



ITF ANNUAL TECHNOLOGY NEEDS SURVEY 2009

DETERMINING 2010 THEME DAYS

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Client:
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Compiled by: Dorothy Burke
Reviewed by: David Liddle
Approved by: Neil Poxon
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The Enterprise Centre, Exploration Drive, Bridge of Don, Aberdeen AB23 8GX, Scotland
Tel +44 (0) 1224 853400 Fax +44 (0) 1224 853480 Email itf@oil-itf.com Web www.oil-itf.com

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1. BACKGROUND

1.1 PURPOSE

ITF's key role is to deliver theme days and issue calls for project proposals which reflect the technology requirements of its member companies. In this way any proposed Joint Industry Projects (JIPs) should reflect closely ITF members' stated technology needs and therefore achieve a high level of subscription and participation in the resulting JIPs.

2010 Theme Days must reflect ITF member company requirements to ensure we continue to deliver proposals according to our member needs. In that way we will ensure that ITF continues to deliver valid JIPs which attract funding and support from across our membership base.

1.2 TECHNOLOGY SURVEY VALUE

After discussion at the August 2009 members meeting it was agreed that overall this annual survey was a useful process and delivered valuable insight to ITF members on industry technology requirements across its membership base. In addition it was endorsed as a suitable means to identify those common challenges which could most usefully be addressed by the collaborative approach which ITF offers.

1.3 THEME DAYS

The member consensus was that the current delivery method of a number of industry theme days was a valid approach which should be continued. The themed meetings formed a useful basis for discussion with members and other selected industry experts and subsequently informed targeted calls for proposals, which in turn attracted relevant and useful project proposals from a wide range of technology developers and academia.

1.4 TECHNOLOGY SURVEY PROCESS

During a facilitated session as part of the August 2009 members meeting it was proposed that the process by which the annual survey was carried out be enhanced as follows:

- Increased participation by technology and discipline experts throughout member companies should be sought directly by ITF
- Interim findings should be provided to members ahead of the AGM in order for them to consider the proposed topics/themes prior to the AGM facilitated session
- Member representatives would coordinate the input from their organisation and determine and rank the key issues on which their company was focused for 2010 and beyond, according to their internal technology planning process

2. METHODOLOGY

2.1 ONLINE SURVEY

The Survey Monkey tool (www.surveymonkey.com) was used as an enhanced means of capturing online responses to this year's technology survey. This enabled links to the online survey to be emailed to member representatives and also to other technology and discipline experts either directly from ITF or via member representatives. The survey can be filled in quickly and easily and the survey software provides statistical analysis of the responses collected with download of data and custom graphing and charting of survey responses. The survey data captured is confidential to each member company by means of a separate password-protected online data collector. Data collected can be filtered and analysed by company, also by technology discipline, with results collated individually or across all respondents. This method enables rapid and effective analysis of online responses across the membership by authorised members of ITF Technology team.

2.2 MEETINGS WITH MEMBER REPRESENTATIVES

Face to face meetings with ITF Member Representatives within each member company were carried out where possible by two members of the ITF team. This ensured that detailed technology needs were captured and additional feedback sought regarding enhanced engagement of ITF with its members to ensure optimum delivery to its members. Face to face meetings were held with 16 of the current 20 members during the course of the survey process. In addition, ITF staff met with other technology experts across key geographical locations of member companies where possible.

2.3 CONFERENCE CALLS

Where geography or diary clashes did not permit a face to face meeting within the two month time frame allocated to this year's survey, a conference call was arranged with the member representative and other technology/discipline experts from within the member company. Conference calls were carried out with 4 member companies.

2.4 ITF FACILITATED SESSIONS

Data collected via the online survey and the face to face meetings and conference calls was collated during facilitated sessions which involved ITF Technology Managers and Technology Analysts. This ensured that specific topics and responses could be addressed by ITF internal experts in Subsurface and Production, Wells and Subsea using their topic expertise and their knowledge of market and technology needs through their engagement with the wider oil and gas industry. The facilitated sessions were carried out using the Pinpoint facilitation methodology.

2.5 CREATION OF TOPIC AREAS

The facilitated sessions allowed further breakdown of the member responses from the online survey and meetings into inter-related topic areas. This enabled analysis of the number and variety of subjects which were grouped under a particular topic heading – and ensured that topics reflected a consensus of views and covered a range of areas of interest to each of the ITF members. Finally the online survey data collected was cross referenced to calculate the significance of each of the topics to be calculated on a weighted average basis.

2.6 THEMES

Further analysis with ITF Technology Managers enabled a short-list of Themes for 2010 to be determined based on the statistical and facilitated analysis of the survey and meeting outputs. This list was then fed to the Member Representatives for consideration prior to the AGM where final themes would be discussed and determined.

3. RESULTS

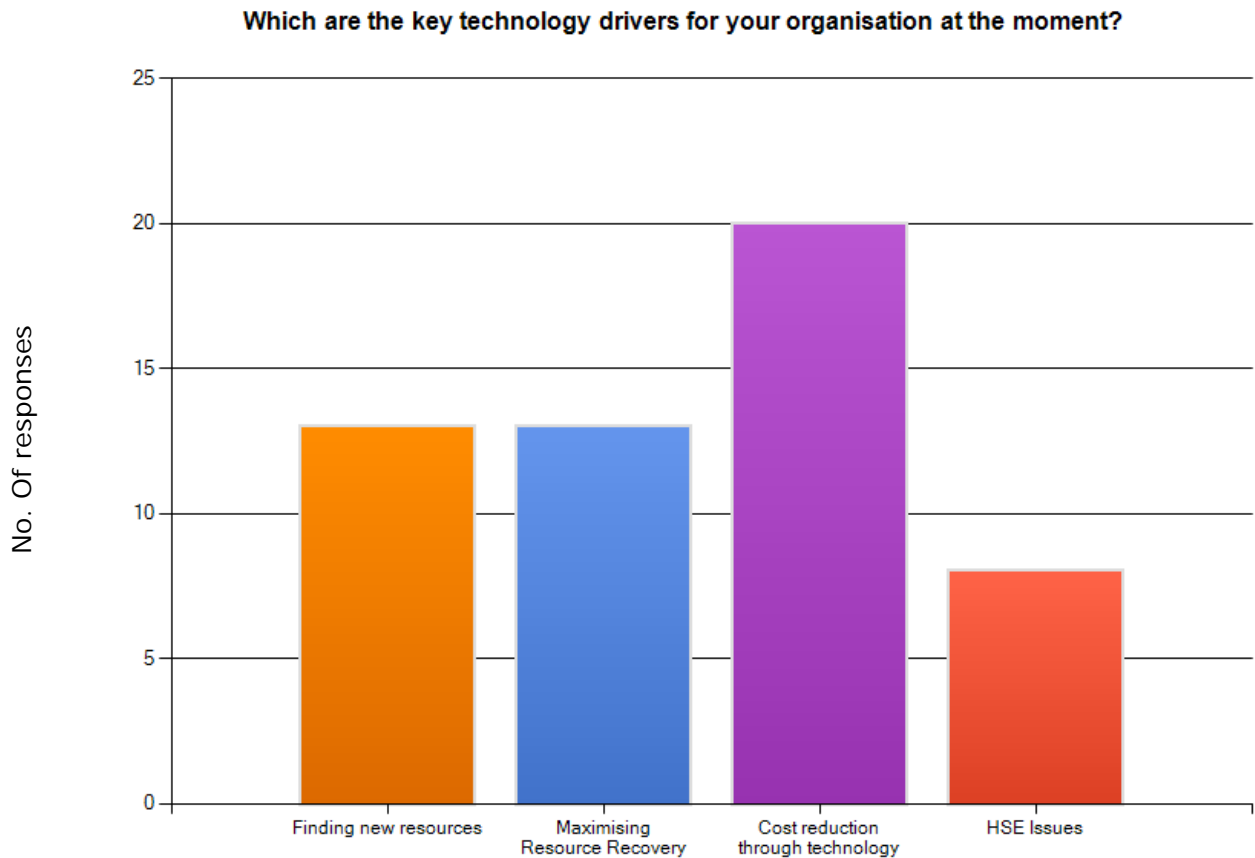
3.1 ONLINE SURVEY

27 responses were received from individuals within 12 member companies (and cross reference data from 2 non member companies). This enabled collection of ranked data on technology drivers along with free data responses on key technology challenges (and a rating of their significance from 1-5) across subsurface, production, wells and subsea.

