Offshore Oil and Gas Decommissioning

Decom North Sea / Zero Waste Scotland Project
Platform Removal Methods, Inventory Characterisation and Re-use Solutions
Report and Recommendations

DECOM North Sea

ZERO WASTE SCOTLAND

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As one of the key industries in Scotland and a driving economic force, the Oil and Gas sector can play a key role in Scotland's journey towards a Circular Economy.

A Circular Economy involves keeping products in use for as long as possible to extract the maximum value from them. Within the sector there are significant opportunities, particularly around re-use and decommissioning, to unlock value from the equipment and materials used in oil and gas extraction.

Zero Waste Scotland have been pleased to be involved in the production of this report along with Decom North Sea and ABB Consulting. A shift in mindset is an integral part of the process of incorporating the Circular Economy into the Oil and Gas sector and we trust this report will stimulate discussion, innovation, greater collaboration and, ultimately, maximise the productive use and value of offshore equipment and resources.
Zero Waste Scotland

The UKCS Offshore Industry is facing significant change. The oil price has fallen, costs have been escalating and the Wood Review is being implemented by the new Oil and Gas Authority. Decommissioning activity is increasing and evidence is pointing to increased costs.

Hence we are pleased to have worked with ZWS and ABB Consulting to deliver this report. Many of our members, drawn from Operators, major contractors, service specialists and technology developers, have contributed and we appreciate their input. The findings will enable industry debate on alternative removal methods and highlight benefits of re-use and a Circular Economy approach.

With decommissioning expenditure in the North Sea set to increase from the current £1bn pa, Decom North Sea plays a vital role in solution development, cross-sector learning and building supply-chain capability. I commend this collaborative report for enabling an understanding of methods which have the potential to reduce decommissioning costs and increase efficiency.
Decom North Sea

Contents

1. Executive summary

1.1 The challenge

Over the next two decades offshore decommissioning activity in the North Sea will inevitably increase as existing field infrastructure approaches the end of its productive life. The physical process of taking offshore platforms out of service safely and securely is a sensitive, complex and technically formidable undertaking. The decommissioning challenge involves the removal of heavy structures from the most inhospitable offshore environments. It is important for Platform owners to understand the full range of removal methods available to them, as this has the potential to reduce the overall cost of decommissioning.

In addition, if these methods can facilitate the re-use and re-sale of decommissioned assets and equipment, this will bring further economic benefits and improve the sustainability of decommissioning.

1.2 Removal methods

The report gives details of the three principal recognised platform removal methods; and highlights their advantages and disadvantages. It additionally examines the effect the removal method has on the opportunities for re-use and re-sale. A summary is in Table 1.

1.3 Circular Economy and re-use

A Circular Economy involves keeping products in use for as long as possible to extract the maximum value from them. The report considers the key principles of creating a Circular Economy through the late stages of a platform's life.

The report identifies key Operator concerns and uncertainties about re-use and re-sale and suggests ways to improve the uptake of the Circular Economy principles. It also considers how Circular Economy principles could be enabled in the future by ensuring learning from current decommissioning programmes is fed back into future designs for decommissioning.

Table 1: Removal methods

Piece small	Piece small is the removal of the platform in small sections, typically less than 20 tonnes. This method limits the size of assemblies that can be removed for re-use / re-sale. However, it does allow the early removal of individual items of equipment, which will limit the level of deterioration and may increase the opportunities for re-use.
Piece large (or reverse installation)	Piece large is the removal of the platform in sections or modules of up to 5,000 tonnes. This can allow re-use of assemblies up to the size of complete modules. Re-use will be dependent upon ensuring that adequate preservation routines are in place prior to removal.
Single lift	Single lift is the removal of the platform topsides in a single unit, with the jacket also being removed in a similar manner. Using single lift, the full platform topsides could potentially be re-used in a new location. If this is not possible, assemblies up to module size could be re-used following onshore dismantling. Re-use of smaller pieces of equipment will also be possible, but care will be required to avoid deterioration prior to removal and damage during the removal process.

1.4 Study methodology

Through a combination of industry surveys, workshops and discussions key Operator concerns relating to alternative technologies and methodologies were identified and diagnosed. Suggestions for overcoming these concerns were presented by oil and gas contractors and contractors from outside normal upstream activities, including expert input from onshore demolition contractors and leading global asset re-sale specialists. The latter two groups presented an alternative perspective not considered in previous decommissioning studies. The companies involved proposed how safe, cost effective and innovative solutions could be achieved, whilst addressing the Operators' concerns.

1.5 Findings

Operators wish to understand more about the following:

- Financial viability of piece small / piece large decommissioning
- Awareness of supply chain companies which could enable alternative techniques
- Health and Safety implications of:
    - Extended offshore decommissioning work
    - Contractors less experienced in the offshore industry
- How Environmental standards will be met using alternative methods
- Technology solutions for alternative removal methods

1.6 Conclusions

- There are significant opportunities to reduce the cost of decommissioning projects using alternative techniques
    - Companies which require these techniques include demolition contractors, marine engineers, port facilities and global asset re-sale specialists
- All such removal techniques have a part to play during decommissioning:
    - In preparation for heavy lift
    - During module separation
    - As a cost-effective alternative to heavy lift options
- Late life extension and economic recovery of oil and gas can be maximised by enabling access to redundant spares from decommissioned assets

1.7 Recommendations

- Industry study to establish when alternative methodologies may be the most cost effective options
- Raise awareness of removal methods via industry events and education campaigns to improve Operator understanding of alternative methods
- Share learning from the onshore demolition market and downstream Oil and gas sector on what is required to maximise re-sale of decommissioned and redundant plant and equipment

2. Project remit

A decommissioning technology challenges workshop was held by Decom North Sea and Industry Technology Facilitator (DNS) / (ITF), following the DNS Decom Offshore 2014 Conference. During this members identified a requirement for a Removal and Disposal Landscaping Study. This was subsequently identified as an ideal project on which to work with Zero Waste Scotland, to additionally consider the effects of decommissioning methods on Circular Economy principles and impact on the potential for re-use of decommissioned equipment.

Following a competitive tendering process with member companies, DNS engaged ABB Consulting (ABB) to deliver the project in conjunction with themselves and Zero Waste Scotland.

This project had two main parts:

2.1 Removal and disposal methods

- To research the issues and requirements within oil and gas Operators related to using alternative platform removal methodologies and to identify any barriers or uncertainties relating to the alternative concepts and methods
- Raise the awareness of the different removal and disposal methods for piece small, salvage and piece large techniques and understand why these removal and disposal methods have been used less frequently to date
- Identify challenges associated with lift and removal techniques
- Propose ways to overcome the challenges – including enabling innovative technologies and identifying companies which can offer solutions using these techniques
- Examine how such techniques can also be used to minimise waiting time for lift and optimise module separation prior to heavy lift

2.2 Platform inventory and re-use solutions

- Increase the understanding and take-up of a Circular Economy approach during oil and gas decommissioning
- Characterise a typical asset inventory for an offshore platform in order to seek Circular Economy opportunities, which can maximise return on equipment and components to offset decommissioning costs
- Understand how different removal techniques impact re-use and affect Circular Economy principles
- Identify opportunities and learning from the onshore demolition industry (where re-sale has demonstrable benefit) and transfer best practice on management of liability
- Identify global opportunities for re-sale and re-use of decommissioned oil and gas assets and equipment

3. Context

This section describes the background and context against which this report has been prepared. It covers key decommissioning issues and the main drivers behind the project.

This section will cover:

- Methodology
- UKCS oil and gas decommissioning
- Decommissioning methods
- The Circular Economy
- Platform inventory & re-use / recycling
- Decommissioning methods used
- Port capabilities

3.1 Methodology

The study was completed in four main stages:

Operator survey
A survey was developed by ABB and submitted to all UKCS North Sea Operators to gain an understanding of their approach to decommissioning. The objectives of the survey were to:

- Identify and understand the barriers within their organisations to the use of alternative removal methods
- Gain an understanding of the influences and strategic drivers used to shape project and contracting strategies
- Identify the importance of Circular Economy issues and re-sale or re-use opportunities to the Operators

Asset inventory
A generic platform asset inventory was prepared (see Appendix C) to share during the workshops with Operators and asset re-sale specialists. The purpose of this was to establish and explore ideas around which items could be re-used or re-sold. The inventory was structured to identify opportunities at a number of levels (i.e. platform level, modular level and equipment level) to maximise the potential retained value.

In addition to use within the workshops, the asset inventory was sent to three asset recovery specialists for them to identify items that they could potentially re-sell.

Industry workshops
Two industry workshops were held in Aberdeen. The first workshop was attended by Decom North Sea members only, with the second workshop open to all companies. The purpose of the workshops was to:

- Highlight the issues identified within the Operator survey and identify how these could be overcome
- Identify the re-use and re-sale opportunities for platform equipment using the generic asset inventory as a guide

A list of workshop contributors is shown in Section 9.

Analysis and reporting
The output from the workshops was analysed and the key themes arising were used to identify further research requirements. The information obtained, combined with ABB's own knowledge and experience, was used to carry out more detailed assessment of the key themes. Conclusions and recommendations were then identified.

3.2 UKCS oil and gas decommissioning

The United Kingdom Continental Shelf (UKCS) is home to over 300 structures extracting oil and gas that require removal in the future. These include subsea equipment, pipelines and mattresses as well as jackets and topsides ranging from the smaller structures in the Southern and Central North Sea, (mainly gas producing assets), to the larger installations in the Northern North Sea, (mainly oil producing assets).

Many of the structures were constructed and installed in the 1970s and were hailed as technological feats. However when they were designed and installed, little or no consideration was given to decommissioning and removal at the end of field life.

The offshore Oil and Gas industry in the UK has seen a large increase in the anticipated cost of decommissioning over the past 7 years from an estimated £14bn in 2008 to over £40bn today. There is now considerable drive from within Operators and the Treasury to look at reducing the cost of decommissioning. A large proportion of the cost of decommissioning will be borne by the UK Taxpayer. The current level of tax relief is between 55% and 75%, depending on the year of installation.

Edward Davey MP, Secretary of State for Energy and Climate Change, commissioned Sir Ian Wood in June 2013 to undertake a comprehensive review of the regulation and stewardship of the UK's hydrocarbon reserves.

The Wood Review made a number of recommendations relating to decommissioning:

- **Action 25:** A new single decommissioning forum should be set up responsible for delivering significant decommissioning cost reduction, promoting innovation and greater cooperation, jointly led by the new regulator and Industry
- **Action 26:** The industry technology strategy should include decommissioning cost reduction as one of its key objectives
- **Action 27:** The regulator should ensure assets are not prematurely decommissioned, making the necessary linkage between decommissioning and access to infrastructure
- **Action 28:** New late-life business models should be promoted combining the skills of the Operator and decommissioning practitioner with a timely transaction between the two
- **Action 29:** The regulator should work closely with the industry to investigate game changing decommissioning concepts which could radically change the value proposition

The Wood Review clearly recognises the need to explore new technologies to take on the challenge of reducing the total cost of decommissioning assets and this study aims to support its recommendations.

Table 2: Type, location, number & size of North Sea oil and gas installations

Country	Steel Jacket	Concrete Substructure	Subsea	FPSO	Total	Tonnes
UK	227	12	56	17	312	2290
Norway	69	13	54	9	145	1750
Netherlands	118	2	7	0	127	340
Denmark	39	0	0	0	39	114
Germany	1	1	0	0	2	0

Source - KIMO International

3.3 Decommissioning methods

There are a wide range of platforms and structures across the North Sea and so a range of decommissioning methodologies must be considered to select the best method for the stage, size and type of asset.

There are a variety of approaches that can be taken to the removal of platform topsides and jacket structures. The selection of removal method will depend upon a number of factors, including the nature of the platform structure, the availability of resources and the overall costs. The methods are broadly categorised into the following principal groups.

3.3.1 Piece small

Piece small is generally defined as the removal of platform topsides in small pieces of up to approximately 20 tonnes. These pieces can be lifted either by the existing platform cranes or temporary cranes onto a supply boat or barge.

This method is not suitable for platform jackets (either steel or concrete) and these would need to be considered separately.

3.3.2 Piece large

Piece large includes both modular removal and reverse installation methods. This is considered to be the removal of the platform in large sections greater than 20 tonnes, potentially up to 5,000 tonnes. The topside facilities are mechanically separated and lifting points installed. The modules are then individually lifted directly onto a barge.

Piece large can also be used for removal of steel jackets. These can be cut up underwater into sections and these sections lifted individually onto a supply vessel or barge.

Figure 1: Mobile Shear

3.3.3 Single lift

Single lift is where the entire platform topside structure is removed as a single unit. Currently, the maximum weight that can be lifted is 48,000 tonnes. This method requires the design of the topsides to have sufficient structural integrity to allow the lift, otherwise significant structural reinforcement is necessary.

This method is also appropriate for steel platform jackets, although most concrete jacket structures will be too heavy and lack sufficient structural integrity for this method to be used.

Figure 2: HVDC - Light Station ValHall

3.3.4 Refloating

This method can be used for the removal of jackets, generally once the topsides have been removed. In the case of steel jackets, buoyancy tanks are fitted to the legs of the structure and used to lift the structure from the sea bed. The jacket is then floated into sheltered water where it can be cut up using piece small or piece large techniques.

Some concrete jackets have been designed for refloatation at the end of their life. However, there are significant concerns as to whether this will be technically feasible and therefore these have not been considered in detail in this report. For more information on this, refer to HSE research report 58, Decommissioning Offshore Concrete Platforms.

To date the majority of platforms removed from the UK sector of the North Sea have been removed by single lift. In the main, these have been smaller Southern North Sea Gas producing assets.

Table 3 indicates the method used for the structures which have been decommissioned from the North Sea to date.

Table 3 - Example of UKCS Fixed Platforms Decommissioned & Removal Methods used

Platform Name	Type of Jacket	Topsides Decom	Jacket Decom
Camelot CB	Small steel	Single lift	Single lift
Forbes AW	Small steel	Single lift	Single lift
Frigg CDP1	Concrete	Piece small / Piece large	Not removed
Frigg MCP-01	Concrete	Piece small / Piece large	Not removed
Frigg QP	Small steel	Single lift	Single lift
Frigg TP1	Concrete	Piece small / Piece large	Not removed
Inde JD	Small steel	Single lift	Single lift
Inde JP	Small steel	Single lift	Single lift
Inde K	Small steel	Single lift	Single lift
Inde L	Small steel	Single lift	Single lift
Inde M	Small steel	Single lift	Single lift
Inde N	Small steel	Single lift	Single lift
Leman BK	Small steel	Single lift	Single lift
Maureen A	Gravity-based steel	Refloated	Refloated
North-West Hutton	Large steel	Piece large	Piece large
Viking AC	Small steel	Single lift	Single lift
Viking AD	Small steel	Single lift	Single lift
Viking AP	Small steel	Single lift	Single lift
Viking FD	Small steel	Single lift	Single lift
Welland South	Small steel	Single lift	Single lift
West Sole WE	Small steel	Single lift	Single lift

Source: ABB research from vaious sources

3.4 The Circular Economy

A Circular Economy involves keeping products in use for as long as possible to extract the maximum value from them. Zero Waste Scotland, in partnership with Decom North Sea, have been exploring opportunities to establish a CE approach in the oil and gas decommissioning sector.

