# Results of the 2015 Operational Geoscience Survey


## Tim Herrett, Tim Herrett Ltd.


An Operations Geologist at Work – Ian Clement



Note that this paper has been peer reviewed for potential publication. It is essentially a presentation of all data with some limited comment and analysis from me.


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## Abstract

The operational geoscience discipline, incorporating mainly operations geologists but also well planners, pore pressure specialists, geomechanics experts and wellsite geologists, has it seems changed significantly over the years. No longer is it exclusively a well execution phase role involving data acquisition and distribution. Now it is a wide ranging, responsible and dynamic role encompassing safety critical functions through the entire life of a well. That is the perception at least.

The 2016 operations geology conference will be the third to be held but there are key questions that we are still to answer specifically - 'who are we' and what exactly do we do? Just what do we mean by the operational geoscience community? What are our demographics? What education levels do we have? What are the usual career path(s) for operations geologists and what is the mix of consultants and staff? Are we adequately appreciated and remunerated for the work we do?

The survey, conducted anonymously using a commercial online website, attempted to answer some fundamental questions and, additionally, to either confirm or dispel a number of preconceived ideas about the profession with some hard data.

Approximately 120 people from 26 countries fully completed the survey and, indeed, the respondents gave confirmation just how wide ranging and technically challenging the role has now become. The data show overwhelmingly that operational geoscientists are involved in the complete life cycle of a well. While technical skills are important, soft skills such as communication are judged equally as important.

The data reveal a number of varied but well-defined career paths into the discipline with as many as 50% of the respondents having mudlogging as a starting point. Virtually all respondents stress the importance of a grounding in wellsite work, preferably in excess of a year. In general, the discipline works long hours, probably too long but, in general, we are well remunerated for it.

Although while some of the respondents feel they are well appreciated in their role, others feel they are not and that there is a perception gap between what it is thought we do and what we actually do. Our worth and skills still seem to be undervalued. There is still work to be done to raise the profile of operational geoscience in the industry and demonstrate how we can add much value.

In common with the rest of the industry we will lose some highly experienced exponents of operational geoscience in the next few years. In Europe, certainly, the indications are we will have a bigger demographic issue, with many practitioners retiring, than in the oil industry as a whole.


## Genesis of the Survey

After the formation of the convening committee for the 2016 Operations Geology conference the author suggested that we should organise a survey of the operational geoscience discipline. The

convening committee agreed and a range of questions were suggested for a survey that was to be totally anonymous and to reach as wide an international audience as possible.

Although we all think we know what the discipline is and what it does this is generally based on personal experience and conjecture. As far as we are aware there has been no previous attempt to properly understand the discipline. Stag, the geological services company, had surveyed their own consultants and presented their results at the 2012 conference (*Gardner and Fagg, 2012*). However, the intention of our proposed survey was to be more inclusive involving staff and consultants from both service providers and operating companies internationally. This proposal was unanimously agreed by the convening committee.

What do we mean by the term Operational Geoscience? The core of this discipline is obviously the operations geology role itself which has gradually evolved over the years, well beyond its original remit of essentially well data management and distribution predominantly during the execute phase of a well. There is a now a great deal of evidence to suggest that it has become a safety critical and key communications role encompassing the full life of a well from pre-planning to post-well review. The intention of the survey was to more accurately define what the operations geology role is today and, in addition, raise its profile. There is some concern within the discipline that some people still perceive the operations geology role as a menial task and do not give it its due recognition. To change this perception, we need hard data.

Operational geoscience also consists of other roles which provide both vital support and, frequently, have evolved into specialisms from operations geology itself:

- Well planners – focussed on the planning aspects of a well but pass on the information to an operations geologist for the execute phase. Should have operational knowledge and experience.
- PPFG – experts who are focussed on pre-well prediction of formation pressures, also providing support during the execute phase.
- Geomechanicists – wellbore stability is a key issue that needs to be addressed given the variety of well trajectories and stress environments that wells are now drilled in.
- Wellsite geologists – Senior wellsite geologists can be drafted in early to help with well planning and are obviously mainly involved in the well execute and well review phases.
- Operations geology management – Senior operations geologists who manage and support an operations geology team.

There is a case to include mudlogging in Operations Geoscience as it is the rootstock for both wellsite and operations geology as well as giving invaluable foundation of rig-site experience.

The survey questions, discussed and agreed by the conference convening committee, were designed to give answers to the following:

- Who are we?
- What are our demographics and gender?
- What is our background?
- What do we do?
- How much do we work?
- What are our main challenges and frustrations?

- What fulfils us?
- Are we appreciated?
- What do we earn, are we adequately rewarded?
- What factors do we consider when pursuing a job in operational geoscience?

There were a total of 47 questions some of which were multi-part and quite complex.

The on-line provider SurveyMonkey was chosen as the delivery mechanism. This helped to both facilitate distribution of the survey internationally and also, very importantly, maintain the anonymity of the respondents. The organisational committee is grateful to the Petroleum Group of the Geological Society for providing financial support for the use of SurveyMonkey.

The web-link for the survey, which went live on 28th October 2015, was distributed via:

- The Geological Society of London (GSL) through their print media, website and e-mails to their members.
- Convening committee members to their contacts with requests to pass on to their colleagues and friends.

The results were collated on the SurveyMonkey website which provides simple statistics. The subtler data relationships, however, required much more detailed examination of the complete downloaded data set.

## Results and validity

As of March 31st 2016, a total of 198 people had responded to the survey. Of these approximately 120 had completed the survey fully and a further 30 or so who had answered most of the questions. Those who had not were either:

- Not operational geoscientists, but were in an associated discipline (e.g. biostratigraphy) and so the questions were not fully relevant.
- Were operational geoscientists and did not persevere to the end or did not respond to some of the questions.
- Not completer finishers!

Even the partially completed surveys contained useful data. Rather than scrap these they were included in subsets used for analysis.

With the total number of respondents, the results are generally statistically robust. However, when the data are broken down into subsets, for example data from outside the main European arena, then the results of analysis of these data is more of an indication.

There is evidence of potential survey bias towards responses from operating companies, as explained later in this paper. Also, there were responses from 26 countries where work practices and pay levels vary significantly so, where possible, these data have been split accordingly.

## About the Respondents

The response to the survey, as hoped, was international from a total of 26 countries. Figure 1 shows the countries of origin and where those same people are working.

