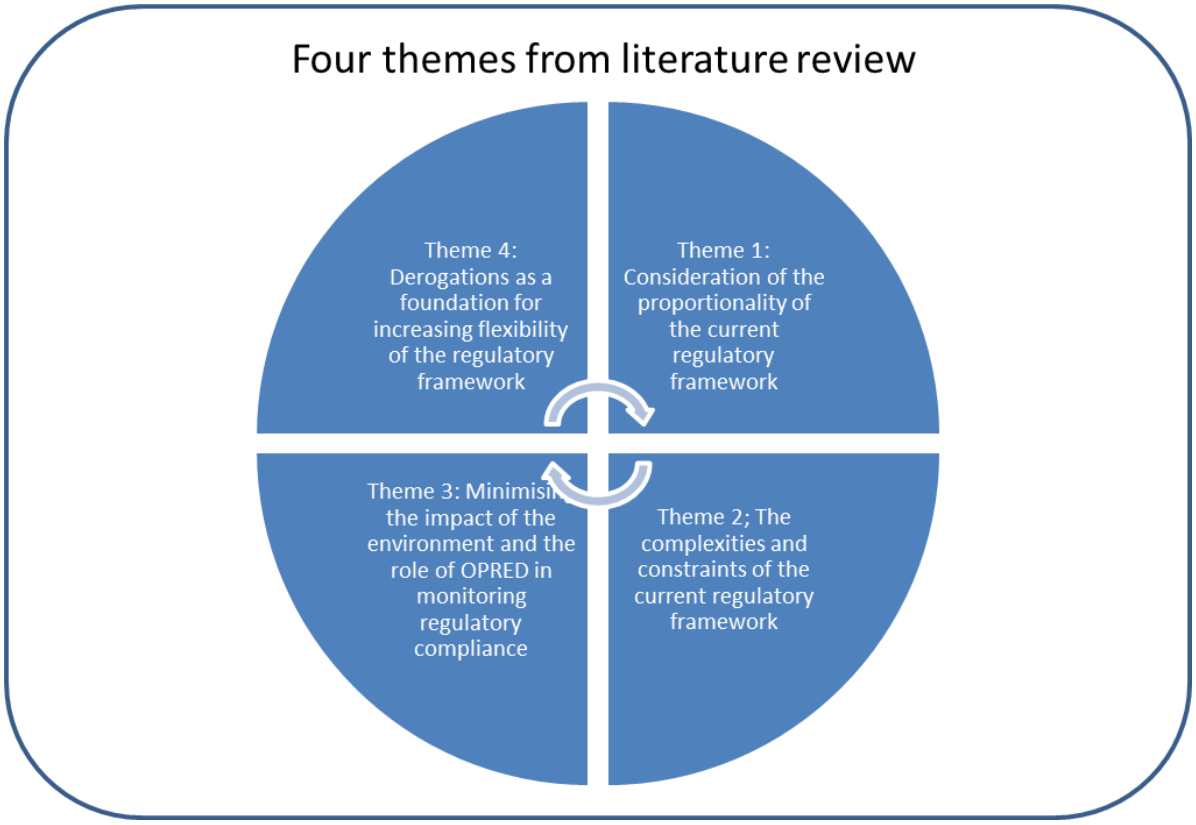

Figure 6-1: Emerging themes from literature review. Source: Author

6.2 Theme 1: Proportionality of the current regulatory framework

This first section focused on providing data in response to theme 1 arising from the literature review which was the proportionality of the current regulatory framework. The questions asked were; are the regulations evidence based, and do they reflect lessons learned from previous decommissioning projects and do they provide a balanced approach to satisfy the various stakeholders with an interest in the decommissioning of redundant offshore oil and gas infrastructure? The responses received for this section provide an overarching set of participant views on the UK regulatory approach. Table 6-1 captures the views of the participants on whether the current regulations are based on evidence.

Table 6-1: Participants views on proportionality of the current regulatory framework – are the regulations evidence based

Participants views on proportionality of the current regulatory framework – are the regulations evidence based?			
Participant	Yes	No	Participants quoted responses
Decom01		√	"considering the regulations were put in place decades ago I doubt there was much evidence to base them on"
Decom02		√	"not sure but the current regulations don't reflect the reality of the challenges faced"
Decom03		√	"to base the regulations on the aftermath of Brent Spar is not an evidence-based approach". "This is more a politically driven process than an evidence-based process"
Decom04		√	"no there is definitely a gap between what is expected and what can be achieved"
Decom05		√	"the regulators do not appear to differentiate between the different lifecycle phases of an offshore platform"
Decom06		√	"I think they are out of step with what needs to be done so I kind of doubt they are evidence based"
Decom07		√	"the current regulations are politically based not evidence based"
Decom08		√	"there can be no so such thing as a completely clean seabed and I can't believe there is an evidence base that could support that approach"
Decom09		√	"the regulations are a result of the political response to the badly handled and poorly reported episode around the Brent Spar"
Decom10		√	"very little if anything has changed with the regulations over many years so they can't be evidence based"
Decom11		√	"they have to be based on some evidence surely, but what that is I am not sure as some of the expectations seem odd"
Decom12		√	"people talk about the influence of Brent Spar driving the regulations but that was more 30 years ago" "stakeholders should be looking at more recent decommissioning projects

			in order to bring in regulations that reflect current experience"
Decom13		√	"the current regulations do not take account of the difficulties involved in decommissioning and for that reason they cannot claim to be evidence based"
Decom14		√	"some of the regulations appear to be overzealous and over ambitious and deliver zero additional benefit for stakeholders so I doubt there is the evidence to support them"
Decom15		√	"whilst I don't agree with some of the regulations there is likely to be some basis for them"

From the analysis of the statements made by the participants it is clear that there is a general belief among the participants that the current regulatory framework is not evidence based. A number of specific perspectives can be drawn from the participant's responses. They are that the regulations are politically driven; that the regulations do not reflect the challenges of decommissioning; and that they are influenced by historical incidents.

The current regulations are politically driven

The idea that the current regulations are politically driven was raised by participants Decom03, Decom07 and Decom 09. This concept of a politically driven regulatory framework is covered in some depth in the literature which argues that there a strong evidence base that supports this concept and this concept is discussed with the literature in chapter 2. Participant Decom09 also stated that "we need to remove the political influence from decommissioning and be realistic about what is actually achievable".

The regulations do not reflect the challenges of decommissioning

Many of the participants touched on the challenges of decommissioning at some stage of the interviews. Participants Decom02, Decom04, Decom06, Decom13, and Decom14 all made this point which points to a growing opinion that regulations need to be achievable and realistic in their ambition. Participant Decom 14 strengthens this point by suggesting that there "needs to be an honest dialogue between all stakeholders and Government about setting realistic decommissioning objectives"

Current regulations are influenced by historical incidents

A number of participants made reference to the Brent Spar. The circumstances surrounding this controversial incident is well documented in the literature and is covered in depth in chapter 2. Participants Decom03, Decom09, and Decom12 all mentioned Brent Spar and that it should not be considered as a solid foundation for basing the decommissioning regulations and rather the experience of more recent decommissioning projects would form a better basis for future regulations.

Under the same theme of the proportionality of the regulatory framework participants were asked to consider whether the regulations incorporate learnings from previous decommissioning projects. Table 6-2 provides the participants views on the proportionality of the current regulatory framework and whether they incorporate learnings from previous decommissioning programmes?

Table 6-2: Participants views on proportionality of the current regulatory framework – do they incorporate learnings from previous decommissioning programmes?

	Participants views on proportionality of the current regulatory framework – do they incorporate learnings from previous decommissioning programmes?			
Participant	Yes	No	Not sure	Participants quoted responses
Decom01		√		"the regulations have not evolved, and we are still attempting the impossible for some parts of the programme" "this is my fourth decommissioning programme in 16 years and nothing has changed"
Decom02		√		"no one is listening to us, we know this can be done better". "Government needs to be more responsive and lead the way"
Decom03			√	"well plug and abandonment is fairly regulated, but I do sense frustrations more widely across the team"
Decom04		√		"the industry and the regulator needs to take a joint approach towards decommissioning…. we have a shared agenda along with other stakeholders to get the get these projects done right".
Decom05		√		"our approved programme states that we will for example remove all the mattresses and we know that that will not happen" "attempting to achieve some of the regulatory driven objectives just adds time and cost, we have to

				try but I don't see the point"
Decom06			√	"BEIS have improved the process for processing permit applications for example for flushing pipelines which on reflection is more of a process rather than regulatory improvement"
Decom07		√		"the industry has a huge task ahead and this should all stakeholders working together". "it is not a case of them and us, the regulations should enable decommissioning not make it more difficult than it needs to be"
Decom08		√		"it is almost as if both regulators and operators know that some of the asks are too difficult to achieve but we have to go ahead and try anyway"
Decom09	√			"the approach within our company is to take a learning by doing approach and to learn from what works well and also what has not worked" "it should be a shared experience for both the industry and Government…we can all improve how we do things"
Decom10			√	"the regulator has introduced a streamline decommissioning programme template which is helpful"
Decom11		√		"no and it is frustrating, they should evolve as experience grows". "decommissioning is new, we are all learning, and the regulations should reflect this…. the regulator needs to learn from this process"
Decom12			√	"my experience has been that you just have to go with the regulations". "change might come but it won't come easily"
Decom13		√		"we have provided feedback to Government, to Oil and Gas UK but nothing has changed"
Decom14		√		"we can improve our approach step by step, but Government needs to look in the mirror as well" "…. only by working in partnership can we maximise the benefits and improvements"
Decom15		√		"we continually raise our concerns and difficulties with the regulations to BEIS but there have been no changes to date" "we have had to go back to BEIS and say that we have tried to decommission in line with the approved programme but for some aspects it has not been possible"

From the responses from the participants it is clear that overall feeling is that the regulations have not changed to reflect any learnings from previous projects. There are some particularly strong views on this sub-theme potentially reflecting a degree of frustration from individuals who have been involved in a number of

successive decommissioning programmes where experiences gained have not resulted in any change of approach to the following project. A number of linked perspectives can be drawn out from the responses. These are that industry and Government have a shared agenda; change to the regulations needs to be driven by the regulator; full compliance with the regulations is very difficult to achieve.

Industry and Government have a shared agenda and ambition to deliver successful decommissioning programmes;

It was clear from the strength of the views given by the participants that both industry and Government share the goal of making a success of the decommissioning challenge. Participants Decom04, Decom07, Decom09 and Decom11 particularly make this point and additionally Decom09 and Decom11 raise a complementary point that both industry and Government need to learn from the experiences of each programme to improve the system as a whole.

Change to the regulations needs to be driven by the regulator;

The responses from the participants Decom02, Decom13 and Decom15 point to the fact that they themselves can't change the regulations. The industry can put forward a case for change, but regulatory change has to be driven by Government.

Full compliance with the current regulations is very difficult to achieve

The responses from Decom01, Decom05, Decom08 and Decom15 suggest that it may not be possible to fully comply with the absolute interpretation of the current regulations as they stand which would suggest that the current regulations are not proportional with regards to the realities of decommissioning activities offshore.

6.3 Theme 2: Identifying the complexities and constraints of the current regulatory framework

In this section of the questionnaire the focus was on gathering data in response to research question 4 which is are there elements of the current regulations that are proving difficult to comply with? Whilst the quantitative analysis on this topic in the preceding chapter was targeted at rating the usefulness of the regulations and guidance for different elements of a decommissioning programme and identifying the difficult elements, this qualitative analysis was very much directed at further understanding the practical experiences of individuals responsible for implementing the regulations whilst undertaking the daily challenges of decommissioning redundant offshore oil and gas infrastructure to provide a broader picture of their views. The questions asked were: do you consider the current regulatory framework for decommissioning is easy to interpret and work with? have you experienced any difficulties in implementing the current regulatory framework to take forward your projects? The responses received for this section provided a set of more in-depth participant views on the UK regulatory approach from a practical implementation perspective. Table 6-3 captures the views of the participants on both whether the current regulations are easy to work with and interpret together with whether participants had faced difficulties in implementing the regulations.

Table 6-3: Participants views on identifying the complexities and constraints of the current regulatory framework

Participants views on identifying the complexities and constraints of the current regulatory framework						
Participant	Question 12		Question 13		Participants quoted responses	
	Yes	No	Yes	No	Question 12	Question 13
Decom01		√	√		"the guidance supporting the regulations is rather vague" "practical examples of good practice would help"	"you have to go through a whole series of processes just to develop the programme which takes a long time,"
Decom02		√	√		"the regulations are written in standard legalistic	"the regulations should be more flexible and allow us the opportunity to tackle each program

					terminology and we are left to interpret what we can and cannot do”	on a case by case basis…. I don’t believe a one size fits all approach is an effective way to manage the decommissioning challenge we face”
Decom03		√	√		“the regulations are set at a fairly high level and the BEIS guidance is more a list of expectations rather than providing direction”	“finding a solution to meet the requirements of the Consent to Locate permit was difficult”
Decom04		√		√	“plug and abandonment activities are pretty standard in terms of the rules applied”	* No specific issues raised
Decom05		√	√		“I prefer to seek guidance from colleagues on what is possible within the regulations rather than interpret them by myself” “some sections of the regulations just don’t stack up in the real world”	“the clear seabed requirement is difficult to resolve…… achieving a satisfactory solution for pipelines has proved very difficult”
Decom06		√	√		“it is far simpler to get guidance from the Environmental Management Team at BEIS than trying to understand the regulations…. the guidance notes don’t help a great deal on environmental issues”	“the permit requirements for the decommissioning programme can at times be overwhelming in terms of sheer volume and associated complexity”

Decom07		√	√		"difficult to work with"	"it is just too complex and confusing" "there should be some form of process flow and greater flexibility within each element to design an optimal approach"
Decom08		√	√		"it would help greatly if the whole process could be simplified by making it clearer what is allowed and what is not"	"anything subsea provides challenges in terms of interpreting the regulations and the approved way forward is very often an unsatisfactory outcome for the operator and contractors"
Decom09		√		√	"well abandonment is fairly straightforward from a regulatory perspective"	* No specific issues raised
Decom10		√	√		"there needs to be more consistency for example in oil discharge permits for pipeline operations and the oil in water compliance requirements should be more realistic in terms of achievability"	"it is difficult to keep on top of the permitting requirements on a decommissioning project particularly for pipelines and seabed disturbances etc"
Decom11		√	√		"it is confusing, we need clearer guidance from the regulator because it should not be this difficult to put together an acceptable decommissioning programme"	"I recall that it took us too many versions and meetings with BEIS before the programme was accepted"
Decom12		√	√		"out of date and ineffective sums it up". "the	"there are so many variables between each project that we need

					regulations were put in place before we understood the difficulties involved in dealing with infrastructure offshore"	more flexibility and options in acceptable program design"
Decom13		√		√	"it is difficult at times to align my speciality within the overall decommissioning regulations"	* No specific issues raised
Decom14		√	√		"the BEIS guidance is not particularly helpful in aligning real solutions with regulatory expectations"	"everything needs an individual environmental impact assessment even if one already exists for the platform next door" "you end up with consultants churning out very similar reports which adds cost for no added value"
Decom15		√	√		"the regulations don't help, I prefer to follow guidance but even that is too overarching"	"finding an acceptable solution for pipelines has been difficult" "how clean does a pipeline need to be before you can satisfy the regulator…."it is the law of diminishing returns, you can repeat pigging and flushing activities without improving the end result which just adds additional cost to the process

The table above reveals that there is a general view amongst the participants (* except for the well services participants) that the current regulatory framework is not easy to interpret and work with and it is common to experience difficulties in implementing the current regulations when taking forward projects? There appears to a common thread of linking the regulations themselves with the underpinning guidance provided by the regulator as a kind of hand in hand package which according to many of the participants is not currently working in

terms of providing sufficient information in a format that would help the participants and others more widely. A number of particular elements of the decommissioning process were identified as causing participants particular difficulties in regulatory compliance such as pipelines and other subsea items. Additionally, the supporting comments point to a lack of choice and flexibility. There are a couple of perspectives that can be drawn from these results with both focussed on the lack of practicality of the regulations and of the supporting guidance.

Regulations need to reflect the reality of practical decommissioning:

Participants clearly view the current regulations as unsatisfactory from the perspective that they do not take into account the practical difficulties faced in delivering a decommissioning project, particularly in terms of what is actually achievable in terms of regulatory compliance**.**

Guidance documents need to reflect a practical approach: Guidance should be focussed at a practical level rather than an overarching position or simply outlining content requirements. A practical set of regulatory guidance notes explaining in more detail possibly by example of what is acceptable and what is not would be valued by industry.

6.4 Theme 3: Minimising the impact of decommissioning on the environment and the role of OPRED in monitoring regulatory compliance

In this section of the questionnaire the focus was on gathering data in response to theme 3 emerging from the literature review and the associated research questions: is the impact on the environmental minimised under the current regulations? and what methodology should BEIS deploy to ensure regulatory compliance during decommissioning process? The questions are in response to the literature review where emerging findings cast doubt on the value of the current regulations in terms of protecting the marine environment, and on the lack of ongoing audit trail of decommissioning activities considering the significant amounts of public money that is involved through the provision of tax relief on decommissioning costs which by default amounts to a significant opportunity cost lost to the exchequer. The questions that were put to the participants were; are you aware of the reporting requirements that provide an audit trail for OPRED?; do you think that the current regulatory requirement to

provide a short close out report at the completion of a decommissioning project provides a satisfactory audit trail of the offshore decommissioning activities?; do you believe that protection of the marine environment during offshore decommissioning activities is a concern for all stakeholders?; and do the decommissioning regulations in the North Sea minimise the impact of decommissioning on the environment?

Table 6-4 summarises the pertinent responses to the question posed on the current regulatory audit trail.

Table 6-4: Participants views on the role of OPRED in monitoring regulatory compliance

		Participants views on the role of OPRED in monitoring regulatory compliance				
Participant		Question 16		Question 17		Participants quoted responses
		Yes	No	Yes	No	
Decom01		√		√		"there has to be a degree of trust between the Government and industry that we will do what we say would do in the approved programme"
Decom02		√			√	"if I was an external stakeholder I think I would be looking for more of a regular reporting regime to provide stakeholder confidence that the project is being delivered as agreed"
Decom03		√			√	"one report over the lifetime of a project which might take 5 years is probably pushing the boundaries of acceptability" "we should be more transparent to stakeholders"
Decom04			√		√	"a lot can change during the period of a decommissioning campaign and it would be better to capture what has been done more frequently
Decom05			√	√		"we do report back periodically to BEIS on how the project has been progressing" "it might not be a formalised process, but it does happen"
Decom06		√			√	"it is still early days for decommissioning, but as more and more programmes come on stream there probably should be a stronger audit of the activity trail"
Decom07		√			√	"if we are carrying out our roles effectively we should welcome a stronger audit trail which can only enhance our reputation"
Decom08		√			√	"it would be in our own interests as the operator responsible for the asset to be able to

					demonstrate that we are doing it right"
Decom09		√		√	"more frequent audits might identify opportunities for improvement which would be a positive result"
Decom10	√		√		"the current system demonstrates the positive working relationship the industry has with BEIS"
Decom11	√			√	"as an operator we are committed to decommission correctly, to meet our regulatory requirements and I would welcome further scrutiny during the project" "through the audit process we can demonstrate this"
Decom12	√		√		"the current audit trail might be acceptable for the moment but as the awareness of the scale of decommissioning grows stakeholders will want greater certainty of our activities". "potentially the general public might become interested as well"
Decom13	√			√	"the regulator has always paid close attention to drilling operations both prior to and during operations". "having an external review of what we are planning to do and doing prevents us from becoming complacent and adds value to our operations" "no good reason why we should not extend this approach onto decommissioning"
Decom14	√			√	"from a reputational perspective a regular, transparent audit trail would be a positive step forward" "I don't think that it need to be continuous, it could be yearly or at the end or beginning of different work scopes"
Decom15	√			√	"decommissioning should be seen as a partnership between the operator and the regulator and therefore a more visible audit trail would support the partnership approach and maintain our respective reputations." "We do not have anything to hide, in fact it's an opportunity to show what we can do".

Whilst it was clear that the participants were aware that OPRED had a role in monitoring regulatory compliance with twelve out of fifteen (80%) participants stating this, their additional comments indicated this was primarily related to their experience of permit applications and reporting non-compliances rather than day to day operational aspects of delivering a decommissioning programme. The majority of the participants were not content with the current audit trail indicating that it could be strengthened whilst four of the fifteen recipients thought that the current approach was acceptable. Interestingly there was

reference to the audit demonstrating trust and partnership between the operator and the regulator a view that is occurring across a number of the themes in this study. Other terms emerging from the participants responses were once again reputation and transparency. In terms of perspectives arising from this line of questions the following can be drawn:

Recognition that general awareness of decommissioning is increasing, and demonstration of compliance is becoming more important.

The participants generally recognise that the awareness of decommissioning is on the increase due to the increasing numbers of programmes coming through and the requirement to demonstrate compliance is increasing in importance.

A strengthened audit process will increase confidence of stakeholders that regulatory compliance is a corporate objective.

There is a common thread running through some of the participants, particularly those representing operators that the audit trail is not a threat but presents an opportunity to demonstrate to stakeholders that regulatory compliance is being taken seriously as a corporate objective within the companies.

A stronger audit trail protects the reputation of both Government and industry.