There are well recognised benefits to implementing Circular Economy principles. These include:

- Reduced environmental impact from lower material and energy use
- Economic benefits from maintaining the maximum value of equipment and products, value that is lost when they are disposed of or downcycled
- Significant increases in employment compared with direct disposal

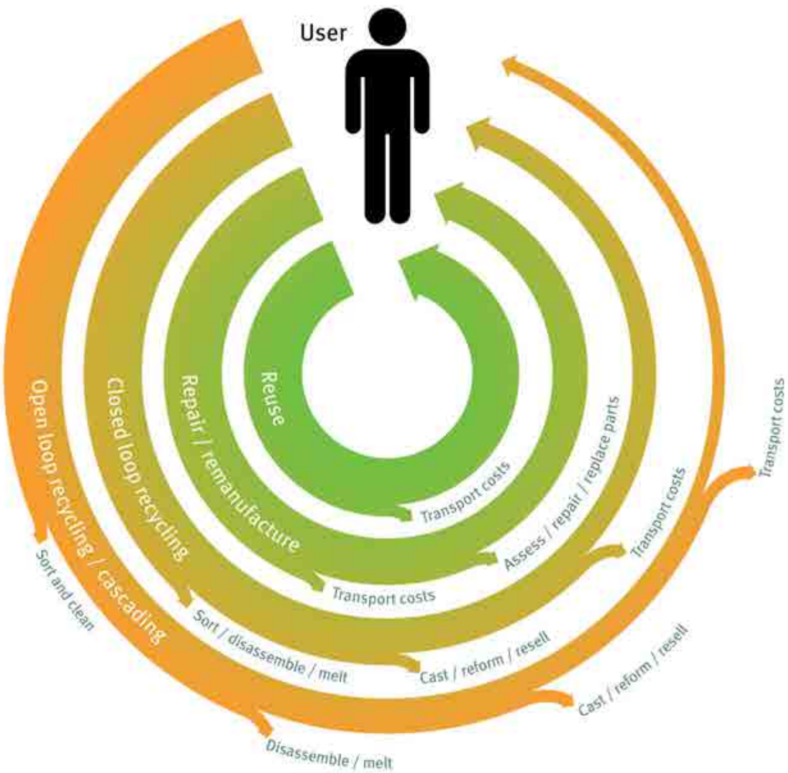
In the Zero Waste Scotland report Circular Economy Scotland, a Circular Economy is described as follows:

At its best, a Circular Economy (Figure 3) restores old products, parts and materials back to their original use in a way that uses the least resources to deliver the same function. Ideally, this means direct re-use of products, which preserves both the highly engineered character of a product and its useful function.

Where a product needs repair or reconditioning before it can be used again, remanufacturing preserves the most value. These are the tightest 'loops' within a Circular Economy. The next best route is recycling, which can be closed or open loop. Closed loop recycling turns products into materials that can be used to create the products they were recovered from: examples include glass bottle to glass bottle or speciality alloy to speciality alloy recycling. In contrast, open loop recycling, or downcycling, creates material suitable only for lower value applications. For example, glass bottles can be used for construction aggregate and speciality alloys can be downcycled into bulk metals. Although lower value, this avoids the use of new materials.

Achieving a more Circular Economy will mean governing differently. More collaboration, both within and across sectors, needs to be underpinned by more entrepreneurial institutions, whether led by the state or industry.
(Source - Circular Economy Scotland report)

Figure 3: Circular Economy Scotland report - Keeping value in a Circular Economy.



3.5 Platform inventory & re-use / recycling

Table 4 contains an extract from Appendix C showing the types of equipment which are typically found on an offshore oil and gas platform in the North Sea and indicates whether they are likely to be re-useable or re-saleable.

Table 4: Extract from Appendix C

Module	Re-use options at module level?	Assemblies	Re-use options at assembly level?	Equipment	Re-use options at equipment level?	Re-sale to specialist	Recycle
Accommodation block	Re-use on other platform. Temporary accommodation onshore.	HVAC	No	Fans			Y
				Ducting			Y
				Dampers			Y
				Motors		Y	Y
				Insulation			Y
		Living quarters / ablutions	No	Soft furnishings			Y
				Partitions / ceilings			Y
				Beds			Y
				Showers / toilets etc.			Y
		Catering equipment	No	Ovens / hobs			Y
				Dishwashers			Y
				Preparation tables			Y
				Fridges / freezers			Y
				Dining furniture			Y
				Serving counters			Y
		Fresh water generator	Yes if built as a small module	Vessels	Re-sale if stainless steel	Y	Y
				Pipework			Y
				Pumps		Y	Y
				Filtration			Y
				Valves			Y
							Y
		Fresh Water Distribution	No	Storage tank	Re-sale if stainless steel	Y	Y
				Distribution pumps		Y	Y
				Coalescer units		Y	Y
				Filter units		Y	Y
				Pipework			Y
				Valves			Y
		Sewage treatment system	No				Y
		Lifeboats and lifting / release equipment	Yes if built as a small module	Lifeboats	Yes - if to current standards		Y
							Y

As demonstrated by Table 4, a significant proportion of the asset and equipment, following and beyond CoP, may be suitable for re-use, re-sale or recycling. The full asset inventory in Appendix C demonstrates the range of assets and equipment (in addition to those typically expected, such as accommodation blocks, canteens etc.) that may be suitable for use in other industries.

3.6 Decommissioning methods used

The current techniques being deployed, both for decommissioning and dismantling, are basically “reverse engineering”, or normal operational practice. However, if equipment is not suitable for re-use or re-sale and the remainder of the asset has been cleaned to a level that is deemed to be ‘hydro-carbon free’, standard demolition techniques can prove more cost effective and demonstrate extremely high safety standards. The project then becomes a material segregation project, with no need to protect the asset value. The demolition techniques that could be applied offshore are discussed later within this report.

Re-sale and re-use of plant and equipment must be considered well in advance of Cessation of Production (CoP). This greatly enhances the opportunities to find alternative uses and to develop preservation strategies. This avoids much of the equipment that could be re-used falling rapidly into disrepair and consequently becoming unusable.

3.7 Port capabilities

The removal technique(s) used will determine which disposal yards are capable of handling the removed structures and equipment. If the majority of redundant offshore structures are removed single lift this is likely to create a potential bottle neck in the system. This may result in delays to decommissioning programmes, increased costs, through increased time from CoP to removal and reduced competition within the market. There is a danger that this will result in decommissioned structures being transported to different disposal yards out of the UK.

Currently, the only yard on the United Kingdom mainland that can accept the largest of the heavy lift vessels is the upgraded Able yard on Teesside. If alternative methodologies are deployed, then opportunities to use a range of yards on the UK east coast arise, including Peterhead, Aberdeen, Montrose, Tyneside and Great Yarmouth. Other UK yards are reviewing the potential benefits of upgrading their facilities.

The opening up of these yards also allows greater consideration to be given to the onshore logistics required once the platforms have been brought to shore.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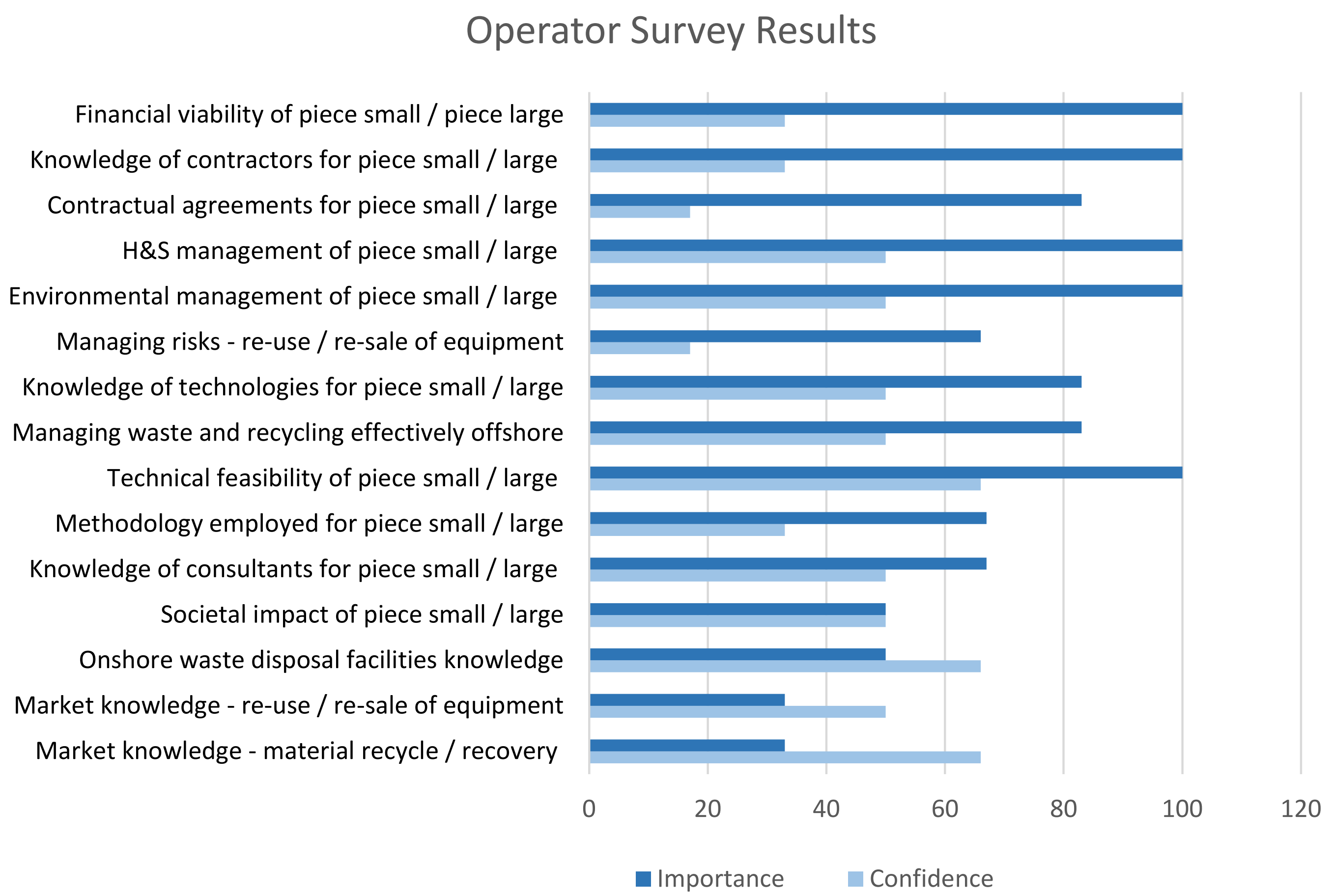
4. Operator survey summary

The Operator survey asked a number of questions relating to the challenges and hurdles that need to be overcome in order to undertake piece small or piece large removal of offshore platforms. The respondents to the survey were asked to assess the importance of certain factors in relation to piece small, piece large, re-use and re-sale, and their level of knowledge on each specific factor.

The results have been collated and the respondent's replies shown in graphical form in Figure 4. For example, the first question regarding financial viability of piece small / piece large removal, the graph shows 100% of Operators think it is essential to understand the financial viability of piece small / piece large removal, but only 33% of Operators are confident that this can be calculated accurately.

Figure 4: Operator Survey Results



The output of the survey clearly shows all Operators agree on the importance of 5 factors (Identified as essential by all respondents), these are listed and analysed in detail opposite.

4.1 Financial viability

Understanding of the costs involved in each decommissioning strategy is essential. There is currently an understanding of the costs of single lift and piece large, but so far there is limited benchmarking data available to determine the overall costs of a piece small project.
To complete an assessment of the project costs, the following factors need to be considered:

- Costs of labour working offshore
- Productivity of labour and effects of offshore conditions (weather, sea state) etc.
- Cost of vessel hire
- Cost of decontamination

It is also important to understand the availability and cost of alternative vessels to support removal and the cost savings that vessel support could offer, as set out below:

- Transporting labour offshore by boat vs helicopter flights
- Vessels to power platform vs existing platform power systems
- Using vessels as hotel vs accommodation module on platform

A further consideration is the amount and cost of decontamination and enabling works required to facilitate alternative removal methodologies.

There is only a small number of contractors who have practical experience of working offshore. It is important to factor in how competition to this area may drive down cost in the future.

Evidence is required to demonstrate the antiscipated productivity of different technologies working in an offshore environment. Then these should be based on rates achieved onshore, with the application of factors for offshore working environment and weather. This can then be assessed by Operators. In addition, typical costs for vessels to support offshore demolition are required to assess the costs. This information will ensure greater accuracy in appraising and costing alternative removal methodologies.

> “Little accurate offshore piece small benchmarking data available. Achievable productivity in an offshore environment remains uncertain. Both techniques may be in competition.”

> “Some knowledge of contractors who have proven experience in undertaking work offshore, more experienced contractors required.”

4.2 Knowledge of contractors

Operators consider it essential to have knowledge of competent contractors available to undertake alternative removal methodologies. Only a small proportion of onshore demolition contractors have been involved in previous offshore decommissioning workshops and seminars, with a few expressing interest in working offshore to date. Operators are not generally aware of the rigorous systems, procedures and training undertaken by demolition contractors in order to work in hazardous environments such as Nuclear, Chemical and Petrochemical.

To overcome this requires that more UK demolition contractors engage with Operators to share learning and experience from onshore demolition projects including the nuclear sector. This could be achieved with the help of Decom North Sea through its initiatives to drive collaboration.

> “Lack of exposure and poor outdated perceptions of onshore demolition industry creates the lack of confidence in the contractor community.”

4.3 Health and safety management

Another key Operator concern is managing health and safety risks. It is important that health and safety management is understood for comparative assessment. Operators expressed that it was important to demonstrate practical experience. It is therefore necessary to share practical experience from onshore demolition and demonstrate how this is applicable to an offshore working environment.

This could be achieved by engaging early in the planning process with a demolition consultant or contractor to carry out risk assessments and produce a health and safety plan. It is very important to discuss concerns with contractors and consultants, which is not new for demolition contractors. In the 1990's the same issues existed in the chemical industry where they used engineering companies to remove structures. It was only when a demolition contractor had an opportunity that the chemical industry realised the cost savings that could be achieved, which proved to be over 60%. The nuclear industry have also recently worked with demolition contractors, undertaking feasibility studies and the demolition of buildings within live nuclear sites.

"Understanding of health and safety management of both techniques required for comparative assessment / option selection."