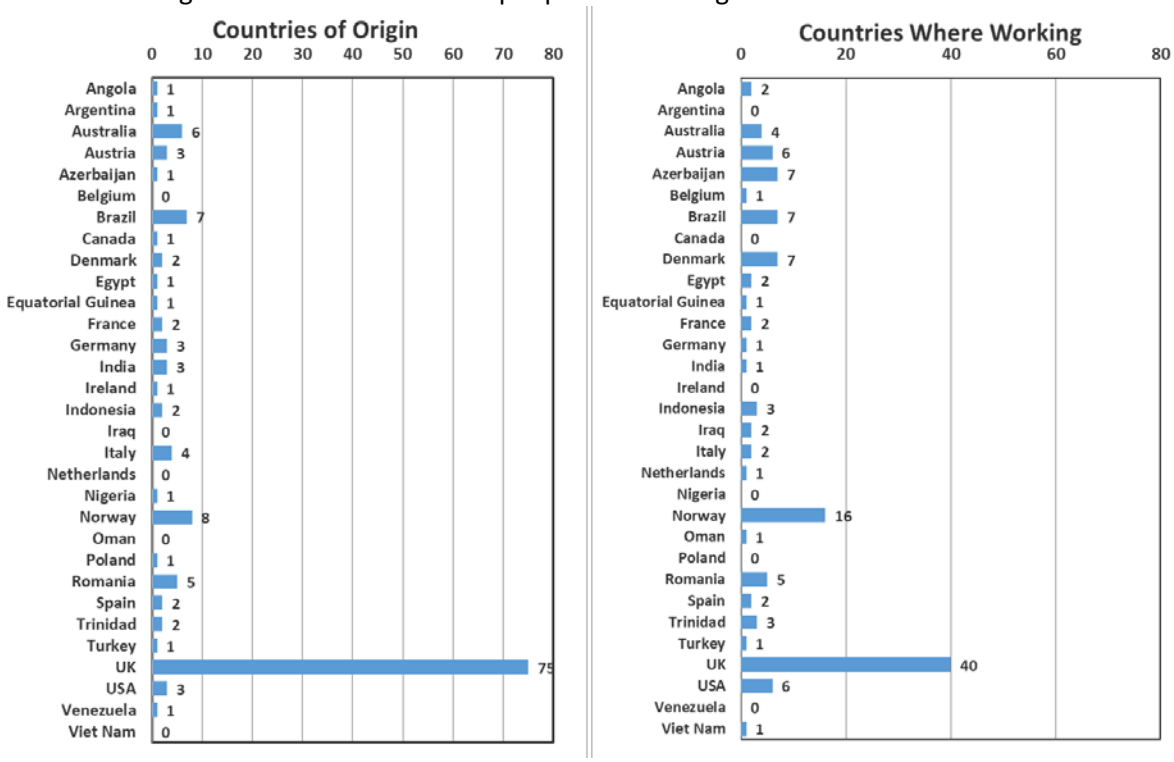



***Figure 1: Plots of numbers of respondents showing country of origin and where they are working***

Unsurprising, by far the highest number of respondents are from the UK, making up over half (55%) of the total. The number of other countries represented exceeded expectations but the relatively low numbers from the rest of the world makes statistical analysis for these individual countries impossible.

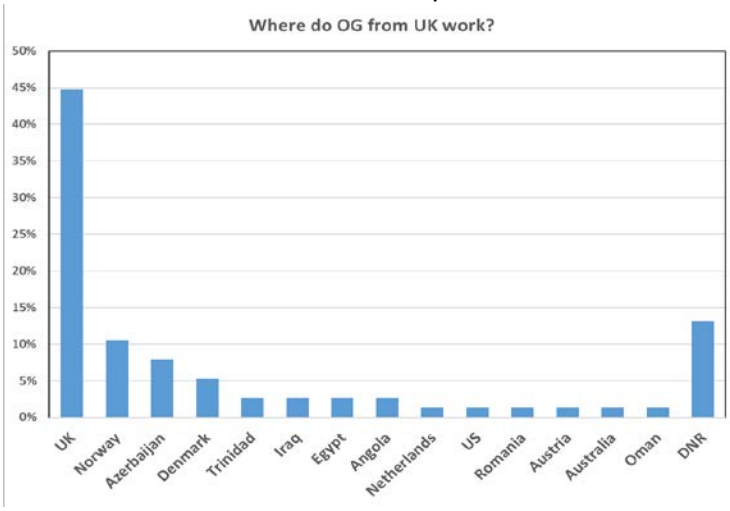



***Figure 2: Countries in which operational geoscientists from the UK are working***
***(DNR = Did not reply)***

The UK is the exception but is so dominant it probably has the effect of skewing the overall statistics. Where possible the UK or 'North Sea' statistics are broken out to illustrate various points.

An obvious feature from Figure 1 is that a large percentage of those who originate in the UK were not working there at the time of the survey. Figure 2 illustrates the countries they are working with no real surprises in geographical spread.

The next highest number of respondents outside of the UK were from Norway with 8, all of whom work in Norway. 73% of respondents are working on a well being drilled in the country where they reside.

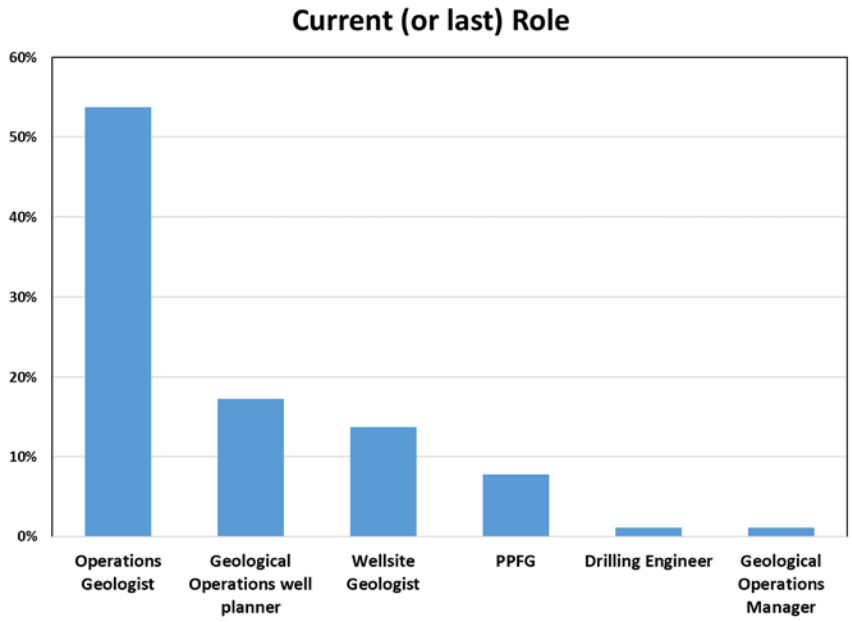



***Figure 3: Current/Last Role***

Figure 3 shows the most common roles of the respondents to the survey. Others included biostratigraphers, trainers, students, production geologists, stratigrapher, subsurface team manager, well engineering manager, development manager and geomechanics roles.

Obviously for some of these not all the questions would have been entirely relevant unless they were previously actively involved in operational geoscience.

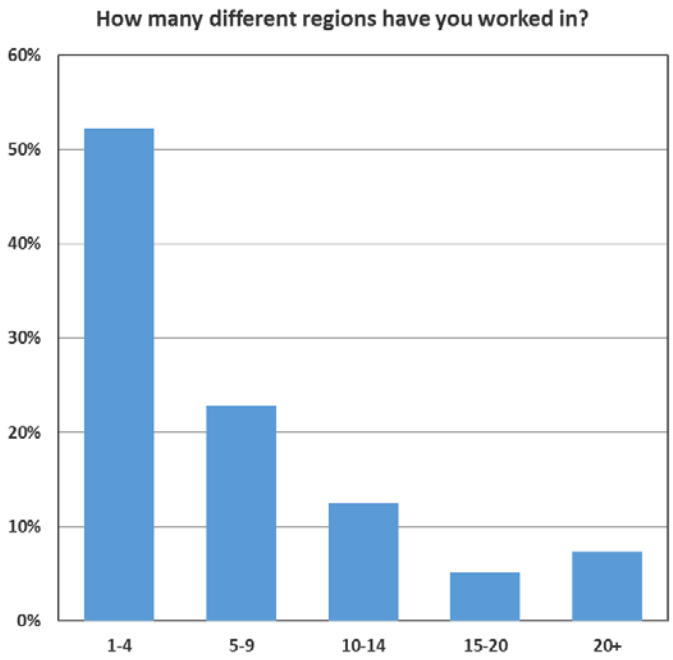



***Figure 4: Number of regions worked***

Figure 4 illustrates how many regions (defined as basins and sub-basins) the respondents had worked in. Over 50%, including some highly experienced people, had only worked in 1-4 regions which seems rather low. Potentially if you become settled into an area where there is plenty of work then there is some reluctance to move, or maybe certain staff positions make it difficult to move. Certainly, some oil companies like to use people with prior experience in an area which may inhibit movement to new areas. Whatever the reason, there may be some concern at the majority of respondents having such a narrow focus.