An initial question was posed on Key technology drivers within the member organisations with options to be chosen one or more of: Finding New Resources, Maximising Resource Recovery, Cost reduction through technology and HSE Issues

The Survey Monkey software generates output graphs of the responses to the 'multiple choice' questions from all respondents to the survey.

Figure 3.1 Graph of Key Technology Drivers



From this it can be seen that the main technology driver with highest priority across ITF member organisations is Cost reduction through technology.

3.1.1 Subsurface

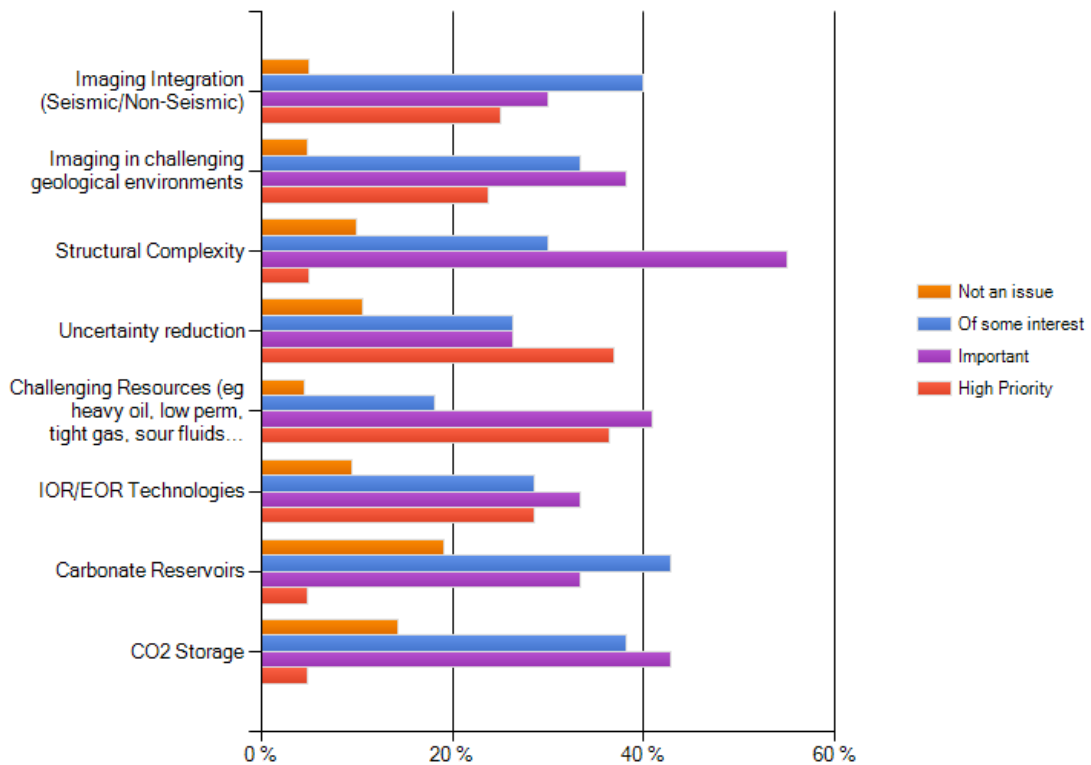
Subsequent questions were designed to identify key issues in the different disciplines. The first section dealt with subsurface issues and the initial question here was a multiple choice format which allowed respondents to respond to a number of subsurface issues and rank their importance by one of 'Not an Issue', 'Of Some Interest', 'Important' and 'High Priority'.

The online software then produced various different graphs of the results which gave the spread of individual responses and calculated weighted averages of the responses to determine which were the key high level issues.

Issues listed were: Imaging Integration, Imaging in Challenging Environments, Structural Complexity, Uncertainty Reduction, Challenging Resources, IoR/EoR Technologies, Carbonate Reservoirs, CO2 Storage

Figure 3.2 Subsurface issues: survey responses

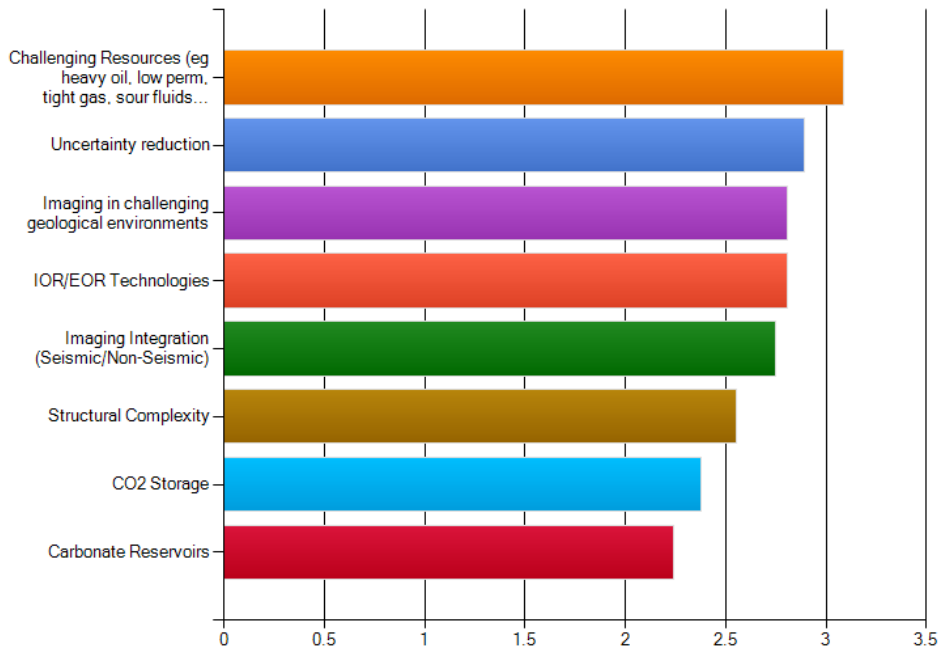
Subsurface: Please rate the following technologies and their current importance to your organisation:



Also from the Survey Monkey software it is possible to obtain a graph of weighted average results from this question. This allows us to get an impression of which of these issues is considered more important at the macro level.