4.4 Environmental management

The Operators main environmental concerns are exposure of the workforce to hazardous materials and environmental release to sea. A further concern is how materials can be managed effectively offshore.

The Operators lack of confidence is driven through a need to understand how piece small and piece large removal will take place. A clear description of the approach needs to be given for both methodologies and shared as a standard amongst all Operators.

"Understand from feasibility studies undertaken how this can be managed - no practical experience demonstrated."

Onshore contractors understand the need to follow procedures to ensure protection of the environment, as robust environmental management is a key requirement for working within the onshore process industries. Contractors have experience of dead leg and trapped pressure point identification, management of residual materials and containment of fluids. Demolition consultants and companies are used to working in these high hazards environments and have the systems, processes and procedures in place to manage the risks.

Managing waste offshore depends on the removal methodology, space available to sort and segregate into skips. Again this is not new, demolition contractors understand the most efficient solutions to segregate and recycle waste, whether this is done in an offshore environment or back on shore. Onshore experience can be shared with Operators to demonstrate capabilities and overcome Operator concerns.

"Technical feasibility of both piece small and piece large has been demonstrated."

4.5 Technical feasibility

The survey results show all Operators agree that it is essential to understand the technical feasibility of piece small or piece large removal and that 66% of Operators are confident that this can be achieved.

This indicates that Operators who have undertaken decommissioning in the past, plus Operators considering decommissioning programmes, have considered and carried out comparative assessments between the three alternative removal methodologies. Their assessments have demonstrated the viability of alternative removal methods.

"Would like to understand contract model for sale of plant items to manage and mitigate risk."

4.6 Other considerations

The following three factors were also considered to be very important by the Operators responding to the survey (83%)

- Contractual arrangements for piece small / piece large: It was noted that the contracting approach to single lift is relatively straight forward, with a single contractor taking on the bulk of the work and associated risks. This model may not be available when using alternative methodologies and at the present time, there is no standardised contract designed specifically for this type of work
- Knowledge of technologies for piece small / piece large: The Operators acknowledged that they were unaware of the capabilities and technologies that exist within the onshore decommissioning and demolition industries
- Managing waste and recycling effectively offshore: The process for segregating and ensuring that waste was not lost or double handled, particularly during piece small decommissioning is not clear to Operators at this point in time. Demonstration of how this would be effectively managed is required to provide confidence that it will not become an issue during implementation

Figure 5: Nab Lighthouse - Before

Figure 6: Nab Lighthouse - During

Nab Lighthouse development - demolition contractors used to remove steel structure prior to construction of new tower.

Figure 7: Nab Lighthouse - After

5. Workshop findings

In this section we summarise the key findings from the two workshops, identifying the various Operator concerns when appraising alternative removal methodologies. This section also identifies specific challenges when considering re-use or re-sale of redundant equipment and spares.

During the first workshop the tone was one of resistance to alternative removal methodologies. The second workshop had a much more positive attitude towards the alternative methodologies with contractors putting forward ideas about how they could be applied successfully.

5.1 Removal techniques

The key findings are summarised in this list and covered in more detail below:

- Operator confidence in alternative methods
- Use of onshore contractors and techniques
- Understanding of equipment types for offshore use
- Assessment of project options
- Offshore workload
- Financial risks

Figure 8

5.1.1 Operator confidence in alternative methods

Operator confidence was identified as a key issue in the adoption of alternative strategies (including piece small, piece large, refloatation and salvage,) this was a clear output of the Operator survey. In discussions during the workshops, the main issues were confirmed by attendees, and were attributed in part to there being a lack of information available to Operators regarding:

- Environmental, health and safety issues. There was concern from Operators that the use of alternative techniques would entail significantly greater work offshore than a straight forward single lift. This is seen to significantly increase the risk to personnel through the increased number of man hours spent working offshore
- Costs in comparison with the use of single lift. The cost models for single lift are relatively straight forward to develop and this option is perceived to have limited financial risk under the right contracting model. In comparison, work rates for piece small decommissioning offshore are unknown and the costs of this strategy are heavily dependent upon the accuracy of the data being used in the cost models. Therefore this is perceived to be a significant potential cost risk
- Viability of the other options. The technical issues with single lift / reverse installation methods are well understood within the Operator organisations. There is less information available regarding the alternate options as they have not been widely used within the North Sea

Operators confirmed that they have little awareness of the capabilities of the onshore demolition companies and how these contractors may be able to deploy their expertise offshore. It was noted that to date, there has been little interaction between these contractors and the Operators.

"Need to demonstrate to offshore community that demolition is not 'rough and ready' as perceived - It is a thought through and considered process."

5.1.2 Use of onshore contractors and techniques

It has been noted in the previous section that Operators are risk averse and this issue also affects the judgement applied in the selection of decommissioning strategies. Specific issues raised were:

- The willingness and suitability of personnel from onshore demolition industry to work offshore. This issue was raised by a number of offshore organisations, but the concern was not shared by the onshore demolition contractors. One factor feeding this view was that the level of training and certification undertaken by onshore demolition personnel is not understood by the offshore community, where demolition is still regarded as a low skill industry
- The alternative techniques, particularly piece small, were not considered to be feasible within the boundaries of the existing operating regime and associated management systems used by offshore Operators. An alternative regulatory / management process would be required in order to allow some of the alternative techniques to be used. The view was expressed that once a platform is hydrocarbon free (as far as practicable) and isolated from all hydrocarbon sources, it could then be considered as any other non-oil and gas offshore structure

"Perception that onshore personnel would not be suitable / willing / able to work offshore - may be strong resistance from them to go offshore."

5.1.3 Understanding of equipment types for offshore use

One of the workshop objectives was to obtain information regarding the different equipment, tools and techniques that could be deployed offshore with regard to implementation of alternative decommissioning methodologies and in particular those that have not already been widely used within the industry. The key equipment requirements were identified as:

- **Lifting** - It was noted that existing platform cranes have limited capability and may be in need of costly and time consuming repairs. Alternatives identified (in addition to heavy lift vessels) were self-erecting tower or pedestal cranes that can be deployed relatively easily on a platform
- **Cutting** - In addition to diamond wire cutting, which is already used extensively in decommissioning, the capability of cutting shears should also be considered as these are used extensively within the onshore demolition sector
- **Vessels** - A number of alternative vessels could be adapted to suit offshore decommissioning offering a saving over the cost of the existing oil and gas services fleet. It was highlighted that further cost savings could be achieved through transporting contractors, accommodation, and power for the platform all being run from the support vessel. This would offer cost savings compared to using helicopters to transport contractors, flotels for accommodation and using existing power on the platform, which could prove uneconomical when the platform is in lighthouse mode

Much of the equipment above can be deployed remotely via robotic, hydraulically controlled machines. These could be operated from a vessel adjacent to the platform, which would minimise the number of personnel on the platform and therefore the associated risks.

These technologies and other additional technologies could be further developed as required. In order to achieve this, contractors would need to work closely with Operators to identify the technology challenges and then work with their suppliers to develop appropriate solutions.

A more detailed discussion on the relevant equipment and its applicability is covered in Appendix D.

“Robotic demolition machines available (shears on machines) that could be driven remotely from support vessel. Various sizes available.”

5.1.4 Assessment of project options

In assessing decommissioning strategies, it was agreed that there is no one solution that works for every case. Each platform needs to be considered individually and the pros / cons of each methodology assessed against the specific platform conditions.

It was noted that the smaller the pieces that a platform is broken into, the greater the options with regard to craneage timing, support vessel cost / availability and choice of port facilities.

This needs to be set against the increased amount of work to be undertaken offshore to dismantle the platform. The idea of a ‘sweet spot’ for each asset was discussed, where the conditions for that asset at the time of decommissioning dictate the optimum method of decommissioning.

“Is there a ‘sweet spot’ (in terms of platform size) where piece small is more efficient than heavy lift / single lift.”

5.1.5 Offshore workload

Through experience of constructing and operating platforms for many years, Operators are aware of the costs of carrying out work offshore. Significant cost drivers were identified as flight costs to / from the platforms, accommodation costs and poor productivity due to the constraints of weather, safety systems etc. Therefore, the logic that is usually applied is to minimise the amount of work that is done offshore.

> "Perception - always going to be cheaper to do demolition onshore"

The workshops discussed how some of these costs can be significantly reduced such as adopting the concept of walk to work vessels, with labour transported by ship. These vessels, if correctly specified, could provide all accommodation requirements and also provide craneage, load handling and essential platform services that would allow the early shut down of the platform systems. This would make the process of decommissioning simpler as there would be fewer (if any) residual live systems on the platform.

5.1.6 Financial risks

The potential risks associated with adopting an alternative decommissioning strategy were considered. A number of examples where significant cost or time overruns have occurred were cited. The single lift option is considered to involve the least financial risk as the majority of the work is undertaken by or through the single lift contractor. Therefore, risk can be transferred to the contractor via the commercial agreement.

> "Reverse installation (heavy or single lift) seen as first option, but costs are prohibitive due to vessel availability / cost."

Alternative strategies will therefore need to offer considerable advantages over single lift in order for them to overcome the perceived risks associated with them. It was suggested that the potential cost saving would need to be in the order of 50%. However, the financial case needs to be appraised on typical Northern North Sea and Southern North Sea platforms in order to demonstrate the potential for cost reduction.

A number of general issues that affect decommissioning methodology selection were also raised. These are summarised as:

- Issues with availability of information on the design, construction and subsequent modifications of the platforms can have a significant impact on project costs. This is an issue that varies between platforms and is usually worse when a platform has had multiple owners. The information requirements for any decommissioning strategy will need to be considered in the early parts of any project and technologies such as 3D scanning should be considered in order to reduce survey requirements and to fill gaps in existing knowledge base
- Residual contamination levels following decontamination. The actual definition of clean will vary depending upon the anticipated final disposal route. Greater decontamination was anticipated as being necessary for equipment that was destined for re-use, and preservation strategies will also be required. Greater decontamination and removal of trapped liquids and dead legs would be required if using piece small, this would be required to remove the potential for environmental release during demolition offshore. Less cleaning would be required offshore if using piece large or single lift, where modules or topsides could be removed with further cleaning taking place onshore. Any environmental release would have less impact due to availability of drainage systems and interceptors to capture any release
- The overall scope of works that should be undertaken was questioned. The environmental benefits of full removal of underwater structures need to be clearly understood in order to demonstrate that undertaking this work would provide the overall best practicable environmental option
- Contractual models were considered. At this point, Operators are open to any contracting model for discussion. It was noted that early contractor engagement would allow the best solution development for any specific platform. It is understood that the concept of a standardised decommissioning contract is also being considered by LOGIC, part of Oil and Gas UK

5.2 Circular Economy and re-use

The key findings were as follows:

- Linking decommissioning methodology and the Circular Economy
- Release of equipment for re-use
- Markets for the equipment
- Cost of equipment recovery
- Typical equipment that could be re-used

5.2.1 Linking decommissioning methodology and the Circular Economy

During the workshops, the only significant issue identified linking the selection of decommissioning methodology and the Circular Economy related to the size of the items that could be re-used. Re-use at a module or even full platform level requires that item to be removed intact. Therefore piece small would not be possible.

“Does the decommissioning methodology reduce or increase potential for equipment re-use?”

For smaller items of equipment, it was considered to be no more technically difficult to remove items of equipment offshore as part of a piece small decommissioning strategy than it is to achieve this onshore following a single lift or piece large decommissioning route.

However, other advantages of using a piece small route for recovery of equipment for re-use were identified. The ability to remove items earlier in the process reduces the overall timescale that preservation maintenance needs to be carried out, increases the timeframe for a re-use opportunity to become available and reduces the potential for damage during the decommissioning process.

It is important that any equipment that has a significant re-use potential or re-sale value is identified early in the decommissioning methodology selection process. An informed decision can then be made if the recovery of this equipment can be economically achieved and which decommissioning methodology is most appropriate.

5.2.2 Release of equipment for re-use

It was generally acknowledged by personnel attending the workshops that the North Sea Operators, due to the nature of their business, need a high degree of confidence in unproven methods to minimise risk. An example of this is that Operators have been reluctant to release equipment on to the re-sale market. One reason for this was highlighted as a concern that some residual risk will remain with the re-sold or re-used equipment.

“Perceived liability issue if future failure of equipment that has been sold on. Operators are very risk averse.”

It was noted that this risk can be mitigated through a number of means and that the asset re-sale companies already have in place contracts and processes that minimise or eliminate the risk entirely. It was also noted that regulations within this area place the onus on proving equipment suitability on the new user, not the previous owner.

A further area of concern was identifying the point at which the Operators’ duty of care to trace all wastes returned to shore comes to an end. The preference expressed was that this point would be at the time that the equipment was transferred to the ownership of an asset re-sale specialist, as this avoids extended liability monitoring.

5.2.3 Markets for the equipment

Due to the risk averse nature of the industry, there is also a reluctance to consider the re-use of old equipment. The reasons for this relate to:

- Perceived risk that the equipment will be less reliable than a new item and that the overall cost saving from re-used equipment will be lost in reduced production efficiency or downtime and maintenance costs
- The use of existing equipment may introduce some perceived undesirable compromises within the final design, as it is unlikely that it will be a perfect fit with the design requirements and may also cause issues with equipment layout
- In certain areas (e.g. combustion equipment, pressure vessels etc.), the modern regulatory requirements may not be met by older equipment and this may entail significant re-engineering of the equipment prior to re-use
- Older equipment may not provide the same functionality or effectiveness as modern equivalents. This is particularly the case with electronic items such as control systems, but also applies to other items such a process equipment

"Early identification of equipment is essential to allow marketing and ensure adequate preservation is in place."

It was noted that these issues are particularly prevalent within the UK Oil and Gas sector. Other industries (including safety critical industries such as aerospace) have a significant re-use sector, particularly for spare parts. It was also noted that elsewhere, equipment suppliers actively manage their old equipment with re-use in mind. One example quoted was Solar Turbines, who have a remanufacturing facility in the USA and actively resell used, refurbished equipment.

Figure 9: Onshore case study - Decommissioning of a LNG Plant

There was a major issue with the disposal of the Perlite insulation on the vessels. Traditionally this is disposed of to landfill and would have cost several millions of pounds. Alternative uses where investigated, the Perlite was re-used as aggregate in the manufacturing of construction building blocks. Overall re-use / recycling on the project was over 99%.

5.2.4 Cost of equipment recovery

The cost and benefits of equipment re-use were considered within the discussions at both workshops. The main issues identified were:

- Removal of equipment for re-use will need to be more carefully planned and executed than removal for recycling, due to the need to maintain the integrity of the equipment. This would potentially entail additional cost and offshore working
- There will be a delay between the Cessation of Production (CoP) and the time that the platform will be decommissioned. In order to maintain the equipment integrity during this period, it will be necessary to implement a preservation regime. The cost of this will need to be more than offset by the additional value that can be realised from the re-use of the equipment
- There were also queries raised regarding the potential implications of Value Added Tax on re-used equipment. This issue is under investigation, by others, but the actual VAT treatement will depend on a number of factors specific to each platform

"Perception that cost to maintain or recover intact outweigh market value."