## Gender and Demographics

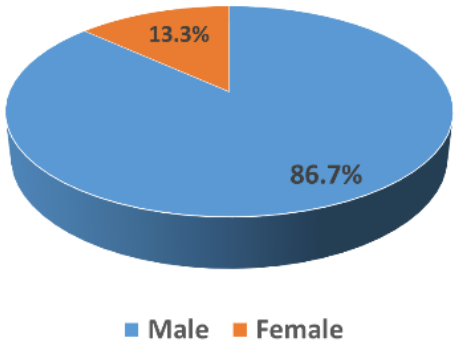



***Figure 5: Gender distribution***

Of the 196 respondents who answered the question on gender 13.3% were female and 86.7% male (Figure 5). This statistic illustrates that operational geoscience discipline is still male dominated although 'drilling down' into the statistics shows a subtler demographic breakdown.

Figure 6 illustrates the worldwide operational geoscience demographic (on the left) showing the male female split. On the right, for comparison are the demographic results from the 2015 PESGB annual salary survey.

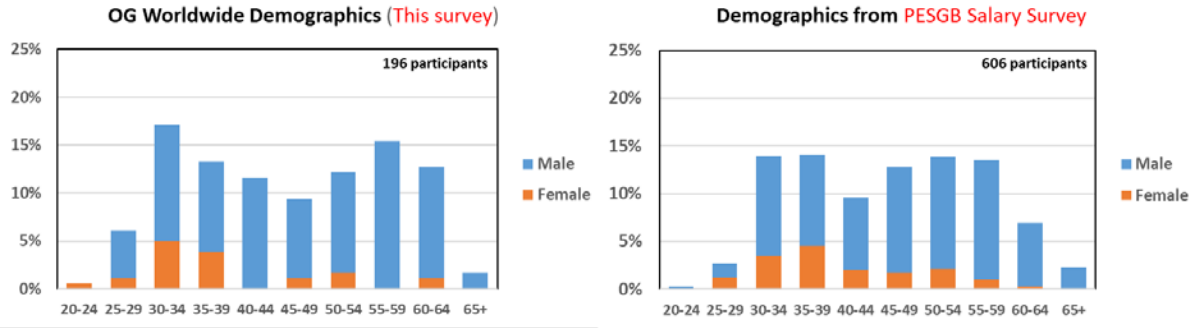



***Figure 6: Worldwide operational geoscience demographics including male female split (left) and comparison from demographics from the PESGB annual salary review.***

On the face of it there are obvious similarities between the two plots, as might be expected, but the operational geoscience plot shows more accentuation at the young and old end of the scale. Encouragingly, there would appear to be a good number of people in their thirties who have joined the discipline having obtained their basic training and are now gaining vital experience. At the opposite end of the scale, in the 60 to 64 age group, there seems to be a reluctance to retire early compared with the PESGB membership.

There are a higher proportion of females in the younger age groups and, in a similar fashion to the PESGB results, tails off with age. Without historic data it is difficult to establish if the higher proportion of females in the younger age groups is typical of past years and for, different reasons, they subsequently leave, or that that we are seeing more females in the discipline now than previously.

It is only when the data are examined in more detail and geographically that a more interesting picture emerges. The data were split into two, the traditional 'European North Sea' countries of the UK, Norway, France, Germany, Austria and Denmark etc. and the 'Rest of the World (called 'Outside Europe' in Figure 7, below).

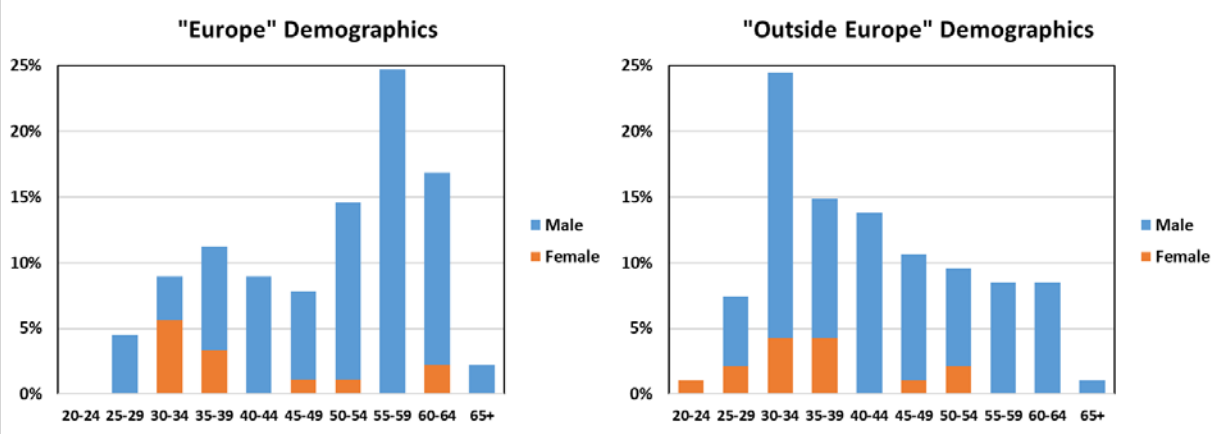



***Figure 7: Demographics for Europe (left) and rest of world (right)***

These plots show a remarkable difference with one being almost the mirror image of the other. The 'Europe' demographics indicates a fairly low number of young operational geoscientists, interestingly a large proportion of whom are female. At the other end of the age scale there is a massive peak and, in fact, those 50 and above make up 60% of the total number of respondents. In the next ten years all these people will be retired and, given the current state of the industry, many of these may already have retired, by choice or not.

This will be a massive loss to the industry in terms of experience and expertise and paints a picture that is far worse than is generally imagined. Not only that, the depressed state of the industry may also inhibit young blood joining the discipline which will, in turn, lead to demographic issues in later years.

The 'Outside Europe' plot, on the left of Figure 7, shows a much higher percentage in the younger age ranges and then a gradual decrease with age.

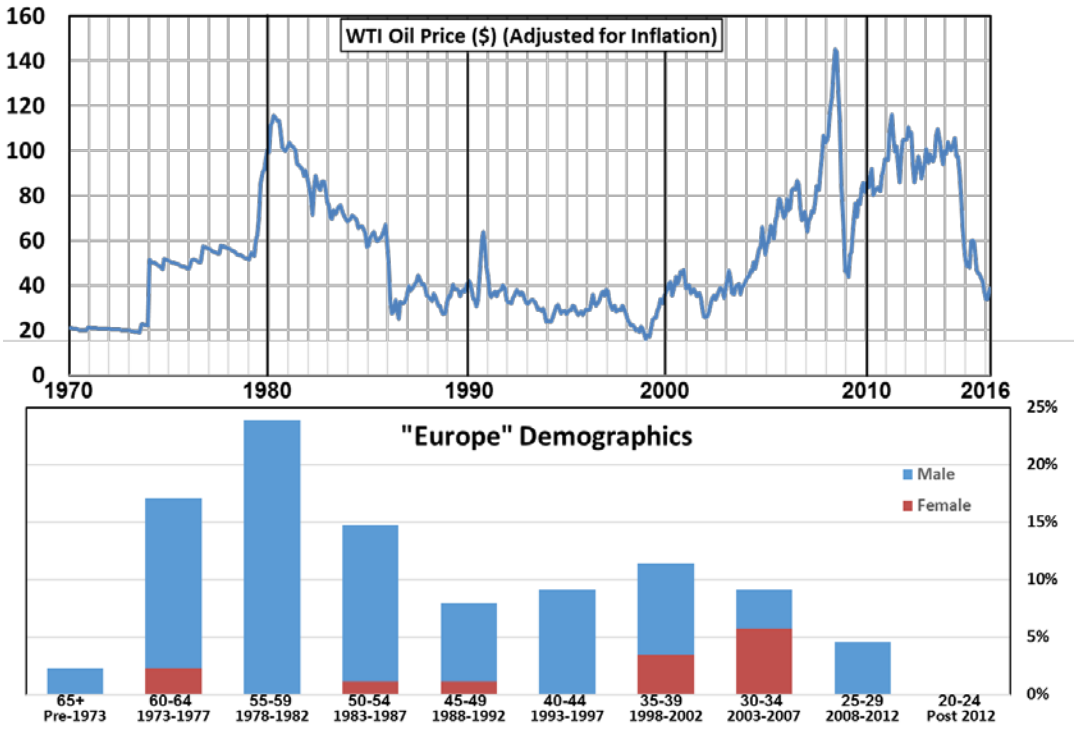



***Figure 8: 'Europe' Demographics versus oil price adjusted for inflation***

How can these differences be explained? Unfortunately, an issue with the survey data itself cannot be ruled out. There is some unverifiable, anecdotal evidence that some of the younger consultant operations geologists didn't want to participate in the survey. This may partially explain some of the results presented later in this paper but, given the numbers involved in the survey, this may not change the graph too significantly.

