PART B
Opportunities & Markets

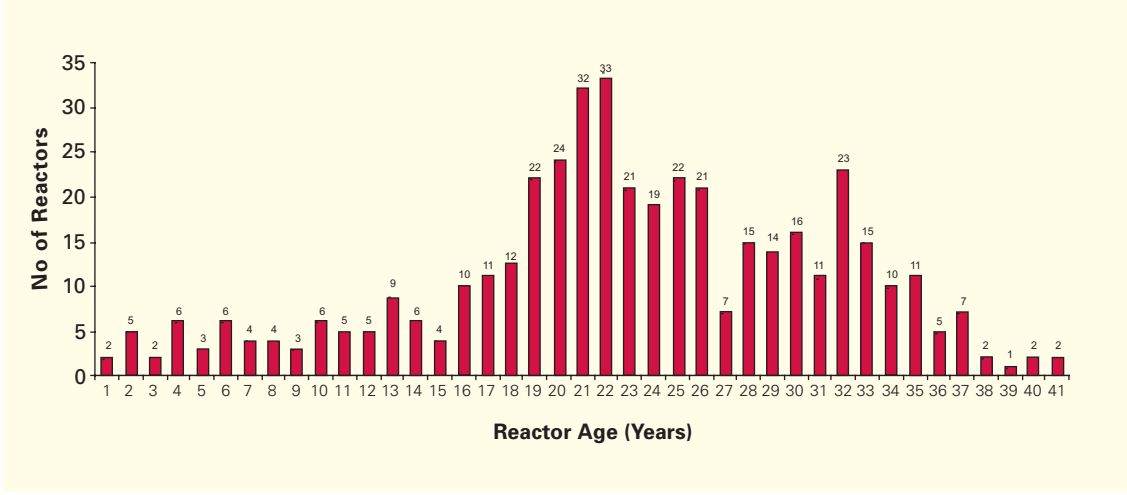
2. UK and Global Nuclear Decommissioning Opportunities

2.1 Global Nuclear Decommissioning Opportunities

Figs 2.1, 2.2 and 2.3 below together with information in the report on global nuclear decommissioning markets show that significant opportunities are fast developing associated with the decommissioning civil nuclear power plants and their support facilities across the world. This together with global environmental clean up of sites associated with nuclear weapons manufacture, deterrents and defence means that a tremendous opportunity for the UK nuclear industry supply chain in global decommissioning is happening now and is set to grow over the next few decades.

Figure 2.1 below shows the number of civil nuclear reactors worldwide by age and the scale and timing of the potential decommissioning opportunity for civil power reactors, with a design life typically in the order of 35 years.

Fig 2.1 Number of reactors in the world by age



The chart shows that there are 151 operational reactors approaching 20 years old, 200 reactors 20 years old or greater, 70 reactors 30 years old or greater and 19 reactors 35 years old or greater. This indicates that there are nearly 90 reactors worldwide coming up for dismantling and decommissioning over the next ten years.

Plans for lifetime extension of power plants in a number of countries are being formulated which may allow a number of the reactors to run beyond their original design lifetimes. However, this does not affect the ultimate size of the potential opportunity.

2.2 A Global Nuclear Decommissioning Timeline

Fig 2.2 below provides a global decommissioning timeline for each country in the world with civil nuclear power reactors. The timeline is based on a 35 year reactor lifetime from start of commercial operation except where country policy has dictated otherwise. It indicates in years (or group of years) and the number of reactors that will reach the end of a 35 year lifetime for each country in the world nuclear community. The timeline shows those countries that are likely to provide shorter term, medium term and longer term decommissioning opportunities of nuclear power reactors. It should be noted that a number of these countries also have variously other fuel cycle facilities including experimental reactors, fuel fabrication and reprocessing facilities. In addition a number of countries have a clean-up and decommissioning legacy that remains from former weapons manufacture and defence facilities.

Fig 2.3 shows the global picture for shut down and decommissioning commercial reactors and gives indications of those countries currently engaged in reactor decommissioning operations and clean up.

The information in the timelines in Figs 2.2 and 2.3 has been used in the global decommissioning market assessment and selection process outlined in section 3. It is left to the reader to consider the information in the figures.

Fig 2.2 Global Operational Nuclear Reactors – Forecast Decommissioning Timeline

Year	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	TOTAL
Country																																					
Argentina					1									1																							2
Armenia											1																										1
Belgium											3							2			2																7
Brazil																1															1						2
Bulgaria		2																	1					1													4
Canada		4					3			1				3	4		3				4																22
China																									3									6			9
CZ Republic																4																	2				6
Finland												2							2																		4
France					1				9			9			18				5		6										11						59
Germany	1		4				3			7						3																					18
Hungary														4																							4
India	2			1								1			2							3			1					4							14
Iran																																		2			2
Italy																																					0
Japan	2	1	4			6			2			7				7				6			7			4						2				53
Lithuania	1				1																																2
Mexico																					1					1											2
Netherlands				1																																	1
N Korea																																					0
Pakistan			1																											1							2
Romania																																					0
Russia			3		8					5			4			5			3					1							1						30
Slovakia											2					2												1						1			6
Slovenia														1																							1
S Africa															2																						2
S Korea									1			2		3				3								7							2				18
Spain		2												3		2			2																	9
Sweden			1			4					3			3																							11
Switzerland					3					1					1																							5
Taiwan								2				2			2																							6
Ukraine												3				2	3		4								1										13
UK		4		2		2	4									10										1											23
USA	2	3	4	5	6	12	8	3	6	3	1	2	4	1	3	7	7	8	6	6	2	3			1		1										104
TOTAL	8	16	17	9	20	24	18	5	18	17	10	28	8	19	32	43	13	13	23	12	15	6	7	2	4	14	2		1		17	1	6	6	3		442
Graph is based on a 35 year lifetime from start of commercial operation except where country policy has dictated otherwise																																					

Short term Medium term Long term

Fig 2.3 below shows the global picture for shut down and decommissioning commercial reactors and gives indications of those countries currently engaged in reactor decommissioning operations and clean up.

Figure 2.3 Global Shut Down &/or Decommissioning Commercial Reactors

Country	Year																															
	64 to 70	71 to 75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	Total
Armenia																1																1
Belgium														1																		1
Bulgaria																													2				2
Canada				1							1													2									4
France		1					1				1	2					2	1	1		1				1								11
Germany		2					1				1	1			2	1	7					1										1	18
Italy									1					1			2																4
Japan									1																1								2
Kazakhstan																										1							1
Lithuania																															1		1
Netherlands																								1									1
Russia										1	1				1	1																	4
Slovakia						1																											1
Spain																										1							1
Sweden		1																								1						1	3
Switzerland	1																																1
Ukraine													3						1				1					1					6
UK				1				1							1	2	1	2			1						2		2	4		4	21
USA	8	3	1		1	1			1					1		2			3				1	2	3								27

2.3 UK Non Nuclear Opportunities

An initial review of seven UK non nuclear markets was undertaken to assess future opportunities for decommissioning and to develop the UK decommissioning supply industry. Assessment of the opportunity potential for each UK market was based on:

- Long term growth prospects
- Strong market drivers
- Scale of UK opportunity
- Weak UK supply industry e.g. scope or need for development

Opportunities were ranked low, medium or high to provide a preliminary view of the overall potential in the following matrix.

Figure 2.4 UK Non Nuclear Decommissioning Opportunity Potential

Market	Opportunity	Long UK term growth	Strong market drivers	Scale of UK opportunity	Weak UK supply industry	Overall Opportunity Potential
Offshore	30 year plus decommissioning of North Sea offshore installations	High	High	High	Med	**High**
Fossil fuel power plant	30 year plus decommissioning of power stations	High	Med	High	Med	**Med-High**
Defence (non nuclear)	Decommissioning MOD facilities and sites	Med	Med	Med	Low	**Med**
Green ship recycling	Accelerated phase out of single hull tankers	Med	High	Low	High	**Med**
Mines	Rehabilitation of coal, mineral and metal extraction sites	Med	Med	Low	Low	**Low-Med**
Industrial plant	Demolition buildings and remediation of brownfield sites	Med	Low	Med	Low	**Low-Med**
Refineries	Demolition and remediation of brownfield sites	Low	Med	Med	Low	**Low-Med**

Preliminary analysis indicates the highest opportunity potential is in decommissioning North Sea offshore platforms and installations over the next 30 years and beyond, where there appears to be scope for supply chain development in the UK. Requirements are diverse covering a wide range of supplier requirements.

Decommissioning fossil fuel power plants also offers considerable potential, although there is an established supply industry. Overall opportunities were therefore judged to be medium to high potential.

Defence (non nuclear) and green ship recycling were ranked of medium potential due to the medium term prospects, drivers and scale of opportunity in the UK. Opportunities in non nuclear defence cover both broad (e.g. demolition, site recovery etc) and specialist areas (e.g. remote handling). Green ship recycling will require development of new facilities in the UK.

Mining, industrial plant and refineries appear to have limited prospects due to the scale of the opportunities and/or the presence of a strong existing UK supply industry, although there could be niche opportunities for new entrants.

More detailed analysis of the opportunities is provided in the UK non nuclear decommissioning market profiles in section 3.2 of the report.