As a result of the above issues, it was suggested that for re-use of equipment to be viable there will have to be a significant premium above the equipment's scrap value. Typically onshore this is in order of three times its scrap value. This figure will vary depending upon the value of the equipment concerned and the decommissioning method.

In addition to the financial incentive it was suggested that other measures should be considered in order to promote the re-use of equipment. These include:

- Promotion of social benefits of re-use and developing and maintaining the environmental credentials of the Operators whilst supporting the Circular Economy

- Promotion of re-use through an awards scheme

Figure 10: Topsides being lifted off the Welland platform prior to being refurbished and redeployed on a new development in West Africa.

5.2.5 Typical equipment that could be re-used.

Within the workshops, a typical platform inventory was shared and comments invited on the potential for re-use of equipment, either at a module, equipment or item level. The inventory is included as Appendix C.

It was noted that there has been an example of a full platform topsides from the Southern North Sea sector being re-used on a new installation. Figure 10 was the Welland platform that was decommissioned by Perenco. The topsides were re-used on a new Mobile Offshore Production unit (MOPU) in a gas field off Western Africa (see Figure 11).

Additionally, Statoil have recently reached agreement with ConocoPhillips for the re-use of the complete topsides of the Huldra platform on a new development (subject to project approvals).

Both of these platforms are relatively small (Topsides weight; Welland 1,000 tonnes – Huldra ~5,000 tonnes, both unmanned installations). In the case of the Welland, significant re-engineering and refurbishment was required, due to the time between CoP and removal. However, this demonstrates that the concept of re-use at a platform level is economically viable and the learning from this exercise can be incorporated into future projects.

"Equipment needs only to be in re-saleable condition - does not need to be perfect."

Figure 11: Welland topsides re-used on a new MOPU in the Sanaga field.
(Photo from Overdick GmbH.com)

A number of asset re-use specialists identified the key items that could be re-used include:

- Power generation equipment
- Standalone process modules - Glycol regeneration, desalination etc.
- Rotating equipment
- High value or long lead time fixed items
- Tubulars e.g. for piling

Other items may also be suitable for re-use or re-sale, dependent on age, condition and specification.

A more detailed analysis was supplied by IPPE and Indassol following the workshops. This is included within the inventory data included in Appendix C.

A number of factors affect the quantity of equipment that could be re-used. These factors were identified as:

- Availability of information. This is a key factor in confirming the equipment design details and specifications, therefore its suitability for any future application. Maintenance information is also of use to demonstrate that current condition of the equipment and to identify any significant issues / modifications that have been completed
- Age, specification and condition of equipment are also significant factors. The older the equipment, the less likely it is to conform to modern design standards and the more potential issues that may exist with remaining design life etc.

6. Discussion of findings

This section of the report covers the findings and analysis of the workshops, Operator survey and discussions with various suppliers across the decommissioning and equipment re-use industries. The areas discussed are:

- Advantages / disadvantages of alternative methodologies
- The case for alternative removal methodologies
- Practices learning from other sectors

6.1 Alternative removal methodologies

This section details some of the potential advantages and disadvantages of the three main removal methodologies. This is not an exhaustive list, but highlights some of the main factors that will need to be considered when developing the comparative assessment. As discussed earlier, the removal methodologies will be influenced by the platform design and size, and there may not be the opportunity to consider alternative removal options.

We have assumed that for the purposes of this report and following assessment, that a typical platform would be suitable for each of the main removal methods. Typically a platform may require a combination of a number of different removal techniques, even single lift may require some piece small decommissioning to allow for well P&A or the construction of new pad eyes / lifting attachments for example.

6.1.1 Piece small

Piece small is considered to be the removal of the platform in small sections generally less than 20 tonnes.

Advantages	Disadvantages
— A heavy lift vessel is not needed, providing greater flexibility around timescales for removal for both the platform and the jacket — No long term delay — Piece small can start during late life which has the added value of freeing up deck space, reducing topside weight and reducing maintenance cost — All plant, equipment and structural sections can be removed and materials segregated into the various recycle streams and loaded onto a supply boat or barge — Re-sale / re-use items can be removed at an earlier stage and potentially delivered to the end user sooner, encouraging re-use, reducing the leading time when equipment becomes available. This will allow for identified critical equipment to become available for other operating platforms at an earlier stage — Increase in onshore disposal yard availability to receive and process materials once it comes a shore	— A higher level of decontamination of plant and equipment maybe required prior to topside ‘dismantling’ to prevent potential loss of containment. Heavily contaminated material may need to be sealed up and lifted whole and transported to shore for further decommissioning — Piece small decommissioning will involve more hours being worked offshore — There are a number of workforce safety issues e.g. multiple vessel trips to shore, limited number of demolition personnel with experience of working offshore, the timing for the decommissioning of essential life support services, decommissioning crew’s lack of familiarity with installations — The removal rate may be influenced on the initial availability of the deck area for material processing — Piece small removal of the jacket will require significant additional subsea working than the other removal options — Work will stop whilst supply vessels transport dismantled items to shore — Perceived lack of cost certainty with the potential for costs to escalate — Increased risk of dropping items to sea bed — Safe systems of work and procedures will need to be reviewed and modified. Current systems are for keeping process operations safe and may not cover the risks associated with this type of work

6.1.2 Piece large / modular removal

Piece large includes both modular removal and reverse installation methods. This is considered to be the removal of the platform in large sections greater than 20 tonnes, potentially up to 5,000 tonnes.

Advantages	Disadvantages
— A wider range of heavy lift vessels are now available, this will allow for greater flexibility when planning removal activities — Smaller number of lifts required, reducing the time offshore — Modules only have to be separated for lifting, reducing the preparation time and reducing the risk of loss of containment — Modules can be lifted by one crane in a single campaign and stacked on barges for transport to shore. Removal can be undertaken on a 24 hour basis, reducing the risk from delays due to bad weather — The use of a support vessel to transport the workforce is potentially a much cheaper alternative than helicopters to transport workers to platform — Plenty of options in regards to onshore yard availability to receive and process modules further — Re-sale / re-use plant and equipment will remain in situ and be removed once delivered to shore, where it will potentially be easier to remove. General rule is less lifts equals less opportunity for damage	— Lifting points on the modules must be reinstalled, or if in-situ retested — The platform may have been significantly modified since original construction. This may require some equipment to be removed to obtain a suitable centre of gravity — There is increased work associated with separation of the modules compared to single lift, but less than piece small — There are more lifts for the lift vessel which will increase the likelihood of delays due to bad weather — There may be additional difficulty associated with handling items out of reach of the cranes that may require multiple repositioning. This will be determined by the type and size of the crane — Greater cost certainty with the potential for costs to run away reduced — Jacket may require additional structural stiffening to allow for lifting to prevent the jacket collapsing whist tailing and lowering onto transport barge — There may be a delay in removing the re-sale / re-use plant and equipment, so preservation measures will be required

6.1.3 Single lift

Single lift is where the entire platform topside structure and jackets are removed as single lifts. Currently, the maximum weight that can be lifted is 48,000 tonnes, but this is very dependent on the structural makeup of the platform / jacket

Advantages	Disadvantages
— The same lift vessel may be used for both the top side and jacket — There are fewer lifts, therefore less time is required for module separation and time at sea — Less cleaning required of the platform offshore, reducing the risk of loss of containment — Less labour hours working offshore equals less exposure, equals less opportunity for HSE events — Greater cost certainty — Re-sale / re-use plant and equipment will remain in situ and be removed once delivered to shore, where it will be potentially easier to remove. General rule is less lifts equals less opportunity for damage	— Limited number of heavy lift vessels and disposal yards that are available to cope with the potential high demand, this will have a potential impact on programme and cost — Additional maintenance costs due to platform being in a 'lighthouse' state for a significant period of time prior to removal — Lifting points on any modules and the integrated deck may need to be reinstalled if not using Pioneering Spirit type vessel. Suitable modifications to the platform may be required, with additional structural steelwork fitted to provide suitable lifting points — The flare may have to be cut and removed in sections — If a tandem lift is required for the topside, it must be loaded onto a barge and seafastened, as it cannot be placed on the deck of the heavy lift vessel — Limited number of yard facilities to receive heavy integrated decks. This could become the bottleneck resulting in removed topsides / jackets being transported greater distances to find suitable disposal yards — Jacket may require additional structural stiffening to allow for lifting to prevent the jacket collapsing whist lowering onto transport barge. There may be a delay in removing the re-sale / re-use plant and equipment, so preservation measures will be required — There may be a delay in removing the re-sale / re-use plant and equipment, so preservation measures will be required

6.2 Assessment of alternative removal methodologies

Following the workshops, a number of issues were identified that influence the costs of an alternative removal strategy. Further information on these issues was researched through discussions with Decom North Sea members and suppliers. A summary of those discussions is summarised below.

The information in the section below can be used to support the production of project estimates and would contribute to any comparative estimates carried out.

6.2.1 Offshore productivity - cutting

Although data on productivity in the onshore demolition industry is readily available, concerns were raised into how relevant this data will be offshore. Further discussions took place with demolition contractors to identify the expected work rates for various technologies and their estimation of the losses due to restricted workspace and inclement weather. (Offshore rate calculated from actual onshore rate with application of factors indicated to allow for offshore working conditions).

Table 5: Indicative offshore work rates

Technology	Estimated offshore rates tonnes / day / machine	Workspace restriction included in calculations	Inclement weather included in calculations
Demolition shear	55 tonnes per shear	-40%	-15%
Diamond wire	7 tonnes per unit	-25%	N/A
Cold cutting	6 tonnes per unit	-10%	-15%
Hot cutting	15 tonnes per man	-20%	-15%
Crane lifts	N/A	N/A	-40%

Source: Average of rates obtained from various demolition contractors

The cutting techniques listed above are in regular use in the onshore demolition industry and have been used offshore previously, although offshore productivity has not been well documented. The figures provided can therefore be used as a guide in project calculations regarding the duration and cost of carrying out piece small demolition. As more experience is gained it should be possible to refine this data to give greater confidence in time and cost estimates for piece small removal projects. It was also noted that remotely operated demolition machines fitted with appropriate cutting equipment can be used to improve the safety, by removing the Operator from the workface.

6.2.2 Offshore productivity - lifting

A significant number of lifting activities will need to be undertaken throughout the decommissioning process.

Table 6: Indicative lifting / slinging times (Source: Industry norms)

Item to be lifted	Estimated duration	Estimated man-hours
Equipment <20 tonnes	0.5 hour	1
Equipment 20 - 100 tonnes	1 hour	3
Equipment 100 - 200 tonnes	2 hours	8

The estimated durations for these activities are detailed in the Table 6. Note that these durations include for normal slinging activities, but do not include for the installation of new lifting points or the inspection / repair / replacement of existing lifting points.

The figures provided within this table can be used to help compile project estimates of the likely duration and cost of any removal project. Whilst the existing platform crane could be used to lift smaller demolished sections, this is very much dependant on its current condition and capacity and whether it has been maintained. Alternatives that could be used to facilitate piece small removal include self-erecting tower cranes and pillar cranes that can be mounted on the jacket legs. Cranes could also be mounted on the support vessel to remove sections of the platform throughout the removal process.

The requirements for lifting will be reduced / removed if an excavator fitted with shears and loading attachment are used during piece small operations. Lifting would still be required for any items that are required for re-sale / use.

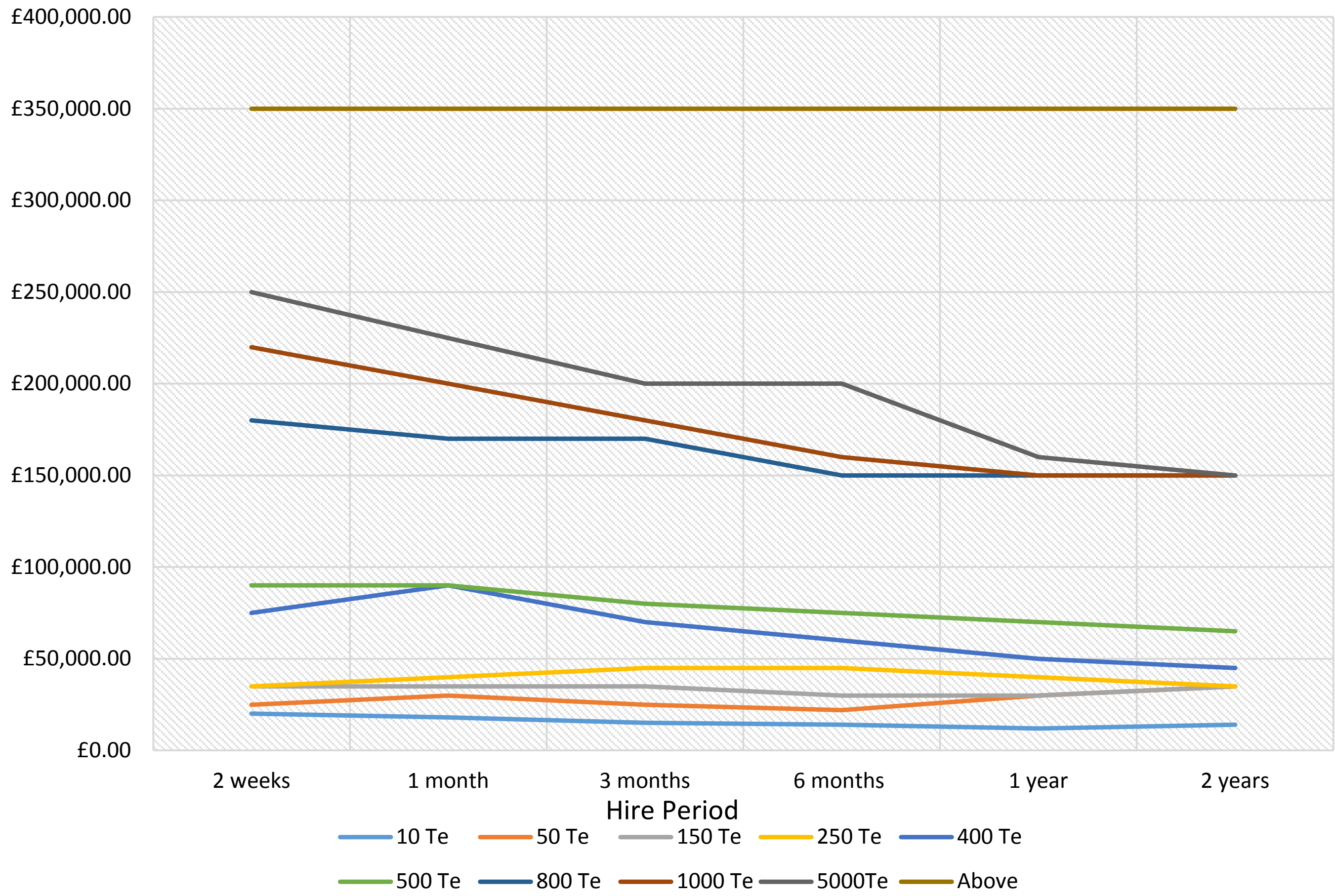
6.2.3 Support vessel and accommodation costs

One of the largest barriers to piece small is the perceived cost of transporting men and materials to the platform to be removed, and then providing accommodation off the platform whilst it is prepared and removed. Traditional methods would be extensive use of helicopters and additional accommodation for example floatels. Alternative methods where considered and one potential solution is discussed below.