Reputation appears frequently in the participants views and supports the view that the current audit trail is weak from a reputational perspective and that more regular audits would provide a stronger foundation on which to defend reputations if that requirement was ever needed to be called upon. Table 6-5 summarises the pertinent responses regarding the environmental aspects of decommissioning:

Table 6-5: Participants views on minimising the impact of decommissioning on the environment

Participants views on minimising the impact of decommissioning on the environment						
Participant	Question 18		Question 19		Participants quoted responses	
	Yes	No	Yes	No	Question 18	Question 19
Decom01	√			√	"yes absolutely, protection of the environment is a core objective for our organisation"	"I doubt that it does as we have to undertake significant disturbances of the seabed for some activities to comply with the regulations
Decom02	√			√	"minimising the impact of decommissioning on the environment reflects on the industry as a whole"	"ROV footage has demonstrated that the areas around platforms are heavily populated with marine life and I don't understand the need to remove all of these structures"
Decom03	√			√	" the marine environment is fundamentally important, it is a given not an option"	"My personal opinion is that it is worthwhile investing a little more now to benefit future generations". "It would be fantastic if we really could return the seabed to its original condition"
Decom04	√			√	"protection of the environment has been hammered home to us in the drilling world which I agree with"	"the regulations have a strong emphasis on the environment and I agree with that approach"
Decom05	√			√	"it can't only be about the environment. I think there has to be a balance between often competing priorities…. business need, corporate objective, deliverability and the environment"	Looking at the regulations they don't offer much flexibility and that can't deliver the optimum environmental results for every project"

Decom06	√			√	"it is important that the whole supply chain is bought into the concept of minimising the impact on the environment".	"when you consider the amount of marine growth that has to be removed from platform foundations to aid removal you do wonder if removal is the right approach"
Decom07	√			√	"it's all about a common-sense approach, you can't have it all so our focus is on providing a balanced approach to decommissioning"	"it would help more if we could reduce the amount of energy and associated emissions that occur as a result of complying with the regulations"
Decom08	√			√	"the potential reputational damage of losing our focus on the environment would be significantly damaging"	"we strive to get this right, but the regulations always drive us in one direction and they need to give us more flexibility, so we can get it right"
Decom09	√			√	"yes, it would be difficult to argue against that statement"	"there's not a great deal of difference between shipwrecks and redundant installations and they are probably best left where they are." "it seems an enormous effort and cost to bring them onshore"
Decom10	√			√	"the environment is an important pillar underpinning our business reputation and needs to be given due diligence when planning our decom activities"	"removing all installations as a default option appears to be rather self-defeating if we want to minimise the impact on the environment". "the marine environment has adapted to the intrusion of our industry"
Decom11	√			√	"it only takes one mistake to cause an environmental incident which would have a negative impact on our company"	"if we could streamline the decom requirements and minimise what has to be removed then our energy use would be reduced, and onshore recycling would be

						minimised”
Decom12	√			√	“as an environmental scientist it is difficult to comprehend why anyone would think otherwise”	“the common approach applied to all projects does not maximise protection of the environment, there needs to be more flexibility applied to gain the most benefit”
Decom13	√			√	“paying particular attention to the environment during decommissioning programmes protects our reputation…. the same could be said for the Government’s reputation”	“my knowledge is fairly limited on the environmental aspects but the emphasis on the environment suggests that the regulations are probably minimising the impact”
Decom14	√			√	“of course, any other approach would be indefensible”. “if we get it wrong it will reflect very negatively on the industry”	“the marine environment has adapted to the installations in terms of the development of mini ecosystems” “in some cases I would prefer for the structures to remain undisturbed”
Decom15	√			√	“the environment is important but not at any price, a balanced approach is more likely to match the demands of all stakeholder groups”	“one fisherman’s organisation preference for the Murchison jacket was that it should be left in place above the sea surface as it would be easier to avoid rather than cut to the level of its footings”

In terms of the responses to the first question of whether the participants believe that protection of the marine environment during offshore decommissioning activities should be a concern for all stakeholders? The responses were fairly unanimous and in hindsight this should have been anticipated and possibly the question should potentially have been around, how they would rank the importance of the environment compared with other decision determinants such as economics, business need and technical difficulty? That reflection aside, the responses did reveal a number of perspectives which characterised their views.

These perspectives are that reputation is critical to both Government and industry; and that the environment should not be considered in isolation.

Reputation is critical to both Government and industry:

Another perspective winding its way through the responses is the concern over the risk to corporate reputation which is a legitimate risk if previous history is a potential baseline on which to gauge public reaction. The events surrounding the Brent Spar incident generated a significantly negative image for the oil and gas industry. Equally as noted by some participants, the Government reputation is at stake here principally from the Government role as a guardian of the marine environment in terms of its stewardship of activities in the North Sea as it approves each decommissioning programme and the details of the execution plan within, and this perspective is further captured from the next set of questions within this theme.

The environment should not be considered in isolation:

Whilst there was a common agreement amongst the participants on the importance of environment and a clear in some cases corporate objective of minimising the impact of decommissioning activities on the marine environment, it was important to note that approximately one third of the participants thought that there are other factors that need to be considered in parallel with environment and there was a common use of the word "balance" between what might be considered as competing agendas such as business need, cost and deliverability.

6.5 Theme 4: Derogations as a foundation for increasing flexibility of the regulatory framework

In this section of the questionnaire the focus was on gathering data in response to research question 7 which is; are there alternative decommissioning approaches and regulatory practices that have the potential to add flexibility to the current UK regulatory regime? The questions focus on capturing participants views on the current regulations regarding derogations for some of the redundant infrastructure in the North Sea and their views on whether the regulatory frameworks in other basins around the world offer more flexibility in

available decommissioning options than in the North Sea. Table 6-6 captures numerically the response of the participants and table 6-7 captures comments from the participants covering questions 25 to 28. A supplementary but important question 29 was asked of the participants regarding who should responsible for any liabilities stemming from any infrastructure left behind post decommissioning.

Table 6-6: Questionnaire section 5(i) Derogations as a foundation for increasing flexibility of the regulatory framework

Questionnaire section 5(i) Derogations as a foundation for increasing flexibility of the regulatory framework			
Questions presented	Responses received		
	Yes	No	
Q25. Do you consider the current decommissioning regulatory framework to be sufficiently flexible to encourage innovation?	5	10	
Q26. Are you aware of the current system that allows derogation applications for jackets greater than 10,000 tonnes	13	2	
Q27. Do you believe that system that allows derogation applications for jackets greater than 10,000 tonnes is appropriate	2	11	
Q28. Are you familiar with the Rigs to Reef programmes utilised in the Gulf of Mexico and other basins around the world	13	2	
	Responses received		
	Operator	Government	Shared
Q29. Who should be responsible for the ongoing liability for plug and abandoned wells and any infrastructure that is not removed following a decommissioning programme?	3	2	10

Five out of fifteen (33%) agreed that the current regulations were flexible enough to encourage innovation and the supporting comments for these individuals will be considered in the qualitative chapter. On reviewing the data regarding awareness of the derogation system it was initially surprising that 2 of

the participants (13%) with established experience of decommissioning were not aware of the derogation system or the rigs to reefs programmes utilised around the world. On further reflection the participants (D09 and D13) were both well services specialists and therefore it partly explains why they may not have been particularly aware of these topics. Their supporting comments also indicated that their involvement is very much undertaken in the early phases of a decommissioning programme and their involvement is thus limited in duration. The majority of the participants (73%) disagreed that the current derogation system was appropriate with a number of the participants supporting comments citing the arbitrary nature of the 10,000-tonne limit which is in line with the literature review where no evidence can be found to argue that this limit is evidenced based. Other than the two well services participants, all others indicated that they were aware of Rigs to Reefs programmes.

The final question raised in this section of the questionnaire whilst not directly focused on increasing the flexibility of the regulatory framework, it is linked in that ongoing liability is an issue for all stakeholders and for example in the Gulf of Mexico, donating an item of redundant infrastructure into a rigs to reefs programme also includes transferring the liability from the operator to the relevant state authorities in return for a parallel donation from the operator to the state rigs to reefs programme. The commercially driven response that I was expecting from those representing operators would have been for Government to take the long term ongoing liability but it was interesting that the results favoured a shared interest in liability between Government and industry with ten (67%) of the fifteen participants selecting this option and only two (13%) of the participants suggesting that Government should take on the liability and three (20%) of participants selecting the status quo with the operator maintaining liability.

Table 6-7: Participants views on derogations as a foundation for increasing flexibility of the regulatory framework

Participants views on derogations as a foundation for increasing flexibility of the regulatory framework		
Participant		
Decom01	"why is it the limit set at 10,000 tonnes? there is no discernible difference between a jacket weighing 10000 tonnes and one weighing 9,000 tonnes for example"	"Yes, this should be an additional option that should be available in the North Sea"
Decom02	"it is a completely arbitrary figure and takes no account of individual constraints"	"there is no reason why some form of rigs to reefs could not be introduced here"
Decom03	"I would support a case by case basis as no two platforms are identical"	"absolutely but this is not appropriate for all installations and all locations". "as I said before it should be on a case by case basis
Decom04	"a 10,000-tonne foundation is a substantial structure and I can see the logic that it is too difficult to remove"	"this might not be a step forward from an environmental perspective and I would need to see the evidence before signing up to this additional approach"
Decom05	"every jacket or gravity-based structure should be assessed on merit, on a case by case basis"	"why not, it is a common approach elsewhere but needs to be on a case by case approach". "maybe more localised research needs to be undertaken"
Decom06	"it is not appropriate, it is too high"	"decommissioning is complex and the more flexibility there is will ultimately lead to the best solutions for individual programmes"
Decom07	"we need to set the limit at some level and certainly structures beyond this limit are difficult to remove" "for environmental reasons I also believe that some structures less than this limit should have the option to be left in situ"	"the removal of installations particularly jackets takes a significant amount of detailed engineering, risk assessment, it takes a large work scope to remove jackets and involves significant amounts of energy and generates significant amounts of associated emissions"
Decom08	"I don't understand why we should be so focussed on removal and the associated destruction of the marine	"rigs to reefs is a fairly common decommissioning approach now which has the scientific evidence to back it up". "the evidence is

	habitat that has developed on installations”	accepted elsewhere but ignored in the UK”
Decom09	“there are a lot more considerations on removing infrastructure that go beyond its weight”	“as I discussed in an earlier question I do not see much difference between a shipwreck and any redundant infrastructure left on the seabed”. “rigs to reefs would be a good solution”
Decom10	“every installation has its own challenges and should be considered on a case by case basis”. “you are not comparing like for like so some degree of a broader comparative assessment should be undertaken as part of the decision tree”	“a greater degree of flexibility would be desirable”
Decom11	“every removal is a difficult technical challenge but to say that one removal is more difficult than another based purely on weight is too simple an approach”	“this would be an appropriate scenario for more installations that the current regulations allow in terms of the application for derogations”
Decom12	“I believe that there is an equally strong case for basing the decision on whether to permit a derogation should be based on environmental impact of removal rather than size”	“this is a proven solution that has been demonstrated to work in other areas around the world and should be an option for the UK”
Decom13	“if you have to set a limit it should cover a sufficient range to capture the difficult to remove platforms”	“if you cut and lift a section of the foundation then it should continue its journey to shore for recycling”
Decom14	“there are only a few candidates that meet this limit which does not add up as there are many more platforms less than 10,000 tonnes that are equally challenging”	“if there are proven benefits to the environment from rigs to reefs then it should be used in the North Sea”.
Decom15	“the 10,000-tonne figure was set many many years ago and there has been a great deal of experience and knowledge gained since then which has not been taken into consideration”	“I think we might be one of the only basins where rigs to reefs is not an option and I don’t know why that is the case” “Government should look at the evidence on this”

From the analysis of the statements made by the participants and collated in the table 6-7 it emerges that there is strongly negative view of the current derogation regulations and in particular that the current limit of 10,000 tonnes is considered an arbitrary figure and as Decom01 additionally pondered "was 10,000 tonnes a nice round figure that someone just plucked out the air all those years ago". The literature on this particular point also points to a lack of an evidence-based judgement on where the limit should be set particularly as very little decommissioning had actually taken place thirty years ago when the decision was taken. Regarding the introduction of a rigs to reefs programme in the North Sea, contrastingly, the majority of the participants viewed this statement positively with a number noting that the North Sea was the exception rather than the rule when it came to supporting rigs to reefs as an additional option for decommissioning. To summarise the emerging perspectives from the participants related to theme 4 they can be identified as:

The 10,000-tonne limit is too blunt an instrument to be evidence based. There is a general consensus amongst the participants that the removal or derogation decision for a jacket or gravity-based structure should be considered on a case by case basis incorporating available evidence.

Environmental impact of removal should be part of the decision process. There are consistent references to the potential to negatively impact the environment when jackets have been removed and this was also highlighted from comments supporting the quantitative analysis in the preceding chapter.

On rigs to reefs the current North Sea decommissioning strategy does not reflect the approach taken in other basins around the world. None of the participants could identify why this was the case with some suggesting our regulations were simply outdated and had not kept up with the evidence provided by developments in regulation and scientific based evidence globally.

A rigs to reefs programme would increase the flexibility of the current decommissioning options. Many of the participants thought that rigs to reefs option would increase the flexibility for decommissioning solutions. But this was caveated by a number of participants who suggested that rigs to reefs would not be the solution for every installation or geographic location.

6.6 Summary of chapter

Whereas chapter 5 analysed the participant's responses to the questions under the 4 themes emerging from the literature review from a quantitative perspective, chapter 6 highlighted the outcomes of the qualitative responses from the participants and the subsequent analysis and interpretation. Following a parallel approach to that for the quantitative analysis of the questions and statements put to the participants that reflected the themes and associated research questions arising from the literature. In conclusion and similarly to the outcome of the quantitative analysis the responses provide additional evidence to respond to the research questions and the themes emerging from the literature. As would be expected the comments recorded during the interviews support the quantitative analysis but importantly they provide additional depth and substance to the responses and by interpretation enable the generation of a number of descriptive perspectives that can be used to illustrate the four emerging themes from the literature. Table 6-8 overleaf summarises the perspectives drawn from the qualitative analysis. The following chapter 7 investigates through a case study approach as outlined in the research methodology in chapter 4, the development of a practical audit inspection process for ensuring that from an environmental perspective that decommissioning programmes are being executed in compliance with the approved decommissioning programme.

Table 6-8: Perspectives drawn from the qualitative analysis

Perspectives drawn from the qualitative analysis		
Theme	**Perspective**	**Description**
1	1	Current regulations are politically driven
	2	Changes to regulations needs to be driven by the regulator
	3	Regulations do not reflect decommissioning challenges
	4	Compliance with current regulations is difficult to achieve
	5	Current regulations influenced by historical incidents
2	6	Industry and Government have a shared agenda
	7	Regulations should reflect decommissioning reality
	8	Guidance documents should reflect practical approach
	9	Increased regulatory flexibility required
	10	The environment should not be considered in isolation
3	11	Reputation is critical to both Government and industry
	12	Public awareness is rising, and demonstration of compliance is important
	13	Strengthened audit process will increase stakeholder confidence
4	14	Rigs to reefs is an accepted practice around the world
	15	Environmental impact of removal should be considered
	16	10,000 tonne limit is not evidence based
	17	Rigs to reefs programme would increase option flexibility

CHAPTER 7: CASE STUDY APPROACH TO STANDARDISE DECOMMISSIONING PLATFORM AUDIT.

7.1 Introduction

Chapter 7 as described in the research methodology in chapter 4 builds on the adapted mixed methods approach taken and the quantitative and qualitative analysis undertaken in chapters 5 and 6 by adding an additional set of insights into the analysis envelope with a particular focus on research question 7.

The focus of Chapter 7 is on setting the background and context for the requirement for OPRED to significantly strengthen their audit process for ensuring that decommissioning programmes are executed as per the agreed programme and that they are compliant with the regulatory framework and conditions attached to the approved operating permits issued by OPRED. The chapter considers the changing levels of risk to the environment when moving from the production phase to the decommissioning phase and identifies which elements of the regulatory framework are appropriate for auditing through physical offshore audit by OPRED. The chapter then moves on to describe two illustrative case studies that are used to develop, trial and finalise the OPRED offshore inspection regime that OPRED will adopt for all future decommissioning programmes.

7.1.1 Transition from production phase to decommissioning phase

Decommissioning is the final element of the lifecycle of an oil and gas platform and by its very nature is completely different situation from the previous production phase. In the UKCS the production phase could in many platforms have lasted for 30 or 40 years and in some cases 50 years of steady but declining production until reaching a production level which is no longer economically sustainable. During this production period, the emphasis is very much focussed on managing and maintaining the various elements of the platform production process to maximise production and maintain regulatory compliance. It is common that staff turnover is low and indeed some staff will have spent most of their working lives on the one platform. The staff understand the platform very well, understand how to manage the production variables that can be very particular to each individual platform in order to maintain efficient

production, maximise uptime and minimise downtime. They will have experience of when process elements have gone wrong, when regulatory breaches have occurred, and the steps taken to prevent reoccurrence. The staff know which elements of their process are likely to have performance issues, for example due to age of equipment, wear and tear, weather conditions, complex fluids, weeps and seeps, etc. and where they need to focus their maintenance and monitoring resources whilst maintaining a primary focus of safety.

Whereas the production phase is all about process engineering and maintaining a steady state, the decommissioning phase is not. Decommissioning is all about the safe, secure and best-value execution of decommissioning programmes, the decontamination, dismantling, demolition and removal of platforms. Decommissioning experience in the UKCS remains relatively low and for most operators and staff this may well be their first decommissioning project. Many of the staff who would have been involved through the production phase of the platform life cycle will have moved onto other projects and unfortunately taken their intricate knowledge and experience of the platform with them. Decommissioning will involve the use of multiple contractors who have no previous knowledge of the platform and who may not be aware of any weak areas of the platform that have previously led to regulatory breaches. The contractors will employ large inventories of temporary equipment, for example diesel generators, pumps, flexible hoses, compressors, and hot work equipment which will not be under the real time control of the platform operator but importantly, it remains the platform operator who is responsible for maintaining regulatory compliance and minimising the risk of release of hydrocarbons and chemicals to sea.

7.1.2 Sources of environmental impact

As described in detail in chapter 3, the main sources of environmental concerns arising from oil and gas operations may include permitted and non-permitted discharges, atmospheric emissions and the degradation of drill cuttings piles for example. The onset of the decommissioning phase of the life cycle will change the dynamics of the environmental risks. Once Cessation of Production (COP) is achieved, reservoir fluids will no longer be arriving in significant volumes on the platform but during plugging and abandonment of the production and injection

wells, residual reservoir fluids will require appropriate treatment on the platform which is likely to mean that the process separation technology on the platform will require to be maintained for a period during decommissioning to deal with both plug and abandonment activities and also in most cases to deal with pipeline pigging, cleaning and flushing activities. The use and inventory of chemicals on the platform will change as production chemicals are no longer required but additional chemicals for decommissioning activities will be brought on board. Atmospheric emissions will increase as in addition to maintaining power for normal activities, there will be an increase in temporary combustion equipment, increased shipping movements and the involvement of lifting equipment and demolition machinery. The risk of accidental spills and releases to sea will remain and the risk is likely to increase due to the non-standard operations taking place, and the turnover of staff due to short term contracting of specific tasks and activities. The release of diesel to sea is a common problem offshore and there will be increased bunkering of diesel from supply boats to the platform taking place due to the increased requirement for diesel and the increase in temporary diesel day tanks feeding fuel to the increasing inventory of temporary equipment. There is likely to be disturbance of the sea bed as permits are issued to allow the temporary placement of equipment and decommissioned items prior to final removal and the use of excavators to remove seabed material to allow access for cutting technology as well as the removal of mattresses and grout bags for example in line with the current OSPAR baselines of total removal and clear seabed.

OPRED works in partnership with the Health and Safety Executive (HSE) acting together as the Competent Authority and together with the Maritime and Coastguard Agency (MCA) to ensure regulatory compliance in the industry's activities on the UKCS. All of the above environmental concerns are regulated through a broad range of statutory regulations by OPRED.

7.1.3 Current decommissioning audit trail

The current audit trail for a decommissioning project is extremely simple. OPRED approves the final decommissioning project and a few years later the operator provides OPRED with a short close out report which effectively says that they carried out the decommissioning project as agreed in the approved

decommissioning programme. Whilst the close out report maybe drafted by a third party who are independent of the operator, it is possible to argue that the third party is not truly independent as they are paid by the operator and the report is based on information provided to the third party by the operator. There is generally a period of 2 and 5 years between OPRED approving the decommissioning programme and the operator completing the execution of the agreed programme. In terms of a regular audit of the decommissioning activities that are being carried out in line with the approved programme and compliance with environmental permit conditions and prevention of releases this has not been done to date by OPRED. During semi-structured interviews with OPRED staff in the Offshore Decommissioning Unit, individuals indicated that they did not believe that this was a sustainable position particularly as levels of media interest in decommissioning continue to grow and as the general public become more aware of the opportunity cost lost to the Government and by default to the general population due to the significant levels of tax relief that is available to the operators to offset the cost of delivering decommissioning projects under the current regulatory requirements. To protect the reputation of both Government and operators a more regular invasive audit process by the regulator would provide the tax payer and other interested stakeholders with greater confidence that the decommissioning of the platform has been executed as agreed in the approved decommissioning programme and that sufficient attention has been paid to minimising the impact of decommissioning activities on the environment.

7.2 Case study participant selection and approach

7.2.1 Case Study Participant Selection

The selection of the subjects for the case studies was constrained by the timing of the research and the available decommissioning programmes that had been approved, would be executed during the research period and whose operators were willing to participate. The selection was further constrained by the researchers ambition to develop a decommissioning inspection regime that was suitable for all of the UKCS which necessitated that each of the case studies should be different in terms of scale and location. Permission was gained from the two operators on the condition that their companies and the particular

installations would remain anonymous in any published written documents and not recognisable from any images or descriptions published in the research.

7.2.2 Case study approach

The case study has been developed as a two phase approach.The initial phase wa desk based research to firstly identify the environmental regulations that applied to offshore oil and gas operations and to match them to the operations ongoing during the execution of a decommissioning programme. Further analysis of the perceived scale of environmental impacts involved under each regulation was undertaken together with an analysis of the feasibility of inspecting against each regulation offshore in order to generate the initial boundaries of the inspection process for the second phase of the research. From this initial work a version one, initial model framework for the offshore inspection phase was developed.

The second phase of the research was offshore based practical development of the inspection model based on the outcomes of the phase 1 research. Phase 2 involved two consecutive inspections of each of the nominated platforms undertaking decommissioning activities. The first of the inspection visits was to trial the initial inspection model and identify what worked well and what elements of the model required improvement. On completion of the first set of trials and following a further period of reflection and re-design a second set of trials of the final version of the inspection model were undertaken. The second inspections of the platforms also enabled a revisit of the inspection findings from the first visit to identify what remedial actions and improvements had been put in place to validate the usefulness of the model as an audit tool.