Figure 8 presents the demographic data in reverse, so to speak, giving the approximate data of entry into the industry.

This is plotted with the inflation adjusted oil price since 1970 and shows a basic correlation. The numbers do not increase with the high oil price from the mid-2000s onward as this is the generation yet to join the operational geoscience discipline.

However, there is a tempting, if unverifiable, explanation for the 'European' demographic plot we see. The large peak centred around 1980 coincides with the large expansion of mudlogging in the late '70s and early '80s. The mudlogging companies took on a huge number of university graduates from the UK during this time due to both the expansion in their business, specifically the North Sea, and also the move to equal time (on the rig and off). This generation also benefitted from the outsourcing of wellsite and operations geology roles in the 1980 which led to the establishment and development of a number of geological consultancies.

Gradually this generation progressed worldwide through wellsite geology, operations geology and all the associated specialisms to become very experienced practitioners. This experience meant that they were always in prime position to obtain consultancy or staff work at the expense of the younger

generations coming through. Some of the younger generation obviously persevered and made it but others went elsewhere or fell by the wayside.

Now this entire older generation is reaching the end of its working life and all will retire. Can the younger generations replace them?

In the rest of the world the opposite is true with over half the respondents less than 40. Again, this may be a quirk of the survey data but may also be due to the fact that there has been a rapid increase in activity in these areas in the last oil industry upturn.

Figure 9 presents two graphs summarising the types of companies the respondents worked for and the types of wells they were involved in.

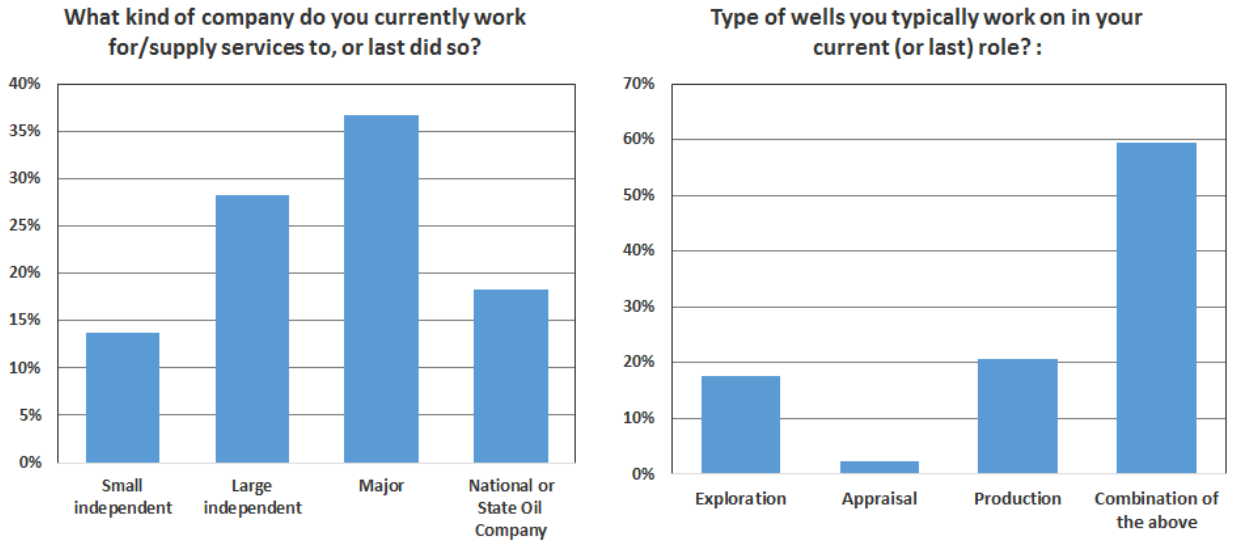



***Figure 9: Types of companies and types of well.***

These results were slightly unexpected showing a bias towards respondents from the majors and large independent oil companies. Combining this with the knowledge that over half of the respondents work in the European arena, which is predominantly a mature province, then it is unsurprising that so few work on purely exploration wells.

## Career Path and Role

One of the questions in the survey concerning their career path did appear to be quite complicated, but over 150 people persevered and completed it, allowing a fairly reasonable analysis of the various career paths in operational geoscience.

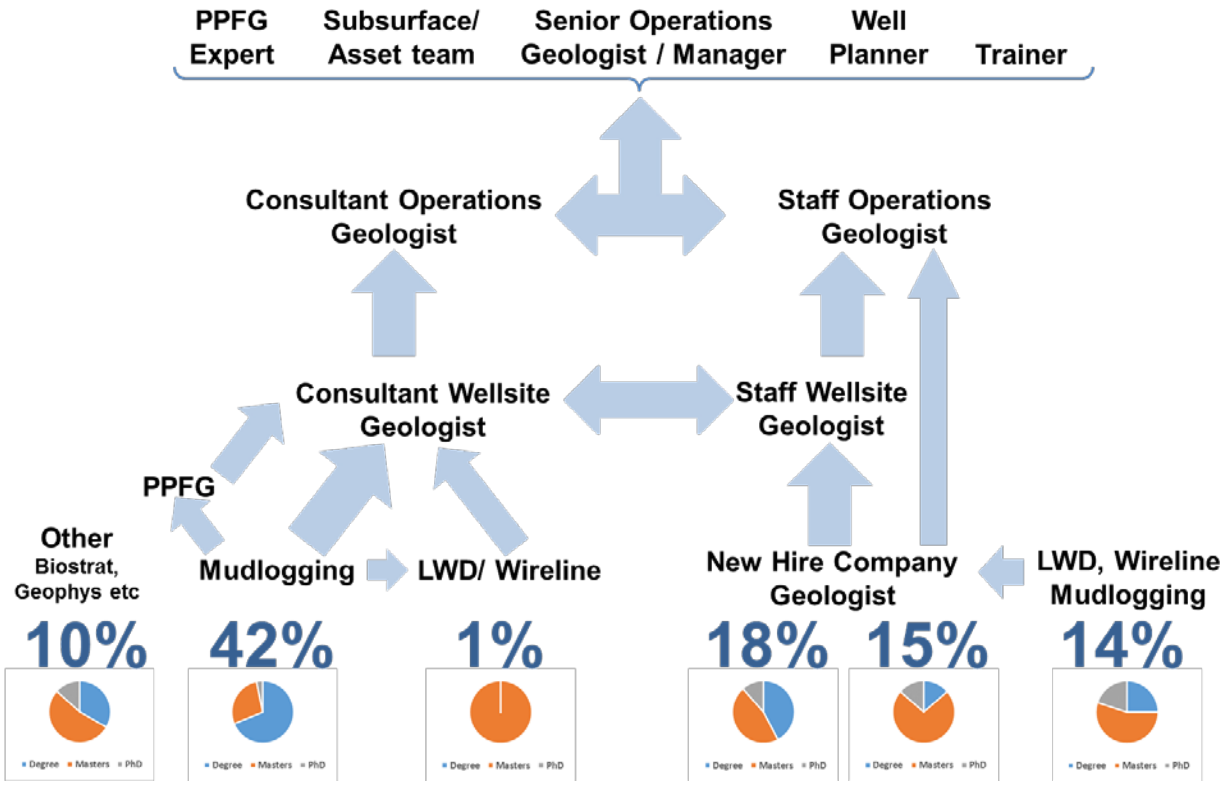



***Figure 10: Career paths and education***

Figure 10 illustrates these career paths. The most common route into the industry, by far, is via mudlogging, progressing up to become consultant wellsite and operations geologists. The pie charts along the bottom of the figure give an indication of education level achieved for each subset. Over two thirds following the mudlogging route are degree level. A proportion of those who follow this route also join oil companies and take up staff positions, later becoming subsurface team members or higher management. Others remain as consultants and are happy to do so, becoming experts in their field in related operational geoscience activities and, given the remuneration data analysed later, are well paid.