The modification of a supply support vessel to transport men and equipment, fitted with a suitable mobile crane and storage containers to bring demolished, re-sale / use equipment back to shore was considered in some detail. This is a potential viable option that warrants additional assessment. Supply vessel rates are dependent on supply and demand as well as fluctuations in the oil price. The required vessel specifications are dependent upon the proposed strategy and a range of different options will need to be considered.

In order to provide an indication of the main costs associated with this potential methodology, the following information was obtained from a marine specialist engineer with regard to typical vessel hire rates. Table 6 gives a guide to the lift capacity and cost in normal market conditions for alternative support vessels.

Figure 12: Typical hire rates for vessels



Notes:

- Mono hulls are generally 20-30% more expensive than Jack up crane vessels
- Seasonal charters for some vessel types are also expensive at times. Significant savings are therefore available for those charterers able to work an Owners ship through the winter months. (Source - TSG Marine)

Other elements that should be considered with regards to vessel costs are mobilisation fee, demobilisation fee, non-productive / downtime through lack of planning, fuel consumption and distance from the platform to the yard disposal facilities.

One option put forward during the workshops was that alternative vessels outside the normal Oil and gas fleet could be adapted to suit offshore decommissioning. It is anticipated that large cost savings could be achieved by the use of these vessels. The vessel would also require a walk to work system to be installed and have sufficient on board accommodation for the personnel required to complete the removal process.

6.2.4 Best value calculation

A key issue raised within the workshops was the fact a large variety of offshore platform sizes, designs and methods of construction exist. There are also a wide range of options within the piece small / piece large definitions that could be considered. Therefore identification of the strategy that would be the most cost effective option is complex, particularly in light of the conflicting cost drivers:

- Piece small removal requires lower lifting capacity cranes and support vessels, which are more readily available and have lower cost day rates. In addition, there will be greater choice of port facilities and less processing to be done onshore
- Offsetting these factors, breaking the platform up into smaller pieces offshore will require increased man-hours and duration of work offshore, which will have a corresponding increase in the costs associated with these activities and increase the potential for an unplanned event

A calculation of the strategy that offered 'best value' would need to be carried out for each individual offshore asset. In terms of calculating the 'best value' many factors will come into effect, including:

- Location of the platform
- Original construction type
- Space available
- Equipment / processes on-board
- Time of year demolition is taking place
- Working patterns
- Age of individual equipment
- Availability of removal methodology
- Distance from platform to disposal yard etc.

6.2.5 Decontamination / clean up requirements

A significant expense in preparation of platforms for decommissioning is the isolation and cleaning strategy, especially in defining the level of cleanliness required. It is clear there are costs associated with achieving a higher level of cleanliness, but this has the benefit of reducing both safety and environmental risks later in the project. The factors that need to be considered in defining the level of cleanliness include:

- The method of removal; piece small, piece large, single lift, the basic rule again is the larger the item removed the less decontamination is required offshore
- Where is the equipment going to - re-use, re-sale or recycle? - This decision is a prime driver on determining how to clean and what level to clean to. If the equipment is to be scrapped then clearly it may not need as high a level of cleanliness to be achieved offshore. If it is to be re-used then a higher level will be required and a suitable preservation process developed to protect the asset value. It is important to agree the required level of cleanliness with the proposed end user (including for recycled materials e.g. steel mills)
- Removal strategy - If the facilities are to remain offshore in 'lighthouse' mode for a period of time following CoP, the cleaning strategy must ensure that potential residual hazards, including 'recharge' of the hazard or new hazards is not an issue (e.g. there has been experience onshore of vapour build up from degrading hydrocarbons, mercury 'sweating' etc.). If the facilities are to be removed to shore within a short period following CoP, then the opportunity exists to reduce the level of cleaning to the minimum required to allow the safe decommissioning offshore and then perform additional cleaning onshore

6.3 Learning from other sectors

Decommissioning and demolition are not new, onshore work of this type has been ongoing for many decades and there is significant learning to be shared with the offshore decommissioning industry.

The nuclear industry are currently going through the process of decommissioning a number of nuclear power plants. This has required a culture change and changing the mindset from this 'is the way we have always done things', still protecting the asset value, to one of a 'decommissioning' mindset, this is material that we need to safely decommission for either re-sale, use or recycle, whilst reducing waste to landfill.

A lot of onshore Operators fall into this mindset of decommissioning - how we have always done it, and there are lots of good arguments to substantiate this process, the workforce are used to following and understands the process etc. However, sometimes there are safer ways of doing things that greatly reduce the risk to HSE. The cutting of a vessel in half to allow better access and remove the need for confined space entry for example.

The Construction, (Design and Management) (CDM) regulations require a number of appointments, one of these being that of a principal contractor to safely manage and coordinate health and safety during a project. The principal contractor is transferred the site and manage the work using their own, specifically developed procedures for this type of work.

During the workshops it was discussed if the Operators would be prepared to transfer the duty of care to an onshore demolition contractor, there was rightly a significant residence to this for the reasons mentioned elsewhere in this report. However, during single lift / piece large removal this is common practice for the 'platform' to be transferred to the heavy lift contractor along with the liability for subsequent disposal. There may be an opportunity, with the necessary due diligence to do something differently, that needs further discussion.

6.4 Circular Economy and re-use

6.4.1 Equipment that can be re-used

Following the workshop sessions, specialist asset re-sale companies were approached to identify items from the generic asset inventory list that they would be interested in for re-sale.

Based on the feedback from the asset recovery specialists and with experienced recycling and demolition companies, it was identified in the workshops that typically 10% - 15% by weight of the modules / equipment could find a potential re-use as per its intended purpose. However, this may well not be in offshore oil and gas exploration. All other materials can be recycled with the exception of hazardous materials that would normally be sent to landfill. However the recovery and recycling of oils has been achieved during onshore decommissioning and demolition, and there will be options to recover some of the waste oils during demolition for recycling.

Based on a Northern North Sea platform a typical project taking into account the principles of a Circular Economy is demonstrated in the pie chart below:

6.4.2 Requirements for re-use and re-sale of equipment

The asset re-sale specialist shared with the workgroup the relevant asset information they would require in order to identify and maximise revenue from re-sale opportunities.

The detailed requirements are listed in Appendix E, but the key items are:

- Equipment data sheets with specifications and drawings
- Historical maintenance, modification and inspection records

Where an asset has changed ownership, particularly if this has happened a number of times, then some of this information may not be available. In these cases, alternative strategies such as equipment refurbishment and testing may be required.

Figure 13: Potential offshore topside material management

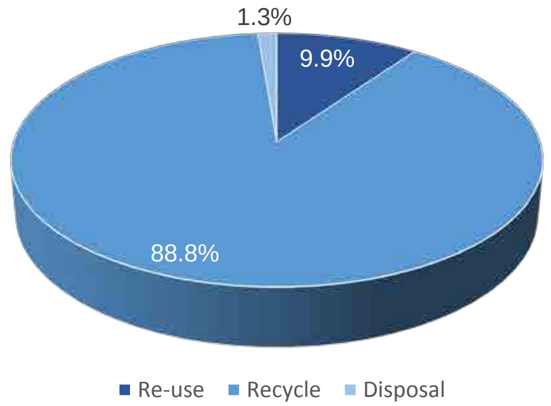
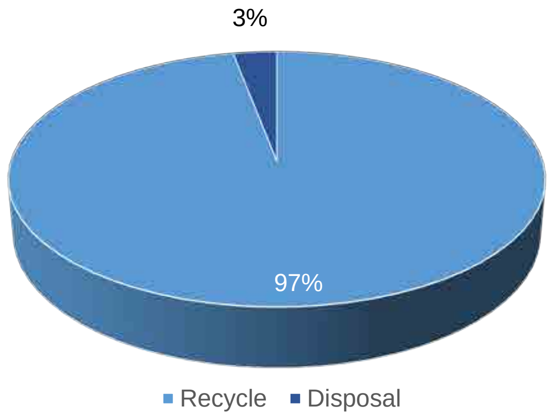


Figure 14: Actual offshore topside material management



In addition, the equipment needs to be preserved in a reasonable condition before it is passed on to the re-sale companies. Therefore, the following points need to be considered when identifying equipment for re-sale:

- Implementation of a routine of preservation and maintenance to avoid degradation of equipment once it is no longer in use
- Work with asset re-sale companies, engineering services companies to identify and remove equipment for re-sale as early as possible - even during late life if not required at this stage

6.4.3 Increasing awareness of re-sale opportunities

Whilst in the workgroup a number of Operators indicated that they were not aware of any opportunities for re-sale. A previous study had indicated oil and gas companies do not want second hand components due to perceived reliability issues and consequent platform down time.

However the re-sale specialists highlighted the global market of end users and buyers of redundant but re-usable plant, in particular markets in the emerging economies such as India, China, Brazil and Africa, where there is a huge demand for redundant power and process plants. Most equipment has a re-sale value, the challenge is to give long enough lead times in order to market and find the person or company who wants to buy.

6.4.4 Promotion of Circular Economy principles

Operators and Duty Holders have a strong leadership position, but are just two of the many players to drive the re-use / re-sale economy. This brings a range of opportunities to:

- Through their own re-use, lead by example to achieve savings and value for themselves, shareholders and tax payers
- Engage with global asset recovery specialists and own internal organisation to identify opportunities for re-use and re-sale
- Communicate and champion the benefit of re-use and re-sale internally within own company to directors and senior management
- Require and encourage waste contractors to share responsibility for increasing re-use through contracting arrangements for decommissioning
- Highlight the opportunities to re-use and re-sale of materials within emerging economies across the globe
- Support other Operators to access available spares to ensure spare parts find a useful life. This will result in maximising the operating life of plant and equipment that would otherwise be scrapped and replaced with new

6.4.5 Design for the Circular Economy

In carrying out this study, it is apparent that it is not possible to fully apply the principles of the Circular Economy at the decommissioning phase. The existing platforms have not been designed with re-use in mind and therefore some of the opportunities around re-use have been missed. To maximise the potential in the longer term, there needs to be shared learning from all decommissioning programmes that can be fed into new designs for offshore platform production.

The design stage of any project has the most influence on the future opportunity for prevention and minimisation. Examples of how prevention is now being managed is through the development of FPSOs and Mobile Offshore Production Units (MOPU) as was the case with the Welland platform which can be moved to new sites easily and re-used. There has also been significant development in the production of anti-corrosion paints to extend the life of FPSO hull's beyond 50 years.

6.4.6 Opportunities for savings during late life operations

There are a number of opportunities for cost savings to be made during late life operations and leading in to decommissioning. Typically, as a platform nears the end of its useful life, some of the installed equipment becomes redundant.

The correct management of this equipment can have a number of benefits:

- Full isolation of this equipment will reduce ongoing statutory maintenance requirements
- Equipment such as instruments can be removed and re-used elsewhere
- Full removal of the equipment, following isolation, can lead to opportunities for re-use that may not be available later on, due to the potential for degradation over time
- Removal prior to CoP can create lay down areas and increase space for activities such as Well P&A

The offshore industry is starting to realise the benefit of aligning an asset's obsolescence strategy with the company's decommissioning strategy. According to the HSE Key Programme (KP4) - Ageing and life extension programme report, asset obsolescence is a growing area of concern. A recommendation from the HSE KP4 report is for Operators to "improve focus on obsolescence management".

Figure 15: Process Flow Chart for different end users

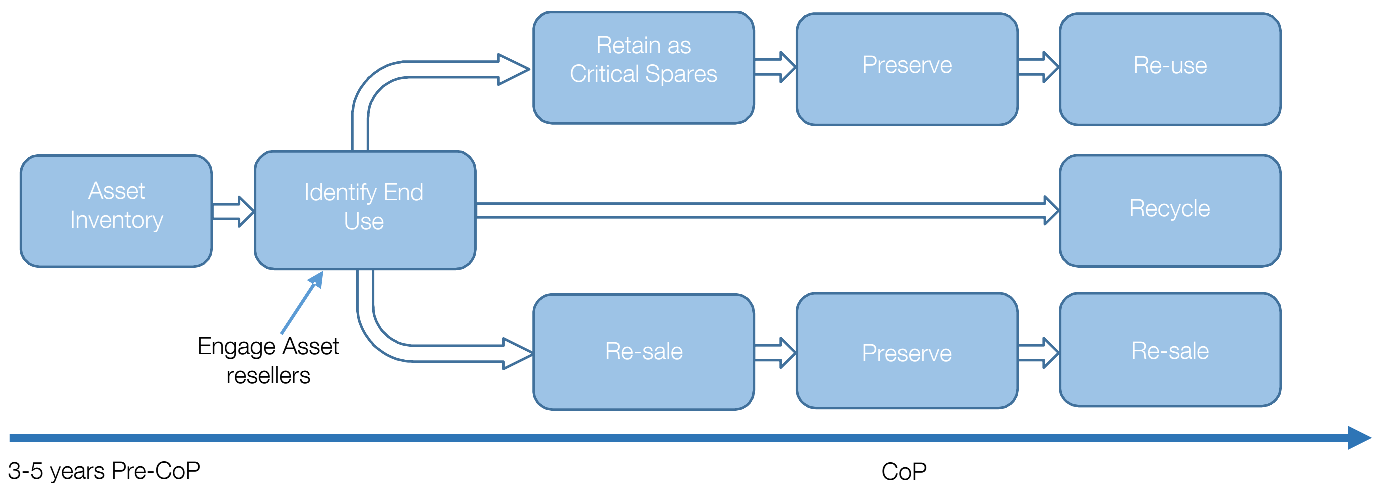


Figure 16: Calculation to define the end value

Platform decommissioning, if managed in line with obsolescence work, can present an opportunity to identify and retain key critical spares for both internal use or for re-sale to other Operators or industries. This is the ideal solution in meeting the principles of the Circular Economy. However, it requires a mindset change; decommissioning strategies should ideally be in place before carrying out Asset Life Extension (ALE) and in parallel obsolescence studies. Understanding the dates associated with process system decommissioning can significantly affect obsolescence strategy - potentially reducing OPEX spend and mitigating the need for costly CAPEX replacement or upgrade projects.