7.2.3 Proposed audit model

The proposed audit approach would involve a degree of onshore pre audit work looking at available data previously submitted by the operator to OPRED such as annual chemical use and discharges, reportable incidents, permitted discharges followed by a two day offshore audit which would reflect the bulk of the data gathering, looking at compliance with various permits and visual inspection. Finally the data and other information gathered would be reviewed onshore and any clarifications sought prior to a report being issued. Figure 7-1 illustrates the conceptualised approach to the audit.

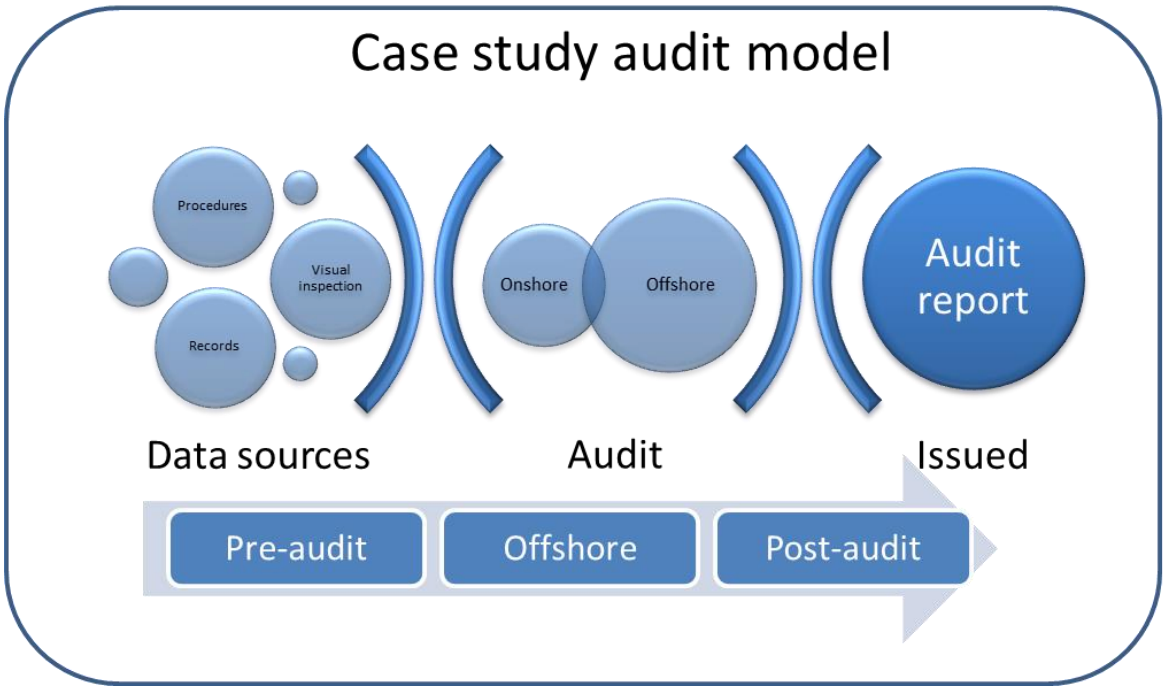

Figure 7-1: Proposed audit model. Source: Author

7.3 Identification of the regulatory envelope for Decommissioning audit process

The broad nature of OPRED's environmental regulatory framework is necessary to cover the complete lifecycle of oil and gas operations and as such not all of the framework is relevant to the decommissioning phase and therefore an analysis of the regulatory framework is necessary to identify which regulations are relevant to the decommissioning phase. Figure 7-2 below identifies the individual regulations that together combine to encapsulate the entirety of the regulatory framework throughout the lifecycle of the field. The lifecycle includes the initial period of exploration, and the development of the field. Through the production phase, and then the eventual decommissioning.

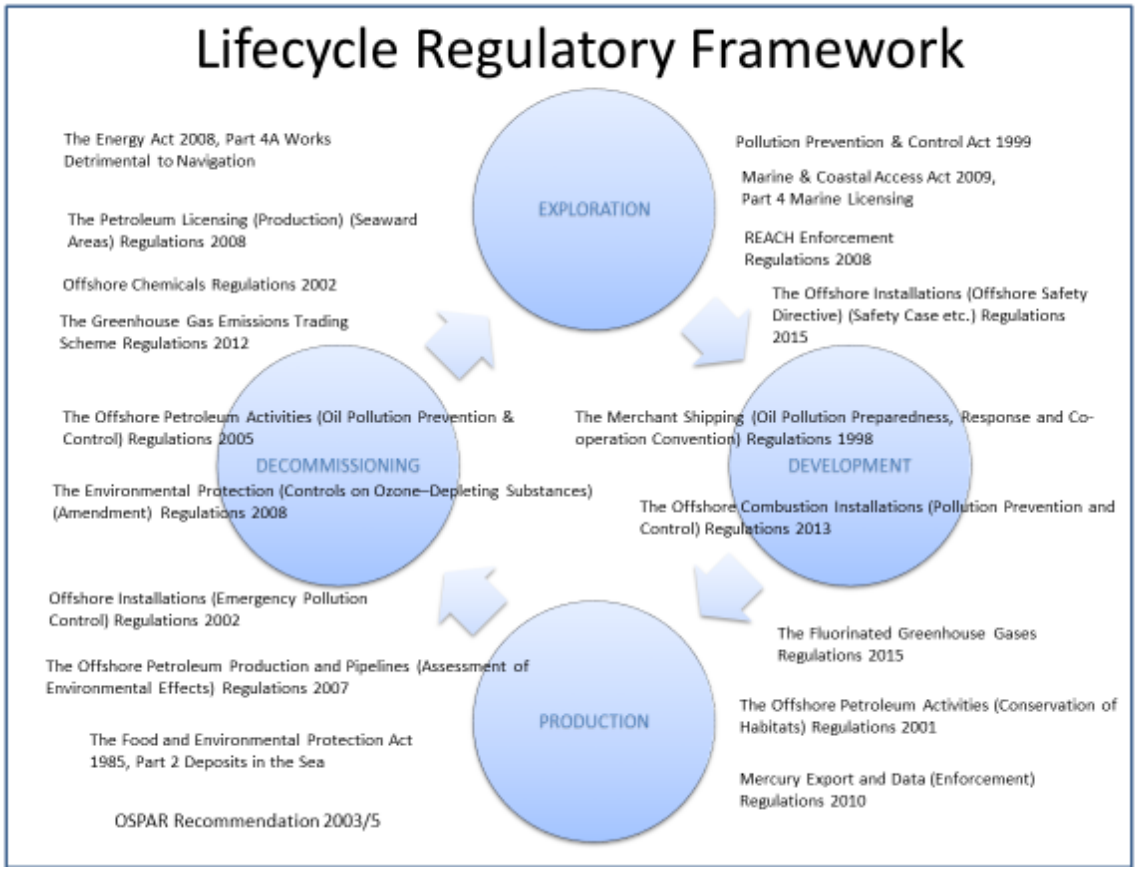

Figure 7-2: Offshore installation lifecycle regulatory framework. Source: Author

Figure 7-2 indicates that the regulatory framework consists of one primary piece of legislation, 18 individual regulations and a commitment to one OSPAR Recommendation that encompass the complete lifecycle of a field. A number of the regulations are no longer relevant once cessation of production has taken place such as the The Petroleum Licensing (Production) (Seaward Areas) Regulations 2008 which is directly related to production licences. Similarly the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) (Amendment) Regulations 2007 are no longer relevant as they are more to do with the development phase of the lifecycle when operators are seeking production consents for field developments, the drilling of wells, and the construction and installation of production facilities and pipelines. Bearing this in mind, Table 7-1 summarises the environmental regulatory regulations appropriate to oil and gas operations and their applicability to the

decommissioning phase of the lifecycle and whether or not the regulation can be inspected offshore.

Table 7-1: Oil and gas environmental regulations

Regulation	Description	Applicability to Decom phase of lifecycle	Could this legislation be inspected offshore
Pollution Prevention & Control Act 1999	Sections 1 and 2 of the Act confer on the Secretary of State power to make regulations providing for a new pollution control system to meet the requirements of European Council Directive 96/61/EC on Integrated Pollution Prevention and Control (the "IPPC Directive") and for other measures to prevent and control pollution.	Yes	No
The Petroleum Licensing (Production) (Seaward Areas) Regulations 2008	These Regulations prescribe the model clauses which, unless the Secretary of State thinks fit to modify or exclude them in any case, will be incorporated in petroleum production licenses for seaward areas.	No	No
The Energy Act 2008, Part 4A Works Detrimental to Navigation	The issue of a CtL to an individual or organisation by the Secretary of State under Part 4A of the EA allows installation of the proposed offshore structure or operations providing they are undertaken in accordance with the consent conditions. It allows OPRED to insist upon the provision of navigational markings that are considered appropriate for the proposed offshore structure or operations	Yes	Yes
Marine & Coastal Access Act 2009, Part 4 Marine Licensing	The MCAA licensing regime applies to several offshore oil and gas operations, including the disturbance of the seabed and the deposit and removal of substances or articles during decommissioning operations.	Yes	No
REACH Enforcement Regulations 2008	The EU REACH Regulation requires the registration of chemical substances by specified deadlines (in 2010, 2013 and 2018) based on tonnage levels and the properties/toxicity of certain substances (ie PBTs, vPvBs and CMRs). Accordingly, the UK REACH Enforcement Regulations contain certain provisions from the Offshore Chemicals Regulations (OCR), so effectively the OCR is the mechanism for supporting the application of environmental protection elements of REACH to offshore installations.	Yes	No
Offshore Chemicals Regulations 2002 (as amended)	Implement a harmonised mandatory control system for the use and discharge of chemicals by the offshore oil and gas industry. Under the regulations offshore operators must apply for permits for the use and/or discharge of chemicals in the course of all offshore oil and gas activities, including oil and gas production operations, well drilling, discharges from pipelines, and discharges during decommissioning activities.	Yes	Yes
The Greenhouse Gas Emissions Trading Scheme Regulations 2012	Under the EU emissions trading scheme for greenhouse gases ("EU ETS") an overall cap is set for emissions of greenhouse gases from specified activities. Operators must monitor and report emissions, and surrender sufficient emissions trading allowances to cover their emissions for each year. A proportion of the total number of allowances is issued free of charge to operators, and the remainder is auctioned. Operators may also buy and sell allowances on the secondary	Yes	No

	market.		
The Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015	The primary aim of SCR 2015 is to reduce the risks from major accident hazards to the health and safety of the workforce employed on offshore installations or in connected activities. Furthermore, the Regulations also aim to increase the protection of the marine environment and coastal economies against pollution and ensure improved response mechanisms in the event of such an incident.	Yes	Yes
The Offshore Petroleum Activities (Oil Pollution Prevention & Control) Regulations 2005 (as amended)	These Regulations are made under sections 2 and 7(9) of the Pollution Prevention and Control Act 1999. They provide for the phasing out of the system of exemptions under the Prevention of Oil Pollution Act 1971 (permitting certain discharges of oil into the sea) and the replacement of that system by a permit system. Regulation 3 provides that, in order for operators of offshore installations to discharge oil into relevant waters, a permit must be granted to them.	Yes	Yes
The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998	Every offshore installation and oil-handling facility must have an approved oil pollution emergency plan (OPEP) setting out arrangements for responding to incidents that cause or may cause marine pollution by oil, with a view to preventing such pollution or reducing or minimising its effect. Personnel with responsibility for oil pollution incident response must be competent, both in oil pollution incident response and the use of their OPEP.	Yes	Yes
The Environmental Protection (Controls on Ozone–Depleting Substances) (Amendment) Regulations 2008	These Regulations implement Community legislation on controls on the production, placing on the market and use of, trade in, and emission of certain substances that deplete the ozone layer	Yes	No
The Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013	These Regulations establish the pollution control regime for the purpose of carrying into effect obligations of the Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions insofar as those obligations apply to offshore combustion installations. In particular, the Regulations deal with the need for a permit in order to operate an offshore combustion installation covered by the Regulations	Yes	Yes
Offshore Installations (Emergency Pollution Control) Regulations 2002	These Regulations give the government powers to intervene in the event of an incident or accident involving an offshore installation where: there is, or may be a risk of, significant pollution or an operator is failing or has failed to implement effective control and preventative operations. OPREDs role is to monitor, and if necessary intervene, to protect the environment in the event of a threatened or actual pollution incident in connection with an offshore installation.	Yes	No
The Fluorinated Greenhouse Gases Regulations 2015	This regulation aims to protect the environment by reducing emissions of F-Gases (i.e. hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6)) from refrigeration, air conditioning units, high voltage switchgear, heat pumps and fire-protection systems, through the establishment of rules on, amongst other things, the containment, use, recovery and destruction of F-Gases.	Yes	Yes
The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) (Amendment) Regulations 2007	For the purpose of the Regulations the relevant activities include (but not limiting to); the granting and renewal of production consents for field developments, the drilling of wells (deep boring) and the construction and installation of production facilities and pipelines	No	No
The Offshore Marine Conservation (Natural Habitats) Regulations 2007 (as amended)	The regulations apply in the “offshore area” beyond 12 nautical miles from the UK coast and protect marine species and wild birds by creating a number of offences that aim to prevent	Yes	No

	environmentally damaging activities. The regulations also enable the designation and protection of areas that host certain important habitats and species in the offshore marine area. Once designated these sites will be identified as Special Areas of Conservation (SACs) for the protection of certain habitats and species and Special Protection Areas (SPAs) for the protection of certain wild bird species.		
The Food and Environmental Protection Act 1985, Part 2 Deposits in the Sea	These regulations are used to cover the discharge or placement of substances or articles in the sea or on the seabed where the deposits could not be covered by other legislation.	Yes	Yes
The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended)	The 2001 regulations require consent for geological surveys related to oil and gas activities undertaken on the UKCS.	Yes	No
Mercury Export and Data (Enforcement) Regulations 2010	Commission Regulation (EC) No. 1102/2008 on the banning of exports of metallic mercury and certain mercury compounds / mixtures was trasposed into UK legislation. The UK Mercury Regulations apply (as appropriate) to all offshore installations that carry out activities such as oil and gas production,	Yes	No
OSPAR Recommendation 2003/5	The recommendation is to promote the use and implementation of environmental management systems by the offshore industry	Yes	Yes

Source: Author 2017

From an audit perspective there are a number of regulations where a paper trail will exist within OPRED through the permitting system for individual activities taking place during the decommissioning phase. For example the Marine & Coastal Access Act 2009, Part 4 Marine Licensing wil provide permits to allow temporary depositing of articles on the seabed. Similarily there are regulations where it is more appropriate to audit onshore rather than through an offshore physical audit. For example compliance with the REACH Enforcement Regulations 2008, the Greenhouse Gas Emissions Trading Scheme Regulations 2012, and the Environmental Protection (Controls on Ozone–Depleting Substances) (Amendment) Regulations 2008 would more easily be audited onshore as the permits, licences and the recording and reporting takes place onshore.

Further important aspects to consider when designing the remit for an offshore decommissioning audit process is the practical nature of the inspection which involves asking the question, can that particular area of regulatory compliance be physically inspected? and indeed for some areas of regulation, a physical inspection maybe the only suitable method for monitoring compliance. Also what is the scale of the environmental impact of not complying with a particular regulation during the decommissioning phase? Figure 7-3 illustrates the

relationships between the ease of offshore inspection of certain regulations against the potential environmental impact of a failure to comply with these regulations.

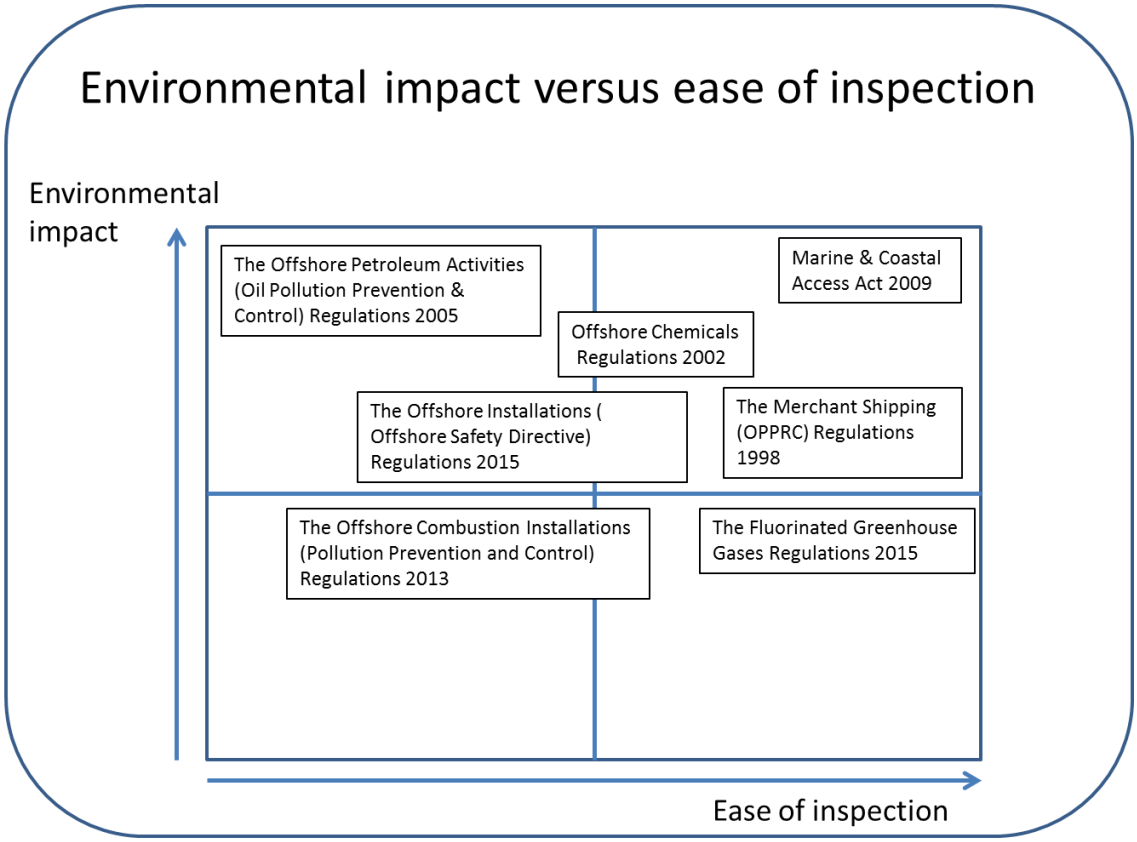

Figure 7-3: Environmental impact versus ease of inspection. Source: Author

As a case in point, the Marine & Coastal Access Act 2009, Part 4 Marine Licensing regulates the aids to navigation and permit conditions of the associated Consent to Locate permit specify the performance requirements of the navigational aids.The navigational aids are there to identify the platform but more importantly they are there to ensure that the platform is "visible" during hours of darkness and during periods of low visibility such as fog or inclement weather and to minimise the risk of collision from other users of the sea. A collision would be a very serious incident from both a safety perspective and a environmental perspective. From an inspection perspective it would be relatively straight forward to inspect whether the aids to navigation were correctly located, maintained and functioning as required by the permit conditions and for these reasons this regulation fits into the top right segment of the matrix.

The aim of the Fluorinated Greenhouse Gases Regulations 2015 is to target a reduction in the levels of emissions of F-Gases (i.e. hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6) from equipment containing these gases. From a regulatory inspection perspective, the equipment is relatively straight forward to locate and both maintenance and usage records are kept onboard the platform. The environmental impact of release of F-Gases from offshore equipment is generally low due to the relatively low volume inventories maintained offshore and hence this regulation fits into the bottom right segment of the matrix.

The Offshore Petroleum Activities (Oil Pollution Prevention & Control) Regulations 2005 (as amended) (OPPC) covers both permitted oil discharges but also prevention of releases and when inspected together is a complicated and far reaching inspection portfolio covering permit conditions compliance, discharge sampling, maintenance of Environmentally Critical Equipment, hose management, bunkering procedures, integrity management, diesel distribution systems, drainage management, work permits, procedures etc. The complexity of the inspection regime is further complicated by the additional temporary equipment that will be on the platform during the decommissioning phase. Failures in these areas will lead to pollution incidents due to the release of hydrocarbon to sea. Taken together the complexity of the inspection and the scale of potential risk to the environment ensure that this regulation fits into the top left segment of the matrix.

The Offshore Chemical Regulations 2002 (as amended) (OCR) covers the use and permitted discharge of offshore chemicals being used on the platform and also the prevention of releases of chemicals to sea. The inspection regime would be similar to that for the Offshore Petroleum Activities (Oil Pollution Prevention & Control) Regulations 2005 (as amended) but would be more confined to specific areas of the platform where chemicals are being used and stored. A release to sea of chemicals will have an environmental impact but the scale of the inventories held on the platform means that the environmental risk is less than the risk from an oil release and the inspection process is less complex than that for OPPC and therefore the OCR inspection regime would fit into the top right segment of the matrix.

For both the OPPC and OCR regulations there is a distinction between permitted discharges to sea and unpermitted releases to sea. Under these regulations, all oil and chemical releases to sea are prohibited under these regulations and are in fact criminal offences.

It is therefore vital that all operators have applied for and hold a valid OPPC and OCR permits which reflect the operations on the installation. The permits will stipulate the conditions whereby for example under OCR a particular named chemical and volume that can be discharged to sea. The OPPC permit for example will most likely cover permitted discharges form produced water and drainage systems. Similarly most companies will have followed a similar procedure to gain an OCR permit to cover chemical use and discharges. Chemicals are used for a variety of reasons such as helping with production, preventing fouling of processing equipment, protecting vital equipment from corrosion etc, and some of these chemicals will ultimately be discharged through the produced water system.