3. The Decommissioning Markets

3.1 UK and Global Nuclear Decommissioning Markets

For any UK company, identifying the right global decommissioning markets to enter is very important since it can be a major determinant of success or failure. A systematic approach to selection of global markets has been used in this study to identify and prioritise the top ten global nuclear decommissioning markets.

Preliminary and fine screening of global markets has been undertaken during this study using questionnaires, a completed example of which is provided below for France as tables 3.1 and 3.2.

Table 3.1 Market Attractiveness for France

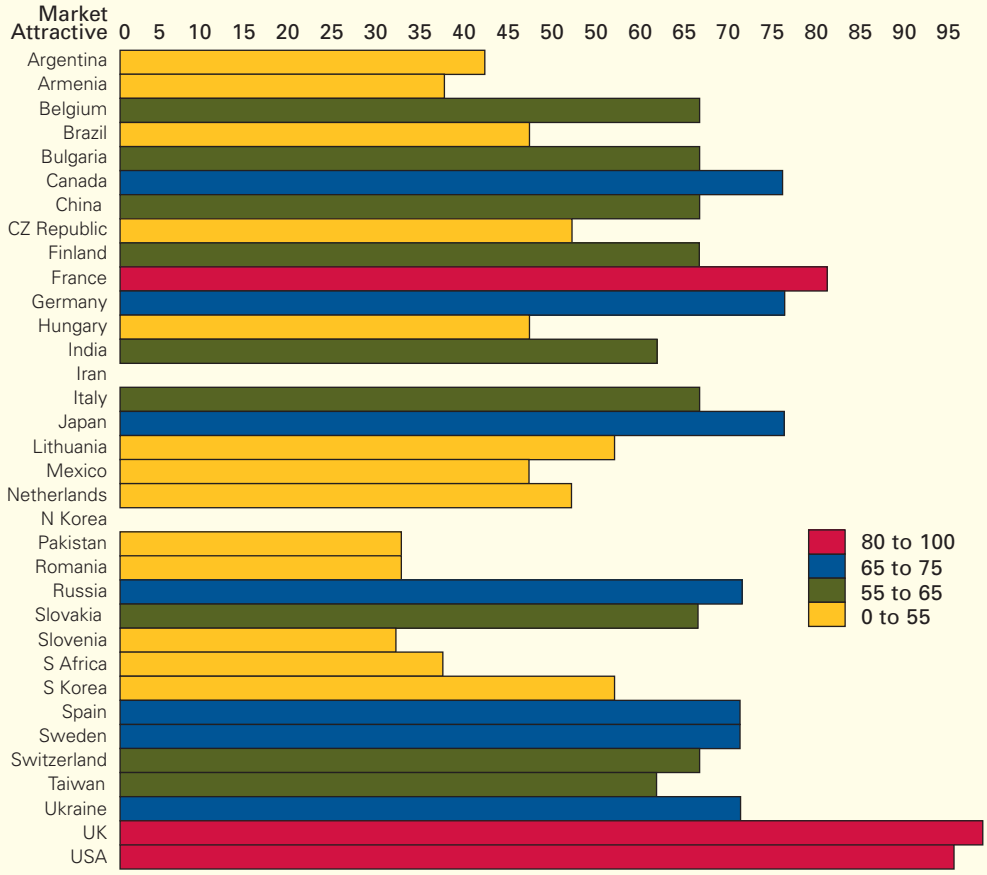
	1. Very poor	2. Poor	3. Medium	4. Good	5. Very good	% Weight factor	Result (grading * weight)
Market Size					✔		5
Market Growth Growth				✔			4
Market potential & timing				✔			4
Profit potential			✔				3
Market access				✔			4
Political/ economic risks			✔				3
Buying power					✔		5
Socio-cultural distance				✔			4
Total							**32 (80%)**

Table 3.2 Relative competitive strength (UK company vs French equivalent)

	1. Very poor	2. Poor	3. Medium	4. Good	5. Very good	% factor	Result (grading * weight)
Product/service demand		✔					2
Prices & conditions				✔			4
Market presence		✔					2
Communication				✔			4
Marketing plan			✔				3
Market share obtainable			✔				3
Financial strength				✔			4
Total							**22 (63%)**

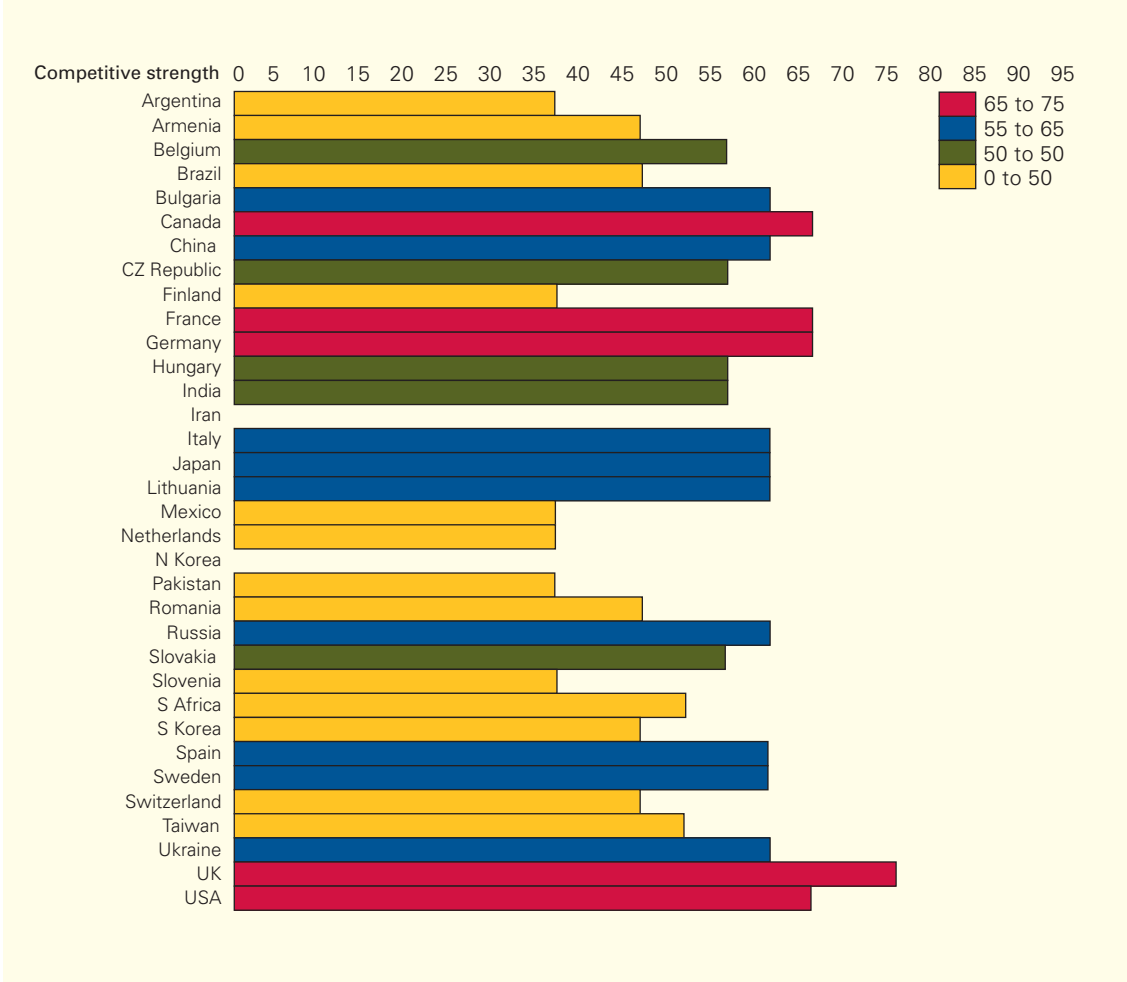
These were completed using information obtained through desk research and interview of companies in the nuclear supply chain both in the UK and overseas for all countries with nuclear reactors shown in figures 3.1 and 3.2.