Identifying the end state for redundant equipment and spares early in the planning process is essential to create enough time to engage with asset re-sale specialists in order to maximise income and the opportunity for re-use. This process has been used onshore where engaging early with asset re-sale specialists has been successful. Defining the end state for equipment is an essential part of the decision process for re-use, re-sale or recycling as further costs associated with preservation and removal will have to be considered, this is set out in the process flow Figure 15.

Figure 17: Shotton Power Station

As the process demonstrates other cost factors such as removal, storage and preservation will need to be considered in defining the end use. The end value of the equipment can be defined as, the equipment or spares value to the business if re-used, or the cost benefit to the business if re-sold. The Figure 16 shows the simple calculation that can be used to define the end value.

We can demonstrate by applying learning from onshore decommissioning, that early engagement with asset re-sale specialists directly affects the success of re-sale opportunities. This allows the end use for individual items of equipment to be defined early in the decommissioning process, allowing for appropriate preservation routines to be applied and for appropriate removal techniques to be identified.

This approach also ensures that resources are not wasted on the preservation of equipment that will not be later re-used or sold.

Figure 18: Installation of solar-powered mechanical pump in Africa

6.4.7 Onshore examples of re-use

A recent example of re-use of a complete asset was the sale of Shotton Power Station in the UK which was sold as a complete unit for re-use in Turkey.

The current equipment re-sellers mainly operate on the basis of selling equipment on a 'sold as seen' basis and only do limited refurbishment prior to re-sale. However with the example of Shotton Power Station the re-seller arranged dismantling, shipping and re-commissioning of the power station in Turkey.

The main markets for equipment currently recovered for re-use are to either smaller companies outside the Oil and Gas sector, or to other countries where labour costs are significantly lower. This makes the re-commissioning and day to day running of used equipment and process plants viable and in addition although old technology in the UK and Europe it is seen as modern in some third world economies.

Re-use can have other benefits too, not just financial ones. The onshore sector has demonstrated that there are social benefits of re-use. An example is where the demolition industry donated a solar-powered mechanical pump to a village in Africa. The pump was installed above a borehole and with the addition of water storage tanks, brought the first potable water source to the entire region around the village.

7. Conclusions

7.1 Alternative removal methodology

The project identified that in order to increase Operator uptake of piece small / piece large approaches, there are a number of Operator concerns which will need to be overcome. In particular, Operators are seeking more knowledge in the following areas:

- Financial viability
- Knowledge of demolition contractors
- Contractual agreements
- Health and safety management
- Environmental management
- Managing risks associated with re-use / re-sale
- Alternative removal methodology
- Managing waste offshore

There is recognition that there is no one optimal removal methodology to suit all platforms. Any one of the three principal removal methodologies, or a combination thereof, may be the most appropriate solution for a particular asset.

There is sufficient confidence that alternative removal methodologies may be appropriate in certain situations to warrant further development of this as an industry issue.

Further work is required to fully develop cost models to demonstrate the financial viability of piece small and piece large methods. Information that will assist in this process has been identified and included within this report , although further gaps in data may become apparent as detailed project plans are developed.

There are a number of demolition contractors who are confident of applying new technologies to offshore demolition. All of these technologies are proven onshore and offer significant cost benefits over currently applied offshore techniques. The relevant technologies are covered in Appendix D.

It has been identified that in order for piece small / piece large methodologies to be successful the work authorisation regime post CoP must be significantly different to the regime adopted during production. This is due to the significantly different risk profile once the main hydrocarbon hazards are removed and new hazards are introduced by the decommissioning process.

Some degree of piece small / piece large removal will be required on all projects to reduce topsides weight and create deck space to allow plugging and abandonment of the wells.

The use of alternative removal methodologies increases the availability of both vessels to carry out the demolition works and ports with the necessary capacity.

7.2 Circular Economy and re-use

The report has identified that there are a number of opportunities to promote Circular Economy principles within the decommissioning process. In particular, there are opportunities to expand the scope for re-use of equipment following decommissioning and there are a number of examples where this is being pursued by Operators.

Specific opportunities that were identified include:

- The large amounts of equipment, currently held as strategic spares for a specific platform could be accessed to extend the life of other production platforms and equipment. This opportunity could be further developed by sharing available spares with other Operators
- Overall, between 10 and 15% of a platform inventory could potentially be re-used using the existing re-sale companies and existing markets
- Re-sale and re-use provides a higher value in the market place than recycling of equipment and therefore offers a potential payback to Operators that use these markets
- Opportunity for re-sale / re-use offers other benefits beyond financial e.g. environmental and societal benefits
- Recycling is less damaging to the environment than disposal and reduces extraction of natural resources from the earth

- The report has identified that there is an opportunity to take the lessons learnt from decommissioning projects, to develop and promote the use of standard equipment in new platform designs and improve the availability for re-use from these future designs
- In order to establish a re-use and re-sale market a number of barriers must be overcome, including raising industry awareness of the opportunities and developing a suitable form of contract to support recycling

Figure 19

8. Recommendations

8.1 Alternative removal methodology

8.1.1 Awareness

The Oil and Gas industry's mindset has always been to veer towards the tried, tested and proven methods. To counter this thought process, the offshore industry requires an awareness campaign to promote and raise awareness of the opportunities and benefits from alternative removal methodologies that are common place and equally proven onshore. This awareness campaign should address the key concerns highlighted in this report and provide case-studies with specific onshore examples applicable to the recognised offshore challenges and key issues.

8.1.2 Comparative cost estimates

It is recommended that Operators initiate a study to produce accurate cost estimates to compare the 3 major decommissioning methodologies and possible hybrids of these. The study should produce detailed probabilistic estimates to provide P10, P50 and P90 costings. The estimates will provide a greater degree of confidence than current values.

In order to improve understanding of the cost issues more widely, it is recommended that these cost estimates are generated for two distinct asset types; a Southern North Sea platform and Northern North Sea platform. This financial comparison could then be shared with all Operators to overcome the concerns relating to the financial viability of alternative removal methodologies.

8.1.3 UK port suitability

It is recommended that a study should be conducted to assess the suitability of UK ports for each alternative removal method. A study should be conducted to assess the suitability of UK ports for each alternative removal method. The study should include the port owners' appetite for as well as capacity and experience of offshore decommissioning. Factors should include as a minimum:

– Vessel sizes and limits
– Weight restrictions on quay
– Crane capabilities
– Facility development potential
– Depth of water

The output of this report would rank the potential facilities and locations that could support offshore decommissioning with the aim to increased competition into the UK marketplace.

8.1.4 Safety management suite

The industry should consider collaboratively developing a specific standard set of safety standards and management procedures that can be applied once the platform is fully isolated and decontaminated As Low As Reasonably Practicable (ALARP) i.e. hydrocarbon free. The intention being to remove the stringent practices applied when the platform is operational.

This development process should be governed by a group of recognised technical and occupation safety specialists from within the Oil and Gas industry and (other high risk industries e.g. nuclear). The focus should be on upholding safety standards whilst improving efficiency.

8.1.5 Jacket / topsides refloatation

Further study of refloatation of jackets is recommended. Whilst stability issues were highlighted for refloatation with topsides, it is considered that refloatation of the jacket back to shore could be economically achieved. The study should review the viability of refloatation of a jacket as part of a joint industry initiative.

8.1.6 Contract models

Consider the development of contract models similar to those used in the nuclear sector. This should look at the development of a tier system with tier 1 to 3 contractors working in collaboration to develop a solution.

8.1.7 Decommissioning duty holder

Carry out further study to gauge interest from contractors to undertake the role of decommissioning duty holder. This should include an assessment of how this could be achieved under current legislation and decommissioning guidelines and at what stage of the decommissioning process this could be implemented.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Chris	Holland	Coleman & Co
Richard	Innes	ENI
Arnbjorn	Joensen	Subsea Deployment Systems Ltd
David	Johnston	Oceaneering
Marcus	Lesser	Brown & Mason
Stuart	Lornie	Oceaneering
Mike	Luchford	Squibb
Ann	Meek	Talisman-Sinopec
Alana	Milne	Intertek
Alex	Moss	Network International
Nigel	Naden	Indassol
Richard	Newman	Hawk Enviro
Alastair	Nieuwenhuyse	Oil Mac
Jill	Rennie	Intertek
Fritz	Smedley	Marathon Oil
Paul	Smy	Shell
Allan	Syme	TSG Marine
Duncan	Thomas	SLR Consulting
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Paul	Yeats	Oceaneering

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Appendix A - Operator survey analysis

Detailed analysis of responses

1 Knowledge of consultants to plan and manage piece small / piece large removal

The results of the survey suggested that whilst it was essential to understand the capabilities of consultancies to help plan and manage alternative methodology, the results for evidenced were significantly different. There appeared to be a general trend in the findings, Operators who had undertaken feasibility studies and had planned decommissioning programmes had an understanding of consultancy companies they could turn to for support, however Operators who were just in the early stages of planning and CoP dates are a number of years away did not fully know the market available to support.

2 Knowledge of contractors to undertake piece small / piece large demolition

Having looked at the results of the survey, the majority of the Operators were uncertain of the companies who could perform alternative piece small / piece large removal techniques. Again the findings from the survey were Operators who had carried out comparative assessments on actual decommissioning programmes had a greater understanding of the market.

3 Knowledge of technologies to undertake piece small / piece large removal

The results of the survey suggest as in section 4.2 above, that whilst the majority of the Operators thought it essential to understand the technologies available, this would form part of the feasibility studies. As suggested above findings were different between Operators with live decommissioning programmes, and Operators within early stage of planning.

4 Technical feasibility of piece small / piece large

The results suggested that Operators who had live decommissioning programmes had undertaken feasibility studies to look at alternative methodology. Whilst all Operators reported that it was essential to understand the feasibility of alternative removal, more Operators understood this area of the market from the studies undertaken by BP on North West Hutton, Shell on the Brent platforms, and CNR on the Murchison platform.

5 Health and safety management of piece small / piece large

Health and safety management was understandably considered essential. The CDM regulations cover this element when a platform comes to shore, Operators who had undertaken feasibility studies had an idea of how this could be managed as it had formed part of the study undertaken.

6 Environmental management of piece small / piece large

As with the health and safety management, this is essential. Again Operators had considered this as part of the comparative assessment when undertaking feasibility studies. Operators who were in early stage of planning were yet to assess fully the environmental considerations and impact of demolition offshore.

7 Managing waste and recycling effectively offshore

Whilst it was considered essential by most Operators, only the Operators who had undertaken comparative assessment and feasibility studies understood how this could be managed. Operators who were in early stages of planning highlighted the need to understand how this could be managed logistically in the limited space available offshore.

8 Financial viability of piece small / piece large

A number of Operators had calculated the financial viability of using alternative methodology when undertaking comparative assessments for different removal methods, however the data they used to benchmark against was not shared with industry, therefore it was thought essential to have useful benchmark data to use during comparative assessment. This was considered an essential element to understand the financial viability of alternative methodology, to demonstrate accurate cost savings that could be achieved.

9 Contractual agreements for piece small / piece large decommissioning

The majority of Operators thought that understanding contractual agreements was essential, in addition most Operators did not understand contract models for use of alternative methodology. It was highlighted by an Operator that the contract should have some mechanism to appropriately apportion risk, and the value of recycled material could be shared in an 'open book' type arrangement.

10 Methodology employed for piece small / piece large

The methodology had been considered by Operators under the comparative assessment and concept selection stage of actual studies, but Operators at early planning stage were not aware of the methodology that would be used offshore as they had not engaged with consultants or contractors.

11 Knowledge of onshore facilities to recycle and dispose of waste

The results of the survey suggest some Operators do not think this is essential to know from an Operators perspective, after consultation with the Operators it was assumed that the vessel support company would understand the capacity of yards to support receipt of goods from particular vessels. Other Operators had an idea of yards available as this had been made available following a Yard capability and capacity survey undertaken on behalf of the industry.

12 Knowledge of markets for re-use / re-sale of equipment

The response from the Operators was not generic and no particular trend can be seen, however it was highlighted that knowledge of the asset recovery specialist in Aberdeen was understood, the market for re-sale or re-use of equipment often old and obsolete was uncertain.

13 Knowledge of markets for recycling and recovery of materials

No specific trends from the survey could be established, whilst some Operators thought that it would be dealt with by the demolition contractor so was not important for them to understand the market, others thought is essential. The Operators who had live decommissioning programmes had undertaken research on available facilities, however it was stated that identifying wider market opportunities was important.

14 Managing risks associated with re-use / re-sale of equipment

The majority of the survey results highlighted the importance of managing risks, but Operators were uncertain of how this could be achieved. The Operators were reluctant to expose risk of any potential future liability if equipment was to be re-used or through re-sale.

Appendix B - Output from workshops

Removal

No.	Theme	Comments	Solutions / suggestions
1	Operators have limited knowledge of alternative decommissioning methods to heavy lift.	— Need information / reassurance regarding EH&S risks, costs, viability etc. — Need knowledge of market - who is available to help / implement — New onshore decommissioning facilities in development / abroad that Operators may not be aware of — Limited / no sharing of information between upstream / downstream parts of Operator organisations — Limited understanding of how demolition offshore would work - logistics / waste segregation etc. — Understanding of work rates offshore - how will these compare with onshore? — High staff turnover in industry means knowledge is rapidly dispersed. — Alternative view - many case studies have been given at previous conferences — Need to demonstrate to offshore community that demolition is not 'rough & ready' as perceived - It is a thought through and considered process — Case study required — Supply chain have not made active effort to contact / sell to Operators — Work needs to be done to convince senior management - risk averse culture	Develop cost models for a variety of platforms based on alternative strategies for comparison with Operators existing cost models. Identify and share information on expected work rates, productivity etc. for demolition methodologies deployed offshore. Identify and publicise any case studies on platforms completed to date.
2	Reluctance to use contractors / techniques that are not proven offshore.	— Contractors looking to enter market should become FPAL verified as first step — Contractor assessment - is FPAL the right tool for the demolition contractor assessment? — Perception that onshore personnel would not be suitable / willing / able to work offshore - may be strong resistance from them to go offshore NOTE - This concern not shared by contractors — Suggestion that use of existing offshore personnel would reduce risk of inexperienced personnel — Must be no double standards - decommissioning personnel must have same working conditions as for a new build project — Alternative view - once platform is HC free, the work is essentially a scrapping / waste segregation exercise - should use appropriate systems / contractors / personnel for this — Existing Operator PtW systems not appropriate for demolition — Regulatory environment simpler once HC free, particularly if power switched off — Would Operator hand control of platform to Decom contractor? (duty holder)	Contractor community to engage with offshore organisations such as Decom North Sea, FPAL etc. and gain relevant certification to demonstrate that relevant systems are in place for offshore work. Develop a standard methodology for decommissioning safety case - needs to be governed by appropriate regime for the work being done (i.e. outside of std O&G Operational constraints). This approach to be agreed with HSE / DECC and any other appropriate bodies.