The Merchant Shipping Oil Pollution Preparedness, Response and Co-operation Convention Regulations (OPRC) 1998 from a OPRED perspective are a critical regulatory component for minmimising the potential environmental impact of oil and gas operations. During a decommissioning phase where there are large numbers of subcontractors and new people on the platform and less of the original core crew from the production phase, the importance of being able to respond appropriately to a pollution incident is important. There will be increased bunkering of diesel, breaking containment of vessels and pipelines, plugging and abandonement of wells and unrecorded historical modifications to platform which could all lead to pollution events. Every offshore installation will have an approved oil pollution emergency plan (OPEP) as a regulatory requirement. It details their preparedness for responding to incidents offshore that could significantly impact the marine environment. The primary risk being a release of oil to sea. It is inherent and a requirement that any personnel on the platform with a role to take in a response situation is competent in the use of the OPEP. From an inspection viewpoint, this is a relitively straightforward area to inspect. Inspectors would look for evidence that the staff are competent in the use of the OPEP, that they have exercised the OPEP and that any oil spill response equipment stated in the OPEP is available. Any delay or mistakes in responding

to a pollution event will significantly increase the environmental impact, scale and duration. The ease of inspection is fairly straight forward and for these reasons the regulations fit in the top right hand segment of the matrix.

The Offshore Combustion Installations Pollution Prevention and Control Regulations 2013 (PPC) relate to emissions from combustion equipment above a specific thermal capacity. It also means that OPRED puts in place specific permit conditions to protect the environment. The approach is based on BAT which sets a median line between costs and environmental benefit. Inspection would involve looking at the records and evidence of operating efficiency, maintenance, and exhaust sampling which all should be available on board the platform facilitating an efficient inspection. In terms of environmental impact, atmospheric polutants are not regarded as immeadiately harmful to the environment as an oil or chemical release but there is the longer term and cumulative environmental impact of atmospheric emissions to be considered and therefore the PPC regulations fit into the lower left segment of the matrix. Based on this analysis and revisiting the entirity of the OPRED regulatory framework for offshore oil and gas activities, results in figure 7-4 below which summarises the appropriate regulatory envelope for decommissioning audits which are highlighted in blue.

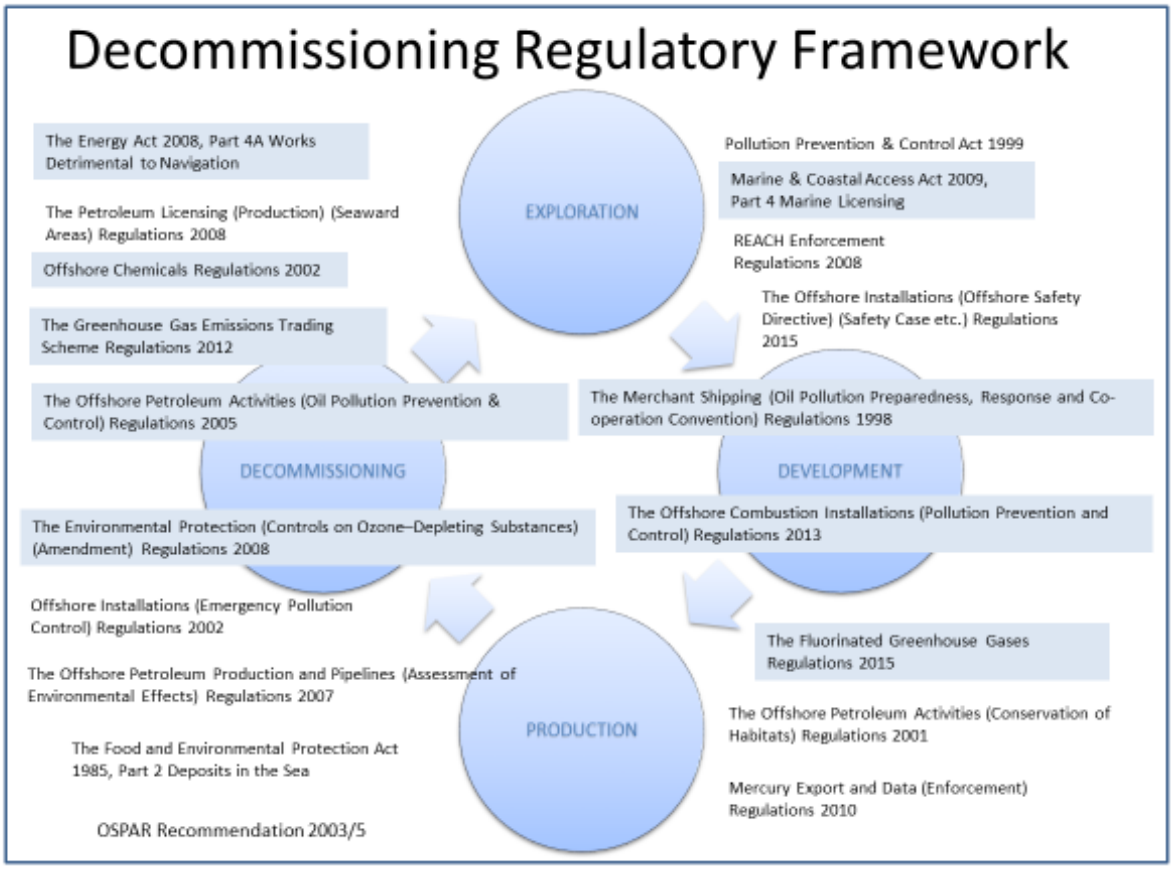

Figure 7-4: Offshore installations regulatory envelope for decommissioning inspections. Source: Author

7.4 The Audit framework

The initial concept of the Environmental Decommisssioning Inspection Audit Model was designed to capture the key compliances within the environmental regulatory envelope regulated by OPRED that would be required during the decommissioning phase of offshore oil and gas infrastructure. From considering the OPRED regulatory envelope the boundaries of the working concept are captured in the figure 7-5:

Figure 7-5: Decommissioning audit compliance expectations. Source: Author

From the desk-based research the following tables provide insight into the audit information required to assess the aspects of the regulatory framework that were most likely to be suitable for a physical inspection, The information in these tables will provide the basis for the first inspections of the two platforms undergoing decommissioning and participating in this research. There are five main categories of regulatory interest which have emerged and these categories breakdown further into specific subsets of interest. These main categories are overarching general concerns, potential loss of containment, atmospheric emissions, well operations and aids to navigation.

7.4.1 Overarching concerns

The inspection template will have to cover concerns and aspects of decommissioning such as whether there is any indication of an oil spill, other discharge or sheen? Does the platform induction include environmental requirements? A meeting should be held with platform staff to discuss incidents such as releases or non-compliances that have been previously reported. The meeting could be used to review them, actions taken and enable a close out of the incident to be concluded. This meeting could also be used to discuss any recent surveillance reports from aerial surveillance, satellite detection or 3rd Party reports. The topics for the information required under this heading are detailed in figure 7-6 below.

Figure 7-6: Decommissioning audit overarching concerns. Source: Author

7.4.2 Loss of containment

The next category of concern is the potential loss of containment which would lead to a release to sea of hydrocarbons or chemicals. Many of the most likely sources of releases to sea that would require auditing are linked with the OPPC permit such as oil discharge records, drains management, the treatment and removal of oil on sand, and the produced water system. A common area of concern in terms of loss of containment is the diesel system on an installation. Historically the failure of bunkering hoses and overfilling of day tanks has led to releases to sea and during the decommissioning phase it is often the case that the use of diesel increases significantly due to the increased inventory of diesel driven temporary equipment and the loss of fuel gas for power generation. With this context it would also be appropriate to audit the readiness of the installation to deal with a loss of containment through the application of their approved OPEP. The topics for auditing are captured in figure 7-7 below and the method of auditing would involve looking at records, procedures, discussions with relevant staff, and physical inspection of the platform.

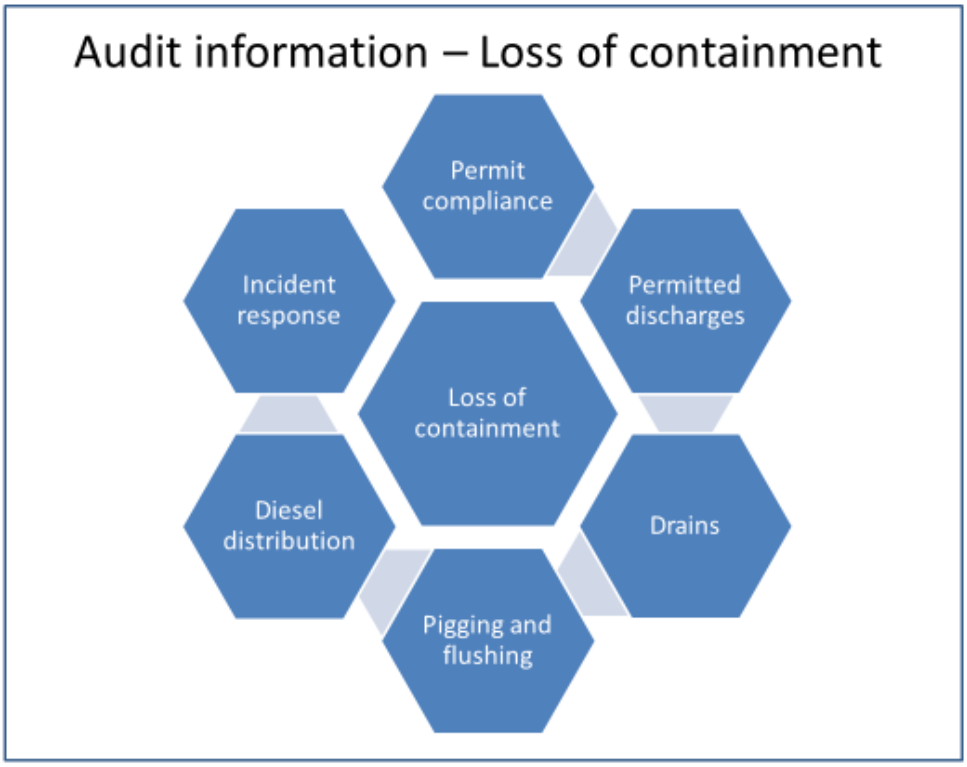

Figure 7-7: Decommissioning audit loss of containment. Source: Author

7.4.3 Atmospheric emissions

Atmospheric emissions will continue to be emitted during decommissioning and will continue to do so long after an installation is declared to be hydrocarbon free due to the requirement for power generation and refrigeration requirements. Therefore, the compliance with permit conditions is required to be maintained and audited. The topics requiring auditing under this heading are captured in figure 7-8 below.

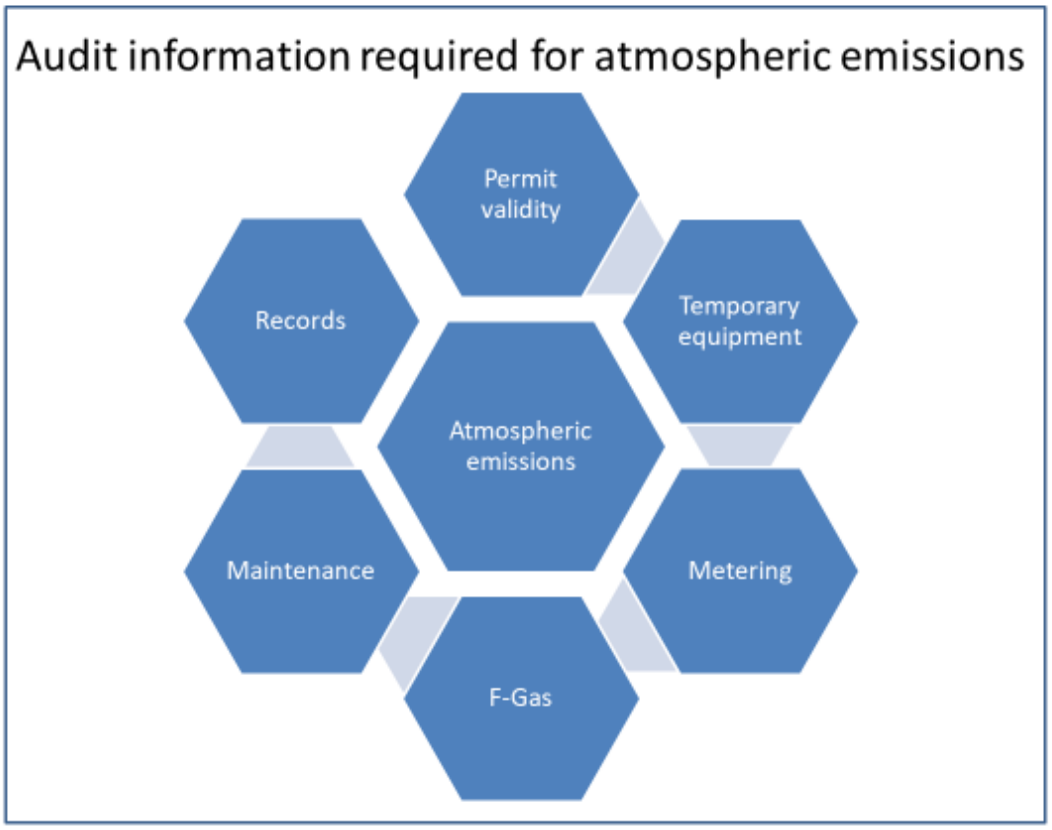

Figure 7-8: Decommissioning audit atmospheric emissions. Source: Author

7.4.4 Well operations

As discussed earlier the completion of plug and abandonment of the platform and subsea wells removes a major potential source of environmental impact from the installation. During the plug and abandonment campaign the risk of release of reservoir fluids and well operations chemicals to sea remains a potential risk to the environment. The risk is particularly relevant if the operator has to reactivate

a platform drilling package that has not been used for many years where poor integrity of storage vessels, mud pits and associated pipework which has resulted in numerous reported releases in recent years. The topics for auditing under well operations heading are captured in figure 7-9 below.

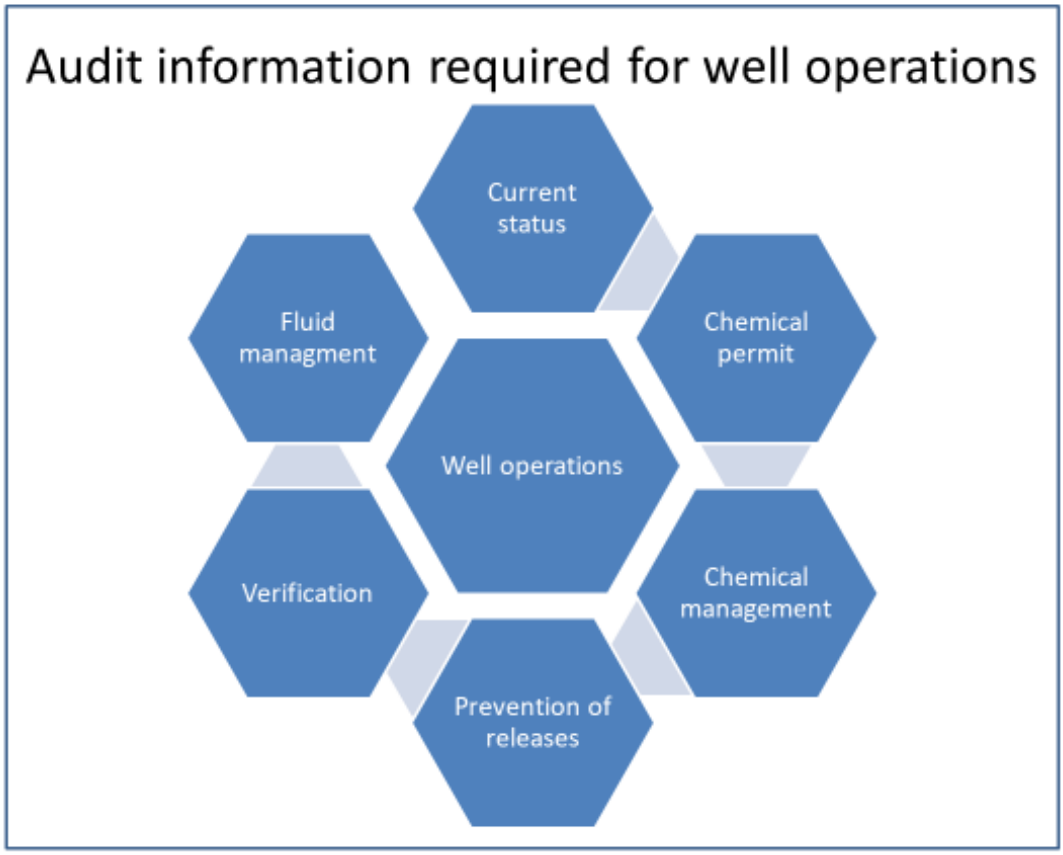

Figure 7-9: Decommissioning audit well operations. Source: Author

7.4.5 Navigational aids

Whilst potentially not recognised as an environmentally critical element on an installation, the requirements of the standard marking schedule are designed to reduce the risk of other vessels colliding with the installation, the consequences of which could be catastrophic with regards to the marine environment.

Operators must comply with the permit conditions and have suitable systems on the installation that can demonstrate that they meet the conditions. The audit would target this through analysis of maintenance records and physical

inspection. The topics for auditing under this heading are captured in table 7-10 below.

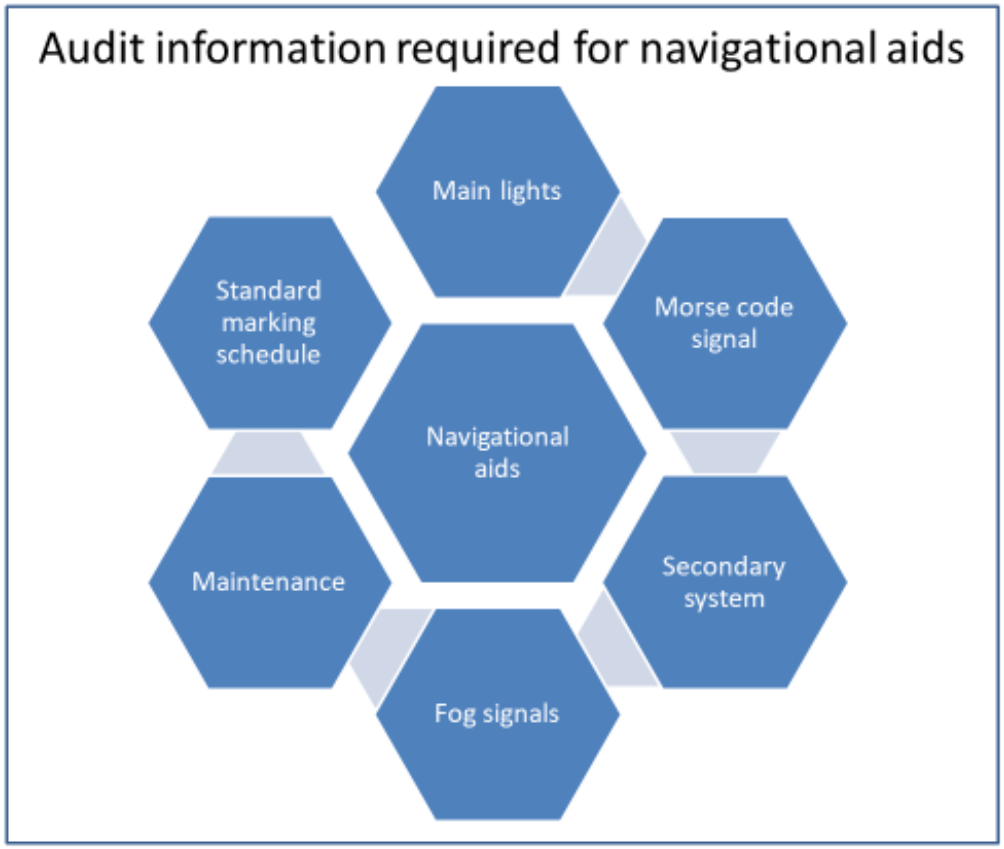

Figure 7-10: Decommissioning audit navigational aids. Source: Author

7.5 Case Study First round of audits - Learnings from first round of decommissioning inspections

Each of the first inspections of the two identified platforms were carried out over a two-day period and involved physical inspections of various elements of the platform, inspection of documentation, interpretation of data recorded on the platform systems and discussions with platform staff responsible for the various elements listed on the draft inspection model template.

During each of these preliminary inspections a number of common constraints to the inspection were identified which were ultimately out with the control of the

person undertaking the inspection and would need to be addressed during the planning for and prior to undertaking the second round of inspections. Ensuring sufficient time was available to cover the inspection topics was a significant issue. Issues beyond the control of the person undertaking the inspection included travel to the platform. Departure times to the platforms is controlled by the operator in conjunction with the helicopter provider and early departures times cannot be guaranteed which would impact on available time on the platform for the inspection. Equally departures from the platform to shore could take place by mid-morning, again impacting on time that would be available for inspection activities. For installations in the Northern North Sea sector, travel arrangements can generate further constraints on available inspection time due to the requirement to take a fixed wing flight to and from the Shetland Islands prior to the helicopter transfer to and from the platform. A further but absolutely essential constraint is the requirement to undergo a safety induction on arrival at the platform and before any inspection activities can begin. The length of time that it takes to complete a safety induction can vary from one platform to another but it unlikely to take fewer than 2 hours and can take up to 4 hours depending on the requirements of individual operators and platforms. Personal safety of the inspector and other personnel on the platform is a vital component of working offshore and should be taken into consideration when planning for the inspection.

Whilst one of the stated aims of developing the inspection model is to design it in such a way that it is appropriate for all offshore oil and gas installations whether they are manned or unmanned permanent platforms, floating production and storage operations, whether the hydrocarbon involved is oil, condensate or gas production, and irrespective of location on the UKCS. It is clear that not all of the inspection topics are appropriate for all installations and this needs to be accounted for in planning the duration and agenda for the inspection. For example, a platform may export all production fluids and not have production fluid separation facilities on board or a platform may have surrendered its combustion permit once cessation of production has arrived if it is relying on a number of smaller diesel driven temporary generators for power generation rather than the original platform turbines. The impact of these timing constraints on the available time for inspection over the two-day period resulted in a

conclusion that a two-day inspection was not deemed to be sufficient to fully reflect the envelope of the regulatory framework and the time period for the second round of inspections was therefore increased by 50% to a 3-day inspection period.

From a practical perspective, utilising the first version of the inspection model to trigger both the physical inspection of the platform and to initiate discussions with the platform personnel responsible for the various elements of the inspection inevitably raised further areas to inspect or in most cases encouraged the inspector to drill down further into the detail regarding how the operator was complying with the conditions within each of the permits that had been granted by OPRED. This was an important learning to be taken from the first round of inspections that needed to be incorporated into the final version of the inspection model.