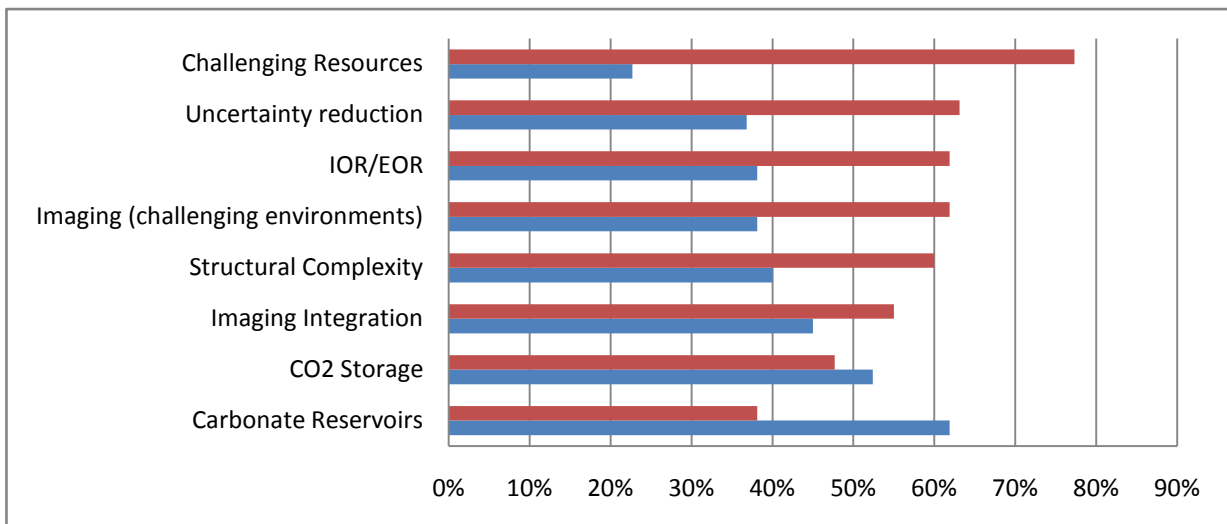
Figure 3.3: Subsurface: Weighted Average responses

Subsurface: Please rate the following technologies and their current importance to your organisation:



Finally the data was downloaded into spreadsheet format and a further graph produced (from the data in Figure 3.2) which compared responses to the top two categories (Important/High Priority) against the lower two categories (Not an Issue/Of Some Importance). This graph (Figure 3.4) was also used in the analysis which preceded the recommendations of themes made in Section 5.

Figure 3.4 Subsurface Combined rankings (Important/High Priority vs Not an Issue/Of Some Interest)



3.1.2 Production, Wells & Subsea

The remainder of the online survey dealt with key issues in production, wells and subsea.

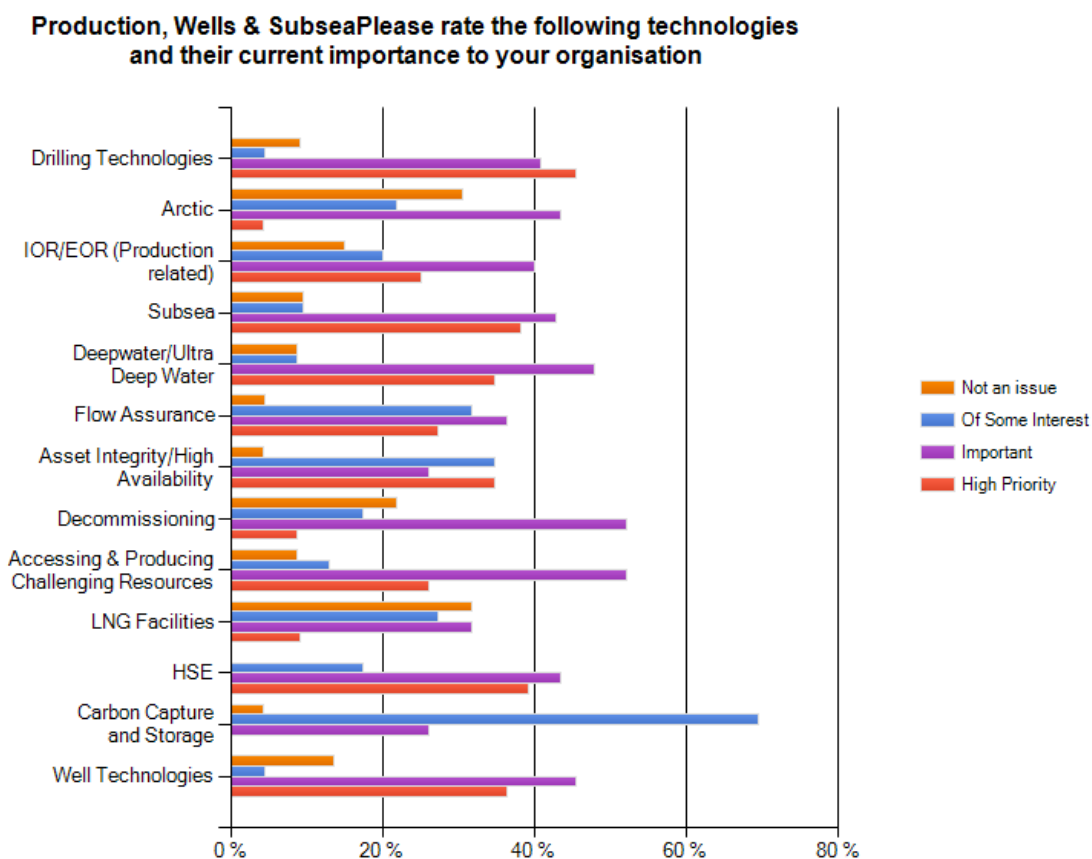
Question 7 asked respondents to rank key Production, Wells & Subsea issues:

Drilling Technologies, Arctic, IoR/EoR (production related), Subsea, Deepwater, Flow Assurance, Asset Integrity, Decommissioning, Producing Challenging Resources, LNG Facilities, HSE, Carbon Capture and Storage, Well Technologies.

These were ranked into: Not an Issue, Of Some Interest, Important and High Priority

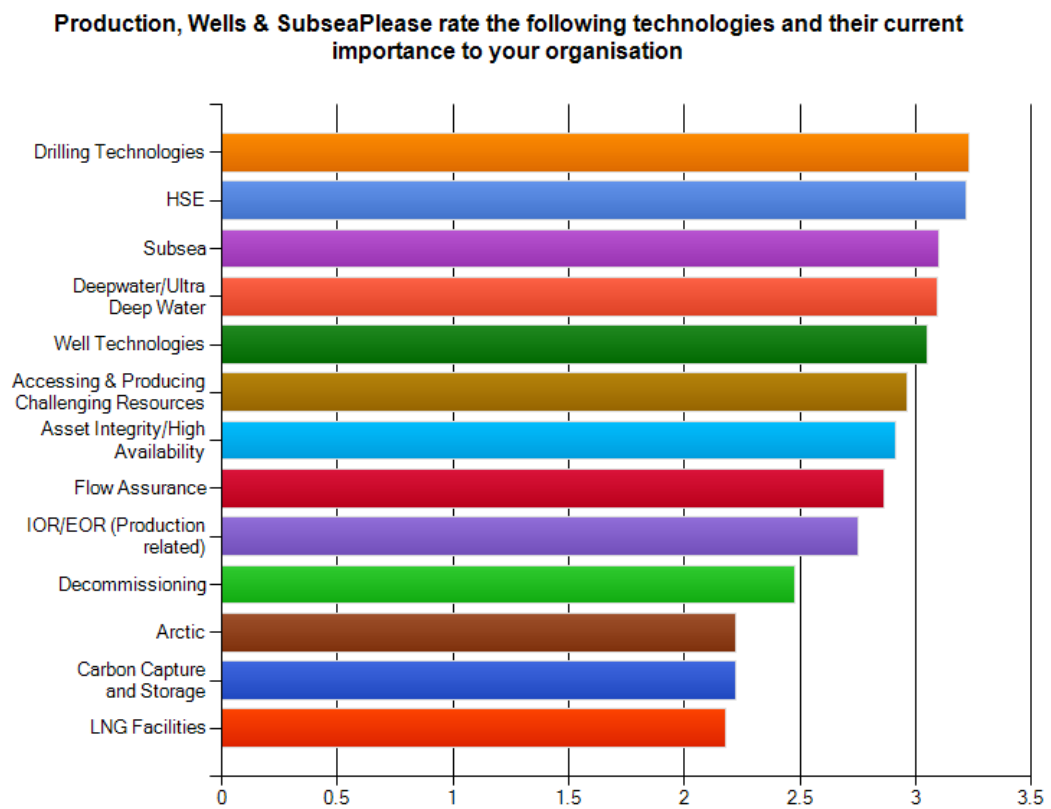
The graph of responses is given in Figure 3.5 below