A significant proportion, typically with a higher degree, having worked and got experience in the service provider sector, then join the oil company direct and progress as staff wellsite and operations geologists. Some of these remain with the oil company but others move back into the consultancy sector. This movement, and that of consultants to staff, is driven by a variety of factors such as personal motivation and industry downturns.

Over 30% of respondents, again typically with higher degrees, join the oil companies direct from college and, after a period of oil company orientation, become either staff wellsite or operations geologists. Transitioning directly from an oil company new hire to a staff operations geologist seems a difficult route but, hopefully, includes a period of wellsite work and effective mentoring.

A small percentage of respondents moved out of the industry for a while or performed non-operational roles before returning at a later date, again driven by industry downturns. A number of university Petroleum Geoscience MScs now have an Operations Geoscience module included in their curriculum.

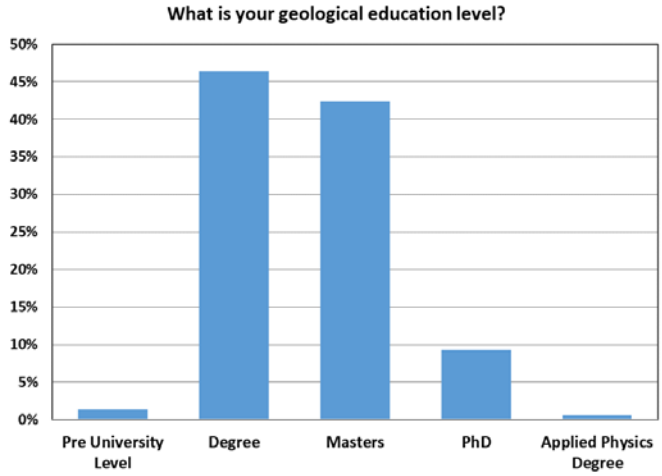



***Figure 11: Education level***

It is worth noting that all the respondents, with the exception of one or two, had a degree in geology. Figure 11 shows a plot of the respondent's highest education level.

Degree level is still the most common and there is evidence that some respondents, after an initial period of work, go back to college to obtain a higher degree, especially when there is an industry downturn. A degree in geology is still seen as a prime requirement for entry into operations geoscience.

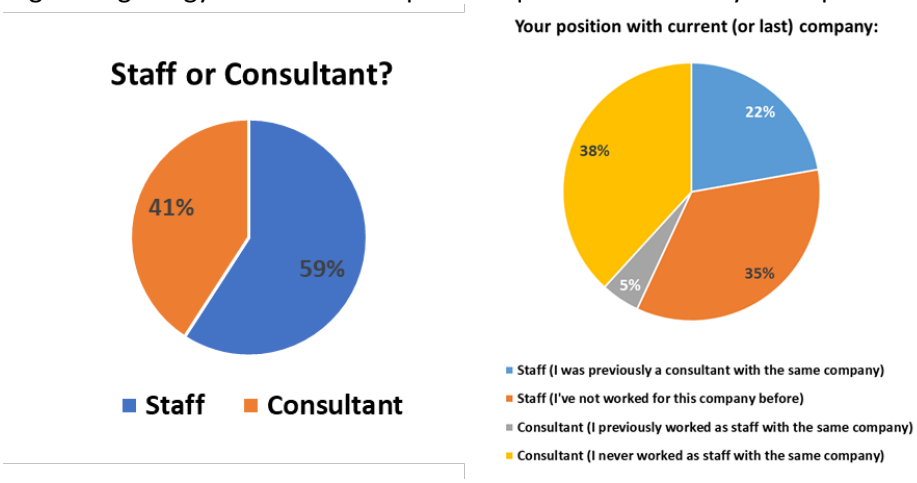



***Figure 12: Staff versus Consultants***

Figure 12 presents two pie charts which illustrate the relative numbers of staff and consultants. Surprisingly the ratio of staff to consultants is approximately 60:40 as illustrated by the pie chart on the left. Again, this may be a possible indication of survey data bias towards the big oil companies. An alternative interpretation may be that the companies are increasingly seeing that operational geoscience is a key role that needs to be a staff position. This is certainly the case with BP (McBeath & Herrett 2014) who have an accelerated development programme for staff operations geologists.

The pie chart on the right shows a more detailed split and, unsurprising in this case, 22% of staff were previously consultants with that company. Only 5% have worked as staff before becoming a consultant with the same company.

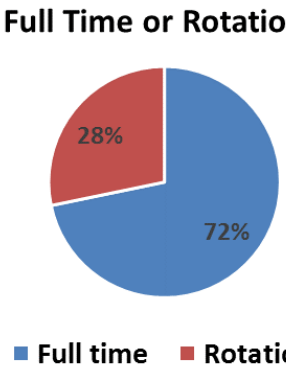



***Figure 13: Full-time or Rotational***

Figure 13 indicates that almost three-quarters of the respondents are in a full time rather than a rotational role. Figure 14 shows the results of splitting the data between European and non-European subsets and also rotational versus staff roles.

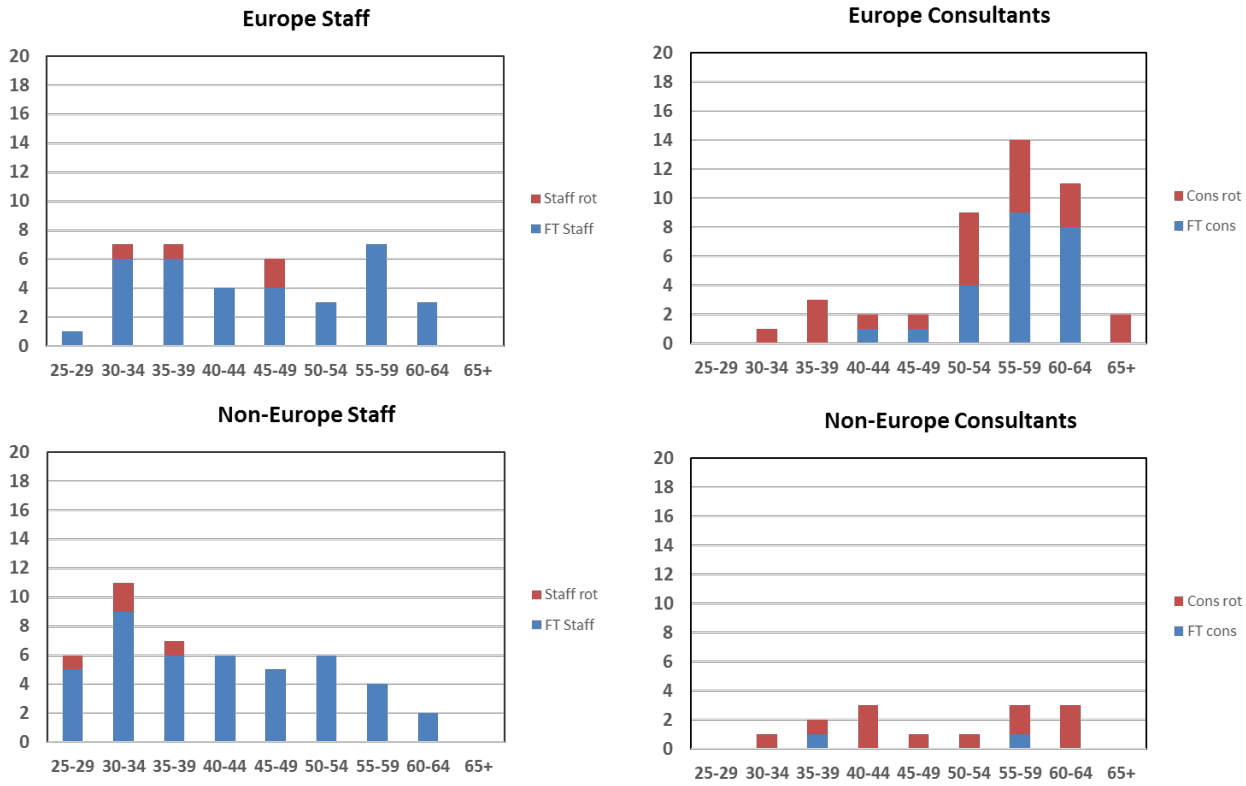



***Figure 14: Staff versus Consultancy Difference by Region***

There is actually very little difference between European and non-European staff roles. However, the consultants show a pronounced peak in the European data, from that '70s/'80s generation, whereas the younger age groups are very similar. Also, as would be expected, the majority of the rotational roles are consultants or are younger staff.