In terms of regulatory findings, the first round of decommissioning inspections identified a number of issues on each platform which highlights the importance of OPRED instigating a physical decommissioning audit trail through an inspection process. In both cases there was a decrease in the number of core crew on the platform and an increase in the number of contractors undertaking specific short-term decommissioning activities. This a significant management of change issue with the platform transitioning from a period of many years of stable production with settled and experienced personnel maintaining the platform utilising years of specific experience of these case study platforms to a situation where contractors new to the platforms were changing the long-term status of the platform. According to Gill (2003) management of change requires effective leadership that recognises the cognitive, emotional and behavioural aspects of individuals in the change process and therefore during decommissioning, operators need to recognise the impact of change on employees and introduce a strategic vision with values and empowerment at its core to deal effectively with the challenges that will be faced during the decommissioning phase.

During the inspections it was at times difficult to identify which items of equipment had been decommissioned from items of equipment that were simply historically out of service due to a lack of visual identification and this lack of

visual management increased the risk of accidental releases of hydrocarbons and chemicals. This is illustrated in the images below in Figure 7-11.

Figure 7-11: Poor identification of decommissioned equipment. Source: Author

The inspection of the first platform identified increased volumes of temporary equipment and temporary hoses that would contain hydrocarbons or chemicals, and activities involving breaking of containment and flushing processes. Specific breaches of regulations reported back to the operator for action included issues around aids to navigation, damage to hydrocarbon hoses, holes in the helifuel bund, training and competence gaps and the use of procedures that were not fit for purpose. Other regulatory findings included breaches of Fluorinated Greenhouse Gases regulations, and issues of concern with regards to the handling, management and disposal of waste oil to minimise the risk of release. The following images in figure 7-12 illustrate some of the findings:

Figure 7-12: Images of regulatory findings from offshore installation.

Source: Author

The inspection of the second platform located was at a similar stage of decommissioning as the first platform but the platform was of a much greater scale with many more contractors and equipment on board. Specific breaches of regulations identified included, blocked drains, evidence of hydrocarbon release and loss to sea of drilling mud in the area of the wellheads, poor chemical storage, poor document control and unsatisfactory exercising of their Oil Pollution Emergency Plan (OPEP). The following images in figure 7-13 illustrate some of the findings:

Figure 7-13: Images of regulatory findings from offshore installation.

Source: Author

The lessons learned from the first round of decommissioning inspections were incorporated into a revised version of the Environmental Decommissioning Inspection Model which was used during the second round of inspections on the platforms.

7.6 Case Study Second round of audits

The second set of inspections took place approximately 12 months after the first set of inspections. The time gap was set to provide sufficient time for the analysis of the findings from the first set of inspections and to revise the Environmental Decommissioning Inspection Audit Model to reflect what had been learned from the first set of inspections. The 12-month period also provided an opportunity for the operators to respond to the regulatory findings and advice

provided by the first round of inspections and to modify their procedures against the back drop of minimising the impact of their activities on the marine environment. It can be seen from the images below in figure 7-14 that for example the identification of decommissioned items of equipment was significantly improved upon from the first inspection visits:

Figure 7-14: Improved marking of decommissioned equipment. Source: Author

Following revision of the inspection model a final version of the inspection model was used for the second round of inspections.

7.7 Summary of Chapter 7

Whilst chapters 5 and 6 considered in detail all 4 of the emerging themes from the literature, chapter 7 focused on theme 3, minimising the impact of the environment and the role of OPRED in monitoring regulatory compliance to deliver the practical aspect of this DBA. Additionally, chapter 7 provides additional insights into the challenges of decommissioning and this adds value to the triangulation of data from chapters 5, and 6 in chapter 8. The final version of the audit model was subsequently given a final and successful trial at an additional platform in June 2017 (additional to the two platforms which participated in the audit model development) to ensure that it was fit for purpose and suitable for any installation in the decommissioning lifecycle phase. The final version of the audit template has not been reproduced in this thesis due to the

commercially sensitive and regulatory nature of its contents but figure 7-15 provides an overview of the template structure, focus and areas of concern.

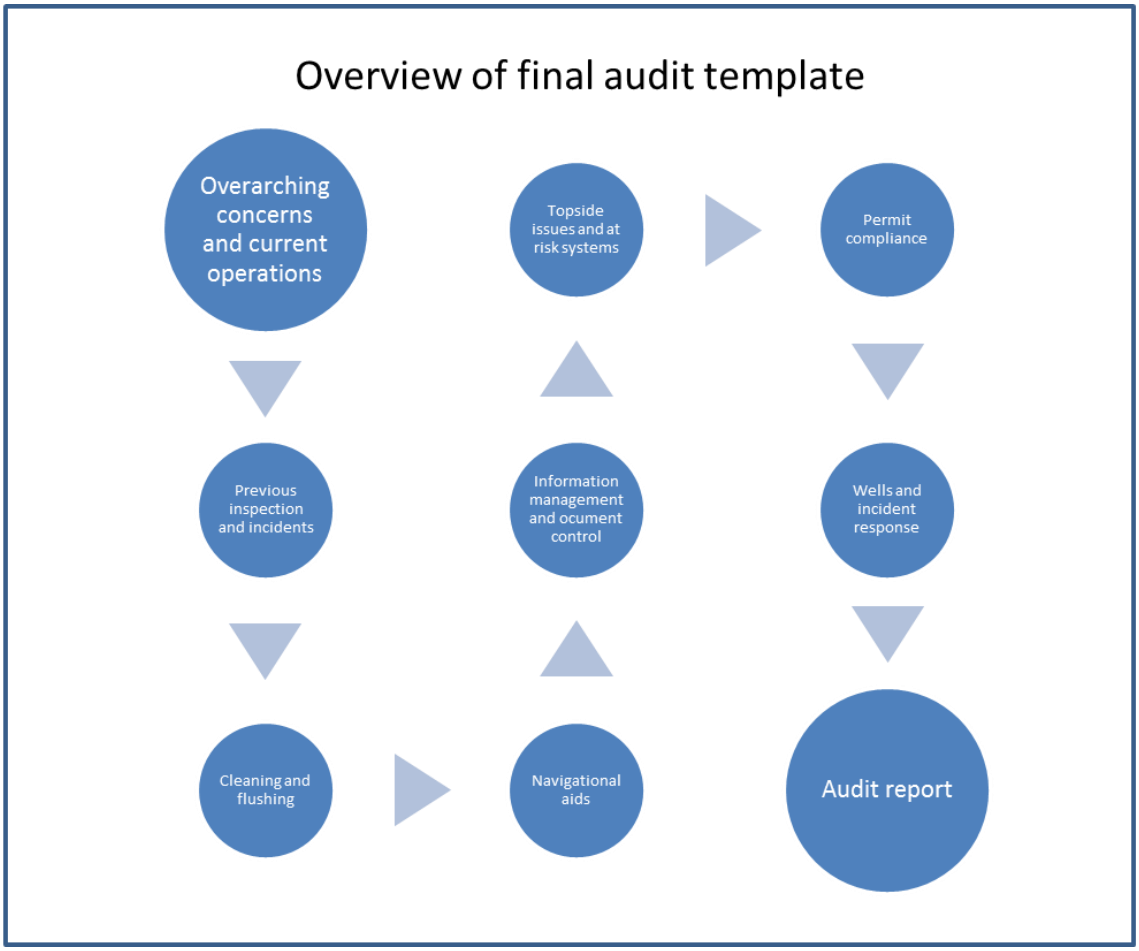

Figure 7-15: Overview of final audit template. Source: Author

Chapter 8: COMBINING EVIDENCE BASED DECOMMISSIONING OPTIONS AND PROPORTIONATE REGULATORY PRACTICES: A DISCUSSION

8.1 Introduction

This chapter discusses in depth the identified evidence based decommissioning options and proportionate regulatory practices that could be combined to develop an alternative framework for future decommissioning on the UKCS. Through chapters two and three a number of themes emerged which were reflected in the design of the research methodology. The research analysis chapters five and six together with the case study data from chapter seven generated the participant's input into these themes providing relevant information that can be collaborated / triangulated with the literature and arguments developed in chapters two and three. In this chapter the key perspectives and drivers of change arising from the analysis are discussed and provide the basis for the practical alternative framework that has been developed. The merits of the parallel practical model for auditing the decommissioning execution are also discussed.

For ease of reference and to provide context for this discussion, figure 8-1 below summarises the themes and perspectives that emerged from the mixed methods research approach:

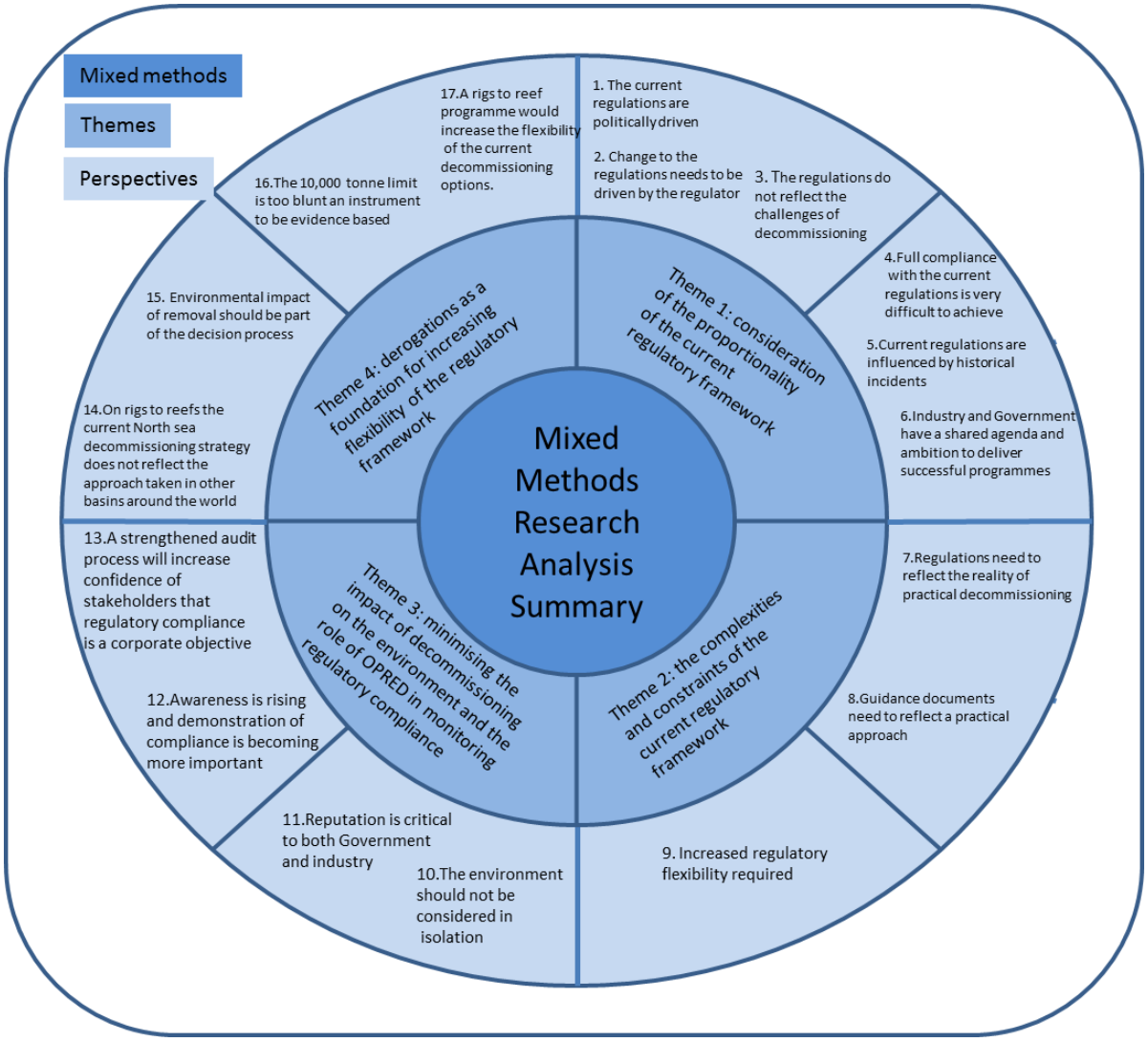

Figure 8-1: Summary of the themes and perspectives emerging from the research. Source Author

8.2 Evidence based decommissioning

The proposed changes to the available decommissioning options for decommissioning are summarised in Tables 8-1 which link these proposed changes with the appropriate themes from chapters two and three, the associated perspectives from chapters five and six, and the original research questions.

Table 8-1 Evidence based decommissioning options

Evidence based decommissioning options			
Options	Themes from chapters 2 and 3	Perspectives from chapters 5 and 6	Research questions
Remove limit of 10,000 tonnes for derogations	Themes 1,2,3,4	1,3,5,7,9,13,14,15	1,2,3,4,5,6,7,8
Introduce a rigs to reefs programme	Themes 1,3,4	1,3,5,6,9,13,14,16	1,2,3,5,6,7,8
Remove the assumption that a clear sea bed is the base case	Theme 1,2,4	1,3,4,7,14	1,2,3,4,5,7,8

The primary argument of the research was to demonstrate that the current regulatory framework which came into force in the late 1990s was now out of date, did not reflect the available evidence, knowledge and experience gained that has accumulated during this period of twenty years and that the OPRED audit process was not sufficient to provide a credible evidence base, considering the sheer scale and cost of the decommissioning challenge. It was argued that this led to a non-evidence based, inflexible, inefficient system that added additional time, complexity, cost and environmental impact to the decommissioning process and was contrary to the ambitions of the broad stakeholder community. It was further argued that the regulatory framework was not proportionate to the environmental impact of decommissioning and required change to reflect the reality of the environmental risk during the decommissioning phase of the infrastructure lifecycle and that operationally, additional options and increased flexibility were required to facilitate efficient execution. Taken together these arguments build a robust case that the Regulator should undertake a fundamental review of the current regulatory framework and a number of practical and regulatory changes are proposed for consideration in that review. These changes together with the review would

provide the developmental envelope for an alternative evidence based and proportionate approach to decommissioning.

8.2.1 Removal of the 10,000-tonne derogation limit

The first proposed change emerging from the research is the removal of the 10,000-tonne limit for derogations from the regulations. The literature review clearly supports the argument from the perspective that there is no evidence that identifies why the figure of 10,000 tonnes was chosen as the weight at which a jacket foundation will prove difficult to remove. It is therefore an arbitrary figure that does not take other factors into consideration. The argument being made is not that every jacket should be left in situ or that every jacket should leave its footings in place. The argument put forward is that each application should be assessed on an individual case basis to determine the basis for removal or derogation. Each jacket will have a different decommissioning evidence base in terms of how heavy is it, how long has it been in place, the environmental status of the seabed in its vicinity, the number of foundation piles, their diameter and ease of access, the location and scale of the drill cuttings pile, the levels of marine growth accumulated, the degree to which it could be classed as an artificial reef, technical challenges of removal, depth of water, etc. Therefore, there are a number of variables that should be considered, technical difficulty, health and safety, environmental impact of leaving in situ, the environmental impact of removal in terms of disturbance of the seabed and the marine growth established on the jacket, and impact on other stakeholders. Some of these variables are illustrated in figure 8-2 the decision funnel below.

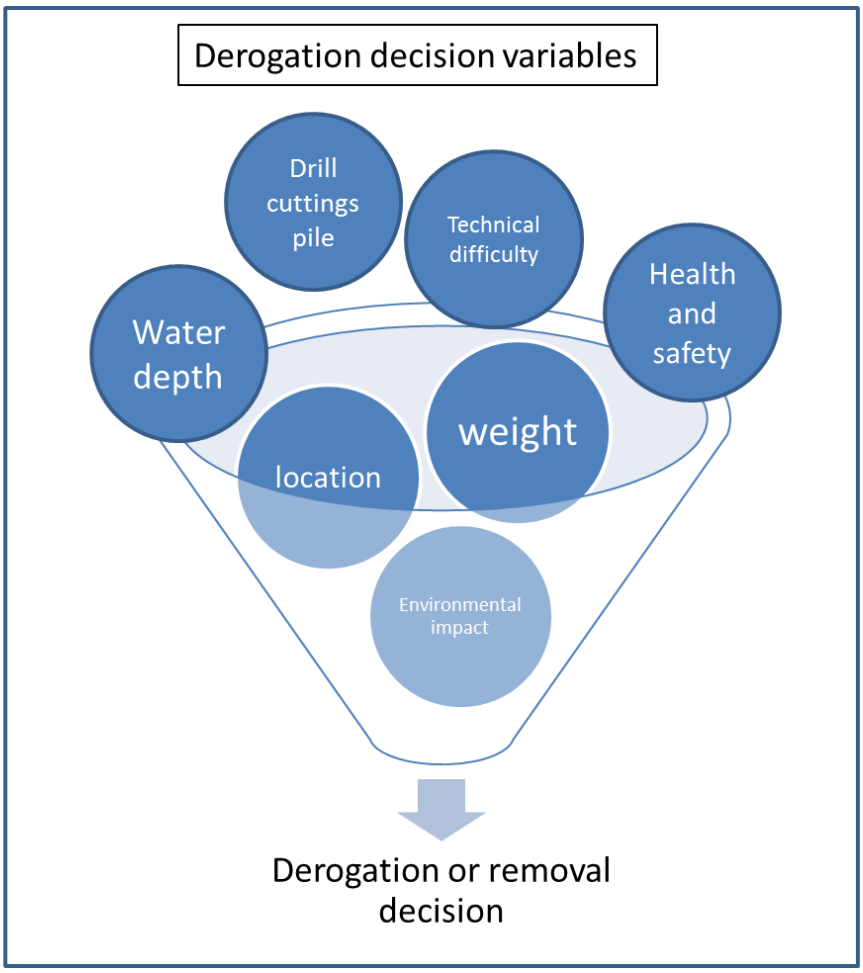

Figure 8-2: The derogation decision funnel. Source: Author

The evidence from the literature review, including that of Jorgensen (2011), Bellamy and Wilkinson (2001), Penner (2001) and Pulsipher and Daniel (2000) presenting the evidence of politically biased original regulatory decisions and the lack of evidence in archives of OSPAR. Additionally, there is clear evidence (Jorgensen, 2012) of the link between OSPAR's desire to prevent the use of redundant offshore infrastructure as material for artificial reefs (OSPAR, 1999) and the decision to instigate a clear sea bed policy. The proposal for removing the derogation limit was further supported by the outcome of the mixed methods research. From a quantitative perspective the results indicate that 73% of the responding participants stating that the current 10,000 tonne limit was not appropriate. Analysis of the qualitative data from the participants on the derogation limit supplemented the quantitative results and could be broadly separated into 3 categories of opinion; firstly, that each installation should be assessed on an individual case basis; secondly that the current limit is arbitrary;

and thirdly that the environmental impact of removal needs to be considered. The triangulation of evidence and analysis is illustrated in figure 8-3 below:

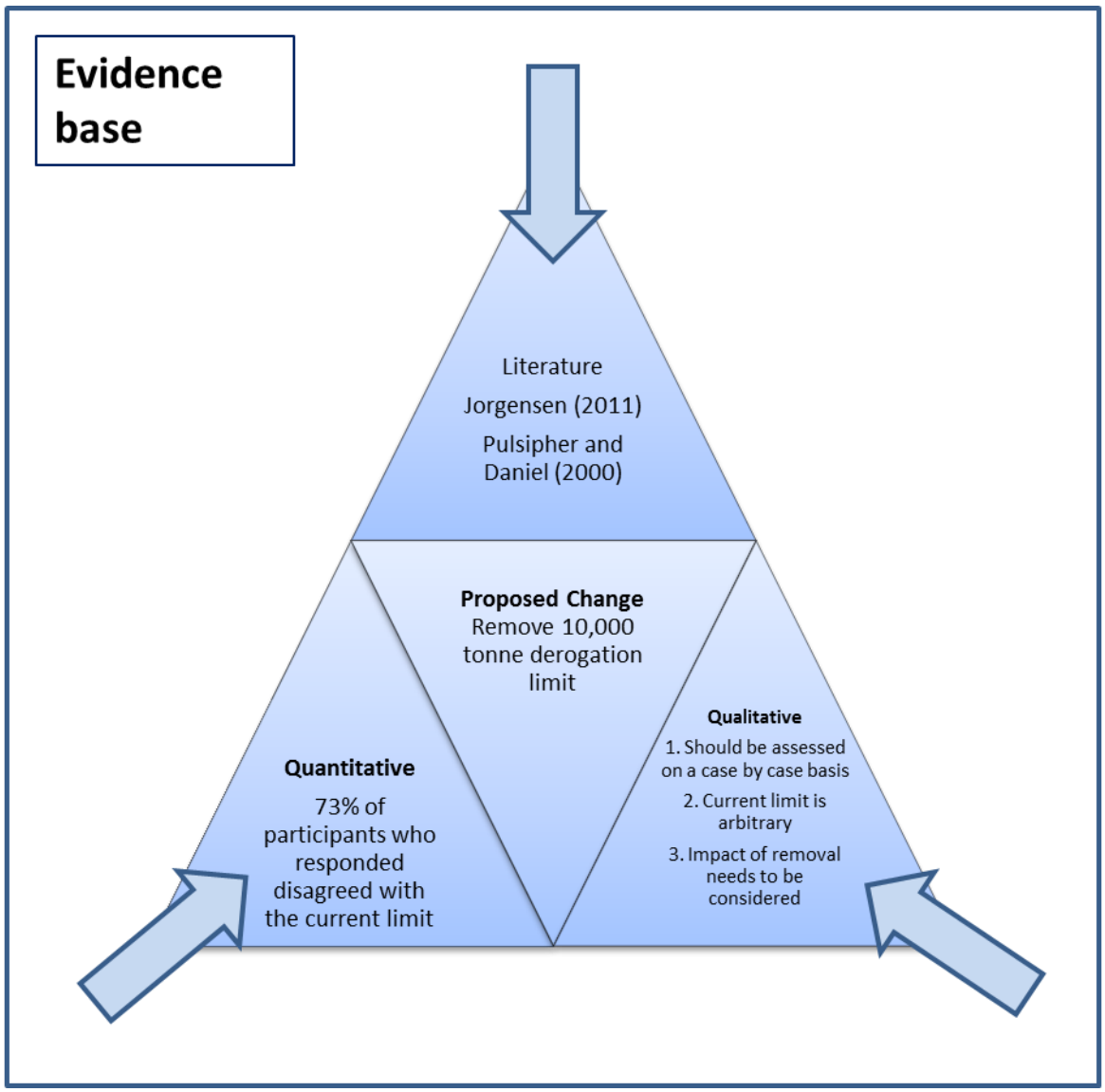

Figure 8-3: Triangulation of research evidence – removal of derogation limit. Source: Author

8.2.2 Introduction of a rigs to reefs programme

The second proposed change is the introduction of a rigs to reefs programme. At first glance this is likely to be the most controversial proposal as it directly contrasts the OSPAR 98/3 decision which put a moratorium on leaving parts of obsolete oil and gas infrastructure in the sea, a decision that has been in place

for almost 20 years. The OSPAR 98/3 decision is reviewed every 5 years and to date no contracting country has put forward an argument for change partly through lack of available evidence and partly through fear that other OSPAR contracting parties may respond by imposing even stricter decisions on decommissioning. However, that said, there is now a growing body of evidence both from literature and from the increasing knowledge and experience gained through executing decommissioning programmes since the 98/3 decision was taken that would support a fundamental review of Decision 98/3. As discussed earlier, the legal significance of OSPAR 1998/3 with regards to decommissioning the UKCS should not be underestimated and taking forward the recommendations from this thesis that impact on 1998/3 would be challenging to implement. For example, Decision 98/3 which is reviewed every 5 years by the contracting parties is legally binding on the party's signatory to the OSPAR Convention which includes the UK. Additionally, there are longstanding and substantial differences of view between the contracting parties to the OSPAR Convention. In particular between those whose waters contain large numbers of offshore installations (essentially the UK and Norway) and the others (the Netherlands, Germany, Ireland, France, Spain, Belgium, Denmark, Finland, Iceland, Portugal, Sweden, Luxembourg, Switzerland - the EC Commission), who are also involved but to a lesser extent. Building a consensus for evidence-based change amongst the contracting parties would be a significant challenge. One potential route forward would be for rigs to reefs to be added as an additional fifth element of permissible derogations under Decision 98/3 through the 5 yearly review process.