Figure 3.5 Production, Wells & Subsea Issues: survey responses



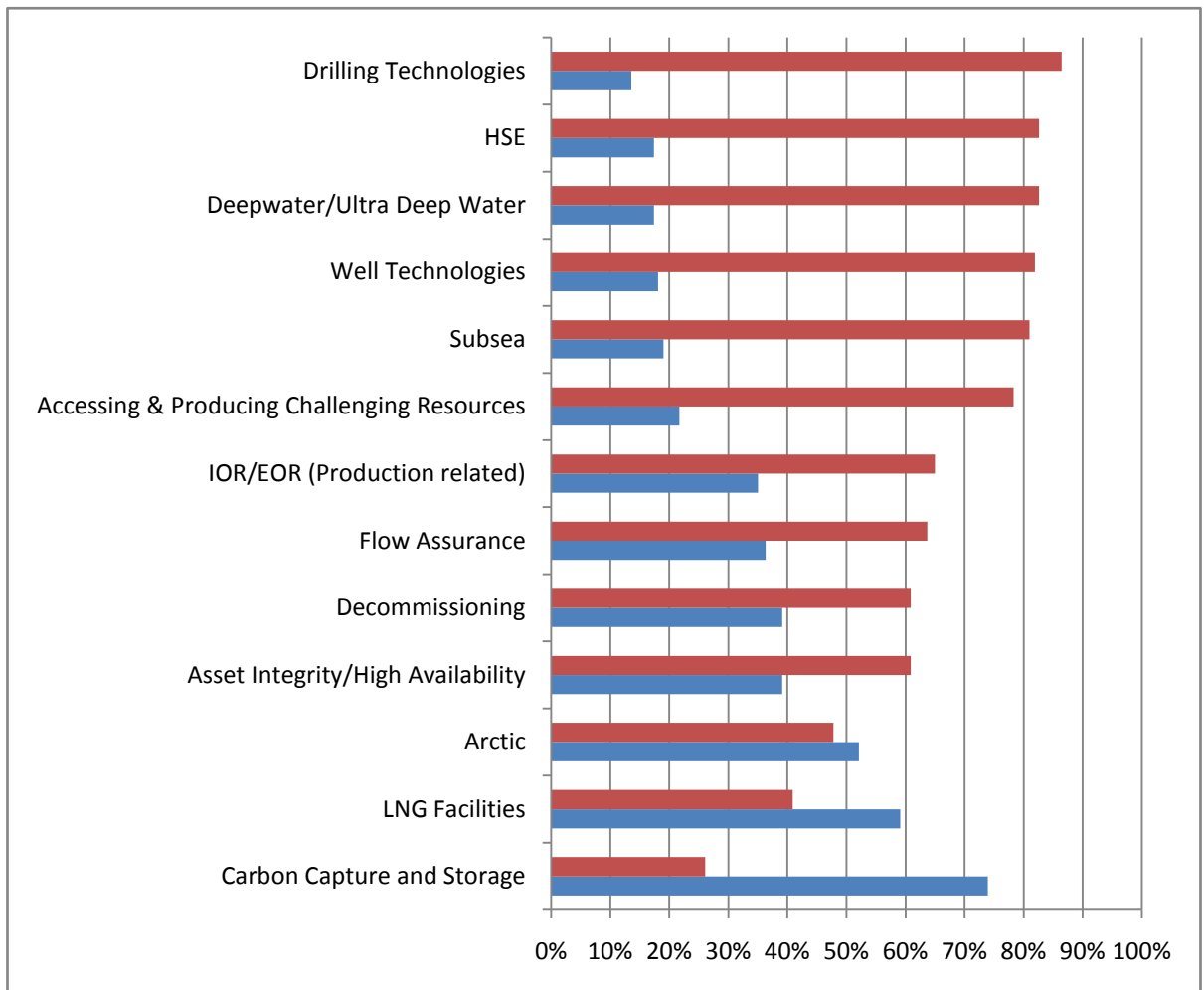
The Survey Monkey software automatically generates a graph of weighted average results. This indicates issues which are considered most important across the survey respondents (see Figure 3.6 below)

Figure 3.6 Production, Wells & Subsea Issues: weighted average responses



Finally as previously, the online data collected was downloaded into spreadsheet format and a further graph produced (from the data in Fig 3.5) which compared responses to the top two categories (Important/High Priority) against the lower two categories (Not an Issue/Of Some Importance).

**Figure 3.7 Production, Wells & Subsea Combined rankings
 (Important/High Priority : vs: Not an Issue/Of Some Interest)**



This graph was used in the analysis which recommended proposals for themes contained in Section 5.

4. TOPICS

4.1 ANALYSIS OF DATA

Analysis of the data collected was carried out as follows: data output from the online survey was sorted into grouped topics during a facilitated session with the ITF technology team. Thereafter the detailed output collected from the face to face ITF Member meetings was additionally allocated to the topic headings. Topics were then sorted into order using two methods.

Method 1 was based on the frequency of responses from the online survey and detailed meetings. A graph of the frequency is included in Figure 4.1 (Subsurface) and Figure 4.3 (Production Wells & Subsea) below.

Method 2 utilises the Significance ratings collected from the online survey to calculate a weighted average of significance of the topics. Results of this are shown in Figure 4.2 (Subsurface) and Figure 4.4 (Production, Wells & Subsea) below.

4.2 SUBSURFACE TOPICS

Figure 4.1 Subsurface Topics – Frequency of responses (Online + Detailed Interviews)