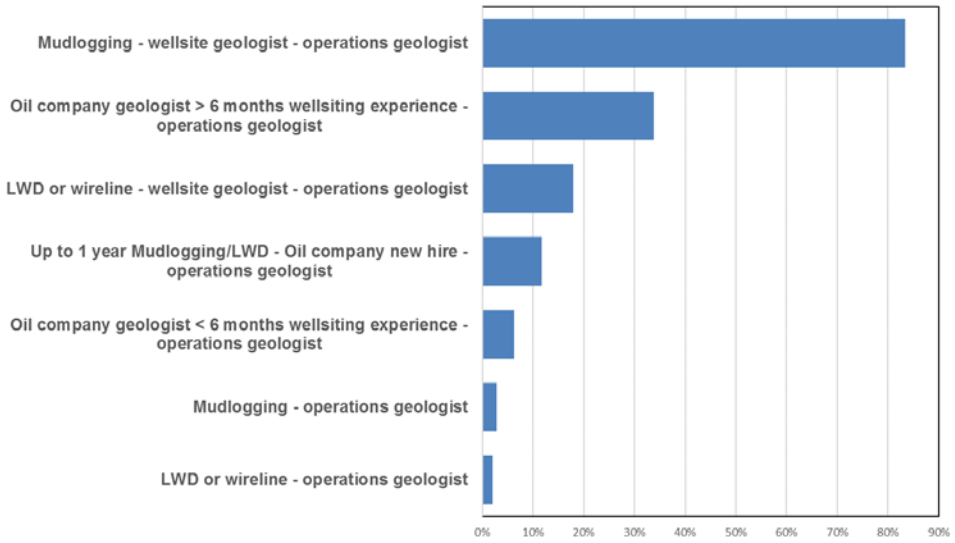



***Figure 15: Most appropriate career path***

Figure 15 shows the results of the question regarding the most appropriate career path. This was a multi-choice question and why the total percentages add up to more than 100%. In the majority of cases the respondents first choice was the route they themselves took in the industry.

However, in these cases if the first choice was not mudlogging then it was invariably the second choice. The mudlogging route is the overwhelming preference as the most appropriate career path by a large margin. It is also interesting to note that the top four choices all require that a considerable amount of time, (minimum 6 months but most likely a year) be spent at the rig-site. This conclusion concurs totally with that of the Stag survey of their consultants in 2012 (Gardner and Fagg, 2016).

## What do Operational Geoscientists Do?

There has been anecdotal evidence to suggest that the operational geoscience discipline is involved in the complete life cycle of a well and has gone much further than the original remit of the job. This is an important aspect that the survey was designed to test and confirm. Four phases covering the whole life of a well were chosen:

**Pre-Well Planning** – Initial review of a prospect evaluating regional and local context.
**Well planning** – From setting well objectives, evaluating final well location up to spud.
**Execute** – Drilling and evaluation of a well, data collation, distribution and management.
**Review** – Evaluating well success compared to objectives, final well reporting and data distribution.

For each phase a number of specific common tasks were listed (based on the authors experience with Exxon and BP) and the respondents had to decide between no involvement, contributing or responsible. Obviously some of the respondents to the survey, e.g. wellsite geologists would not be involved at all in the early well planning tasks and the results presented below are for the full population of respondents.

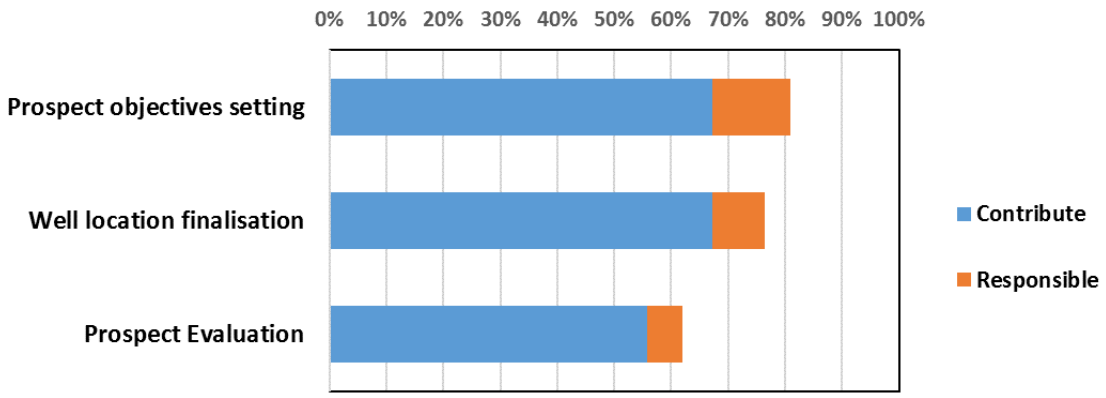
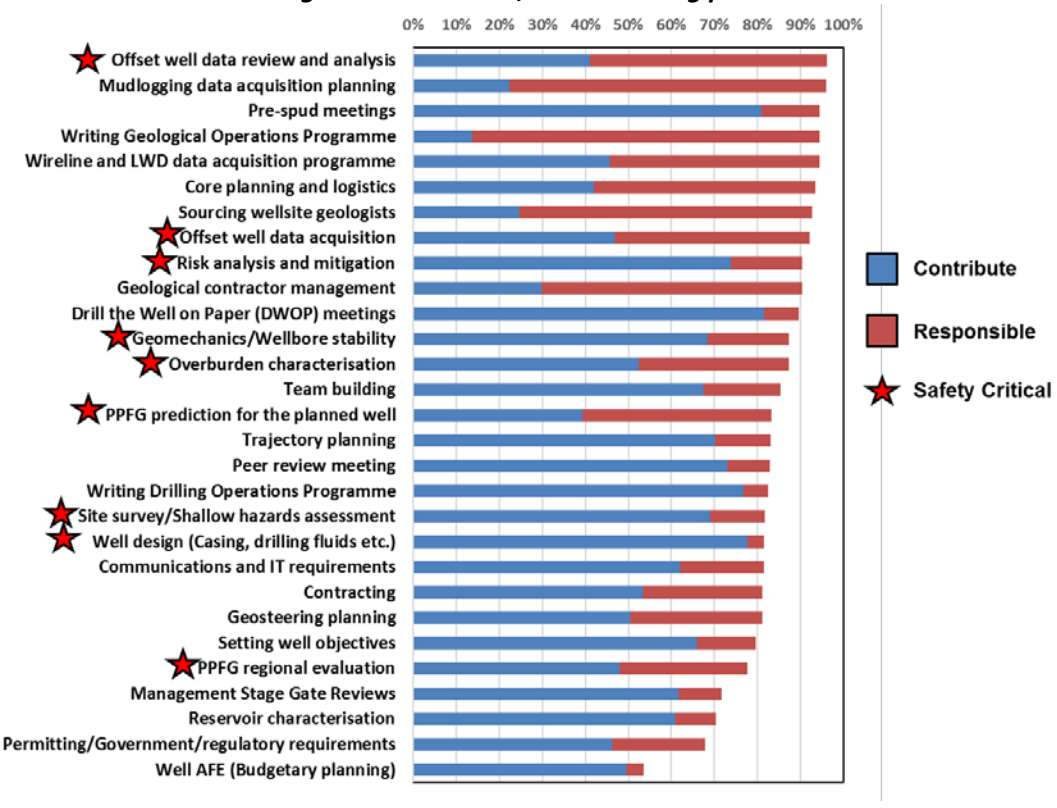



***Figure 16: Pre-well Planning Phase***

Figure 16 shows the results for the pre-well planning with greater than 55% of respondents at least contributing to the three tasks for this phase. Surprisingly, some were even had some responsibility for these tasks and confirms just how embedded the operational geoscience role has become within the life of a well.