There is a clear evidence-based argument within the research that has been built on two solid foundations. Firstly, that there is clear evidence in the literature that the decision was a political decision, a reaction to historic events and a political desire to prevent redundant infrastructure being put forward as a legitimate source of material for artificial reefs (Jorgensen, 2011). Secondly there is also clear evidence in the literature that rigs to reefs programmes around the world have brought environmental benefits to the marine environment (Dokken et al, 2000) and (Gallaway et al, 2009). This is further supported in the literature (Macreadie et al, 2011) and (Cripps and Abel, 2002) amongst others that similar benefits could be achieved if a rigs to reefs programme was developed for the

UKCS. Whilst the majority of published research has focused on the Gulf of Mexico, the conclusions form the published research for the North Sea mirror the findings in the Gulf of Mexico. For example, (Gass and Roberts, 2006) identified that North Sea Platforms provided safe havens for the threatened cold-water coral Lophelia Pertusa, a habitat that OSPAR itself states needs to be protected and Soldal et al (2002) whose study identified large aggregations of economically important fish in close proximity to a North Sea platform. Additionally, research by (Claisse et al, 2014) suggest that the platforms have a high ratio of structural surface area to seafloor surface area, resulting in large amounts of habitat for both young and adult fish over a corresponding small footprint of the seafloor. This is supported by Jorgensen et al (2002) in their study of fish residence in the vicinity of a decommissioned platform in the North Sea and by Bourna and Lengkeek (2013) in their study in Dutch waters of the North Sea. The proposal for introducing a rigs to reefs programme was further supported by the outcome of the mixed methods research.

From a quantitative perspective 73% of the participants believed that a rigs to reefs programme benefits the marine environment with the remaining 27% of participants not willing to commit to take a particular stance as they had not viewed any of the available research on rigs to reefs. Every participant agreed that they could see no reason why a rigs to reefs programme could not be implemented on the UKCS. Interpretation of the qualitative data suggests that the participants overwhelmingly support the introduction of a rigs to reefs programme for the UKCS. The participant's responses can be filtered into different categories. Firstly, rigs to reefs would add more flexibility to the currently available decommissioning options; secondly that rigs to reefs is an established approach embraced elsewhere; thirdly that environmental benefits have been proven; and fourthly that this should only be approached on an individual case basis. The triangulation of evidence and analysis is illustrated in figure 8-4 below:

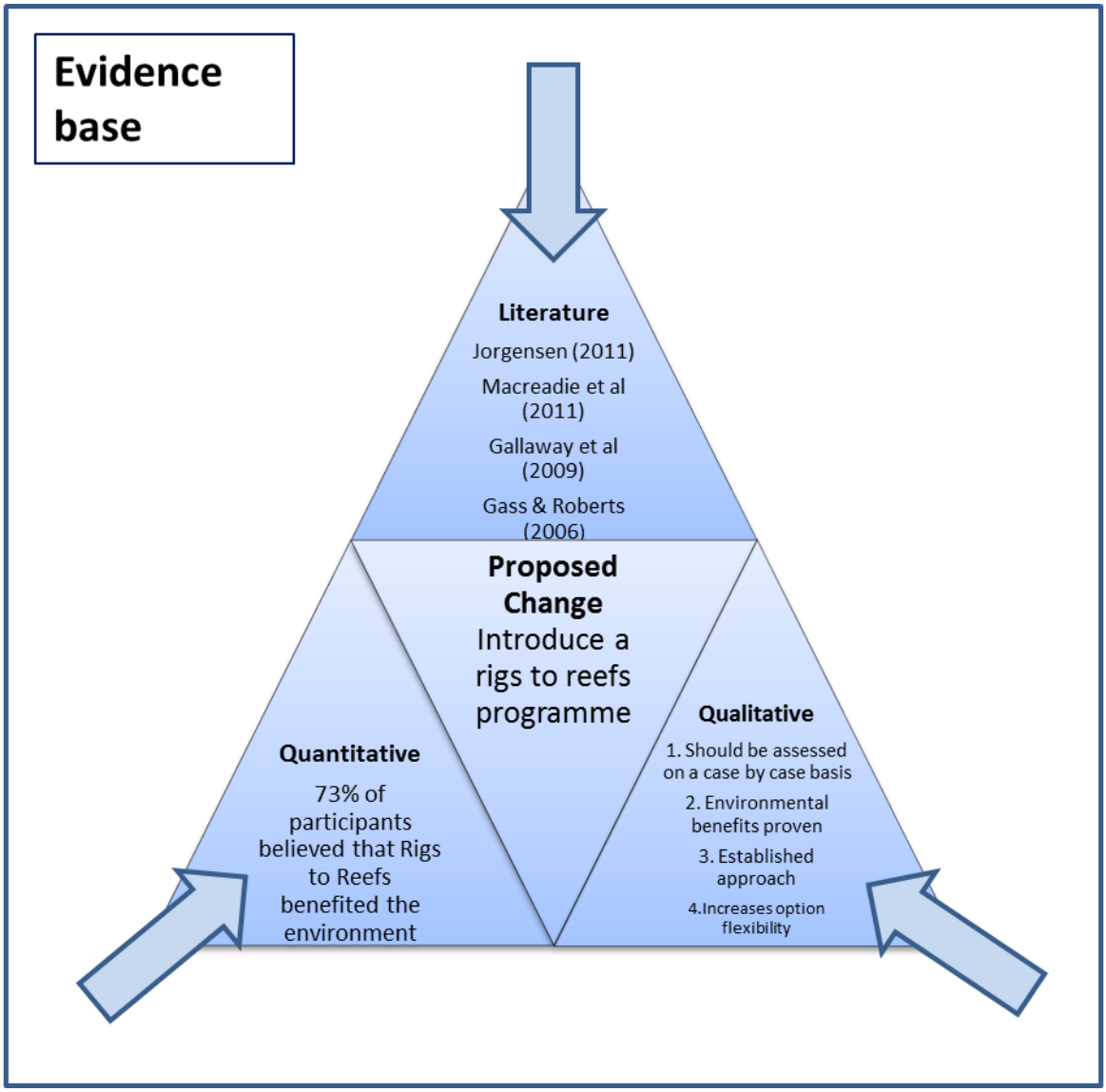

Figure 8-4: Triangulation of research evidence – introduction of a rigs to reefs programme. Source Author

8.2.3 Remove the assumption that a clean sea bed is the base case

In terms of the decommissioning phase, the current regulatory framework is extremely prescriptive in terms of removing everything that was deposited on the seabed as part of the installation and production phases of the installation. When the regulations were first imposed it was a statement of intent rather than a regulatory requirement based on evidence of achievability and this is demonstrated in the literature Bellamy and Wilkinson (2001), Pulsipher and Daniel (2000) and Penner (2001). Anything left behind during decommissioning would be considered as dumping which is prohibited under OSPAR regulations

(OSPAR 1998). Absolute adherence to the clear sea bed philosophy was a rather simple statement to make from a political perspective but the available evidence indicates that it is an improbable ambition from a practical perspective. There is clear evidence from the available regulatory required close out reports from completed decommissioning projects that the concept of an absolutely clear seabed has not been possible to achieve and efforts to comply with the requirement have simply added additional time, cost, disturbance of the seabed, increased the use of diver intervention with its associated risk to life and increased atmospheric emissions for no additional marine environmental benefit.

From the quantitative analysis of theme 2, identification of the complexities and constraints of the current regulatory framework, 80% of participants indicated that they had experienced difficulties complying with the current regulatory framework. From utilising a value system calculation with the results captured in table 5-3, it is clear from the responses that the participants believe that the current regulatory framework is unhelpful when dealing with the subsea infrastructure and pipelines with the regulations being ranked as the second and third least helpful for these aspects of the decommissioning programme. The analysis of the qualitative responses to the questions around the complexities and constraints of the current regulatory framework highlighted clearly identifiable perspectives from the participants. These were that increased flexibility needs to be built into the regulations to optimise decommissioning solutions and that both the regulations and guidance needs to reflect the complexities of decommissioning and provide a more practical rather than a political framework to provide the foundation for efficient and achievable decommissioning programmes. Within these common perspectives a number of specific comments were made by the participant's opinions on the complexities and constraints of the current regulatory framework that are relevant to this proposed change. Examples of these are captured in table 8-2 below.

Table 8-2: Examples of comments linking through emerging perspectives to proposed change

Proposed change	Perspectives	Comments
Remove the assumption of a clean seabed	More flexibility required	"the regulations should be more flexible and allow us the opportunity to tackle each program on a case by case basis…. I don't believe a one size fits all approach is an effective way to manage the decommissioning challenge we face"
	Regulations need to reflect a more practical approach	"it is just too complex and confusing" "there should be some form of process flow and greater flexibility within each element to design an optimal approach"
	Regulations need to reflect the evidence of experience to date	"the clean seabed requirement is impossible to resolve…… achieving a satisfactory solution for pipelines has proved very difficult"

The triangulation of evidence and analysis is illustrated in figure 8-5 below:

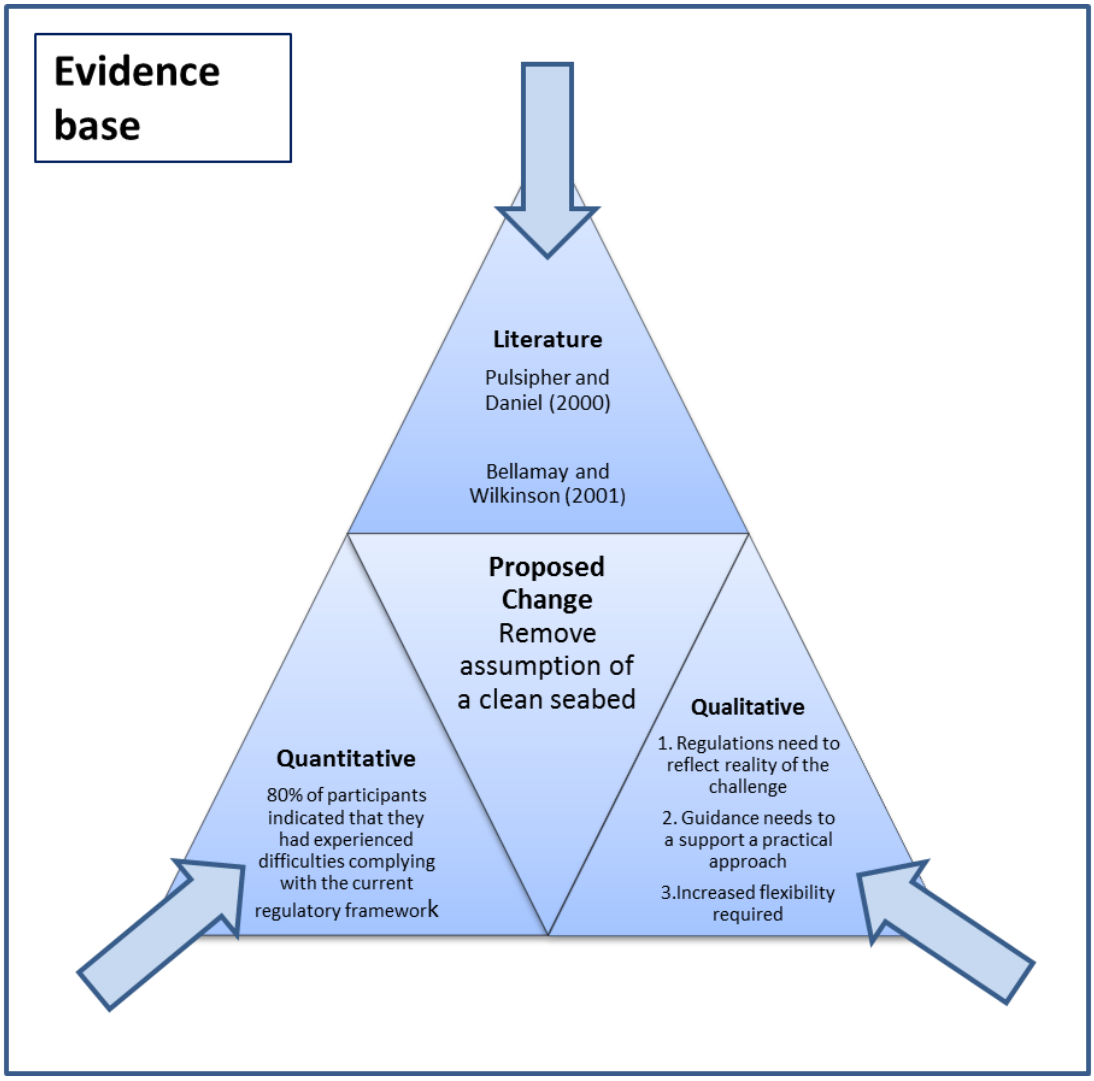

Figure 8-5: Triangulation of research evidence – remove the assumption of a clear seabed baseline. Source: Author

8.3 Proportionate regulatory practices

Table 8-3 below lists the proposed changes to the current regulatory practices. This reflects a more proportionate approach for the regulation of decommissioning activity. The proportionality aspect reflects the practical bias of the proposed decommissioning approaches but also reflects the significantly reduced environmental impacts of decommissioning activities compared with the impacts of the production phase of a platform's lifecycle.

Table 8-3: Triangulation of research evidence – remove the assumption of a clear seabed baseline

Proportionate regulatory practices			
Practices	Themes emerging from chapters 2 and 3	Perspectives emerging from chapters 5, 6 and 7	Research questions
Increase the OPPC limit for permitted discharges	Theme 1,2,3	2, 3,4,6,7,10	1,2,3,4,5,6,7,8
Reduce the number of well notifications required	Theme 1,2,3	2,3,4,6,7,9	1,2,3,4,5,6,7,8
Introduce broader area Environmental Impact Assessments	Theme 1,2,3	2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8
Introduce a single OPPC permit to cover all activities involving cleaning and flushing	Theme 1,2,3	2,3,4,6,7,9, 10	1,2,3,4,5,6,7,8
Strengthen the audit process to increase stakeholder confidence	Theme 1,2,3	2,6,7,10,11,12	1,2,3,4,5,6,7,8

8.3.1 Increasing the OPPC limit for permitted discharges

It is argued based on the evidence of the available data that the OPPC limit for permitted discharges of oil during decommissioning is not proportionate when compared with the significantly greater volumes of oil discharges permitted during the production phase. Once again it is reflective of the one size fits all approach of OSPAR irrespective of the realities of the actual oil discharges during decommissioning. It is a much more difficult to treat discrete batches of fluids containing oil on an ad hoc basis during decommissioning to meet the current OPPC oil in water limits for discharge when compared with the treatment of oil in water under a steady process situation during the production phase. The total oil permitted and discharged annually during decommissioning of an installation can be measured in kilogrammes whereas the total oil permitted and discharged annually during the production phase is measured in tonnes (up to 175 tonnes for one platform). The requirement for decommissioning is therefore disproportionate.

From the quantitative analysis 87% of the participants stated that they did not view the current regulatory framework as proportionate. Whilst a specific question was not asked regarding the OPPC oil in water discharge limits two of the participants who were environmental advisors, and therefore responsible for applying for OPPC permits, raised their concerns around the proportionality of the required limits considering the small volumes of oil in water discharged during decommissioning. Similarly permitting requirements generally were viewed by the participants in question 14 as the most unhelpful area of regulation. The qualitative analysis of the participant's responses also supports the general consensus that the current regulatory framework is not proportionate. In terms of the oil in water discharge limits being disproportionate this is supported by the perspectives emerging from the qualitative analysis that the current regulations are both politically driven and influenced by historical events.

8.3.2 Reduce the number of well notifications required and introduce broad area Environmental Impact Assessments

Whilst it is of course vitally important that the plug and abandonment of wells is undertaken correctly it is also a fact that the planned approach taken to plug and

abandon wells on a particular installation or field are virtually identical. The current regulatory requirements insist that the operator has to draft and submit for approval a well notification for each individual well that details the approach to be taken and the environmental risks involved. These documents are substantial in volume, highly detailed and are individually assessed by HSE and OPRED before approval is given individually on a well by well basis. This involves a significant amount of staff resource, time and cost for all three parties involved; the HSE, OPRED and the operator. For example, the Brent field has 140 wells and under the current regulatory framework, the operator has to draft 140 individual well notifications and both HSE and OPRED have to examine and approve individually 140 well notifications. The frustration arising is that the approach to be taken for the vast majority of these wells will be identical and significant savings in people resource, cost and time could be achieved by simplifying the well notification approach.

The situation is similar for environmental impact assessments. Each installation requires an environmental impact assessment irrespective of whether or not an environmental impact assessment already exists for the immediate vicinity. Additionally, environmental impact assessments are required for each permit application related to the decommissioning activities. For example, specific environmental impact assessments are required each permit application submitted for pipeline flushing, oil in water discharges, temporary laydown of equipment on the seabed, and for any planned disturbances of the seabed. Once again, the regulatory requirement for multiple permits and associated environmental impact assessments requires significant people resource, time and cost which is avoidable if a simpler more pragmatic approach is adopted.

In terms of the results of the quantitative research, these proposals are supported by the general consensus that the regulatory framework is not proportionate to the tasks involved and that they do not reflect learnings from previous decommissioning programmes. From the qualitative analysis there are a number of comments identifying the requirements to submit multiple permits for similar work.

The proposal is twofold. One that the requirement for individual well notifications for decommissioning programmes is removed. This should be replaced by a

single well notification that should be drafted for each installation and that it should cover all wells. In reality this is likely to reflect a common approach for most of the wells and where there are specific well plug and abandonment requirements for a specific well that there are highlighted within the single well notification. Secondly that a single environmental impact assessment is submitted that covers all potential decommissioning activities identified in the approved programme.

8.3.3 Introduce a single OPPC permit to cover all decommissioning activities

The argument for this proposal very much mirror the arguments put forward for the proposals regarding well notifications and environmental impact assessments. The current regulatory framework requires individual permit submissions for flushing individual pipelines, overboard discharges from cleaning and flushing vessels, sand discharges etc. The proposal is that the requirement for multiple OPPC permits is removed and replaced with a requirement for a single OPPC permit application that covers all anticipated activities contained within the approved decommissioning programme.

Across these three areas of permitting concern, the analysis of the qualitative responses to the questions around proportionate regulatory practices highlighted three clearly identifiable perspectives from the participants. These were to do with the difficulty of complying with the volumes of regulatory permit requirements, that the current system is not reflective of the practical requirements for decommissioning and that there are other variables that need to be considered in conjunction with the environment.

Within these common perspectives a number of specific comments were made by the participant's opinions on the audit system and monitoring compliance that are relevant to this proposed change. Examples of these are captured in table 8-4.

Table 8-4: Examples of comments linking through emerging perspectives to proposed change

Proposed change	Perspectives	Comments
Introduce a proportionate permitting system	Compliance with current regulations is difficult to achieve	"the permit requirements for the decommissioning programme can at times be overwhelming in terms of sheer volume and associated complexity"
	Regulations should reflect decommissioning reality	"everything needs an individual environmental impact assessment even if one already exists for the platform next door" "you end up with consultants churning out very similar reports which adds cost for no added value"
	The environment should not be considered in isolation	"it can't only be about the environment. I think there has to be a balance between often competing priorities…. business need, corporate objective, deliverability and the environment"

Taken together the evidence for a proportionate regulatory framework is compelling and the triangulation of the evidence for changes to the permitting regulation are summarised in figure 8-6.