Fig 3.1 Global Decommissioning Market Assessment



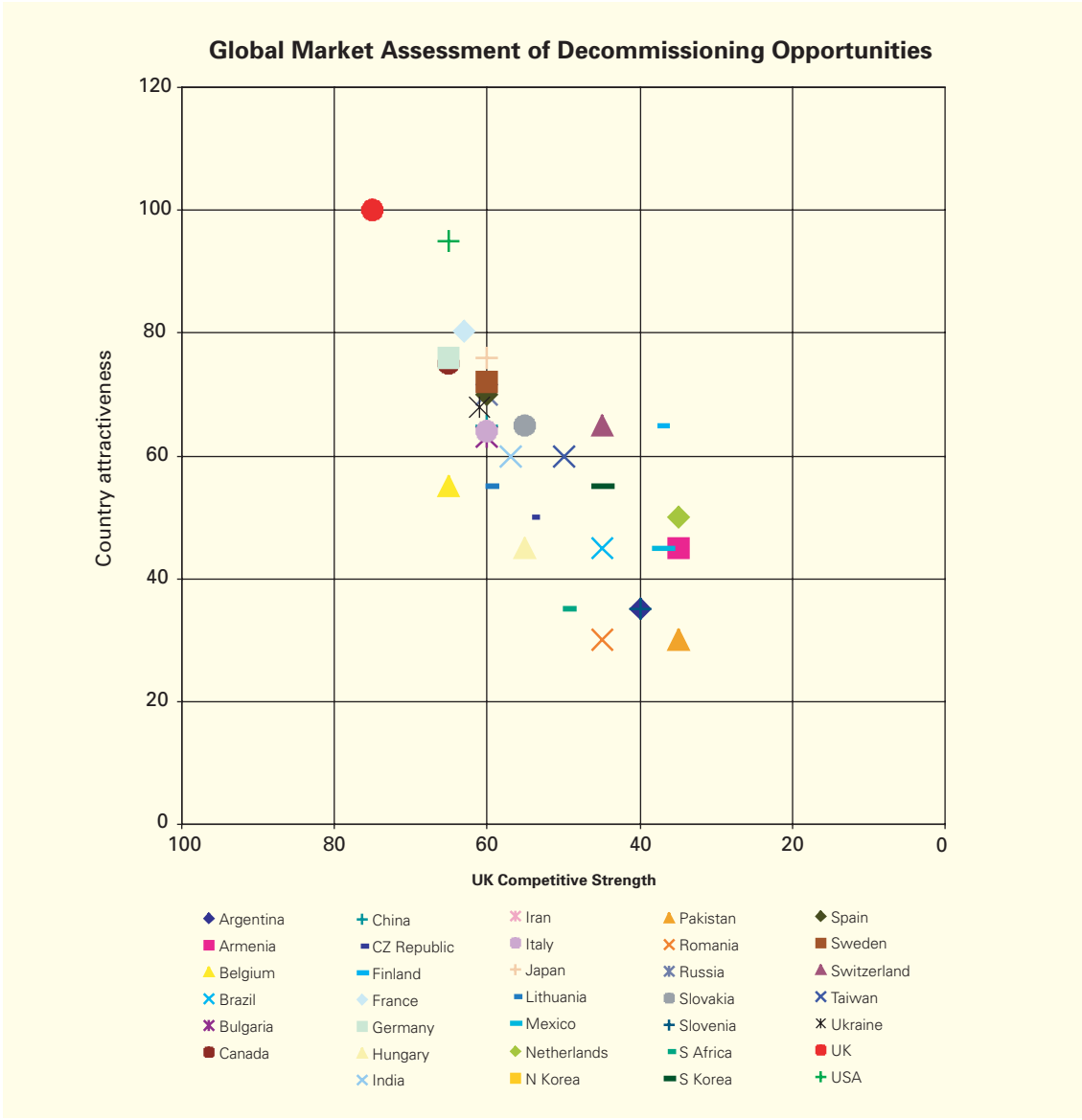
Argentina	Longer term future market	2 Op Reactors
Armenia	Medium term	1 S/D , 1 Op
Belgium	Longer term future market	7 Op
Brazil	Longer term future market	2 Op
Bulgaria	2 reactors to close by 2006	4 Op, 1 planned
Canada	Longer term future market	22 Op
China	Longer term future market	9 Op, 15 planned
CZ Republic	Longer term future market	6 Op
Finland	Longer term future market	4 Op
France	Short, med & long term opps	59 Op,11 S/D
Germany	Short, med & long term opps	19 Op,18 S/D
Hungary	Longer term future market	4 Op
India	Longer term future market	14 Op, 8 Planned
Iran	Longer term, high risk	2 scheduled to start up
Italy	Short term 4 reactors S/D	New repository by 2020
Japan	Medium & long term	53 Op, 2 S/D, 30% inc by 2011
Lithuania	Short term opps	2 Op, 1 scheduled for S/D
Mexico	Longer term future market	2 Op
Netherlands	Short term opportunity	1 Op near end of life
N Korea	Long term high risk	2 PWR under construction
Pakistan	Med term, high risk	2 Op , 1 to be S/D within 5 yrs
Romania	Long term	1 Op
Russia	Short, med & long term opps	30 Op, 4 S/D- Other nuclear
Slovakia	Short & med term opps	6 Op
Slovenia	Longer term	1 Op
S Africa	Longer term opps	2 Op
S Korea	Longer term opps	18 Op, 2 +planned
Spain	Short, med & long term opps	9 Op, 1 to be S/D, 1 decom
Sweden	Short, med & long term opps	11 Op,1 S/D
Switzerland	Med term	5 Op, 2 research decom
Taiwan	Med term	6 Op
Ukraine	Short, med & long term opps	13 Op, 6 S/D,
UK	Short, med & long term opps	23 Op,18 S/D + research
USA	Short, med & long term opps	104 Op + 19 S/D + research

Fig 3.2 Global Decommissioning UK Supply Chain Capability Assessment



From these results a market attractiveness/competitive strength matrix was produced, shown as figure 3.3 below. This was used to compile the top ten global markets in section 4.

Fig 3.3 Global Nuclear Market Assessment



3.2 UK Non Nuclear Decommissioning Markets

In addition to the nuclear industry, which was the main focus of this review, there are many other sectors that have historic legacies that need to be addressed, where decommissioning may be driven by environmental legislation, declining industries or urban regeneration. Many of these sectors are only just emerging and may have long term decommissioning requirements that offer potential business opportunities to UK industry.

Following the preliminary review of decommissioning activity in the UK (section 2.2), a desk based review and stakeholder interviews were carried out on seven sectors where a long term need for decommissioning was identified. The following profiles provide a summary of the market potential, market drivers and existing supply chain dynamics.

3.2.1 Offshore Decommissioning

Drivers

Decommissioning activities by the oil & gas industry come under auspices of several regulatory regimes including the UK 1998 Petroleum Act, international obligations placed on national governments (e.g. OSPAR 98/3, UNCLOS 1982 etc) government guidelines (e.g. DTI Guidance Rules 2000) and the Health & Safety Executive. Under the 1998 Petroleum Act all operators must submit costed abandonment plans for all offshore installations, which incur severe liability if they are not carried out.

Requirement

Following extensive oil & gas exploration and production in the North Sea since the 1970's there have been an increasing number of offshore platforms and subsea installations that will need decommissioning. Facilities to be removed include:

- Topsides
- Subsea wells, manifolds and structures
- Pipelines
- Terminals

There is still debate concerning drill cuttings from some of the earlier platforms e.g. whether to remove or leave in-situ with on-going pollution monitoring. Related shoreline facilities will also need be decommissioned at some stage such as oil terminals, jetties etc.

Market Potential

A number of studies have been commissioned by DTI (see approved decommissioning programmes www.og.dti.gov.uk/upstream/decommissioning/programmes/approved.htm) and Scottish Enterprise (see Oil & Gas Decommissioning Opportunity Review 2005 at www.scottish-enterprise.com/sedotcom_home/sig/sig-energy.htm). Analysis of available forecasts suggest there are around 220 steel jacket platforms, 11 concrete platforms and 18 floating production systems for decommissioning by 2030 and beyond. Best estimates of opportunity potential over the period are:

- Topsides/installations – **£10bn**
- Subsea structures – **£3bn**
- Pipelines – **£2-6bn**
- Drill cutting volumes ~**700,000 m^3** (UK Continental Shelf) and **500,000 m^3** (Northern North Sea)

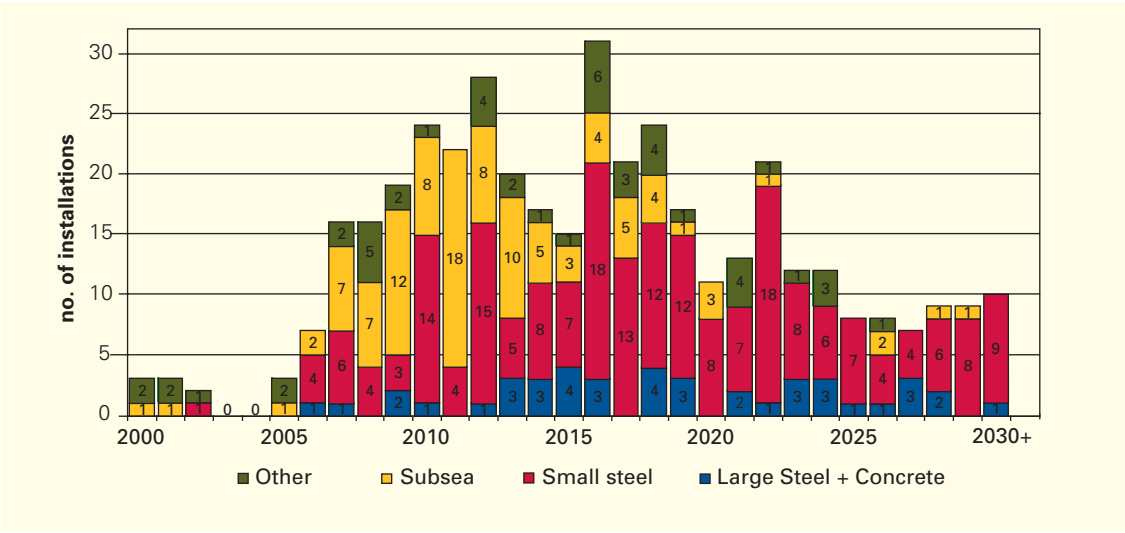
Supply Chain Capability

Offshore decommissioning started back in the 1980's with Piper Alpha, followed by number of installations through the 1990's and the last five years. During this time a supply industry has emerged, although there are still capability/capacity gaps e.g. project managers, heavy lift barges and shore-based facilities to handle structures. The UK supply industry has also developed considerable expertise in advanced remote handling, cutting and control techniques for hazardous subsea working environments that could be transferred to other decommissioning markets e.g. nuclear, defence etc.