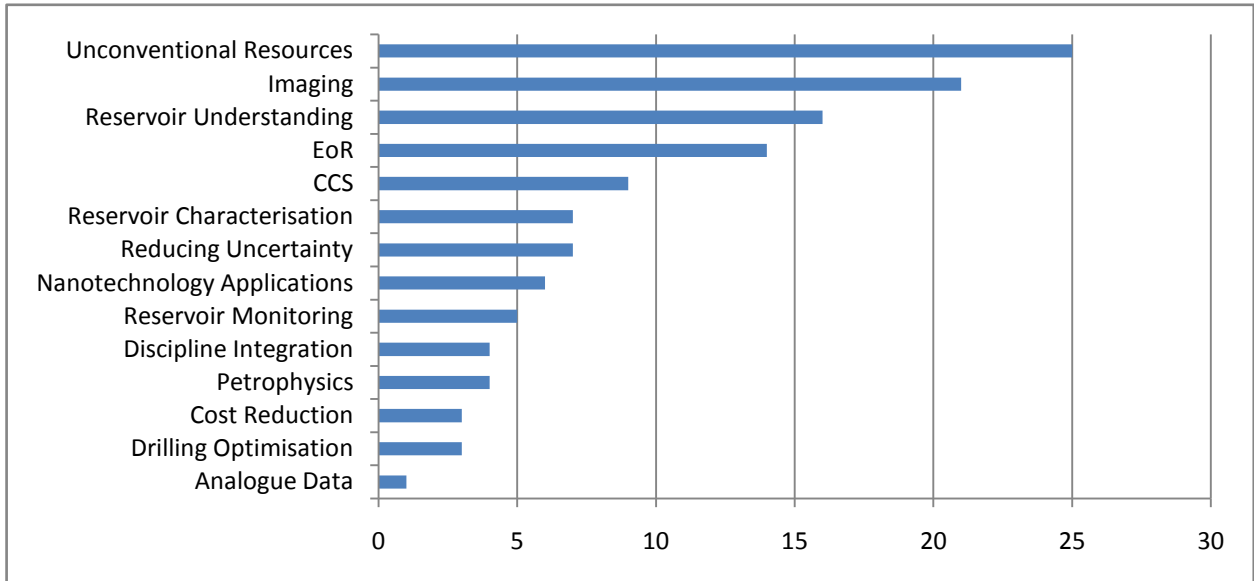
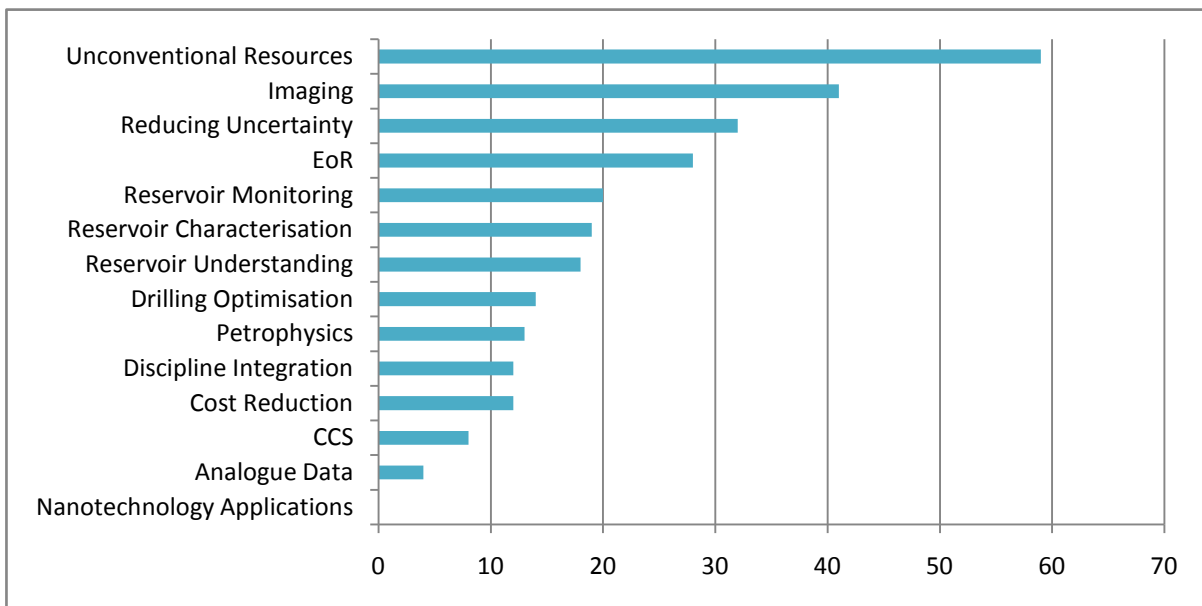


Figure 4.2 Subsurface Topics by Significance (Calculated Significance from Online Survey Results)



4.3 PRODUCTION, WELLS & SUBSEA TOPICS

Figure 4.3 Production Wells & Subsea Topics – Frequency of responses (Online + Detailed Interviews)

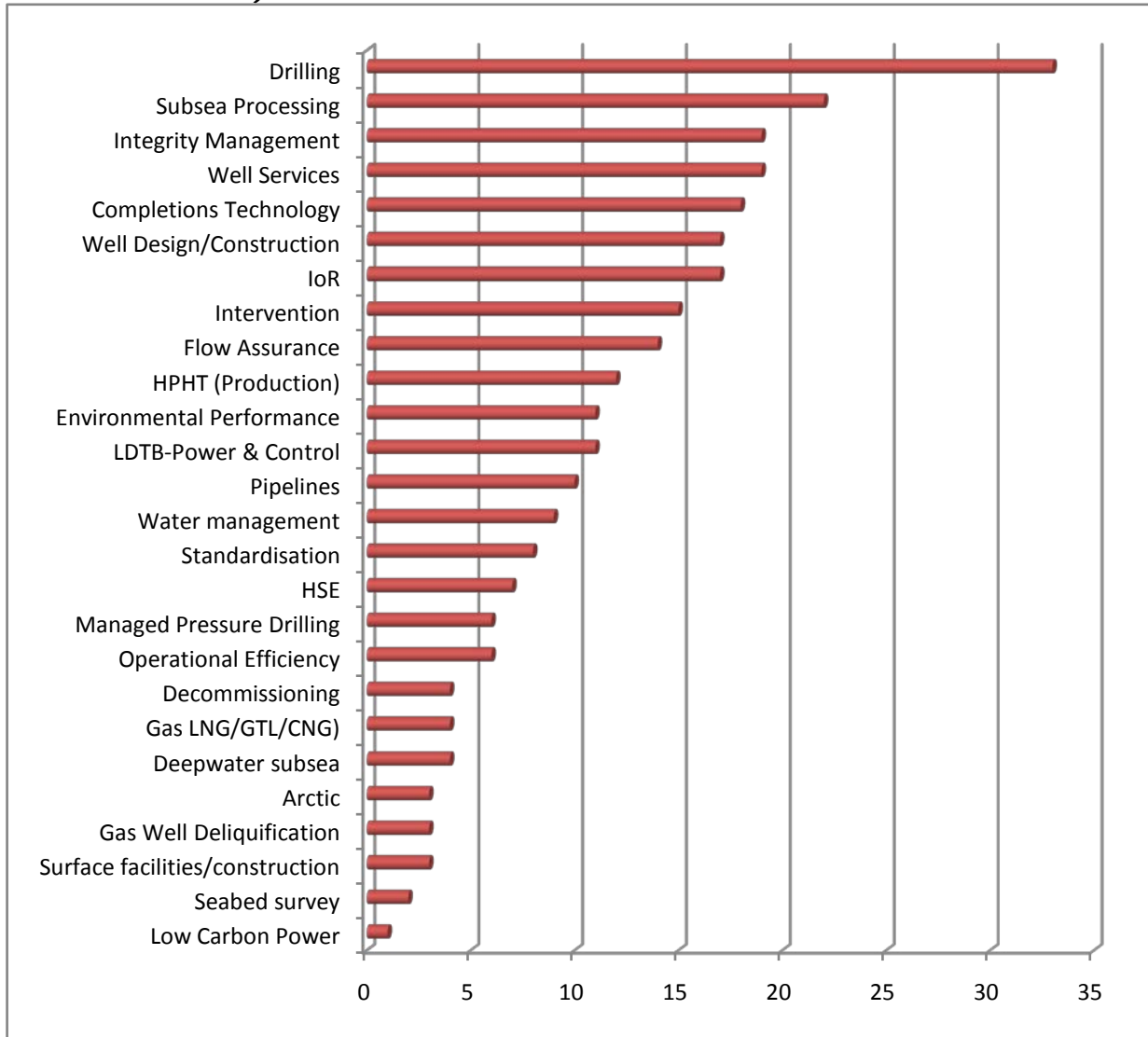
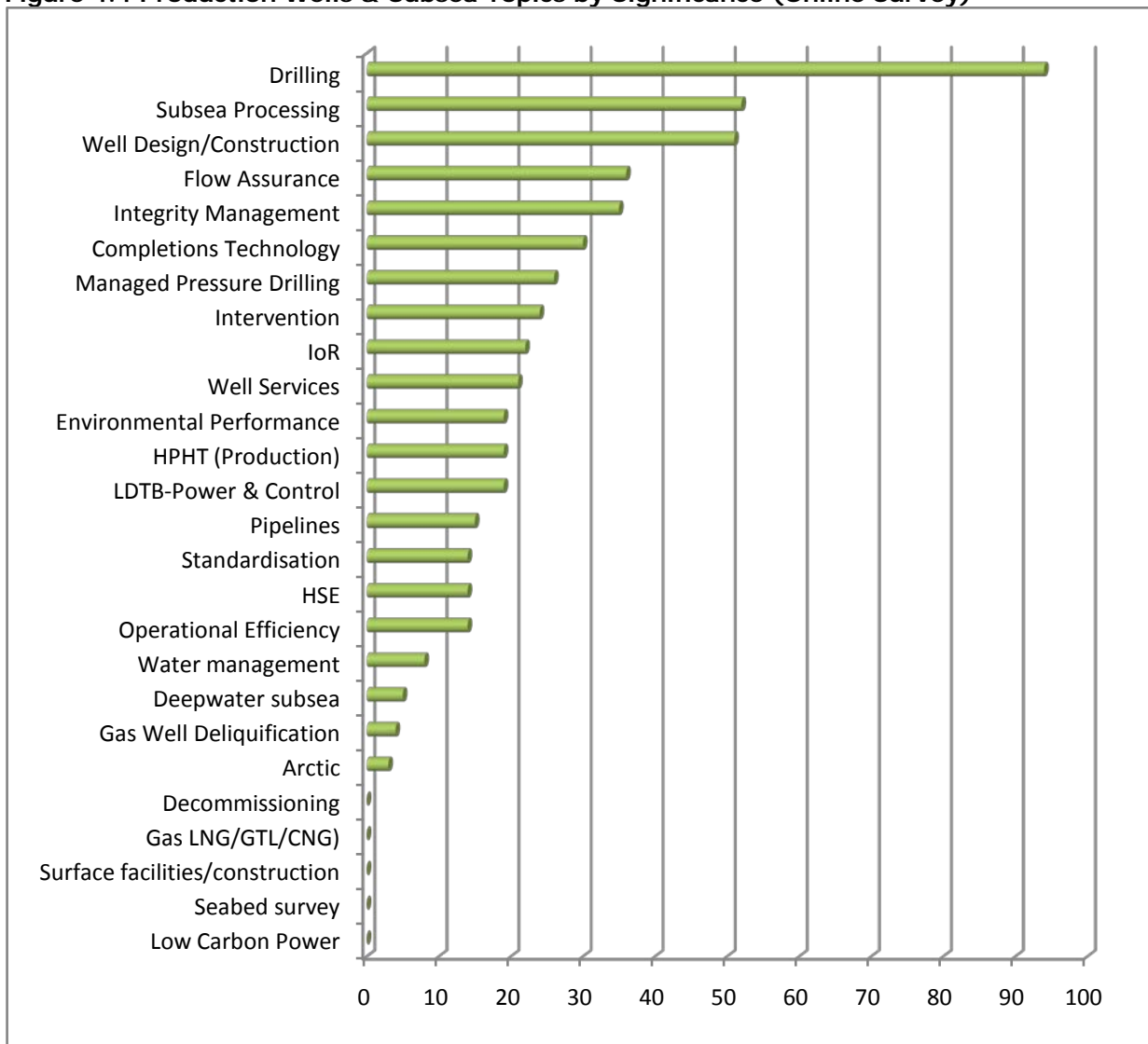