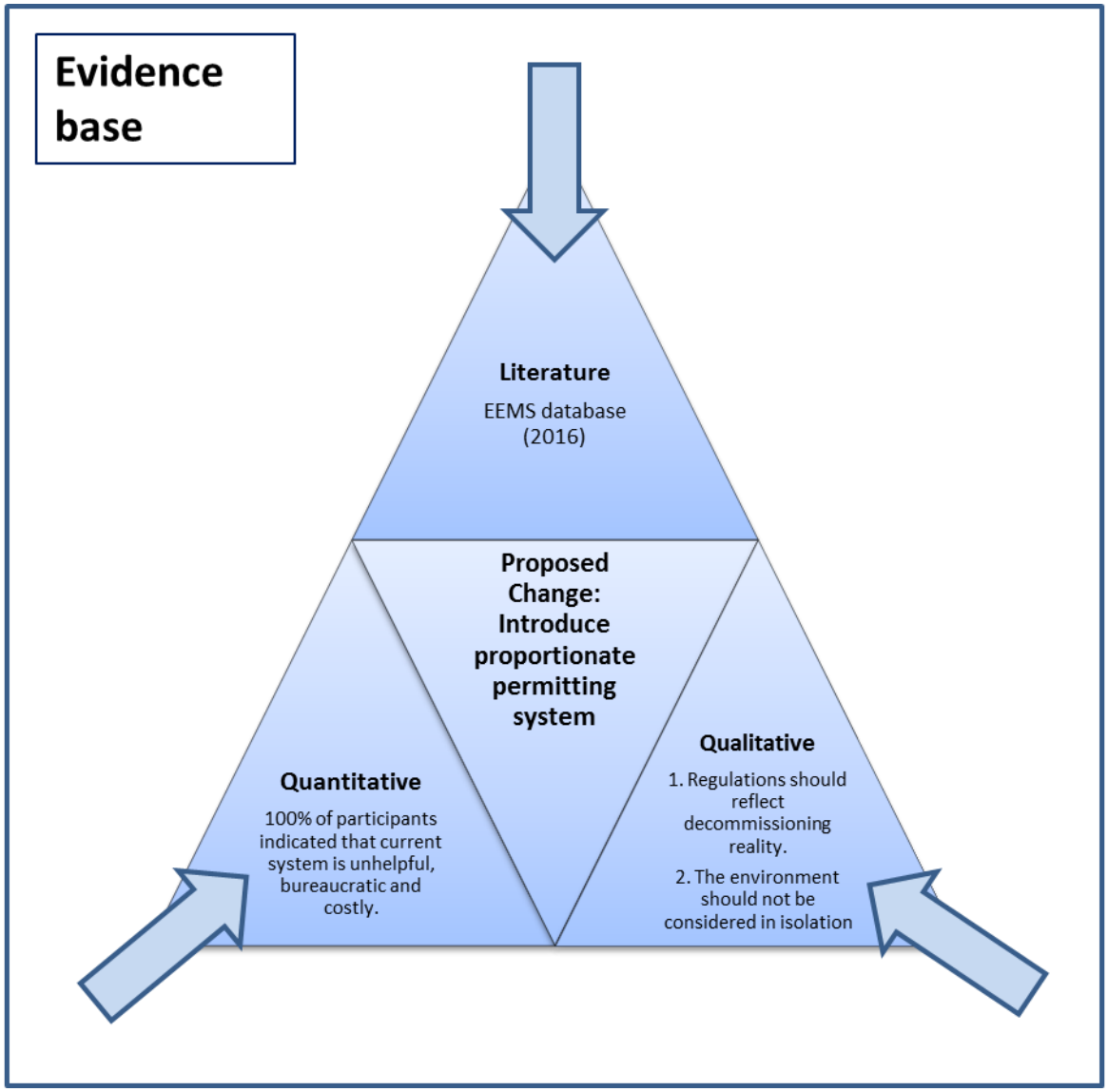

Figure 8-6: Triangulation of research evidence – introduction of a proportionate permitting system. Source: Author

8.4 Strengthening the audit process to increase stakeholder confidence

Decommissioning projects are complex, carried out far from shore and at significant cost. Much of the cost of decommissioning qualifies for tax relief, up to 75% in some cases and therefore falls to the taxpayer as an opportunity cost lost to the Government. It could be argued that there is a degree of public ownership of these projects, but the current audit process is lacking in terms of both depth and visibility of what is actually taking place. As discussed in chapter seven, the

current audit process consists of an approved decommissioning programme and some years down the line a short close out report undertaken on behalf of the operator by a consultancy firm.

The topic was covered in the questionnaire and from the quantitative analysis few participants thought that the single close out report was satisfactory as a method of auditing the programme. When asked if an OPRED inspection regime would improve the audit process, 100% of the participants agreed that it would but interestingly four of the six project managers were not keen on OPRED actually implementing an inspection regime. From the qualitative analysis there is general support for a stronger audit trail and the emerging perspectives from the responses underpin that support. The perspectives arising include the recognition that the general public and media awareness of decommissioning is increasing, and demonstration of compliance is important; the audit trail is what will protect the reputation of both the industry and Government and that a strengthened audit process will increase stakeholder confidence.

Within these common perspectives a number of specific comments were made by the participant's opinions on the audit system and monitoring compliance that are relevant to this proposed change. Examples of these are captured in table 8-5.

Table 8-5: Examples of comments linking through emerging perspectives to proposed change

Proposed change	Perspectives	Comments
Strengthen the OPRED audit system	Reputation is critical to both Government and industry	"from a reputational perspective a regular, transparent audit trail would be a positive step forward" "I don't think that it need to be continuous, it could be yearly or at the end or beginning of different work scopes"
	Public awareness is rising, and demonstration of compliance is important	"one report over the lifetime of a project which might take 5 years is probably pushing the boundaries of acceptability" "we should be more transparent to stakeholders"
	Strengthened audit process will increase stakeholder confidence	"it would be in our own interests as the operator responsible for the asset to be able to demonstrate that we are doing it right"

The significant gap in the audit process was identified early in the research and deemed appropriate to provide the practical problem-solving element of the DBA research, and a problem that matched the skill base of the researcher. The topic of strengthening the audit trail was described in the research methodology in

chapter 4 and tackled in Chapter 7 through a case study approach and the outcome is a Decommissioning Inspection Template with the final version is illustrated in Figure 7-15. The triangulation of evidence and analysis is illustrated in figure 8-7.

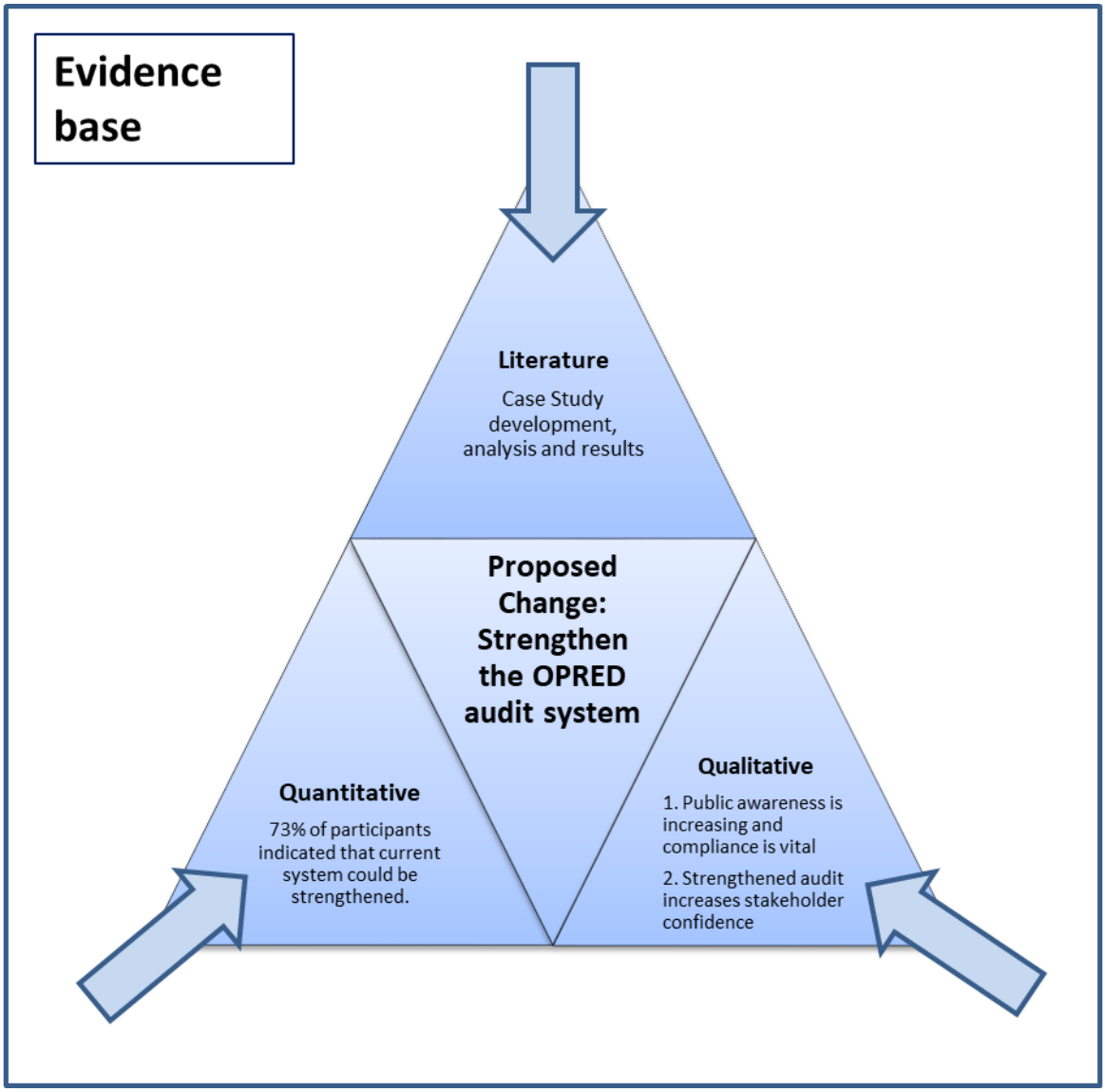

Figure 8-7: Triangulation of research evidence supporting a strengthening of the audit system. Source: Author

Table 8-6 lists additional proposed changes captured in the previous chapters.

Table 8-6: Additional proposed changes captured in the previous chapters

Additional proposed changes captured in the previous chapters		
Update the OPRED guidance to provide greater clarity between regulatory requirement and acceptable decommissioning practices	Themes 1, 2, 3 and 4	Perspectives 7,8
Generate a knowledge transfer mechanism to capture knowledge and experience	Theme 1, 2, 3 and 4	Perspectives 6, 11, 12

CHAPTER 9 CONCLUSIONS, RECOMMENDATIONS AND FURTHER RESEARCH

9.1 Chapter introduction

This chapter summarises the conclusions and presents recommendations and by doing so effectively concludes this thesis. This chapter presents final comments on the research aim and research questions. The comments provide evidence for future policy development with recommendations primarily for regulators but also for industry to consider. This chapter also contains the contribution of this work to the extant literature, namely in the subject areas of decommissioning, marine environment, regulatory policy development, and a practical contribution to practice. Finally, some suggestions for further research are recorded.

9.2 Summary and conclusion on the research aim

Overall the aim of this research aim was to build the case for combining strategic evidence based decommissioning options with proportionate regulatory practices with this new approach providing the developmental envelope for an alternative framework for future decommissioning on the UKCS. The content of the alternative framework was gathered from a comprehensive study of carefully selected expert decommissioning practitioners and practical case studies. Under the overarching research question, the framework content was grouped under three headings that defined the framework process. To support the overarching question a number of sub questions were designed, and these were grouped under three headings. Firstly, questions around whether the current regulatory approach is fit for purpose. Secondly, questions to investigate what has been the practical experience of complying with the current regulatory approach and thirdly questions aimed at identifying alternative approaches. The conclusions under each of these groupings are made in turn, through which the answers to the research questions are addressed.

9.2.1 Is the current system fit for purpose (research questions 1, 2, 3 and 8)

The current regulatory framework is a long-established mechanism built on a foundation of minimising the impact on the environment, and it was necessary to challenge the status quo. To tackle this challenge, it was argued that the current

framework was not evidence based, more that it emerged as a political expediency as a response to negative historical events driven by contracting parties to OSPAR with little economic exposure to the oil and gas sector. It was further argued that some elements of the regulatory framework could actually increase the impact of decommissioning on the marine environment. From this position it was then argued that the regulatory framework should be remodelled to provide a decommissioning envelope that contains a set of evidence-based options for each element of the programme.

Additionally, it was argued that it was disproportionate and, in the end, not evidence based to simply take the regulatory requirements currently applied to installations in their steady, controlled production phase and apply them to the decommissioning phase where processes were ad hoc in nature and subject to unpredictable challenges due to the individual design characteristics of installations.

9.2.2 Practical experience of complying with current regulatory approach (research questions 4, 5, 6 and 8)

The research provides an evidence base that some aspects of the current regulatory framework are difficult or in some cases impossible to achieve. For example, the operator experience to date has been that the ambition of a clear seabed returned to its original condition has not been achieved and is therefore not feasible. The evidence from decommissioning close out reports and from conference presentations by operators and contractors is that this regulatory requirement is not achievable. This was further supported by the responses from the research participants. It was therefore argued that the regulatory framework needs to reflect both what is achievable and the experience of the industry to date. It was further argued that the impact on the marine environment was considerably less from infrastructure that is being decommissioned than from installations during their production phase and therefore that the regulatory requirements should recognise this and be redrafted to reflect the proportionality of the impact on the environment. Additionally, the breadth of response from participants tends to support the findings from the literature review that the current regulatory framework is not delivering the best environmental outcomes from decommissioning activities.

In terms of providing stakeholder confidence in terms of compliance during execution of the agreed decommissioning programme it was argued that there was a significant gap in the current auditing system. It was argued that a platform based invasive auditing approach should be adopted by the regulator rather than relying on a simple close out report provided by the operator after the decommissioning programme has finished.

9.2.3 Identification of alternative approaches (research questions 7 and 8)

The decommissioning regulatory framework for the UKCS has remained unchallenged over the last two decades despite increasing levels of decommissioning activity, knowledge and experience. In parallel over the same period decommissioning activity has been taking place and decommissioning regulatory frameworks developed in other regions around the world where different approaches to the UK are being deployed. It is argued that the lack of flexibility within the current framework adds time, cost and increases environmental impact and that the current framework should be reviewed in the context of other non-UK regulatory regimes to identify lessons to be learned and potentially adopted. It is further argued that practices such as rigs to reefs programmes have a clear evidence base to support consideration of this option for use in the UKCS.

9.3 Contribution to knowledge and practice and the limitations

The outcome of the research has contributed to the theories and growing debate concerning the decommissioning of redundant offshore oil and gas infrastructure. Much of the literature that has been written around decommissioning has been focused on the regulatory approach taken in each part of the world. This research adds to the body of knowledge by looking at the practical application of the UK regulatory framework and the implications for practitioners attempting to comply with the regulatory requirements and permit conditions. The research reflects the experience and knowledge gained by practitioners targeting compliance. Through this analysis, gaps between theoretical compliance demands and deliverability are identified, explained and challenged. From this new knowledge base a number of evidence-based recommendations are made and an alternative, more flexible framework is proposed.

Additionally, this research builds on the available literature and body of knowledge by considering the proportionality of the current regulatory framework. The research challenges a number of the established regulatory requirements from both an environmental impact and a proportionality basis and argues from an evidence-based perspective as opposed to the original political perspective, for a proportionate regulatory approach based on an individual case by case decision format for each decommissioning entity. The research provides the evidence base and the experiences and knowledge gained by practitioners with regards to the proportionality of the current regulatory framework and proposes a number of recommendations to improve the proportionality of the regulatory framework.

The development, trialling and finalising of the audit methodology and audit template are significant contributions to practice and provide the regulator with a proven method of physical auditing of the execution of an approved decommissioning programme that will provide a greater degree of confidence amongst stakeholders that the operator and contractors are complying with all permit conditions and agreed procedures.

Taken together the research contribution adds to the body of knowledge by combining both the available literature with the knowledge and experiences of decommissioning practitioners resulting in a conceptual model combining evidence-based practices with a proportionate regulatory approach for future decommissioning activities.

The limitations to this research are the available targeted literature and the focus on the UKCS. Whilst global literature comparisons are introduced to offset the level of literature specific to the UKCS, there is the acknowledgement that more UK specific environmental research would further strengthen the arguments presented in this research. The arguments presented whilst they are UK focussed, may well be templates that could be utilised in other geographic locations facing the common challenges of cost, complexity and environmental protection in the years ahead.

9.4 Policy implications and Recommendations

From this research a number of evidence-based recommendations are proposed. The recommendations are put forward on a positive platform and are aimed not at finding fault with the current regulatory framework but more a focus on continuous improvement of the regulatory framework. It is important to note that decommissioning is an industry subsector which remains in its embryonic stage. The lessons learned, and knowledge gained to date can provide the foundations for increasing the efficiency of the execution of decommissioning phase of obsolete infrastructure and just as importantly the regulatory envelope that dictates what can and cannot be done.

9.4.1 Primary recommendation: The primary recommendation of this research is that the UK Government should implement a fundamental review of the current regulatory framework for offshore decommissioning on the UKCS and consider the evidence base for proposing changes to OSPAR Decision 98/3. There is now a clear evidence base that the current regulatory framework is not evidence based and does not reflect the experience and knowledge gained during the past two decades. Notwithstanding the legal significance of OSPAR 1998/3 with regards to decommissioning the UKCS, and the likely difficulties in building a consensus for evidence-based change amongst the contracting parties, this evidence-based opportunity and strategic challenge should be embraced and taken forward.

There are a number of additional specific recommendations proposed that the regulator should consider as elements of a new evidence based and proportionate regulatory framework for decommissioning on the UKCS and these are summarised in the following paragraphs. The conceptualised alternative framework for future decommissioning is summarised in figure 9-1 below.

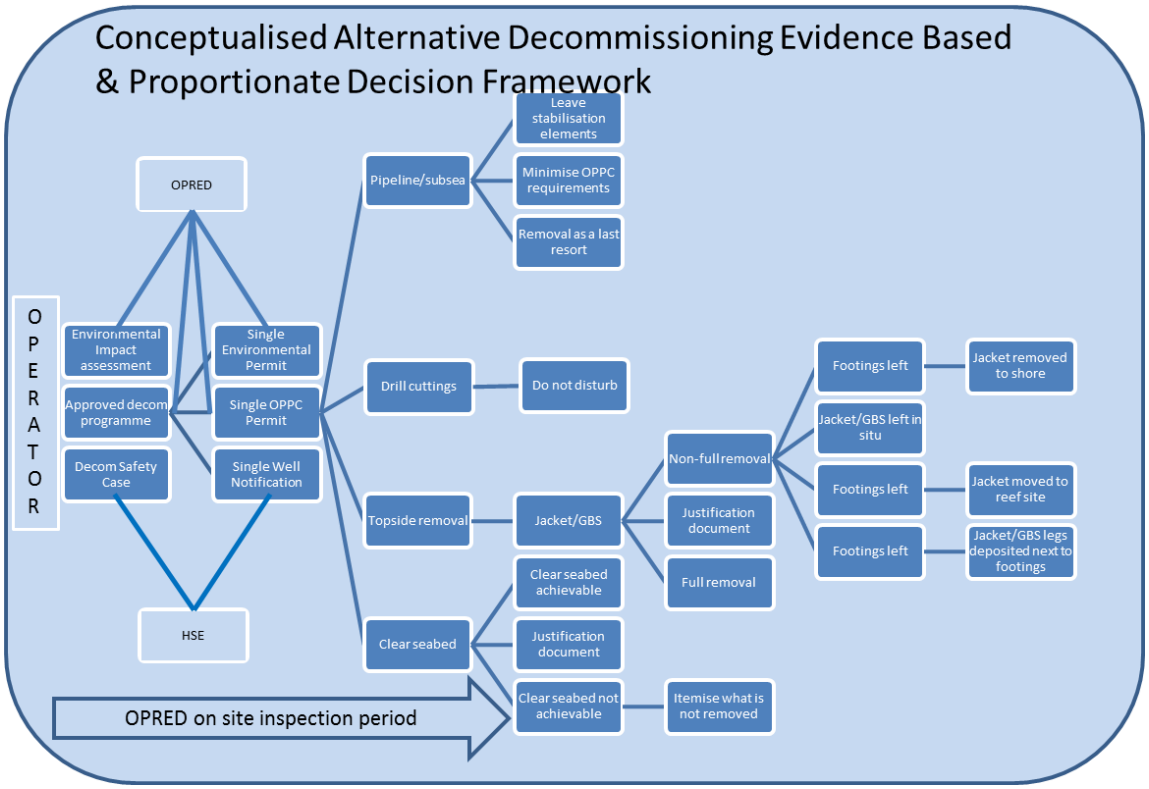

Figure 9-1: Conceptualised alternative decommissioning framework

Recommendation 2

The derogation limit of 10,000 tonnes should be removed and each project should be assessed on an individual case basis. The current requirement utilises a one size fits all approach which does not reflect the challenges faced. There is no evidence base to declare that any structure that weighs 9,999 tonnes is significantly easier to remove that one weighing 10,000 tonnes. This constraint reduces the options for operators to consider.

Additionally, it runs contrary to the IMO international guidelines and other international conventions and this approach has not been adopted by any other region across the world.

Recommendation 3

The UK Government should consider the introduction of a rigs to reefs programme on the UKCS. There is considerable evidence to justify a rigs to reef programme particularly based on the evidence of positive benefits to the marine ecology. There is also evidence that removing infrastructure from the seabed has

detrimental environmental impacts for example, the loss of cold water coral which is a protected species and other marine growth that has accumulated whilst the structure has been located on the seabed.

This is not a proposal that all infrastructure should be left behind, it is rather a proposal that recommends that the merits of utilising a particular piece of redundant infrastructure as an artificial reef should be considered on an individual case basis and not just removed as a matter of course. One potential route forward would be for rigs to reefs to be added as an additional fifth element of permissible derogations under Decision 98/3 through the 5 yearly review process.

Recommendation 4

The current baseline, of a clear seabed, one size fits all approach is not sustainable. The requirement has never been achieved in practice and the failed attempts to achieve this ambition have only reduced the efficiency of the programme as operators spend time and money hunting for items that may have been buried over time by the movement of the seabed or elements that disintegrate when attempts are made to remove. The objective should be replaced by a more practical requirement that operators need to provide a justification of why certain elements of equipment will be or have been left behind.