No.	Theme	Comments	Solutions / suggestions
3	What types of equipment would be used offshore?	— Robotic demolition machines available (shears on machines) that could be driven remotely from support vessel. Various sizes available — Are existing platform cranes suitable for demolition phase? - May need to be re-commissioned if not been looked after (prohibitive cost) — Cold / Hot cutting techniques will be required - section / pipe thicknesses too high for shears alone — Likely cold cutting by diamond wire — Lifting ops could be done using a self-erecting tower crane. These are remote controlled so could be operated from supply vessel or by single person slinging / operating if required — Netting or similar required to prevent debris falling in to sea	Forum for discussions between Operators and demolition contractors to look at specific challenges to be considered with a view to specification of technology challenges and identification of how these may be addressed.
4	Each project will have different needs / solutions – no one size fits all.	— May need to use more than 1 solution for each platform — Is there a 'sweet spot' (in terms of platform size) where piece small is more efficient than heavy lift / single lift — Single lift solution still requires preparatory works — Would piece small work better in other locations outside North Sea? — Heavier the lift - higher the cost. By reducing weight of lifts can reduce cost of vessel that is required. Greater the use of piece small reduces this weight and increases number of vessels that are available to do the work. This also defers cost and reduces spike in cash flow — Smaller weights of equipment brought back increases number of potential yards that can be used - lowers costs	Identify and develop information relating to vessel costs in relation to capability to feed into comparative cost models.

5	Operator logic is to minimise the amount of work done offshore.	— Minimising offshore work is perceived to:
		  — Reduce costs - offshore productivity is low, logistics costs are high
		  — Reduce risk (H&S / costs)
		— Perception - always going to be cheaper to do demolition onshore	

6	Costs and financial risks.	— Single lift is seen as the 'default' option. Perceived to be a single fixed cost with no potential for scope growth — Alternative options considered to have higher commercial risks - potential for massive scope growth from inexperienced contractors — Alternative view - Esso Odin - heavy lift option required ~6 revisits from heavy lift vessel due to unknown grout in legs. Similar losses incurred on Frigg — More facts / figures required to justify costs of alternative options — Need 'disruptive' technology - will need a projected cost saving in the order of 50% in order to overcome fears of increased risks — Cost comparison - Pioneering Spirit @ ~ £1m / day would buy 4-5 months of demolition time working at 50-100 tonnes / day — Piece small should be tested on small projects to build confidence in cost models — Reverse installation (heavy / single lift) seen as first option, but costs are prohibitive due to vessel availability / cost	In the development of cost models for both single lift and alternative methodologies, ensure that adequate consideration is given to the time / costs associated with preparation of platform for each strategy. Develop / publicise information on costs of alternative strategies (as previous recommendations). Develop generic Risk Register for each strategy and identify means for risk reduction or mitigation.
7	Knowledge of platforms / uncertainties of available information.	— Essential to maintain Operator involvement / knowledge of platforms — Consider use of colour coded new wiring of essential services so that all existing wiring can be made dead	

No.	Theme	Comments	Solutions / suggestions
8	Residual contamination - what level is acceptable?	— Other material risks - asbestos / MMMF etc. — NORM / mercury / heavy metals / tar oils not removed by normal cleaning — Consider potential risks of breaking containment offshore - potential release to sea	Develop guide (or identify existing guides) that specify acceptable residual contamination levels, or define a method for determining these dependent on proposed end use. Consider if further technology developments are required to achieve acceptable levels or to improve the efficiency of the decontamination process.
9	Consideration of essential services: — Accommodation for personnel — Fire and gas systems — Access — Lifeboats etc.	— Is use of a support vessel a better option than using / upgrading existing accommodation? — Use support vessel to provide all required services so that platform can be effectively dead — Consider use of alternative vessels, not just existing oil and gas fleet - will still need to meet Operator standards — Maintenance of existing accommodation / services is most significant factor in current cost models — Existing cost models show use of boat based accommodation massively increases costs (based on current oil and gas fleet) — Consider conversion of older vessels from other marine uses - e.g. RORO ferry — Should personnel be moved by helicopter or boat - cost saving / reduced risks? Costs are prohibitively expensive. Needs change to oil and gas mindset — Consider use of colour coded new wiring of essential services so that all existing wiring can be made dead — Alternative vessels should be looked into - vessel should fit the job, not other way round — Consider use of barges - hire costs are lower than most existing vessels — Replace all existing equipment with single box solution - all services from single containerised unit placed on deck — Ekofisk - platform decommissioned piece small, but was bridge linked to existing platform with accommodation and services. Noted that this was stick built, so may have been only option	Consider extended use of lease equipment / sale / buy back arrangements for equipment used in decommissioning and also in late life. Develop cost models based on use of support vessel to supply essential services and how these could be supplied to and distributed around the platform.
10	Scope of works - reduce	— Consider leaving more out there. Rigs to reefs may be appropriate — BPEO for jackets may be to leave in situ — Should consider this in the wider context of marine issues - is the creation of reefs a benefit in maintaining marine ecosystems — Current initiative looking at OSPAR requirements — Need to recognize that most people do not care how much it costs — Will be resistance if Oil industry propose this - need to consider alternative approach and put savings from approach towards CO_2 capture / ocean environment improvements — Living North Sea Initiative (LINSI)? — Need to consider the CO_2 emissions from decommissioning work - is actually very intensive — How clean is recycling? — Emissions from decommissioning are not properly understood - would be properly considered in Europe so this is a cultural issue	This is outside the remit of this report, but is included for completeness.

No.	Theme	Comments	Solutions / suggestions
11	Due to size of projects, Operators need to engage with contractors in order to stimulate investment / technology development / resources.	— Consider use of nuclear contracting model where long term contracts / relationships are the norm — Current preferred contracting strategy in North Sea is via EPCs - may need to change this to engage directly with demolition contractors — Demolition federations are potential first point to look for competent contractors (although this is no guarantee of quality)	It is recommended that Operators engage early with the contractor community.
12	Use of platform refloating and transfer back to shore.	— Used by AF Decom - transported to fjord and dry dock built around it - not a cheap solution. — Maureen jacket was refloated - but was designed to do this — Refloating used in maritime industry for ship recovery — Also used by Aker on Frigg - legs were castellated cut - floatation tanks may have been kept	Use of refloating as a viable option for jacket removal or for gravity based concrete structures, where initially designed for this.
13	Contractual model	— Open to all potential contractual models — Oil and Gas Authority is almost mandating collaboration — Framework agreements are being looked at	
14	Information requirements	— Surveys will be required by contractors — Use of 3D scanning / models will help reduce survey times — Lifting points will need checking / potentially replacing — Noted that in general primary structures are in good condition - secondary structures and gratings are often poor. Inspection reports will be available	

Re-use / waste minimisation

No.	Theme	Comments	Solutions / suggestions
1	Linkage between decommissioning methodology and ability to re-use / recycle	— Does the decommissioning methodology reduce / increase potential for equipment re-use? — Perception that segregation may be easier onshore	Re-use of larger units = larger piece removal required. Re-use will only drive the methodology if there is sufficient financial incentive.
2	Operator reluctance to allow re-use of equipment	— Perceived liability issue if future failure of equipment that has been sold on. Operators are very risk averse — Regulatory environment assists re-use - it is for purchaser to satisfy themselves that equipment is fit for purpose and to recommission — Liability is more of a perceived risk than an actual risk - may be conflated with reputational risk — Contracts exist that can manage the liability issue — Some Operators will sell equipment, provided that it is not safety related — Operators reluctant to supply documentation — Should regulators take more action to encourage / enforce re-use? — Operators need to be aware that there are companies that will assist in this process - at their own cost — Debranding is available through re-sellers to avoid reputational damage — Operator has duty to trace equipment coming onshore may be an issue if no immediate customer for equipment	Consider 're-use awards' or similar incentives for Operators to raise profile of Circular Economy application to the offshore industry and to encourage Operator involvement. Develop fact sheets / information packs to clarify liability issues around re-use of equipment. This should include: — Legislative background — Contractual models — De-branding services
3	Markets for the equipment	— UK Oil and Gas sector very reluctant to use old equipment — Re-use / repurposing has been achieved internally on same field, but struggled when looked wider within same organisation — Savings to new projects from using old equipment are perceived to be lower than the consequent project / production risk — Other industry sectors / other locations are more open to use of second hand equipment — Early identification of equipment essential to allow marketing and ensure adequate preservation is in place. Need detailed information early on to market (manufacturer / model / rating etc.) — May need buffer storage facility to hold equipment prior to re-sale — Onshore experience is that there are good markets for this equipment — Solar have US facility for refurbishment and selling on of used turbines - market exists in US — Need to have all documentation to improve re-sale potential. Estimated could sell 4-5 times amount of equipment if docs available — Re-sellers are willing to take on document libraries as part of equipment re-sale — No re-sale market in UK - design houses do not consider use of old equipment in new designs — Designers do not want 'close fit' specification equipment - even if over capacity. Preference for new build to exact spec required — Noted that resistance is within the Oil and Gas sector - other industries do it - even aircraft — Main markets are SMEs in foreign countries, due to costs, more willing to be flexible and adapt equipment as required — Occasionally equipment will be used as it is available quicker than waiting for new long lead time item (e.g. glass lined vessels) — Most equipment is sold 'as seen' - refurbishment done only in a few cases — Older equipment is becoming harder to resell — Marketing currently done by a variety of means including internet	Develop new or identify existing standards relating to the re-use of equipment, in particular any relating to the re-commissioning of previously used equipment. Consider the development of common portal or website that redundant equipment can be advertised / sold on so that it is easy for designers / specifiers to identify available equipment. (Similar to www.equipmatching.com)

No.	Theme	Comments	Solutions / suggestions
4	Costs of equipment recovery	— Perception that cost to maintain / recover intact outweigh market value — Need to consider this as ‘good PR’ rather than financially beneficial — Considered that will need to make 3x scrap value to make recovery / re-use worthwhile due to increased costs of removal — Alternative view - all equipment is coming to shore anyway - just need to avoid wrecking it in the process — Cost of recovery / refurbishment may outweigh cost of purchasing new — Note that recycling is not without its costs - particularly energy use. Need to consider how these carbon savings can be factored in — Fiscal tax issues with equipment being brought back onshore - is original VAT now due?	Any potential tax issues with bringing equipment back for alternative re-use need to be identified and the actual position confirmed with HMRC. Consider the development of a Key Performance Indicator (KPI) for ‘valorising’ (i.e. realising the full potential value) of redundant equipment. KPI could be based on multiple of scrap value achieved.
5	What could be re-used	— Only markets for certain items of equipment. — Age of equipment is a factor (remaining life / compliance to modern standards / efficiency compared to modern equivalent) — Potential to re-use complete platform topsides if can be removed in single lift and is in good condition (Perenco / Statoil Huldra) — Power generation equipment has lots of potential — Smaller complete modules e.g. glycol regeneration modules — Tubulars are re-used as construction piles in US — Equipment needs only to be in resellable condition - does not need to be perfect — All plant spares held onshore should also be considered for re-sale	Develop a guide to re-use of equipment that covers: — What can potentially be re-used? — Alternative re-uses — How to market equipment

Appendix C - Generic asset inventory

Northern / Central North Sea Platform

A generic asset inventory was developed to identify the types of equipment that are present on the majority of North Sea platforms. The full inventory is based on a typical Northern or Central North Sea Oil and Gas producing platform.

Platforms in the Southern North Sea are generally smaller and are for gas production only. Therefore, they do not include the Oil handling components identified within the inventory.

In addition, any Normally Unmanned Installations (NUIs) do not generally have significant accommodation or welfare facilities.

The inventory is built up to show the location and function of individual items of equipment and how these are built into assemblies and full modules on the platform. This allows re-use opportunities to be identified at a number of levels;

- As a full module complete with all contained equipment,
- As an assembly (e.g. a water treatment skid, or a molecular sieve unit)
- As individual items of equipment.

In applying the Circular Economy principles, re-use of the most complete units feasible is preferred as this will generally retain the most value i.e. re-use at module level is preferred to re-use of assemblies, which is preferred to individual items of equipment. Use of the inventory and identification of the largest units that can be re-used can then be fed into the decommissioning methodology selection as one factor to be considered.

Module	Re-use options at module level?	Assemblies	Re-use options at assembly level?	Equipment	Re-use options at equipment level?	Re-sale to specialist	Recycle
Accommodation block	Re-use on other platform. Temporary accommodation onshore.	HVAC	No	Fans			Y
				Ducting			Y
				Dampers			Y
				Motors		Y	Y
				Insulation			Y
		Living quarters / ablutions	No	Soft furnishings			Y
				Partitions / ceilings			Y
				Beds			Y
				Showers / toilets etc.			Y
		Catering equipment	No	Ovens / hobs			Y
				Dishwashers			Y
				Preparation tables			Y
				Fridges / freezers			Y
				Dining furniture			Y
				Serving counters			Y
		Fresh water generator	Yes if built as a small module	Vessels	Re-sale if stainless steel	Y	Y
				Pipework			Y
				Pumps		Y	Y
				Filtration			Y
				Valves			Y
							Y
		Fresh Water Distribution	No	Storage tank	Re-sale if stainless steel	Y	Y
				Distribution pumps		Y	Y
				Coalescer units		Y	Y
				Filter units		Y	Y
				Pipework			Y
				Valves			Y
		Sewage treatment system	No				Y
		Lifeboats and lifting / release equipment	Yes if built as a small module	Lifeboats	Yes - if to current standards		Y
							Y

Module	Re-use options at module level?	Assemblies	Re-use options at assembly level?	Equipment	Re-use options at equipment level?	Re-sale to specialist	Recycle
Helideck	Complete assembly could be used on new platform with refurb.	Helideck structure	Yes	Steelwork			Y
				Lighting / illumination			Y
		Fire system	No	Skid	Yes - if to current standards		Y
				Pipework			Y
				Foam distribution			Y
		Administration room	No	Seating			Y
				Displays			Y
				Office equipment			Y
				Cabin structure	Yes - site cabin for COMAH site		Y
Power generation	Complete module could be used in new platform or as generation / power distribution unit for industrial site in Asia / Africa etc.	Gas turbine Generator Skid	Yes	Gas generator (compressor)			Y
				Gas Turbine			Y
				Fuel Control			Y
				Oil Pumps			Y
				Generator unit			Y
		Power Generation turbine utilities	Unlikely to be suitable layout for removal as assembly - could be sold with Skid unit as package.	Ducting			Y
				Filtration			Y
				Exhaust Stack			Y
				Dampers			Y
				Cooler (Oil)			Y
				Cooler (Air)			Y
				Turbine Cleaning System			Y
				Fans			Y
				Motors			Y
				Turbine Control unit			Y
				Fire Fighting Equipment			Y
		Electrical Utilities		Earthing Resistors			Y
				MCC Unit			Y
				Cabling (Generic)			Y
				Cable Support Trays (Generic)			Y
				Electrical Distribution equipment			Y
		Emergency Generation Package	Yes	Diesel Engine			Y
				Generator unit			Y
				Control Unit			Y
				Electrical Distribution equipment			Y
		UPS Supplies	Yes - if to suitable standard	UPS Control unit			Y
							Y