Opportunities

Offshore decommissioning activity in the North Sea (including the UK and Norwegian sector) is forecast to grow sharply over the next 10 years offering potential opportunities for UK industry. The following timeline (DTI) provides an indication of UK decommissioning activity over a 30 year period.

Figure 3.4 Offshore Decommissioning Activity



DTI's growth scenario suggests rapid growth in UK North Sea offshore decommissioning activity between 2005 and 2016, followed by decreasing activity upto 2030 and beyond. The bulk of activity in terms of number of installations will be for small steel platforms and removal of subsea structures. A major issue is the supply industry capacity to meet the rapid growth over the 10 years. One option is to transfer appropriate skills and capabilities from other industry sectors e.g. nuclear, waste management, civil engineering etc. This would open up market and product diversification opportunities for new entrants with available manpower resources. Overall, offshore decommissioning potentially offers attractive long term prospects for the UK.

It should be noted that the above timeline may drift due to developments in oil recovery technology that will extend the life of marginal fields and offset decommissioning timeframes.

3.2.2 Fossil Fuel Power Plant Decommissioning

Drivers

Safety and environment are the main regulatory factors that may have an impact on decommissioning fossil fuel power generation plants. However, the primary drivers for decommissioning are related to economic factors such as:

- Replacing plant at the end of their safe working life
- Inefficient plant
- Regeneration of brownfield sites

In reality there are limited incentives for operators to decommission facilities unless they are upgrading facilities. During times of low energy costs, electricity generators may decide to mothball old plants rather than decommission. Security of supply will continue to be a major barrier to decommissioning for the foreseeable future.

Requirement

Fossil fuel based power plant includes coal, oil, gas or a mixture of a mix of several fuels e.g. coal/oil and usually comprise of a combustion zone, pipework, fuel storage facilities, electricity control systems/transformers, and buildings. Decommissioning requirements typically include:

- Removal and recycling of industrial equipment
- Demolition of buildings
- Treatment and disposal of hazardous wastes
- Land remediation and rehabilitation

Market Potential

Nearly 100 fossil fuel power stations are currently operating around the UK. These cover a range of sizes, fuels and age profile with a typical design life of 30-35 years. A number power stations are over 30 years old and due for decommissioning.

- 43 operational gas fired power stations
- 19 oil fired power stations
- 12 operational coal fired power stations
- 8 combined coal/oil fired power stations
- 10 other various power stations

Costs for decommissioning vary considerably with size and activity. For example, replacement of part of an existing power station will cost less than when removal of hazardous waste, land mediation and on-going monitoring is required. Based on an average cost of £40m/station, the UK fossil fuel power plant decommissioning market alone is estimated to be worth around £4bn over the next 35 years. Internationally, there has been growth in new build coal power stations that require decommissioning in the long term.

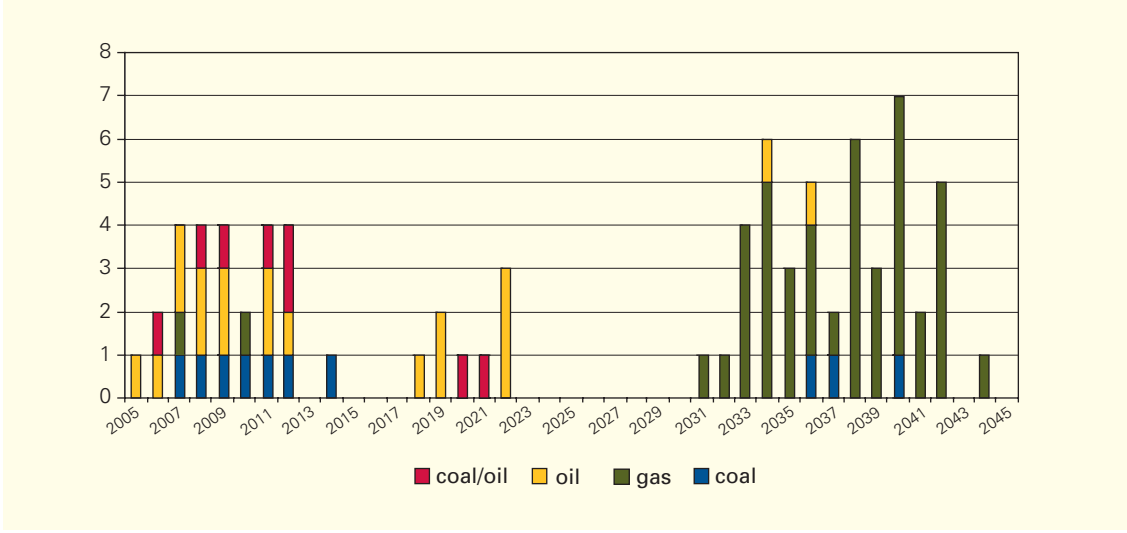
Supply Chain Capability

Decommissioning fossil fuel power stations in the UK has historically been a low level activity. As a result the supply industry tends to operate in a number of decommissioning markets. Dismantling facilities and demolitions accounts for most of the decommissioning activity and main contractors are usually civil engineering groups. If specialist services are required e.g. hazardous waste removal treatment, then work would subcontracted to specialist companies. Current UK supply chain capability and capacity appears to meet existing market demand, although the situation may change as future decommissioning programmes are implemented. There is a strong supplier capability fit with the nuclear, offshore and construction industries.

Opportunities

The following timeline for future decommissioning of fossil fuel power stations in the UK over the 35 years was based on data from the International Energy Agency (www.iea.org/index.asp) and a 30 year design life for power stations.

Figure 3.5 UK Fossil Fuel Power Station Decommissioning Forecasts



This analysis indicates three periods of increasing decommissioning activity in the UK i.e. 2005 -2012 (26 power plants), 2016-2022 (8 power plants) and 2031-2042. (45 power plants). Oil fired stations account for 50% of decommissioning. Most gas fired stations will start to be shutdown from 2031, although security of energy supplies will be a key factor. The power generation industry is also striving to extend the life of power stations which will shift the decommissioning times.

Overall, fossil fuel power station decommissioning offers both short and long term growth prospects, albeit from a low starting point. Existing supplier capabilities generally match decommissioning requirements and the main issue will be supplier capacity to meet demand in the short term.

3.2.3 Defence (non nuclear) Decommissioning

Drivers

Cost reduction is a major driver for decommissioning establishments around the UK, as part of the MOD's strategy to improve efficiency and meet the UK's military long term needs. This includes disposal of many MOD buildings and facilities on some of the 4000 sites around the UK. Environmental issues are also important drivers due to the hazardous nature of some MOD activities e.g. decommissioning nuclear weapons at Aldermaston and long term programmes to recover ordnance from the Irish Sea and other parts of the UK.

Requirement

Decommissioning requirements in the defence sector are diverse, ranging from demolition work to highly specialised niche opportunities for handling, treatment and disposal of hazardous substances. Examples of supplier requirements are:

- Environmental Impact Assessments
- Remote handling and recovery of hazardous materials
- Waste management
- Demolition of buildings
- Site monitoring
- Remediation of contaminated land
- Site rehabilitation
- Remote monitoring and site maintenance
- Shipbreaking and recycling

Projects can range from small to large decommissioning of entire facilities such as naval dockyards e.g. Devonport Royal Dockyard.

Market Potential

Quantifying the value of defence decommissioning in the UK is difficult due to limited information in the public domain. For example decommissioning costs are not detailed in the government's defence spending plans for 2005-2006. However, the decommissioning and related waste management costs for the Devonport Royal Dock are estimated to be around £42m. The ten year environmental management programme for Aldermaston is expected to exceed that amount. Best estimates are that defence decommissioning spend is likely to be over £400 m/year.

Supply Chain Capability

Decommissioning fossil fuel power stations in the UK has historically been a low level activity. As a result the supply industry tends to operate in a number of decommissioning markets. Dismantling facilities and demolitions accounts for most of the decommissioning activity and main contractors are usually civil engineering groups. If specialist services are required e.g. hazardous waste removal treatment, then work would be subcontracted to specialist companies. Current UK supply chain capability and capacity appears to meet existing market demand. Although the situation may change as future decommissioning programmes are implemented, there appears to be a good fit with decommissioning capabilities in other sectors including oil & gas, nuclear and construction.

Opportunities

The defence sector offers wide ranging decommissioning opportunities in the foreseeable future, with long term plans to dispose of sites, manage its weapons facilities and recover contaminated sites. Attractive areas include niche opportunities for specialist companies to long term projects, offering considerable scope for technology transfer and market diversification for new entrants.