Recommendation 5

There are a number of changes proposed to the current regulatory framework which come under a heading of increasing the proportionality of the current framework. The evidence presented indicates that the current framework requirements are not proportionate to the activities being undertaken nor are they proportionate with respect to the impact of these activities on the environment.

These changes taken together would both improve the proportionality of the regulations and reflect a more practical evidence-based approach to decommissioning. The proposed changes would increase the OPPC limit for

decommissioning related permitted discharges; reduce the number of well notifications required, introduce broader area Environmental Impact Assessments; and introduce a single OPPC permit to cover all activities involving cleaning and flushing,

Recommendation 6

The regulator should strengthen the audit process to increase stakeholder confidence. OPRED should utilise the Decommissioning Inspection Template developed in Chapter 5 as part of this research. Strengthening the audit process will demonstrate operator regulatory compliance and help protect both the marine environment and the reputation of both Government and Industry

Recommendation 7

The current guidelines provided to industry by OPRED need to be revised. This should be done in parallel with the review of the regulatory framework. As the guidelines currently stand they do not provide practical advice to the operator. The current guidance is more of an expanded description of what should be in a programme document rather than practical approaches and interpretations of the legislation.

Recommendation 8

The regulator in partnership with industry should develop a knowledge bank as the heart of a knowledge transfer system. The knowledge bank would facilitate the capture and distribution of the lessons learned and knowledge gained from each decommissioning project to provide a source of data and knowledge to facilitate the efficiency of future programmes. Unfortunately, the knowledge and experience gained from previous programmes has not been captured and this has been an opportunity missed. Currently the knowledge and experience resides in a small number of individuals many of whom have either moved cross continent or retired. The opportunity is now there to stem this loss and build a knowledge base for future projects.

9.5 Suggested further research

Whilst one of the recommendations based on the available evidence is to consider a rigs to reefs programme on the UKCS based, there is scope to increase the knowledge base by undertaking further research looking at the best approach to rigs to reefs on the UKCS. This should consider what rigs to reefs model on the UKCS should be adopted and consider whether moving redundant infrastructure to identified sites to develop artificial reefs or whether leaving structures in place is the most appropriate option. Additionally, the issue of whether toppling vertical structures to the horizontal that would provide more surface area for reef development should be researched. Whilst there is published literature on the marine environmental benefits of man-made reefs in UK waters, the majority of the research to date is based on research in the Gulf of Mexico. Whilst the conclusions of the UKCS research, mirror those from the Gulf of Mexico, further targeted UK programme of additional research in this topic would add further evidence on this subject area.

Further research could also be undertaken to consider the approach to liability for redundant oil and gas infrastructure and plugged and abandoned wells. The current position is that in theory the liability remains with the operator in perpetuity. On the adoption of a rigs to reef programme the issue of liability is one area that would need to be addressed.

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APPENDIX A

Offshore Oil and Gas Decommissioning Regulatory Framework Questionnaire

Introduction

The survey questionnaire is designed to capture data for doctoral research conducted at the Robert Gordon University. The questionnaire is divided into three main sections. Please be assured that all persons and organisations/companies will remain ANONYMOUS in any thesis/reports produced. The first section is required for follow-up and for ease with data coding.

COMPANY/ORGANISATION/INDIVIDUAL DATA

Name of Individual Responding:

Organisation represented:

Area(s) of expertise:

Position in Organisation:

Contact: Email:

Contact: Tel:

Section 1

Q1. How many years experience do you have in decommissioning:

< 2 years ☐ 2 to 5 years ☐ 5 to 10 years ☐ more than 10 years ☐

Q2. How many decommissioning programmes have you been involved with:

Less than 5 ☐ 5 to 10 ☐ more than 10 ☐

Q3. In which Basins have you been involved in decommissioning projects:

Gulf of Mexico ☐ North Sea ☐ Other ☐

Q4. How would you describe your knowledge of Decommissioning regulations in the North Sea:

1. Very poor ☐ 2. Poor ☐ 3. Fair ☐ 4. Good ☐ 5. Very good ☐

End of section 1

Section 2 (i): Consideration of the proportionality of the current regulatory framework

For the following questions please answer yes or no and provide supporting comments.

Q5. Do you consider the current regulatory framework for decommissioning in the UKCS to be evidence based?

Yes ☐ No ☐

Comment:

Q6. Do you consider the current regulatory framework for decommissioning in the UKCS to be based on the experience and knowledge gained from those decommissioning programmes that have been completed?

Yes ☐ No ☐

Comment:

Q7. Do you consider the current regulatory framework for offshore decommissioning activities provides a balanced approach to meeting the ambitions of the various stakeholder groups?

Yes ☐ No ☐

Comment:

Section 2(ii) Consideration of the proportionality of the current regulatory framework

For the following serious of questions please indicate your position regarding the following statements selecting from the five available options:

1. **Strongly disagree** **2. Disagree** **3. Neither agree nor disagree** **4. Agree** **5.Strongly agree**

Please provide comments that support your answers.

Q8. The Decommissioning regulations in the North Sea are fit for purpose:

1.☐ 2.☐ 3.☐ 4.☐ 5.☐

Comment:

Q9. The Decommissioning regulations in the North Sea minimise the cost of decommissioning:

1.☐ 2.☐ 3.☐ 4.☐ 5.☐

Comment:

Q10. The Decommissioning regulations in the North Sea facilitate efficient decommissioning strategies:

1.☐ 2.☐ 3.☐ 4.☐ 5.☐

Comment:

Q11. The current regulatory framework for offshore decommissioning phase is proportionate when compared with the regulatory framework for the production phase of the lifecycle:

1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐

Comment:

End of section 2

Section 3(i): Identifying the complexities and constraints of the current regulatory framework

For the following questions please answer yes or no and provide supporting comments.

Q12. Do you consider the current regulatory framework for decommissioning is straightforward to interpret and work with?

Yes ☐ No ☐

Comment:

Q13. Have you experienced any difficulties in implementing the current regulatory framework to take forward your projects?

Yes ☐ No ☐

Comment:

Section 3(ii): Identifying the complexities and constraints of the current regulatory framework

Q14. For the following elements of a decommissioning programme how helpful do you consider the current North Sea Decommissioning regulations to be:

Please provide a rating from 1 to 7 where 1 is helpful and 7 is very unhelpful

Programme Element	**Rating** **Where a rating of 1 indicates that the regulations are very helpful and 7 that the regulations are very unhelpful.**						
	1	2	3	4	5	6	7
Permitting requirements							
Well P&A							
Drill Cuttings							
Topside making safe and preparation							
Topside removal							
Substructure removal							
Pipeline making safe & decommissioning							
Subsea infrastructure							
Seabed remediation							
Site monitoring							

Q.15 What do you consider should be the default decommissioning option prior to comparative assessment for the following elements?

1. *Complete removal 2. Leave in situ 3. Remedial burial/trenching 4. Rock dump/remedial rock dump 5.Partial removal 6. None of these options*

Decommissioning element	**Decommissioning options**					
	Complete removal	Leave in place	Remedial burial / trenching	Rock dump / remedial rock dump	Partial removal	None of these options
Mattresses						
Grout bags						
Frond mats						
Pipelines						
Umbilicals						
Drill cutting piles						
Pipeline bundles						
Gravity Based Structures						
Topsides						
Steel jackets						
Subsea installations						

End of section 3

Section 4(i): Minimising the impact of decommissioning on the environment and the role of OPRED in monitoring regulatory compliance

For the following questions please answer yes or no and provide supporting comments.

Q16. Are you aware of the reporting requirements that provide an audit trail for BEIS and other stakeholders to ensure that projects are carried out in compliance with the approved decommissioning programme?

Yes ☐ No ☐

Comment:

Q17. Do you think that the current regulatory requirement to provide a short close out report at the completion of a decommissioning project provides a satisfactory audit trail of the offshore decommissioning activities?

Yes ☐ No ☐

Comment:

Q18. Do you believe that protection of the marine environment during offshore decommissioning activities is a concern for all stakeholders?

Yes ☐ No ☐

Comment:

Q19. The Decommissioning regulations minimise the environmental impact of decommissioning:

Yes ☐ No ☐

Comment:

Section 4(ii): Minimising the impact of decommissioning on the environment and the role of OPRED in monitoring regulatory compliance

For the following serious of questions please indicate your position regarding the following statements selecting from the five available options:

2. Strongly disagree 2. Disagree 3.Neither agree nor disagree 4. Agree 5.Strongly agree

Please provide comments that support your answers.

Q20. The Decommissioning regulations in the North Sea minimising the impact of decommissioning on the environment:

1.☐ 2.☐ 3.☐ 4.☐ 5. ☐

Comment:

Q21. The Decommissioning regulations in the North Sea are sufficiently flexible to maximise protection of the environment from decommissioning activities:

1 ☐ 2.☐ 3.☐ 4.☐ 5. ☐

Comment:

Q22. The BEIS role in monitoring regulatory compliance of offshore Decommissioning activities in the North Sea adds value to stakeholders:

1.☐ 2.☐ 3.☐ 4.☐ 5. ☐

Comment:

Q23. An invasive offshore inspection regime by BEIS would improve the audit trail of Decommissioning activities in the North Sea:

2. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐

Comment:

Q24. BEIS should implement an invasive offshore inspection regime to monitor the progress of Decommissioning activities in the North Sea:

3. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐

Comment:

End of section 4

Section 5(i): Derogations as a foundation for increasing flexibility of the regulatory framework

For the following questions please answer yes or no and provide supporting comments.

Q25. Do you consider the current decommissioning regulatory framework to be sufficiently flexible to encourage innovation and alternative solutions?

Yes ☐ No ☐

Comment:

Q26. Are you aware of the current system that allows derogation applications for jackets greater than 10,000 tonnes?

Yes? ☐ No? ☐

Comment:

Q27. Do you believe that system that allows derogation applications for jackets greater than 10,000 tonnes is appropriate?

Yes? ☐ No? ☐

Comment:

Q28. Are you familiar with the Rigs to Reef programmes utilised in the Gulf of Mexico and other basins around the world ?

Yes? ☐ No? ☐

Comment:

Q29. Who should be responsible for the ongoing liability for plug and abandoned wells and any infrastructure that is not removed following a decommissioning programme?

1. Operator ☐ 2. Government ☐ 3. Shared ☐

Comment:

Section 5(ii): Derogations as a foundation for increasing flexibility of the regulatory framework

For the following serious of questions please indicate your position regarding the following statements selecting from the five available options:

Please provide comments that support your answers.

Q30. The current trigger point for derogation applications for jacket footings is >10000 tonnes. Based on your knowledge and experience do you consider the current trigger point to be:

1. Way too high ☐ 2. Too high ☐ 3. About right ☐ 4. Too low ☐
5. Way too low ☐

Comment:

Q31. The regulatory frameworks in other basins around the world offer more flexibility in available decommissioning options than in the North Sea?

1. Strongly disagree ☐ 2.Disagree ☐ 3.Neither agree nor disagree ☐
   4. Agree ☐ 5.Strongly Agree ☐

Comment:

Q32. A rigs to reefs programme based on redundant offshore infrastructure in the North sea would benefit the marine environment?

2. Strongly disagree ☐ 2.Disagree ☐ 3.Neither agree nor disagree ☐
   4. Agree ☐ 5.Strongly Agree ☐

Comment:

Q33. A viable rigs to reef approach could be developed and implemented for the North Sea?

1. Strongly disagree ☐ 2.Disagree ☐ 3.Neither agree nor disagree ☐
   4. Agree ☐ 5.Strongly Agree ☐

Comment:

End of Questionnaire

APPENDIX B: Coding manual

Coding manual	
Information about the participants	
i	Type of organisation Operator (1); Contractor (2)
	Specialism Environment (1); project management (2), other (3)
Theme 1 proportionality of the current regulatory framework	
ii	Regulatory framework and evidence base Yes (1); No (2); record all comments
iii	Regulatory framework and learning from experience and knowledge Yes (1); No (2)
iv	Regulatory framework and stakeholder groups Yes (1); No (2)
v	Fitness for purpose? Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5); record all comments.
vi	Regulations and costs Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5)
vii	Regulations and efficiency Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5)
viii	Regulations and proportionality Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5)
Theme 2: Identifying the complexities and constraints of the current regulatory framework	
ix	Regulations, interpretation and usability Yes (1); No (2); record all comments
x	Regulations and ease of implementation Yes (1); No (2); record all comments
xi	Usefulness of current regulations; ranking number will be recorded for each participant. Permitting requirements Well P&A Drill Cuttings Topside making safe and preparation Topside removal Substructure removal Pipeline making safe & decommissioning Subsea infrastructure Seabed remediation Site monitoring
xii	Default decommissioning options; Selected options will be noted. Mattresses

	Grout bags Frond mats Pipelines Umbilicals Drill cutting piles Pipeline bundles Gravity Based Structures Topsides Steel jackets Subsea installations
Theme 3: Minimising the impact of decommissioning on the environment and the role of OPRED in monitoring regulatory compliance	
xiii	Regulatory reporting requirements Yes (1); No (2); record all comments
xiv	Current audit suitability Yes (1); No (2); record all comments
xv	Marine environment and stakeholders? Yes (1); No (2); record all comments
xvi	Regulations and the environmental impact of decommissioning Yes (1); No (2); record all comments
xvii	Regulations minimise the impact of decommissioning on the environment: Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5); record all comments.
xviii	Regulations are sufficiently flexible to maximise protection of the environment : Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5); record all comments.
xix	Regulator monitoring regulatory compliance adds value to stakeholders: Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5); record all comments.
xx	An offshore inspection regime would improve the audit trail: Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5); record all comments.
xxi	Should the regulator implement an offshore inspection audit: Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5); record all comments.
Theme 4: Derogations as a foundation for increasing flexibility of the regulatory framework	
xxii	Consideration of regulatory framework and flexibility: Yes (1); No (2); record all comments
xxiii	Awareness of derogation limits: Yes (1); No (2); record all comments
xxiv	Appropriateness of current derogation limits: Yes (1); No (2); record all comments
xxv	Rigs to Reef programmes: Yes (1); No (2); record all comments
xxvi	Responsibility for ongoing liability Yes (1); No (2); record all comments
Q30	Detail on derogation limits: Way too high (1); Too high (2); About right (3); Too low (4); Way too low (5); record all comments.

Q31	Greater flexibility in other basins around the world than in the North Sea? Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5); record all comments.
Q32	Rigs to reefs programme in the North sea would benefit the marine environment? Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5); record all comments.
Q33	Rigs to reef approach could be work for the North Sea? Strongly disagree (1); Disagree (2); Neither agree nor disagree (3); Agree (4); Strongly agree (5); record all comments.

APPENDIX C: Relevant presentations presented at Decommissioning Conferences during research period.

Conference title	Presentation title	Location	date
Asia Pacific 3rd Annual Offshore Decommissioning Conference	Offshore Decommissioning Regulation	Singapore	October 2011
Decom North Sea Annual Conference	Legislative Requirements for Decommissioning	Dunblane	October 2011
Royal Academy of Engineering Decommissioning Workshop	Decommissioning – The Regulatory Context	London	February 2012
National Petroleum Federation Annual Conference	Impact on decommissioning – regulatory changes present and future	Norway	March 2012
Decom North Sea annual Conference	Legislative Requirements for Decommissioning	St Andrews	October 2012
Asia Pacific 4th Annual Offshore Decommissioning Conference	Global Decommissioning Regulation	Singapore	October 2012
National Petroleum Federation Annual Conference	Impact on decommissioning – adding value within the regulatory framework	Norway	March 2013
Decom North Sea annual Conference	Decommissioning - Where is the knowledge?	St Andrews	October 2013
Decommissioning and Abandonment Summit	Oil and Gas Decommissioning in the UK	Houston	March 2014
Decommissioning and Abandonment Summit	Oil and Gas Decommissioning Comparison between US and UK	Houston	March 2015

APPENDIX D: Table of approved decommissioning programmes

Field Name	Operator at approval	Main installations decommissioned	Year of approval
Leman BH	Shell U.K. Limited	1 x platform	2017
Ettrick and Blackbird	Nexen Petroleum UK Limited	FPSO	2017
		Subsea Equipment	2017
		Pipelines	2017
ANN A4	Centrica North Sea Limited	A4 Wellhead Protection Structure	2017
Janice James & Affleck	Maersk Oil UK Limited	FPSO	2016
		Subsea Equipment	2016
		Pipelines	2016
Athena Decommissioning Programmes	Ithaca Energy (UK) Limited	FPSO	2016
		Subsea Equipment	2016
		Pipelines	2016
Viking Platforms	ConocoPhillips (U.K.) Limited	5 x fixed platforms Viking CD, DD, ED, GD, HD	2016
Leadon	Maersk Oil North Sea UK Limited	FPSO	2016
		Subsea	2016
		Pipelines	2016
Harding STL	TAQA Bratani Limited	Harding Submerged Turret Loading (STL) System	2015
Horne & Wren	Tullow Oil SK Limited	1x fixed platform	2015
		Pipelines	2015
Orwell	Tullow Oil SK Limited	Subsea Installations	2015
		Pipelines	2015
Wissey	Tullow Oil SK Limited	Subsea Installations	2015
		Pipelines	2015
Thames Complex	Perenco UK Limited	3x fixed platforms	2015
		Subsea Installations	2015
		Pipelines	2015
Gawain	Perenco UK Limited	Subsea Installations	2015
		Pipelines	2015
Arthur	Perenco UK Limited	Subsea Installations	2015
		Pipelines	2015

Brent - Brent Delta Topside	Shell U.K. Limited	Brent Delta Topside	2015
Rose Decommissioning Programmes	Centrica Resources Limited	Subsea Installations	2015
		Pipelines	2015
Stamford	Centrica North Sea Gas Limited	Subsea Installations	2015
		Pipelines	2015
Murchison	CNR	Large Steel Platform	2014
		Pipelines	2014
Rubie & Renee	Endeavour Energy UK Limited	Subsea Installations	2014
		Pipelines	2014
Miller	BP Exploration (Alpha) Limited	Large Steel Platform	2013
Schiehallion & Loyal Phase One	Britoil Limited	Schiehallion FPSO	2013
		Pipelines	2013
Ivanhoe & Rob Roy	Hess limited	FPSO	2013
		Subsea installations	2013
		Pipelines	2013
Camelot	Energy Resource Technology (UK) Limited	Small Steel Platform	2012
		Pipelines	2012
Fife, Flora, Fergus, Angus: decommissioning programme	Hess Limited	FPSO	2012
		Subsea installations	2012
		Pipelines	2012
Don	Britoil Public Limited Company	Subsea installation	2011
		Pipelines	2011
Welland	Perenco UK Limited	Small Steel Platform	2010
		Pipelines	2010
Tristan NW	Silverstone Energy Limited	Subsea installation	2010
		Pipelines	2010
Shelley	Premier Oil	Sevan Voyageur FPSO	2010
		Manifold and Wellhead	2010
		Pipelines	2010
Kittiwake SAL Export System	Venture North Sea Oil Limited	Kittiwake SAL Assembly	2009
		Pipelines	2009
MCP-01	Total E& P UK Limited	Manifold & Compression Platform	2008

Kittiwake Loading Buoy	Venture North Sea Oil Limited	Exposed Location Single Buoy Mooring System (ELSBM)	2008
Linnhe	Mobil North Sea LLC	Wellhead Protection Structure	2008
		Pipelines	2008
Indefatigable	Shell U.K. Limited	6 x fixed steel platforms	2007
		Pipelines	2007
NW Hutton	Amoco (U.K.) Exploration Company - now a subsidiary of BP plc	Large Steel Platform	2006
		Pipelines	2006
Ardmore	British American Offshore Limited	Mobile Jack-Up Rig	2005
Ardmore	Ugland Nordic Shipping AS	Single Anchor Loading Systems	2005
		Pipelines	2005
Ardmore	Acorn Oil & Gas Limited	Subsea equipment including guide frame	2005
Brent	Shell	Brent Flare	2004
Beatrice	Talisman Energy (UK) Limited	Fixed Steel Platforms	2004
Forbes and Gordon	BHP Billiton	Infield Pipelines	2003
Frigg TP1, QP & CDP1	Total E&P Norge AS	Treatment Platform 1 (TP1), Quarters Platform (QP) and Concrete Drilling Platform 1 (CDP1)	2003
Durward and Dauntless	Amerada Hess	Pipelines	2002
Hutton	Kerr-McGee	Tension Leg Platform	2002
		Pipelines	2002
Camelot CB	ExxonMobil	Fixed Steel Platform	2001
Blenheim and Bladon	Talisman	FPSO	2000
		Pipelines	2000
Durward and Dauntless	Amerada Hess	FPSO	2000
		Subsea Facilities	2000
Maureen and Moira	Phillips	Large Steel Gravity Platform	2000
		Concrete Loading Column	2000

		Pipelines	2000
Brent Spar	Shell	Oil Storage and Loading Facility	Year of revised approval: 2004
Donan	BP	FPSO	1998
Fulmar SALM	Shell	Single Anchor Leg Mooring Buoy	1998
		16” Pipeline	1998
Emerald	MSR	FPSO	1996
		Pipeline	1996
Frigg FP	Elf Norge	Flare Column	1996
Leman BK	Shell	Fixed Steel Platform	1996
Staffa	Lasmo	Pipelines	1996
Viking AC, AD, AP & FD	Conoco	4 x Fixed Steel Platform	1996
Esmond CP & CW	BHP	2 x Fixed Steel Platform	1995
Gordon BW	BHP	Fixed Steel Platform	1995
Angus	Amerada Hess	Floating Production, Storage and Offloading (FPSO) Vessel	1993
Forbes AW	Hamilton	Fixed Steel Platform	1993
Argyll, Duncan and Innes	Hamilton	Floating Production, Facility (FPF)	1992
		Catenary Anchor Leg Mooring (CALM) Buoy	1992
		Pipelines	1992
Blair	Sun Oil	Pipelines	1992
Crawford	Hamilton Oil	Floating Production, Facility (FPF)	1991
		Catenary Anchor Leg Mooring (CALM) Buoy	1991
		Subsea Facilities	1991
Piper Alpha	Occidental	Fixed Steel Platform	1988