Module	Re-use options at module level?	Assemblies	Re-use options at assembly level?	Equipment	Re-use options at equipment level?	Re-sale to specialist	Recycle
Services	Distributed systems - not feasible as single module	Fire / gas system	Distributed nature of system makes sale as assembly not feasible.	Fire water ring main pipework			Y
				Fire water spray nozzles			Y
				Fire water lift pumps	May be re-usable if in good condition		Y
				Fire detection equipment			Y
				Gas detection equipment			Y
				Fire control system			Y
				Fire alarm equipment			Y
		Seawater system	Distributed nature of system makes sale as assembly not feasible.	Bio-fouling control Unit		Y	Y
				Seawater lift pumps		Y	Y
				Pipework			Y
				Valves			Y
		Heating medium system	Distributed nature of system makes sale as assembly not feasible.	Heating skid		Y	Y
				Pipework			Y
				Pumps			Y
				Valves			Y
				Heat exchangers		Y	Y
				Expansion vessels		Y	Y
		Air compressor package	Distributed nature of system makes sale as assembly not feasible.	Compressor unit		Y	Y
				Drying unit		Y	Y
				Pipework			Y
				Valves		Y	Y
		Control equipment	Distributed nature of system makes sale as assembly not feasible.	Process control system	Likely to be obsolete	Y	Y
				Emergency shutdown system	Likely to be obsolete		Y
				Control desks		Y	Y
				Control room displays		Y	Y
				Panels / annunciators			Y
				Cabling (generic)			Y
				Fibre optics			Y
				Support tray / ducting			Y
		Communications equipment	Distributed nature of system makes sale as assembly not feasible.	Line of sight dish			Y
				Satellite link		Y	Y
				Radio comms		Y	Y
		Fuel gas package	Yes - If built as small module.	Filtration		Y	Y
				Pressure control valves		Y	Y
				Dehydration vessels		Y	Y
				Heat exchangers		Y	Y

Module	Re-use options at module level?	Assemblies	Re-use options at assembly level?	Equipment	Re-use options at equipment level?	Re-sale to specialist	Recycle
Services (continued)	Distributed systems - not feasible as single module	Diesel fuel system	Distributed nature of system makes sale as assembly not feasible	Fuel storage tank		Y	Y
				Distribution pumps		Y	Y
				Coalescer units		Y	Y
				Filter units		Y	Y
				Pipework			Y
				Valves			Y
		Drains systems	Distributed nature of system makes sale as assembly not feasible	Pipework			Y
				Manifolds			Y
				Valves			Y
				Storage tanks		Y	Y
				Discharge pumps		Y	Y
		Washdown facilities					
		Sand jetting system					
		Glycol regeneration package	Yes if built as a small module	Vessels			Y
				Pipework			Y
				Pumps			Y
				Valves			Y
Crane	Unlikely	Crane unit	Yes if in good condition (unlikely)	Boom			Y
				Hook block			Y
				Engine / motor			Y
				Slew unit			Y
				Control cab / equipment			Y
		Pedestal unit					Y
Wellbays		Drilling facilities	Not as assembly	Drill rig	Yes if in good condition		Y
				Mud tanks			Y
				Mud pumps			Y
		Wellhead equipment	Not as assembly	Wing valves			Y
				Pipework			Y
				Actuated valves			Y
				Pressure / flow instrumentation			Y
							Y

Module	Re-use options at module level?	Assemblies	Re-use options at assembly level?	Equipment	Re-use options at equipment level?	Re-sale to specialist	Recycle
Wells stream separation		Test separator system	Yes if built as a small module	Pumps		Y	Y
				Separation vessels	Re-sale if stainless steel	Y	Y
				Pipework			Y
				Actuated valves			Y
				Manual valves			Y
				Pressure instrumentation			Y
				Level instrumentation			Y
				Buffer vessels	Re-sale if stainless steel	Y	Y
		Production separator system	Yes if built as a small module	Pumps		Y	Y
				Separation vessels	Re-sale if stainless steel	Y	Y
				Pipework			Y
				Actuated valves			Y
				Manual valves			Y
				Pressure instrumentation			Y
				Level instrumentation			Y
				Buffer vessels	Re-sale if stainless steel	Y	Y
		Produced water treatment package	Yes if built as a small module	Vessels	Re-sale if stainless steel	Y	Y
				Pumps		Y	Y
				Filtration unit		Y	Y
				Analysis equipment			Y
				Pipework			Y
				Valves			Y
		Produced water reinjection	Yes if built as a small module	Vessels	Re-sale if stainless steel	Y	Y
				Pumps		Y	Y
				Valves			Y
				Pipework			Y
		Sand separation package					Y
Oil processing and export	Yes if within single module	MOL pumps	Yes if built as a small module	Centrifugal pumps		Y	Y
				Filters		Y	Y
				Drive motors		Y	Y
		Processing system	Yes if built as a small module	Filters		Y	Y
				Pipework			Y
				Instruments			Y
				ESD valves			Y
				Manual valves			Y
							Y

Module	Re-use options at module level?	Assemblies	Re-use options at assembly level?	Equipment	Re-use options at equipment level?	Re-sale to specialist	Recycle
Gas processing and export	Yes if within single module	Gas compression equipment	Yes if built as a small module	Gas turbine skid (as power generation)		Y	Y
				Gas turbine utilities (as power generation)		Y	Y
				Gas compressor		Y	Y
				Heat exchangers		Y	Y
				Scrubber vessels	Re-sale if stainless steel	Y	Y
				Pipework			Y
				Pressure instrumentation			Y
				Temperature instrumentation			Y
				Level instrumentation			Y
				Actuated valves			Y
				Valves			Y
				Pipework			Y
		LP (flash) gas compressor	Yes if built as a small module	Gas compressor		Y	Y
				Scrubber vessels	Re-sale if stainless steel	Y	Y
				Heat exchangers		Y	Y
				Motor		Y	Y
		Gas pipeline pig launcher		Pig launcher housing			Y
				ESD isolation valves			Y
				Manual valves			Y
				Pressure instrumentation			Y
		HP / LP flare system		Pipework			Y
				Relief valves			Y
				ESD blowdown valves			Y
				Pressure instrumentation			Y
				Ignition unit			Y
				Boom	Yes		Y
Structure	No	Module structures	Unlikely to be suitable layout for re-use.	Support / main steelwork			Y
				Cladding			Y
				Flooring			Y
				Gratings (steel)			Y
				Gratings (plastic)		Y	Y
				Passive fire protection			N
				Insulation			Y
				Doors / hatches			Y
		Staircases / external walkway structures	No	Steelwork			Y
				Handrailing			Y
				Gratings (steel)			Y
				Gratings (plastic)		Y	Y

Appendix D - Techniques from onshore demolition

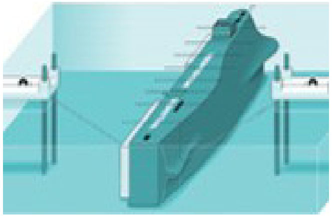
This Appendix provides information on a range of technologies that are (in the main) routinely used within the onshore decommissioning and demolition industry. Some of these techniques have also been used in the offshore sector previously. All of the technologies noted are considered suitable for use in either platform or jacket decommissioning using piece small or piece large methods.

Cranes

At some point during the decommissioning process, the platform crane will become unserviceable. At this point, an alternative means of lifting will be required. The options that have been identified are as follows:

- Self-erecting tower cranes. These are tower cranes that do not require another crane to be present for erection and effectively unfold themselves. The erection process itself is very short and therefore the cranes can be moved around the platforms as required. The disadvantage is that they have a 20 tonne maximum lift capacity, reducing at a radius greater than 5 metres, and therefore would be unsuitable for lifting items to, or from, the platform to the support vessel
- Pedestal cranes. These cranes can be attached to the jacket structure and used for lifting heavier loads than the self-erecting tower cranes. Pedestal cranes have a lift capacity of around 600 tonnes. These cranes can be attached to the platform or to the support vessel and used for both piece small and some piece large removal
- Heave compensated boat mounted cranes. The support vessel can be fitted with a heave compensated crane. A range of sizes are available and are suitable for deployment on to appropriately sized / modified support vessels. Typical heave compensated cranes range from 250 tonnes up to around 750 tonnes, this can support both piece small and some piece large removal

Wire saw

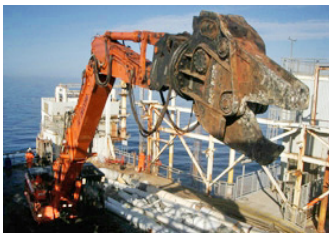


Wire saws are used for the cold cutting of structural steel and concrete. The specification of the wire varies depending upon the application, but is covered with carbide or similar to provide a cutting edge. The wire is strung between two modules, or in the centre of a module and the cable cuts using either a reciprocating or continuous belt motion, through the module cutting it into 2 smaller sections enabling these sections to be lifting with smaller cranes. As an example of the capability of this technology, in 2003 SMIT Salvage, a Dutch ship-breaker and salvage company used the tool to carve up the Tricolor, a 625-foot vehicle carrier that had sunk in the English Channel. The wire saw sliced the Tricolor into nine pieces, one 30-hour cut at a time.

Laser scanning

Laser scan techniques have transformed surveying technology, allowing the build-up of detailed models that allow precise design of dismantling procedures away from the platform. The laser scans, along with photographic data captured simultaneously allows detailed models to be constructed. Additional data can then be added to these models including links to other documents such as drawings. Laser scanning and photographic models are currently used offshore for creating as built drawings, Operator training, offshore workpack preparation etc.

Mobile shear



Shears are mounted on the arm of an excavator or remotely controlled demolition machine. The shear can be used to precisely cut and break up a structure. As an example, the Genesis XP 1400R, can generate 2,245 tons of force per square inch to cut through up to 3-foot-thick sections of steel. The shear head - with eight blades packed into its jaw - is made of a proprietary alloy that 30 percent stronger and more abrasive-resistant than steel. Suppliers such as Genesis and Labounty are currently designing a smaller lighter shear with much more cutting force, this new shear can be used on smaller remote machines making it suitable for deployment offshore. There are other mobile shear producers who can provide similar products.

Remote demolition machine

Remote controlled demolition machines are available in a range of sizes and replace the conventional excavator when using shears and breaking equipment etc. With the new range of models, manufacturers such as Brokk and JCB are breaking way for a whole new field of application when it comes to demolition projects. Considerably larger than the other machines in the Brokk family, their new machine has an unparalleled capacity that makes it perfect for really heavy and demanding demolition work. These machines transported and lifted onto the platform using the support vessel. The remote control functionality allows the Operator to stand at distance away from the main demolition activity and could even be controlled from the support vessel. The remote machines have a reach of up to 30 metres.

CO_2 / nitro-foam inerting

CO_2 / nitro-foam inerting is an innovative method developed for the inerting of process systems that have contained flammable materials. These systems must be made safe prior to opening them up, this method was designed to positively vent explosive vapours in a controlled and safe manner. This type of inerting is used extensively for underground petroleum tanks during onshore demolition, but can also be advantageous when rendering vessels or pipework safe to allow hot works to be used safely offshore during piece small or piece large removal.

Appendix E - Asset re-sale information

During the workshops, it was highlighted by the asset recovery companies that in order to maximise the recovered value of equipment it's important to have key information available. Most of this information is typically found on the equipment datasheet or General Arrangement (GA) drawings. The availability of this information may be poor, particularly in cases where assets have changed hands a number of times. In these cases, alternatives such as refurbishment and retesting may need to be considered.

The type of information required varies depending upon the type of equipment. Therefore this list should be considered as indicative only.

Common information (All items)

- Manufacturer
- Date built
- Basic item description
- Model No
- Weight
- Original manuals
- Maintenance history
- Drawings

Additional information required for specific equipment types.

Power generator

- Power output
- Hours run
- Date of last major overhaul

Heat exchanger

- Material of construction of tubes and shell
- Surface area
- Pressure and temp design rating

Vessel

- Material of construction
- Pressure and temp design rating
- Volume
- Nozzle connections
- If jacketed?
- If agitated and if so power rating of agitator drive

Compressors

- Design gas composition
- Design flow rate - Ncfm
- Design pressure inlet and outlet
- Type of drive - e.g. electrical or gas turbine
- Last major service date

In addition it is always important to have any manuals / maintenance history and drawings for each equipment item in order to maximise value.

Appendix F - Contractor list

In addition to the contractors referenced here, there are many other companies that can provide similar services. It is recommended that reference is made to the Decom North Sea members list and organisations such as FPAL to identify other suppliers.

There are many contractors who are established in the onshore decommissioning and demolition industry. The companies who have expressed an interest to undertake decommissioning work offshore (or may already be offering this) include:

- Brown and Mason
- Cuddy
- Dem-master Demolition
- Hughes & Salvidge
- KDC
- Keltbray
- O'Brien Demolition
- Squibb Group
- The Coleman Group
- Thompsons of Prudhoe
- Veolia
- WRD Group

Due to the number of companies operating in the demolition market and the wide range of experience that they have, Operators need to undertake a full appraisal of any potential supplier. This is to ensure that they have a good health, safety and environmental performance and procedures in place to undertake the complex task of demolition offshore.

Contractors that are looking to become involved in the offshore sector should consider registering with Achilles FPAL. This is used by major buying organisations within the oil and gas sector and operates a pre-qualification system to assess suppliers for tender opportunities and minimise risk within their supply chains.

Specialist cutting

Offshore supply companies exist such as for example Gulfstream Services (GSI) Claxton, TETRA, and Trac Oil and Gas Ltd, who offer a range of innovative cutting tools which can easily be used in offshore demolition. Genesis (shear manufacturer) indicated that they are working on lighter more powerful shears that can be used offshore using smaller remote machines.

Marine engineering and support

In order to provide suitable vessels and equipment adapted specifically to support future decommissioning projects, specialist marine engineering services are required. These companies can identify suitable vessels to support specific removal methodologies including the installation of heave compensated cranes, and walk to work systems. The company who attended the workshops and contributed to alternative vessel support was TSG Marine. The company that carried out the engineering for the redevelopment of the Welland platform into the Sanaga 1 Mobile production Unit was Overdick GmbH & Co.

Asset recovery and re-sale

A number of asset recovery specialists who sell plant from the onshore process and power industry expressed an interest to sell redundant assets and spares from the upstream sector. These companies were:

- Oilmac
- IPPE
- Indassol
- Go Industry Dove Bid
- Network International

These companies have experience in selling full redundant process plants and equipment across the globe. Different contract models are provided to suit specific client requirements. All of these companies are known by the demolition companies who work very closely with asset recovery specialists in order to generate income for clients from projects.

For further information please contact:

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