Figure 4.4 Production Wells & Subsea Topics by Significance (Online Survey)



A comparison of the statistical results which identified key topics was made in selecting the recommended themes for 2010 (see Section 5 below). The process will additionally be used as a key part of the facilitated session during the ITF AGM to finalise the selection of themes for next year.

5. THEMES

The output and graphs produced from the online survey and detailed documentation of the wide-ranging input from ITF Member meetings was analysed during facilitated sessions with the ITF Technology Analysts and Technology Managers. This enabled the team to apply their technology expertise to the extensive Member feedback collected: and combine and collate both online survey responses and annotated responses from individual customer meetings.

Consideration of the output from the facilitated sessions, and comparison with the graphical output from Survey Monkey results in the recommendation that the themes below be implemented in 2010.

5.1 PROPOSED SUBSURFACE THEMES

- 1) **Unconventional Resources**
- 2) **IoR/EoR**

Additional themes for consideration are:

- 3) CCS
- 4) Reservoir Characterisation

5.1.1 Subsurface Notes:

- i) *From the combined analysis of the output from this year's survey (and in particular Figures 3.4 and 4.1), a clear leader emerged as the first of the proposed Subsurface themes: that of Unconventional Resources*
- ii) *The next most popular theme, Imaging, is already being undertaken in 2009 with the Theme Day on 26th November*
- iii) *The Reservoir Understanding topic is largely focused on Carbonates (see detail in Appendix A), which has already been covered in 2009.*
- iv) *Therefore the second of the 2010 Subsurface themes is proposed to be IoR/EoR.*
- v) *Uncertainty Reduction (from Figure 3.4) is felt to be a generic topic which it would be difficult to address in a theme day to generate useful and focused calls for proposals – but this will be discussed at the AGM.*
- vi) *Remaining topics suggested are taken from Figure 4.1 – CCS. There is undoubted interest in CCS but the significance of this issue will be debated during the AGM*
- vii) *The final additional proposed theme of Reservoir Characterisation additionally covers areas such as Reservoir Geophysics and Rock Physics Modelling- and again will be discussed during the facilitated session.*

The selection will be finalised following the facilitated session at the AGM on 25th November, during which the range of themes will be considered.

5.2 PROPOSED PRODUCTION WELLS & SUBSEA THEMES

- 1) **Drilling**
- 2) **Subsea Processing**
- 3) **Completions Technology (incorporating Well Design & Construction)**
- 4) **IoR/EoR**

Additional themes for consideration are:

- 5) Well Services
- 6) Flow Assurance
- 7) HPHT

5.2.1 Production, Wells and Subsea Notes

- i) From analysis of the detailed meeting data and online survey responses from the ITF Members (in particular Figures 4.3, 4.4 and 3.7) a clear leader emerges – that of Drilling. However ITF experience has shown this topic is often one which is indicated as high priority but does not always attract sponsorship of the members for subsequent proposals. This point will form the basis for discussion during the AGM session.*
- ii) HSE (second ranked, Fig 3.7) while always high priority, is not generally a topic on which ITF Themes are run as take up of subsequent collaborative proposals tends to be low.*
- iii) A second theme of Subsea Processing (Fig 4.3, 4.4) also clearly emerges from the data analysis.*
- iv) Integrity Management, another high ranking option, is currently underway as part of the 2009 themes)*
- v) Completions Technology (incorporating Well Design & Construction) is the third proposed Theme.*
- vi) IoR/EoR is the fourth suggested Theme for 2010.*
- vii) Well services is partly being addressed in the current theme of In-well communications. Therefore additional subsets of this topic are proposed for discussion during the AGM to identify whether a related theme should emerge.*
- viii) Flow assurance again has been partly addressed through the Long Distance Tie Backs theme this year. Therefore this should be discussed during the AGM as to whether another potential theme on Flow Assurance should be covered during 2010.*
- ix) The remaining proposed theme for consideration in 2010 is HPHT.*

The detailed input which forms the composition of all topics/themes is included in Appendix A of the report issued to members. Themes will be finalised following the AGM facilitated session on the 25th November.

Dorothy Burke, November 2009

APPENDIX A – TOPICS – DETAILED RESPONSES

This appendix provides detailed responses (non-attributable) from the ITF Members who took part in the online survey and detailed meetings.