3.2.4 Green Ship Recycling

Drivers

- Global ship scrapping practices violate HSE standards
- IMO proposed guidelines for green ship recycling
- EU accelerated phase out of single hull tankers
- UK has 9% of the EU's single hull tanker fleet, but no IMO approved green recycling facility
- Benefits to the environment

Requirement

Green ship recycling is a concept to manage the complete process of scrapping and recycling ships in a safe in and environmentally friendly way. This includes dismantling, disposal and recycling of materials and removal, treatment of and disposal of hazardous wastes to approved procedures. There is currently a world shortage of 'green ship recycling' facilities to cope with the potential demand.

Market Potential

The world merchant fleet has over 36,000 vessels, of which 80% are tankers and bulk carriers. This would equate to around 3000 single hull tankers being scrapped under the EU's accelerated phase out programme by 2010. Only a small number of approved 'green ship recycling' facilities exist worldwide. One is in the US where costs of dismantling warships typically costs $900-£1300 per dt and commercial vessels at $100-$500 per dt. If using these costs for all single hull tanker, the global market would be valued between $15bn-$75bn in 2010. In practice, not all single hull tankers will be scrapped by reputable facilities.

Supply Chain Capability

The UK currently has no IMO approved 'green ship recycling' facility, although Harland & Wolff with its dry dock facilities was cited by IMO as a potential candidate.

Opportunities

There is a potential opportunity to develop a long term 'green ship recycling' industry in the UK at ship breaking/recycling facilities such as Able UK, merchant/naval shipyards and oil & gas fabrications yards. Although the opportunity potential is high, there are likely to be major issues relating to investment, public concerns regarding this kind of facility and planning permission.

3.2.5 Industrial Plant Decommissioning

Drivers

- Provisions of the Occupiers Liability Act 1957
- Occupiers Liability Act 1984
- Water Resources Act 1991
- Owners need to limit on-going liability
- Maximising the site value
- Urban regeneration

Requirement

Decommissioning industrial plants with large facilities for processing chemicals, agrochemical, metals, pharmaceuticals where there are environmental issues require a range of services including:

- Demolition
- Land remediation
- Explosive demolition
- Dismantling
- Decontamination
- Asbestos removal
- Industrial cleaning
- Asset recovery

Market Potential

Changes in the UK economy over the next 30 years will result in many plant closures in traditional industrial areas across the UK. Urban regeneration has also seen major recovery brownfield sites for light industry and housing. Outsourcing manufacture to reduce costs is expected to result in further plant closures. For example, many chemical companies are moving production overseas. This will maintain demand for decommissioning for some time.

Supply Chain Capability

The UK has a well established supply industry providing decommissioning services, with links to the construction sector. Supplier capability strengths are in project management, site clearance and land rehabilitation. Specialist services e.g. asbestos testing and removal is usually subcontracted to independent companies and there no significant capability gaps.

Opportunities

Although there will be a large number of decommissioning projects over the next 10 years, these will be mainly small and of lower value. Overall, the market is assessed to be of medium potential. Capability strengths in project management could be transferred to other sectors where there are capability or capacity issues e.g. fossil full power generation and oil & gas.

3.2.6 Mine Decommissioning

Drivers

Coal, mineral and metal extraction are usually large scale developments that can impact on the environment. The main drivers for decommissioning are:

- Large environmental legacy (coal)
- National and regional government regulation (minerals and metals)
- Demand for regeneration and recreational sites

Requirement

Low decommissioning activity is required in the coal sector, where the main requirement is for niche monitoring and maintenance of sites. Limited investment is made to overcome contaminated water problems due to geological factors. Rehabilitation and landscaping is the main requirement for recovery of mineral extraction sites, although decommissioning metal processing plants may require waste removal and treatment.

Market Potential

Coal – There are 200 historic liability sites, with contaminated mine water, settlement lagoons and gas venting stations. There are also 50 mines currently working that will require future decommissioning. The containment policy by the Coal Authority and disputed ownership is limiting investment and opportunities. Estimated annual spend is £25m.

Mineral & metal extraction – Although there are over 2400 active sites in the UK, decommissioning activities are mainly associated with site recovery involving civil engineering work and is estimated to be worth less than £100m.

Supply Chain Capability

Specialist contractors provide monitoring and maintenance services to the coal industry and established civil engineering companies work closely with owners of mineral and metal extraction companies.

Opportunities

The overall potential decommissioning potential is assessed to be low.

3.2.7 Refinery Decommissioning

Drivers

As with offshore and fossil fuel power plant, there is an industry wide challenge to increase the life of existing refineries due to growing demand and security of supplies. The main drivers for decommissioning relate to:

- Extending existing plant capacity
- Replacing inefficient plant
- Eventual replacement of existing plant
- Low demand

Requirement

Refineries are basically steel structures, pipework, storage tanks and if relevant, dockside facilities. Decommissioning requirements include dismantling, removal and disposal of structures, decontamination, waste removal and treatment.

Market Potential

There have been only five refineries decommissioned in the UK since 1976, although most of the existing plants are 30-40 years old and will require decommissioning at some stage. Final shutdown dates are being pushed back due to extensive refurbishment and maintenance programmes. Over 90% of the plants are re-used or recycled, with possible opportunities for gas storage. The future UK refinery decommissioning market is estimated to be worth less than £800m.

Supply Chain Capability

A number of engineering groups provide maintenance and refurbishment services for rotating maintenance programme. Overall, the existing decommissioning supply industry has the necessary capabilities to meet future requirements for decommissioning of refineries in the UK.

Opportunities

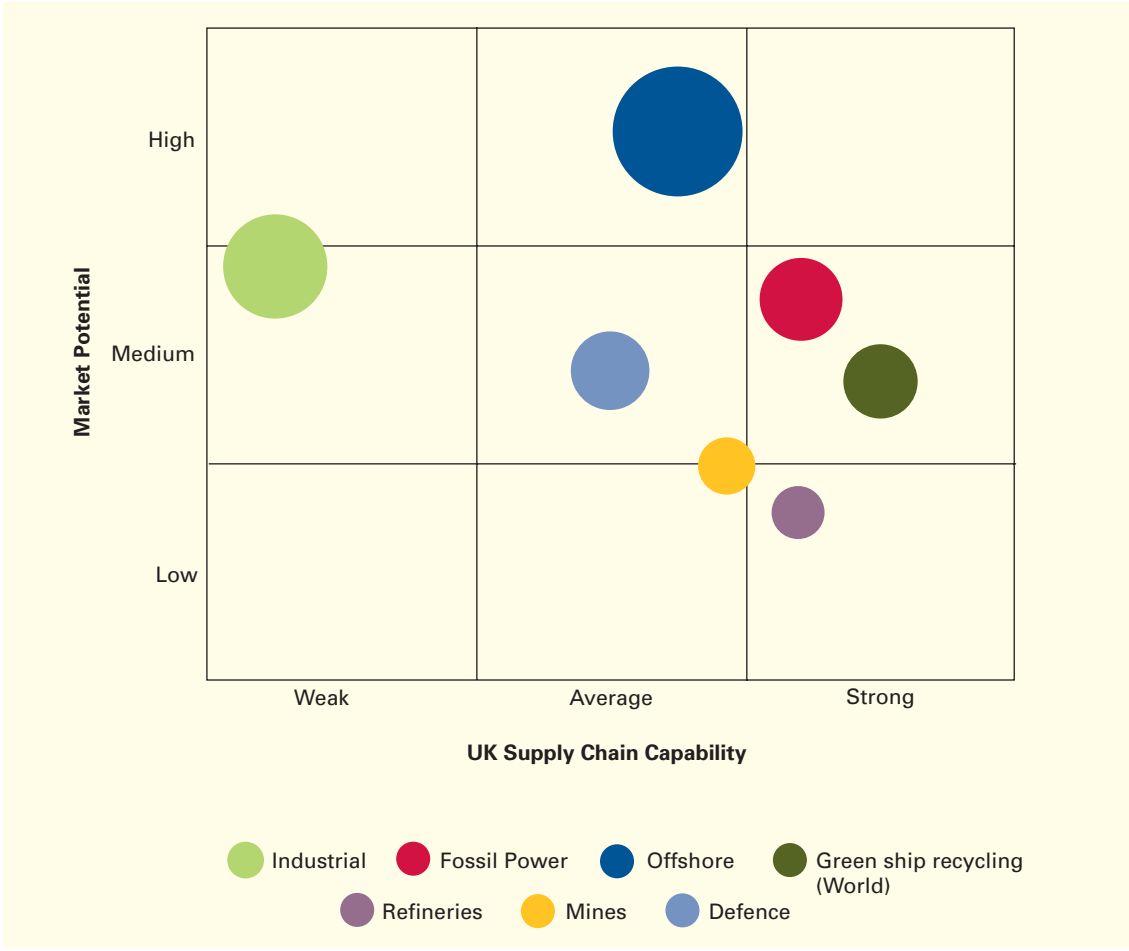
The long term decommissioning potential for refineries is considered to be low.

Summary

An assessment of all seven UK non-nuclear decommissioning markets was undertaken in terms of relative market potential and competitive strengths of the UK decommissioning supply chain. These were scored in a similar way

as the global nuclear decommissioning markets to rank overall opportunity attractiveness as shown in the following opportunity-capability matrix.