Figure 17, below, shows the huge range of tasks that operational geoscience practitioners contribute to, or are responsible for, during the well planning phase. Some of these are obvious and are what could be considered to be 'traditional' operations geology activities, but others have been more recently and increasingly assimilated into the operational geoscience work scope. There are a number of safety critical tasks, marked with a star, for which operational experience of both the subsurface and drilling engineering aspects of work is obviously advantageous.

***Figure 17: Activities, Well Planning phase***



Given the fact that some of the respondents would not get involved in some of these activities, there is a remarkable consistency of results with over 70% of respondents involved in nearly all of these tasks. These results indicate beyond doubt that the role of the operational geoscientist is now firmly embedded within the well planning process.

The safety critical nature of some of these tasks raises obvious questions around training, expertise and whether we are competent enough to perform them. The results of questions regarding training and competency are discussed later.

Figure 18, below, gives the results for the well execute phase. Unsurprisingly, the 'traditional' operations geoscience tasks dominate and, once more, over 70% of respondents are involved in the vast majority of the tasks. One relative surprise was how low petrophysical analysis was at 68% compared to the other 'traditional' tasks most of which are above 80%.

While most operational geoscientists need to understand the results of petrophysical analysis, very few now have to calculate the results. The advent of modern broadband communications and sophisticated software mean that a petrophysicist can receive the data and perform the calculations immediately. It is possibly a skill that is slowly being lost from operational geoscience.

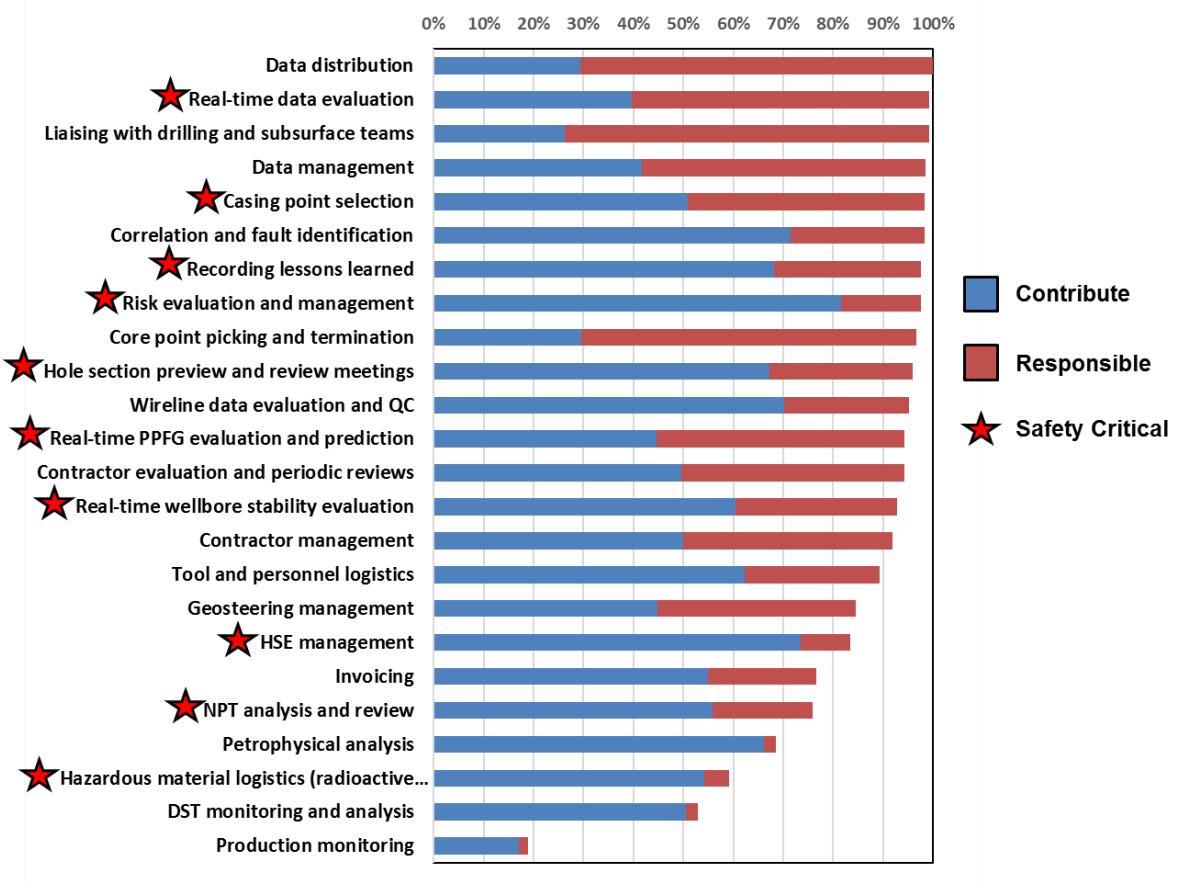



***Figure 18: Activities, Well Execute Phase.***

Again, over half of these tasks can be thought of as safety critical. Do we really have the training, expertise and competence to perform them?