A.1 COMPANIES SURVEYED

All ITF Members were surveyed in person/by conference call and/or via online survey:

<i>BG</i>	<i>ENI</i>	<i>Petronas</i>	<i>Technip</i>
<i>BP</i>	<i>ExxonMobil</i>	<i>Saudi Aramco</i>	<i>Total</i>
<i>Chevron</i>	<i>Maersk</i>	<i>Shell</i>	<i>Weatherford</i>
<i>ConocoPhillips</i>	<i>Nexen</i>	<i>Smith</i>	<i>Wintershall</i>
<i>DONG</i>	<i>PSN</i>	<i>Statoil</i>	<i>Woodside</i>

A.2 SUBSURFACE RESPONSES

All responses are included even where an issue has been mentioned repeatedly – this gives an indication of the frequency of key issues across the membership.

Unconventionals		
Carbonates-sweetspot prediction & geomechanics	HPHT	Tight gas
Challenging Resources	HPHT fracking, geomechanical issues, HPHT fault behavior during production	Tight Reservoirs
Challenging resources (paleogene, onshore tight gas, heavy oil)	HPHT pressure/temp modelling prediction	Unconventional resource management
Characterization and description of tight clastic reservoirs	low perm/tight gas	Unconventionals
Developing Challenging Resources	oil sands/heavy oil/tight gas	Unconventionals - Chemical properties
Developing/Assessing Tight Gas Sands	Shale Gas	Unconventionals - coal seam gas/shales
Development and Pilot Projects in the area of deep heavy oils	Tight carbonate reservoirs	Unconventionals - Micro seismics
Heavy Oil-shallow assets	Tight gas	

Imaging	Reservoir Understanding
Imaging	carbonates modelling
better quality seismic imaging	Carbonate
Deep gas (14,000 – 16,000ft) – again, seismic interpretation	Carbonate reservoirs– Characterization, bypass zones, multiple porosity
difficult to image reservoirs	Carbonates-diagenesis
enhanced CSEM	Carbonates-fracture modelling
Exploration - non seismic (CSEM etc)	Carbonates-integrated/dynamic flow modelling
Fishing imaging	Carbonates-numerical rocks
Imaging	Chalk
Imaging	-fluvial/turbidite reservoirs
Imaging – interpretation of seismic responses (near surface interference complicates)	Pore pressure prediction
Imaging Integration	PVT
Integration of seismic, EM onshore	Sandstone reservoirs
Joint inversion technology - seismic & CSEM	Saturation modelling
multi/wide azimuth survey techniques - subsalt imaging	Subsurface - reservoir engineering
seismic freq enhancement	Turbidite reservoirs
Seismic imaging and velocity modelling	
Sub salt imaging	
sub salt imaging	
sub-salt	
Volcaniclastics	

IoR/EoR	CCS/CO2 Storage	Uncertainty
Maximizing Recover Through EOR	Carbon Capture	Uncertainty reduction, especially in appraisal
- microbiological treatments, enhance gas production rates	CCS - economic capture	Hazard mitigation
Development and Pilot Projects in the area of polymer flooding	CCS- Subsurface Issues	Managing and reducing uncertainty
EOR technologies	CCS-Reinjection techniques	Minimising drilling surprises
EOR technology relevant to our assets	cheap capture and transport of stranded gas	Reliability of products
Eor/IoR	CO2 storage (later)	Subsurface integration, uncertainty assessment & reduction
EoR/IoR/secondary recovery	CO2/N separation	Uncertainty reduction
IOR/EOR		
IOR/EOR Technologies		
IoR/EoR: tighter reservoir production		
Maximising hydrocarbon recovery (EOR / IOR) (cost effective)		
Maximising recovery factors - brownfield;		

Res Characterisation	Nanotechnology	Cost reduction
Seismic reservoir characterization	Nanotechnology;	Cost reduction
Carbonates-characterisation	Nano particles (either for reservoir management or drilling)	Developing fields in a low-cost environment
Characterization and description of carbonate reservoirs	Nanotechnology	Geological analog database - all scales
Net pay estimation from AVO	Nanotechnology (longer term) - measurements	Increasing Product Performance
Reservoir Characterisation	Nanotechnology- how could we use this technology	
Reservoir Geophysics	reservoir nanotechnology	
Rock physics modelling		

Petrophysics	Res Monitoring	Discipline Integration
Deep res logging	4D Seismic	Integrating geomechanics to petrophysics and other ss disciplines
Carbonates-permeability prediction	Fault behavior during production - database	INtegration of Real Time mesurements with earth models
Innovation in core description	Cheaper 4D reservoir monitoring	Optimising cross discipline integration
Rel Perm hysteresis	-4D techniques	Integrated subsurface description imaging.

Res Monitoring	Discipline Integration	Drilling Optimisation	Analogue Data
4D Seismic	Integrating geomechanics to petrophysics and other ss disciplines	Geo-Steering - optimized well path	
Fault behavior during production - database	INtegration of Real Time mesurements with earth models	dynamically adjusting optimum well path in real time	
Cheaper 4D reservoir monitoring	Optimising cross discipline integration	Well placement	
-4D techniques	Integrated subsurface description imaging.		

A.2 PRODUCTION, WELLS & SUBSEA RESPONSES

All responses are included even where an issue has been mentioned repeatedly – this gives an indication of the frequency of key issues across the membership.

Drilling	
The "Well Manufacturing Process" for development of low cost wells in tight gas (considering strategies, techniques, semi intelligent completions, stimulation)	Minimise use of drilling rigs (lower costs/avoid long wait for availability)
Drilling and completions in strongly fractured carbonates considering e.g. losses beyond common LCM or inflow control from fractures	Multi platform self erecting tender assist drilling rig
Coil tubing - reel at surface or everything on xmas tree (no known projects)	Multilateral Wells/Well Extended Reach
Deepwater drilling cost reduction	Put RCD sub sea
Downhole vibration mitigation	Reduce cost/risk of infill wells - cased hole logging/cheaper drilling/TTRD
Drilling deepwater sub-salt	Reduced footprint
drilling dynamics	Reducing drilling costs
Drilling in shales and challenging environments	Robust CT drilling
drilling narrow pore pressure frac gradient margins	Smart wellll drilling
Drilling Technologies	Transitional drilling
drive systems	UDW-drill technologies
-extended reach drilling	Unconventionals - Coil Tubing
Lifting Technology - gas lift/pumping/plunger/foam	Unconventionals - Energy in wellbore
Liquid loading mitigation	well bore departure
longer reach wells	Well costs-drilling
Make appraisal well to production well	

Subsea Processing	
Cheaper injection/subsea injection	Subsea Compression
Economic risk predictions from small discoveries	Subsea Gas compression
Flowlines booster compressors	Subsea Gas Compression/ Separation / Boosting
Multiphase Pumping	Subsea in flowline gas compression/boosting
Multi-phase pumping	Subsea liquid knockout piping
Multiple small pools of oil & gas (HP/HT, sour, normal pressure) - mobile hoover	Subsea processing elec power & distribution systems
Portable test separators	Subsea processing/reinjection/sand mgmt
processing & separation downhole/subses	Subsea Separation
Raw seawater injection	subsea separation
Subsea	Subsea whole of field gas compression
Subsea	Subsea-downhole boosting
Subsea Chemical Storage & Pumping	Subsea-seafloor boosting

Well Services	
Transfer of former high cost solutions such as Production Logging or Intelligent Completions to low cost application such as from CT for high cost to micro coil for low cost	Low Cost Water Shut-off Technology
Cheap water shut off	Maximise automation/remote ops
Down hole instrumentation - gauges (Production monitoring)	maximise well value (don't throw away exploration wells)
downhole gas compression - tight gas	Monitoring/sensors
downhole wireless;	realtime wireless monitoring/optimisation
Expandable technology	Tool reliability
Expandable tubular (deep formations)	Well communication
-free gas boundary delineation during rewatering	Well Construction, Completions and Well Operations in H2S
In well comms	Well service equipment-restricted platform environments;
3 phase measurements at the well site Low cost	