Figure 3.7 UK Non-Nuclear Decommissioning Opportunity-Capability Matrix



Taking into account all of the screening criteria, the most attractive UK non-nuclear decommissioning markets for UK industry in order of priority were:

1. Offshore
2. Fossil power plant
3. Defence (non-nuclear)
4. Green ship recycling
5. Industrial plant
6. Mining
7. Refineries

It is worth noting that UK companies are already developing these markets, although the growth forecast suggests there could be a capacity rather than capability issues.

4. The Top Ten Ranking Markets and Entry Strategies

4.1 The Top Ten Global Markets

The top ten global markets identified by means of preliminary screening based on parameters indicative solely of market attractiveness described earlier has shown that the top ten markets in order of priority are as follows:-

1. UK
2. USA
3. France
4. Germany
5. Canada
6. Japan
7. Sweden
8. Russia
9. Spain
10. Ukraine

However several other countries including Italy, Bulgaria and China had scores close to those at the bottom end of the table and so the process of fine-grained screening was carried out. This is based on the market attractiveness/ competitive strength matrix, itself based on a large number of possible variables for each country. This confirmed the position of the top ten markets indicated above.

These markets represent the best choice for a UK company wishing to establish a presence in a country for the long term. Going international can be expensive, in terms of both money and management time and commitment so a company needs to gain competitive advantage by going international. This top ten may not necessarily be the choice for all companies and the selection process used and described above in section 3 may be followed by any company wishing to establish a best choice according to its own criteria.

A profile of the nuclear decommissioning market for each of these countries has been prepared through both primary and secondary research and is included in Parts D to F of this report. The top three markets of UK, USA and France have been given more attention to detail and hence provide more detailed information about the market place and contacts in those countries than some of the others.

4.2 Global Nuclear Market Entry Strategies

Ten global target markets have been identified above and the question arises as to the best way to enter those markets. This section considers the reasons for exporting, major market entry modes and the criteria for selecting them to allow companies in the UK decommissioning supply chain to select markets that are best for them, given for example that they vary in size and nature of product or service.

4.2.1 Motives for Internationalisation

Before entering international markets UK companies should consider their motives for internationalisation. Discussion with business representatives from a sample of UK companies in the nuclear supply chain provided the following comments and list of reasons:-

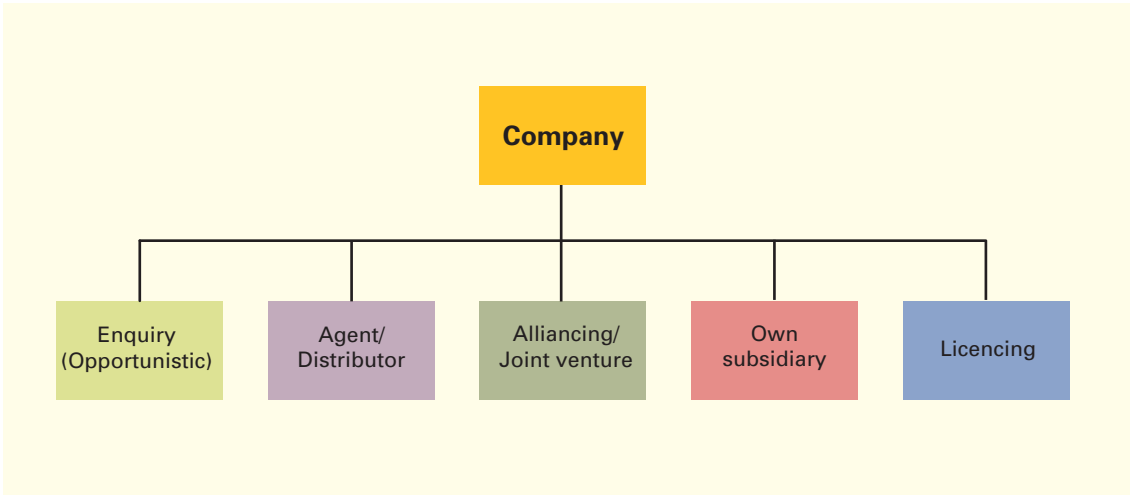
- With limited international experience and a weak position in the home market there is little reason for a firm to engage in international markets. Instead the firm should try to improve its position in the UK market. Additionally, a small company with limited financial resources will often be financially vulnerable. If the firm has already acquired some competences in international business operations it can overcome some of its competitive disadvantage by going into alliances with firms representing complementary competences: this and other strategies are developed further below.
- The fundamental reason for exporting, in most firms, is to make money. But one factor alone rarely accounts for one given action. A number of factors results in firms taking steps in a particular direction. Major motives for starting to export and some considerations include the following:-
- The desire for short-term profit is especially important to SME's that are at a stage of initial interest in exporting. The motivation for growth may also be of particular importance for the firm's export start.
- Managerial urge is a motivation that reflects the desire, drive and enthusiasm of management towards global marketing activities.
- A firm may produce goods or services that are not widely available from international competitors or may have made technological advantages in a specialised field.
- It is self evident that market opportunities act as stimuli only if the firm has or is capable of securing those resources necessary to respond to the opportunities.

- Becoming a participant in global marketing activities may enable the firm to increase its output and therefore climb more rapidly on the learning curve.
- Tax benefits can also play a major motivating role. In the USA a tax mechanism called the Foreign Sales Corporation (FSC) has been instituted to help exporters.
- Reaction to competitive pressures, e.g., a firm may fear losing domestic market share to competing firms that have benefited through global marketing activities.
- A company may be pushed into exporting because of the UK market potential, due to it being small or over-saturated.
- If a firm has excess capacity and its domestic sales or services are below expectation then its inventory may be above desired levels.
- Several small UK companies are aware of opportunities in export markets because their products generated enquiries from Overseas Dealing Departments.
- Seasonality in demand conditions may be different in the UK from other domestic markets.
- Physical and psychological closeness to the international market, e.g., the UK, mainly because of language, is perceived by the USA to be much closer than many other European countries.

4.2.2 Market Entry Modes

Once a firm has decided to enter overseas markets and chosen its target markets abroad, the question arises as to the best way to enter those markets. Discussion with a number of companies in the UK nuclear supply chain has shown that a number of different market entry modes are used and are shown in the following diagram, Fig 4.1.

Figure 4.1: Different Market Entry Modes Adopted by UK Companies



For most SME's the market entry represents a critical first step, but for established companies the problem is not how to enter new emerging markets, rather how to exploit opportunities more effectively within their existing network of global operations.

There is however no ideal market entry strategy and different market entry options are adopted by different UK firms entering the same market and/or by the same firm in different markets.

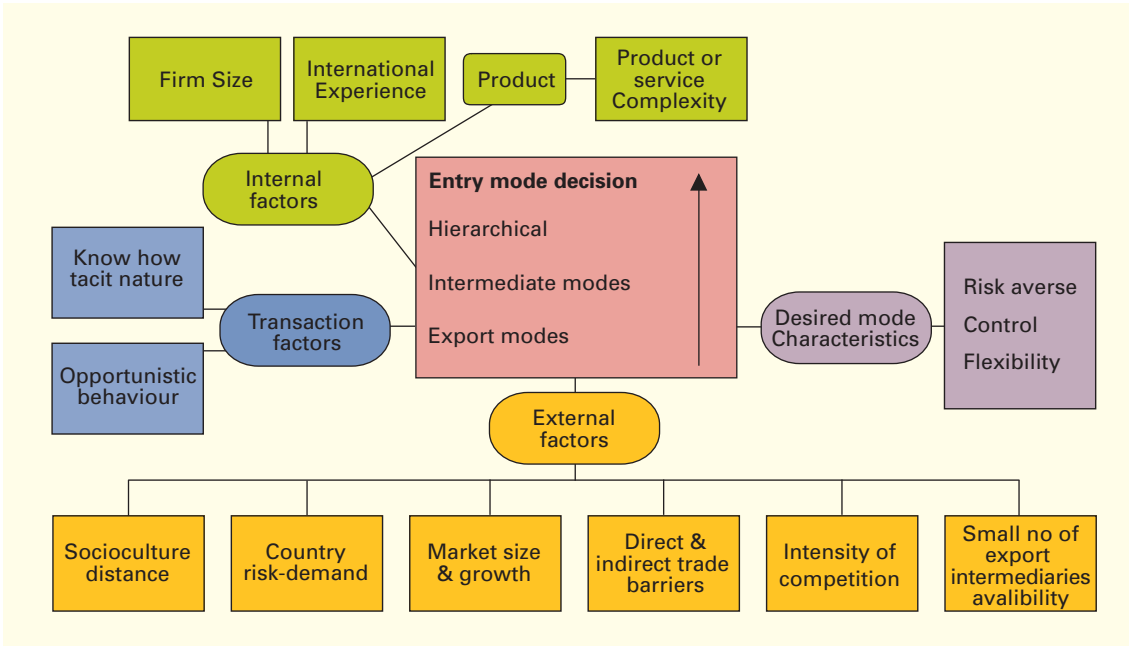
Seen from the perspective of the UK decommissioning supply chain, encompassing a wide range of manufacturers, engineering, design and service providers, market entry modes can be classified into three groups:

- Export modes – low control, low risk, high flexibility
- Intermediate modes (contractual model) – shared control and risk, split ownership
- Hierarchical modes (investment modes) – high control, high risk, low flexibility.