Integrity Mgmt	
Materials & Corrosion Technology	asset integrity - prodn/wells & facilities
Facility integrity - brownfield - corrosion	Corrosion Under Insulation
Integrity	maintain ageing assets
Offshore construction operational integrity	Souring
Smarter use of integrity management tools	H2S
Subsea Tree Reliability	Corrosion detection through insulation
Maintaining Subsea Pipeline/Infracstructure Integrity	Pipeline survey techniques to reduce high degree of errors
Maintaining Well Integrity	4b. Facilities for H2S rich gases (H2S> 10%)
Well integrity	-corrosion
Corrosion	

Completions Technology

Integrated asset mgmt/Smart fields/field of future - optimisation res. Mgmt/Control	Electrical Trees with DHSV
CBM - plastic/composite tubing strings/slotted line completions	IoR/EoR: Completion/stimulation technology
Cheaper onshore D&C	New xmas tree design - eg remove internal tree cup/use 2 crown plugs (research known but more can be done)
Cheaper production systems for small resource pools	Optimization of Completion System design
Cleaner production - Discharge/Emissions - 2013 European Trading Scheme	-sand control & tolerance
completion design	Sand control completions
Completion technology to improve production	sand management cradle to grave policy
Completion Technology to reduce costs	Smart fields/integrated operations
Drilling & Completions	-smart wells & completions
Drilling (completions)	

Well Design (Construction)	
-connector wells for smaller gas reservoirs	Low cost slim holes
Deep Water Well (3000 m)	Low cost smart wells (durable/reliable)
Deepwater Drilling - develop older rigs	Low cost well solutions
Deepwater drilling - retrospective assessment of what is there already	Smart subsea wells
Deepwater Drilling - subsea/risers	Smart wells
hard materials	Tool design and capabilities for future well designs
improved materials and coatings	Treating multiple horizontal wells simultaneously
innovative well construction	Wellbore Stability Analysis
Low cost reservoir access(offshore/HPHT/deepwater)	Wells of the Future

IoR/EoR	Intervention	Flow Assurance
artificial lift	Autonomous ROV's	Deepwater flow assurance
Associated facilities designs for e.g. thermal, chemical, or electrical EOR	cheaper subsea wells/intervention	Direct Electrical Heating
Carbonates-stimulation	Intervention	Flow assurance
Cheap ways to convert wells to injection	Light intervention- WL/coiled tubing	Flow Assurance
completion + stimulation life cycle - value out of wells particularly horizontal - Maximise recovery	Low cost well intervention	Flow assurance
EoR/IoR/secondary recovery	Low intervention - dry tree/subsea	Flow assurance
Improve impact of hydraulic frac stimulation	Lubricators at sea level - connect xmas tree - intervention with no riser (equipment in testing)	-Flow assurance - Direct Electrical Heating
Integration of value chain from reservoir to facility (well & reservoir mgmt)	LWIV - coil tubing;	flow assurance - hydrates, multiphase metering/testing, subsea pumping
IoR EoR- Improve water flood mgmt practices	R&D new techniques - eg intelligent completion, avoid intervention, alternative intervention techniques	-flow assurance modelling
IOR/EOR	Reduced access to subsea wells for remedial activities	inflow controls
IoR/EoR: one trip multizones	-rigless light well intervention	LDHI (KHI/AAA) for Hydrate Management
Maximising hydrocarbon recovery (EOR / IOR) (cost effective)	Subsea Intervention	Metering/retrofitting/wireless
N2 injection	Subsea Intervention w/ Light Vessels	salt precipitation
Reservoir stimulation of low perm reservoirs	well abandonment-deepwater/drilling	Salt Precipitation considering prediction, monitoring, prevention, treatment
Steam flood area inc	Well costs-intervention	Slug reduction
steam reinjection	Wells-autonomous intervention-robotic tools;	

Environment	HPHT Production	Pipelines
Contaminants management	-carbon steel in HP/HT flowlines	cheaper pipelines for more aggressive fluids
Contaminants-oil in water/glycol	Deep water + HTHP-Need to ID technology gaps	-cost/risk reduction of pipeline placement
Environmental friendly chemicals	HP/HT - HPHT Well engineering/exploration vision	Facilities and pipeline cost
Flue gas CO2 capture	HP/HT - MWD/LWD Tools	Non-Insulated Single Pipeline to shore
Green hydrates inhibitors	HP/HT - surface prediction/modelling	Performance and reliability of pipeline wet insulation coatings
H2S measurement onlin in liquids	HP/HT drilling	Pipeline composition
improve plant efficiency-burn less fuel/export more hydrocarbons	HPHT drilling,	Subsea Multi-pig Launcher
Low carbon solutions for offshore power	HPHT subsea	Subsea/unmanned pig launcher
No water overboard	HPHT systems & equipment (HIPPS) materials & welding	Transportation of corrosive fluids
Reduce SOx to environment	Hydraulic subsea high integrity piping protection (HIPPS)	Transportation of supercritical fluids
Reducing chemicals	Retrieval in HPHT	
zero discharges-no flaring, chemicals, capture flue gas, no drill cuttings, water based muds		

LDTB Power & Control	Gas LNG etc	Standardisation
CI & Ctrl on Local Power	Emerging LNG and gas technologies	Data management/integration
-Integrated Long Gas Tie Back Development	-FLNG - stranded gas	Information mgmt-analysis & getting to useful info
Lengthening economic step-out capacity	Gas/LNG	Information mgmt-standards
Local Power Generation	GTL/CNG/FLNG Compression	Instrumentation
Long step control & power	LNG - floating FPSOs / FlexLNG / LNG Processing topsides	reliability of equipment
Lower cost/longer distance tiebacks (flow assurance, subsea multiphase meters)	-LNG Loading in high sea states	RFID-Radio Base control systems
Non-Umbilical Development	LNG technologies	Standardising interfaces/protocols - high tech/low cost
Stranded gas/long tie backs >100km+	Remote LNG Loading	verification of life extension assurance
Subsea-long distance		
Subsea-subsea power		

Water Mgmt	HSE	MPD	Surface Facilities & Construction
Liquid handling	drilling hazard mitigation	managed pressure drilling	bad weather rig movement
Produced water	Environmental footprint reduction	mpd	-Design/construction LNG plants (3D simulation)
Produced Water Separation & Re-Injection (if formation /aquifer water present)	Green pipe dope replacement	Near Balance Pressure Drilling	-Drillings & completions - multi-platform self-erecting tender-assisted drilling system
Unconventionals - Water management	HSE	Pressure Control - managed Pressure drilling	Dry Tree deep draft or extendable draft semi
Water & Gas Isolation techniques;	HSE	Pressure control - MPD	Flowlines/pipelines installation using the float out method
Water management	legislative pressure	Pressure Drilling Management/Well Control	Tension Leg Platform
Water Management and treatment	Production HSE		
water production-control/handling/management			

Operational Efficiency	Decommissioning	Deepwater Subsea	Arctic operations
Energy Efficiency	Decommissioning - opportunity to do things differently as not a carbon environment	Deep & harshwater technology	Facilities for Processing in the Arctics
Low cost automatisaton for automatic production control in marginal fields	Decommissioning;	Deepwater oil and gas	Structural modelling - Arctic
real time pressure rate monitoring	subsea environment monitoring units	Deepwater subsea tech (WA/GoM/Aus)	
shallow gas/power generation	Subsea laser cutting;		
Uptime/availability			

Gas Well Deliquification	Seabed Survey
Gas well deliquification	-seabed/sub-seabed mapping tools
Water production in mature gas fields considering e.g. de-liquification	Surface topography