A firm's choice of its entry mode for a given product/target country is the net result of several forces. There are many factors that influence the UK company entry mode decisions that can be grouped as follows:-

- Internal factors
- External factors
- Desired mode characteristics
- Transaction-specific behaviour

Figure 4.2 Factors Affecting the Foreign Market Entry Mode Decision



4.2.3 How Each Factor Affects the Choice of Entry Mode

Internal factors

Firm size – Size is an indicator of the firm's resource availability; increasing resource availability provides the basis for increasing international involvement over time.

International experience – Another firm specific factor influencing mode choice is the international experience of the managers and hence the firm.

Product or service – The nature of the product or service offered by a company may give it a competitive edge.

External factors

Sociocultural distance between UK and host country – Socioculturally similar countries are those that have similar business and industrial practices, a common or similar language and comparable education levels and cultural characteristics. The greater the perceived distance between the home and host country in these terms, the more likely it is that entry modes involving relatively low resource commitments and high flexibility i.e., alliancing/joint venture agreements provide the best strategy for entry.

Country risk/demand uncertainty – Foreign markets are usually perceived as riskier than the UK market. The amount of risk is not only a function of the

market itself but also of its method of involvement there. When planning its method of entry a company must do a risk analysis of both the market and its method of entry. Exchange risk is another variable and risks are not only economic; there are political risks also.

Market size and growth – Country size and rate of market growth are key parameters in determining the mode of entry. The larger the country and size of its market and the higher the growth rate, the more likely it is that resources should be committed to its development and to consider establishing a wholly owned subsidiary or to participate in a joint-venture. Small markets may not warrant significant attention or resources and may best be supplied by an agent or acting as a supplier to a company already in the market.

Direct and indirect trade barriers – Tariffs or quotas on the import of foreign goods and services together with product or trade regulations and standards as well as preferences for local suppliers, or tendencies to "buy national" provide encouragement for companies to consider a joint venture or other contractual arrangements with a local company. The local partner helps in developing local contacts, negotiating sales and establishing communications as well as diffusing the foreign image.

Intensity of competition – When the intensity of competition is high in a host market firms should avoid heavy involvement, as such markets tend to be less profitable and do not justify heavy resource commitments. Hence other things being equal, the greater the intensity of competition the more the firm should favour entry modes that involve low resource commitment.

Small number of relevant intermediaries available – In this case the marketplace is subject to the opportunistic behaviour of the few intermediaries available and this will favour the use of a resident representative or subsidiary.

Desired Mode Characteristics

Aversion to risk, control and flexibility – If a company is risk averse then export modes that typically entail low levels of financial and management resource commitment will be appropriate. Control is closely linked to the level of resource commitment in a market and if a high degree of control is required then wholly owned subsidiaries are most appropriate. The level of flexibility required with a particular entry mode should also be considered as entry modes involving substantial investment, contractual agreements and joint ventures are difficult to change.

Transaction – specific factors

Tacit nature of know-how – When the nature of the firms' specific know-how transferred is tacit it is difficult to articulate by definition. This makes drafting of a contract for transfer of complex know how very problematic. This provides an incentive for UK companies to use for example a foreign subsidiary.

4.2.4 Assistance and Advice – Practical Steps to Global Market Entry

Much information, assistance and practical advice is available for those companies wishing to engage in global decommissioning markets. The following websites provide a wealth of information with links to other related organisations:-

UK Trade & Investment (UKTI):- www.uktradeinvest.gov.uk
This web site has much information on helping UK companies do business abroad with quick links to a range of helpful information sources and other relevant UK organisations. It also provides information on countries, sectors, its UK network and trade services together with help in succeeding.

Business Link:- www.businesslink.gov.uk
This web site provides a wealth of practical advice for businesses including information on finance, grants and international trade.

Scottish Development International:
www.scottishdevelopmentinternational.com/pages/index.asp
Scottish Development International is 100% government funded and is jointly operated by the Scottish Executive and Scottish Enterprise.

SITPRO (formerly the Simpler Trade Procedures Board:-www.sitpro.org.uk/ Click on "a road map to exporting success" on its home page. It focuses on procedures and documentation associated with international trade. It provides information on expanding overseas, preparation for export and what you need to consider and do. It also provides a list of very useful websites to specialist services providing free information and advice to exporters, e.g., military goods with links to export control agencies.

Foreign & Commonwealth Office:- www.fco.gov.uk
This has links to UK Embassies overseas and export control sanctions on its home page together with much useful information.

4.2.5 Global Funding Organisations

The following sites provide full information and details of global funding organisations and full details of their funding programmes with market and project information together with relevant contacts, tender opportunities when and where applicable. It can be useful for a company to establish whether a country or project in a country is being funded through one of the funding mechanisms as an aid to reducing risk associated with payment and to ensure an adequate level of profitability.

- EBRD European Bank for Reconstruction and Development: www.ebrd.com
- European Commission DG Research: www.europa.eu.in
- European Commission PHARE: www.europa.eu.in
- European Commission Research and Development Information Service : www.cordis.lu
- European Investment Bank : www.eib.org
- European Union TACIS: www.europa.eu.int
- World Bank. International Bank for Reconstruction and Development: www.worldbank.org

4.2.6 The G8 Global Partnership

At the 2002 G8 summit at Kananaskis in Canada, leaders pledged to provide up to $20 billion over ten years for a new Global Partnership against the spread of weapons and materials of mass destruction. The Prime Minister announced that the UK would make available up to $750 million to fund projects in pursuit of the Partnership's aims. This funding will allow the UK to significantly expand its work to address the nuclear, chemical and biological legacies of the Former Soviet Union (FSU).

The signing of bilateral agreements with the Russian Federation during President Putin's State Visit to the UK in June 2003 was the final stage in building a firm foundation for the UK programme's continuing contribution to tackling the proliferation of weapons of mass destruction. However, nuclear legacy issues are not confined to the Russian Federation, and the UK is entering into negotiations with other FSU/CEE countries including the Ukraine and Kazakhstan.

The DTI is responsible for establishing and directing the UK Government's involvement in this programme. The Ministry of Defence (www.mod.uk) is responsible for a similar programme of UK Assistance to Russia, to help manage the destruction of chemical weapons stocks. The Foreign and Commonwealth Office (www.fco.gov.uk) has a particular interest in two specific programmes – Disposition of Surplus Plutonium and Closed Nuclear Cities.

The Department of Trade and Industry (DTI), website is the focal point for information on UK assistance towards managing the FSU nuclear legacy:- www.dti.gov.uk/energy/nuclear/fsu Those interested in keeping up to date on the latest developments in each project and programme should visit the web site which provides full information on projects associated with the Nuclear Safety Programme, N W Russia, Aktau Decommissioning, Closed Nuclear Cities and Social Consequences of NPP Closure.

4.3 UK Nuclear Market Entry Strategy

This section offers practical advice on how and where to gather information about the prospective markets and identifies some of its potential risks, as an input to the development of a business strategy.

4.3.1 Gathering market intelligence

A brief summary on the UK nuclear decommissioning market is provided in Part D of the report.

Gathering market intelligence is the essential first step to developing a successful strategy. Depending upon the chosen position in the supply chain, other players in the industry may represent potential:

- Stakeholders
- Customers
- Partners
- Competitors

The following are key stakeholders:

- The DTI and Treasury (and regional equivalents, e.g., Scottish Executive)
- NDA
- NII (Nuclear Installation Inspectorate)

- The Environment Agency (in England and Wales)
- The Scottish Environmental Protection Agency (in Scotland)
- NIREX
- Office of Civil Nuclear Security
- Local planning authorities
- Local community organisations
- Other supply chain members and potential collaborators

The following are potential customers who are current tier 1 players:

- British Nuclear Group (at both Sellafield and through Reactor Services the Magnox fleet)
- UKAEA

Other organisations with relevant nuclear site management experience, albeit not directly in the civilian clean up environment, include British Energy, Amersham, DML and AWE.

When the tier 1 market is opened for competition by the NDA, it is envisaged that this will attract new entrants, some of whom will be foreign companies. Clearly, there is uncertainty about which companies will emerge.

The arrival of foreign new entrants at tier 1 may provide opportunities for companies who aspire to be part of a tier 1 organisation because although foreign new entrants may be able to compete successfully based on experience and/or superior processes, they are likely to need local partners who have SQEP labour and local knowledge of regulations.

Tier 2 organisations need to be aware of potential overseas new entrants and be particularly proactive in developing contacts with them. A non-British new entrant is likely to be less familiar with local suppliers but will nevertheless need to establish a clear view of its supply chain prior to making a firm bid for a tier 1 opportunity.

The NIA Directory of Members provides a good source of information about current and potential companies at tier 1, tier 2 and tier 3 levels. There is also a significant list on the Foratom website at:

www.foratom.org. Click on “links” on the homepage and then “members” at the top LH menu and scroll down to UK...

4.3.2 Specific Sources of Information About Contract Opportunities [see in particular country profiles in Parts D to F for full details]

A wealth of contractor relevant information is now available on the NDA, British Nuclear Group, BNFL, UKAEA and Reactor Sites (Magnox Generation) web sites. In particular UKAEA & British Nuclear Group (Sellafield & Drigg sites) publishes up-to-date information on forthcoming contract opportunities and contracts awarded.

UKAEA and British Nuclear Group have produced Near Term Work Plans, which have become part of the "contract" between them and the NDA for funding their operations. These (or summaries of them) have been published and are available on their web sites and also via the NDA web site (www.nda.gov.uk).

NTWP's issued so far give:

- An overview of site operations;
- Basic details of site, its location and the role of key stakeholders;
- A summary of each major area of work;
- Proposed budgets for each major area of work over the next two years.

Information contained within the NTWP's is presented at a very high level and by definition is relatively short term in nature. To some extent, these NTWP's provide organisations who aspire to operate at tier 2 with a guide to forthcoming opportunities, although the extent to which work appearing in the NTWP then comes through to contract award has still to be proven.

Lifecycle baselines, which set out the plans for the sites over a longer timescale, give tier 2s a longer view into the future. Importantly, though, there is an annual funding level to be set by the NDA that will influence, for each site, how much can be spent on projects and this will determine, to a significant extent, what can be done (and therefore the work to come out at tier 2). Opportunities at the Tier 1 level will occur when the NDA invites competitive tender for Tier 1 contracts. The current plans show the first round of competitive tender occurring by 2008.

4.3.3 Market Positioning

As it stands, there is no reason why a large organisation should not position itself at different levels in the supply chain (subject to the rules on Affiliates contained in the Energy Act). For example, at one decommissioning site it could offer tier 2 services whereas at another it could offer tier 3 services.

Operating at different levels at the same site is not precluded in the proposed arrangements, but clearly there will be issues to do with transparency and fairness in the competition process.

In addition to opportunities at decommissioning sites, there are likely to be other opportunities for companies to offer services to the NDA, NII or Environment Agency on tasks related to decommissioning.

The market position that a company adopts will depend upon a number of factors that may include its:

- Historical position in the industry. Existing companies in the supply chain will have specific competences and well developed relationships that will be helpful in establishing a natural position in the new arrangements;
- Aspirations;
- Appetite for risk. In the new arrangements, risk is likely to be passed down the supply chain and it could be necessary for tier 2 suppliers to underwrite the risk associated with their contract;
- Ability to add value through IPR or organisational processes;
- Geographical location. Local suppliers are likely to have an advantage, particularly those supplying commodity goods and services at tier 3.
- Ability to meet the key attributes listed in 2.4 above, either alone or in alliance with others.

4.3.4 Survival Issues

It is a clear primary objective of the NDA to obtain value for money by creating a structure for the decommissioning industry that is transparent and competitive. In this model, organisations that fail to deliver value for money will be replaced and therefore survival will depend upon an organisation's ability to compete effectively. Specific survival issues will vary for different organisations and at different levels in the supply chain. Survival issues may include:

- Safety performance;
- Compliance with codes, standards and legislation;
- Responsiveness to customer needs;
- Cost base in commodity markets;
- Ability to retain IPR;
- Awareness of the market environment;
- Ability to build new relationships;
- Ability to take risk;
- Geographical location (the NDA has stated that it will positively discriminate in favour of local suppliers);
- Competitiveness

There are specific survival issues at each level in the new industry structure. At tier 1, it is perhaps unlikely that the current incumbents of decommissioning sites will retain all of their sites – unless they can make a compelling case that they are the tier 1 managers of choice, based on value for money and the ability to drive change.

At tier 2, it is anticipated that there will be a rationalisation of the supply chain such that by 2010 there will be far fewer players. This is likely to lead to acquisitions and mergers with some organisations leaving the industry, others merging and potential acquisitions (including by overseas companies).

One potential risk and cause for concern raised by the contracting model outlined in this report has been the 'locking out' of tier 3 & 4 contractors and limited opportunity to compete by the formation of tier 2 contract bundles. While only time will tell if these fears will be borne out, a number of points including the NDA and Site Licensee's stated aims of using competition and innovation to deliver value suggest otherwise.

4.3.5 Constraints/Regulations/Risks

This section concentrates on some of the potential risks, constraints and drawbacks that participants in the market will need to be aware of and may need to take measures to manage.

4.3.5.1 Regulatory Regime

The Site Licensee Company for a nuclear licensed site in the UK has to work within specific constraints and satisfy regulations that are different from those of many other industries. These constraints and regulations include:

- Site licence requirements and ionising radiation regulations
- Quality assurance
- Environmental protection
- Security

Working on a licensed site or for the licensee may require some aspect of these constraints or regulations to be imposed on a supplier. This will be dependent on the scope of supply for goods and services contracted from each supplier.

Any constraints that are relevant to a specific contract should be communicated as contractual requirements within the licensee procurement documentation.

For companies with little or no nuclear sector experience that are seeking to enter the nuclear sector further guidance is given in Parts D to F. This guidance provides an insight into the regulations and constraints with examples of the implications for tier 2/3 suppliers of goods and services.

4.3.5.2 Risks to the Programme

The NDA annual plan for 2005/06 is currently available and the 2006/07 plan is due to be published early in April 2006. These provide further information on the forward programme to be delivered.

In pursuing the opportunities associated with the NDA programme, the supply chain should recognise the overall risks to the programme, and those associated with the individual sites or projects.

Work in the nuclear industry takes place in a safety critical and highly regulated environment. In addition, the industry is undergoing an unprecedented period of change. These factors combine to give rise to a number of significant risks to the forward programme of which potential suppliers need to be aware when formulating business plans.

Examples of generic risks include:-

- Change in tier 1 suppliers may cause an interruption in workflow during transition, and new relationships will have to be developed;
- Legal challenge delaying the enactment of some components of the plan (e.g. some British Nuclear Group work packages could potentially be delayed by the European Court state aid investigation into the NDA's assuming responsibility for British Nuclear Group);
- Failure to obtain the necessary regulatory approvals within the planned timescales delaying commencement or stopping work mid-programme;
- Security or safety incidents interrupting work;
- Scope of work changes following characterisation of sites and facilities.

Information on some of the major risks to individual site and project risks can be obtained from the summary NTWP's and LCBL's.

In addition to programme risks, the supply chain must be aware of the contractual risks that may be associated with working on a nuclear licensed site. Historically, risks associated with nuclear incidents and contamination have been assumed by the site licensee and covered by their insurances. It is less certain whether the future contracts will indemnify potential contractors against these risks and the supply chain may need to secure their own insurances to cover these risks. This may prove prohibitively expensive and may bias the work to large companies or existing incumbents who can carry the risk or secure the insurances. This could increase the risks of securing work for existing suppliers, or may be a barrier to entry to new entrants.

4.3.5.3 Skills and Capabilities

Another area of potential risk to the fulfilment of the NDA's objectives and constrain the ability of the supply chain to deliver is in the existing techniques and technologies and the availability of skills.

Existing Techniques

In general, existing techniques and technologies are adequate for decommissioning projects although ways of improving them and their performance are being sought. Decommissioning operations are based on the use of a variety of techniques of which the most important are:-

- Radioactivity measuring techniques
- Decontamination techniques
- Cutting techniques
- Techniques for treating, preconditioning and conditioning wastes
- Remote control techniques
- Techniques for worker and environmental protection

All of the above techniques are used in a variety of ways for a number of different purposes and can be broken down into a very large number of methods and processes involving a variety of specialised tools and equipment. Account has to be taken of the secondary wastes being produced during some of the operations. Many techniques used in conventional industries can be used for work in a hostile environment on condition that they are "nuclearised".

Availability of Skills

Concerns about the potential shortage of skills within the UK nuclear industry have been much debated and well documented in recent years.

DTI's report, "Nuclear and Radiological Skills Study" (December 2002) identified that (excluding any demand arising from new build) an estimated 50,000 recruits (60% of the current skilled population) would be required over the next 15 years. The report goes on to point out that the industry will require to recruit these skills against a backdrop of declining numbers of mathematics, engineering and physical science graduates, the fragile state of undergraduate education and the unpopular image of the industry as a career choice.

In particular the report identifies the following 'hot spots' of skill shortage:

- Radiological protection – health physics
- Radiochemistry
- Regulation
- Safety case writing
- Criticality assessment
- Nuclear safety research
- Control and instrumentation
- Corporate capabilities (e.g. design)

The report finds that there are no simple solutions and makes 15 recommendations centred on employer and sector led skill development.

Two statements within the report have striking relevance for suppliers:

- "Another problem is that employers tend to have a short term view of say 3-5 years while the lead time for industry skill development is more in the region of 5-10 years."
- "Responsibility for skill development has become increasingly fragmented and unclear as competition to reduce costs has led to a fragmented management structure with a mix of client and supplier organisations."

In the context of preparing for the NDA companies will need to consider,

- What will be the impact of the proposed 5+5 year site licence contract cycle on tier 2, 3 and 4 contractors when time horizons in skill development are longer term and require certainty of investment?
- How will companies recruit, retain and develop skills when the industry is becoming potentially more fragmented and focused on cost and time reduction?
- How will the NDA fulfil its obligation to ensure that skills are available to undertake its decommissioning and clean-up functions?

From an individual contractor's point the answer is that they cannot wait on external factors but must put in place strategies to develop and retain the resources and capabilities that will ensure competitive advantage now and in the future.