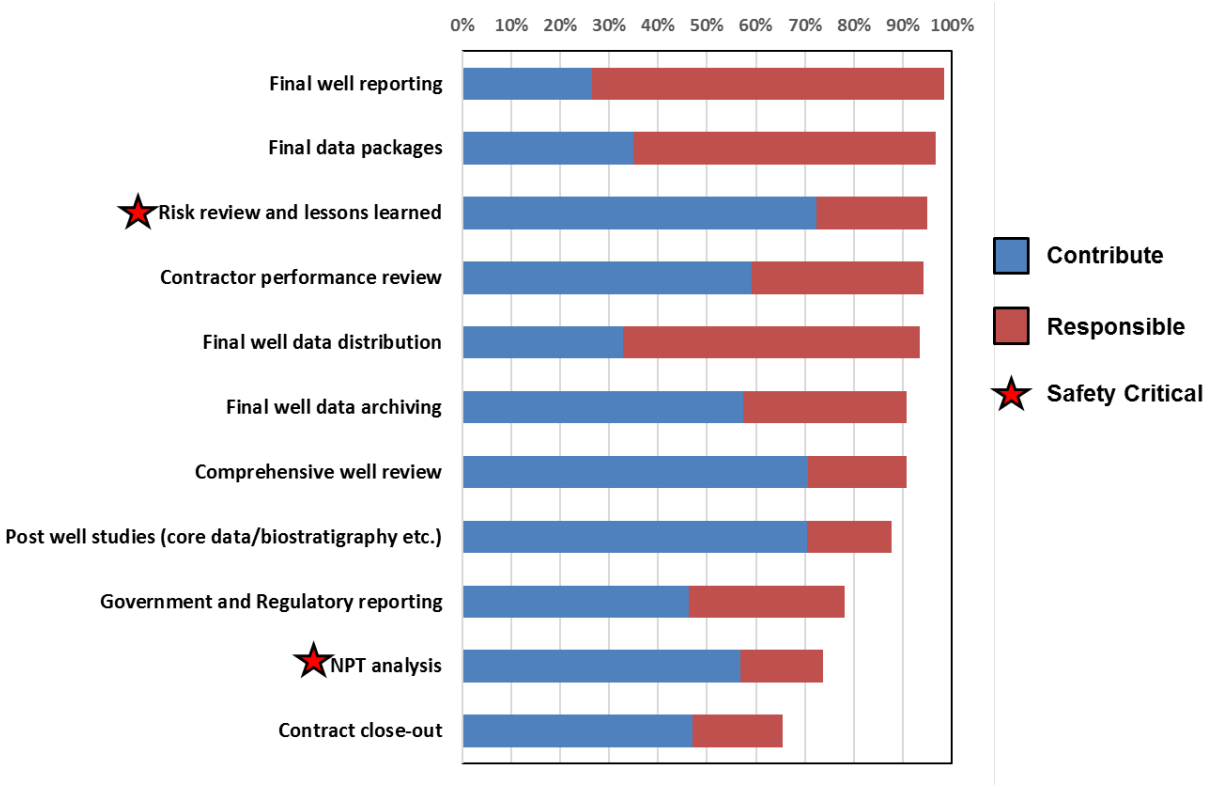



***Figure 19: Activities, Well Review Phase***

Figure 19, above, illustrates the activities performed in the well review phase of a well. Once again there are no real surprises for what are mostly traditional operational geoscience roles.

Far fewer respondents are involved with monitoring wells operated by others (OBO) (Figure 20).

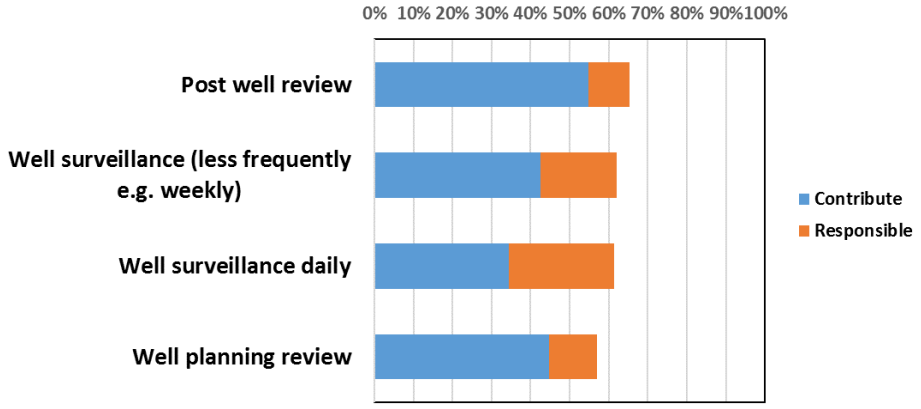



***Figure 20: Activities, Wells Operated by Others***

An interesting aspect of the survey was to test just what influence operational geoscientists had over contracting with respect to the four main geological services of wellsite geology, mudlogging, MWD/LWD and wireline logging. These contractors provide the majority of the data required for properly evaluating a well and, it would be hoped, operational geoscientists would have a major influence over the service itself and also the personnel involved.

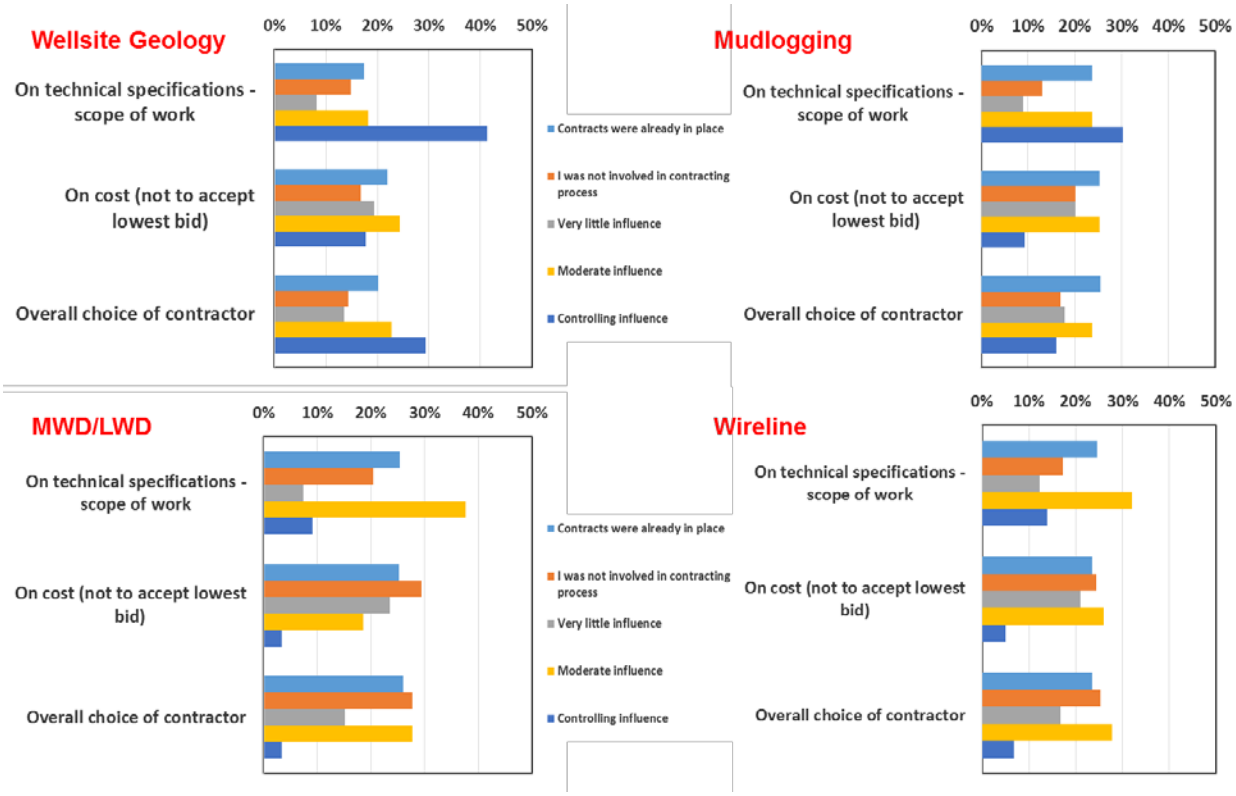



***Figure 21: Influence over geological contracting***

Figure 21 illustrates the results from the survey for each contractor. In 15-25% of cases the contracts were already in place while a significant number were seemingly not involved in the contracting process. This latter may heavily influenced by the role of the respondents, e.g. wellsite geologists, who would not be involved in the process anyway.

Generally, operations geoscientists have a higher degree of influence over the technical specifications (scope of work) than cost for all the contract types. There is a much more moderate, but still significant, influence in LWD and wireline but certainly not a controlling influence. While it would appear that there is much more control over the choice of wellsite geology and mudlogging there is also a significant percentage of respondents (35 to 40%) who had very little or no influence over these key contractors.

Without historic data it is difficult to know if this has always been the state of affairs or whether there has been a trend of declining influence over the choice of contractors. The use of supply chain management (SCM) and, in some cases, regional or international contracts does seem to dilute the amount of influence that operational geoscientists have. Should operations geoscientists have a more controlling influence over all these contractors and should there be a move to regain it? The discipline certainly has the most knowledge and experience to at least make technical decisions over these important services.

## Dealing with Data

The volume of data handled during the course of a well has increased exponentially over the years. A daily report and a weekly batch of mudlogs has now become a daily avalanche of digital data – reports, PDF logs, spreadsheets, LAS files etc from a variety of data providers. All these data need to be quality controlled, managed, distributed and archived. It is the archiving process that has historically been an issue. How easy is it to find these data again at a later date?

Smalley (2002) stated that geoscientists spend 44% of their time finding, accessing and QCing data but only 6% of time archiving it. The amount of time spent hunting for data is actually non-productive time (NPT) and, essentially, it is because the archiving process in many companies is poor. One of the aims of the survey was to investigate this question.

Figure 22 plots the responses from survey split by company type.

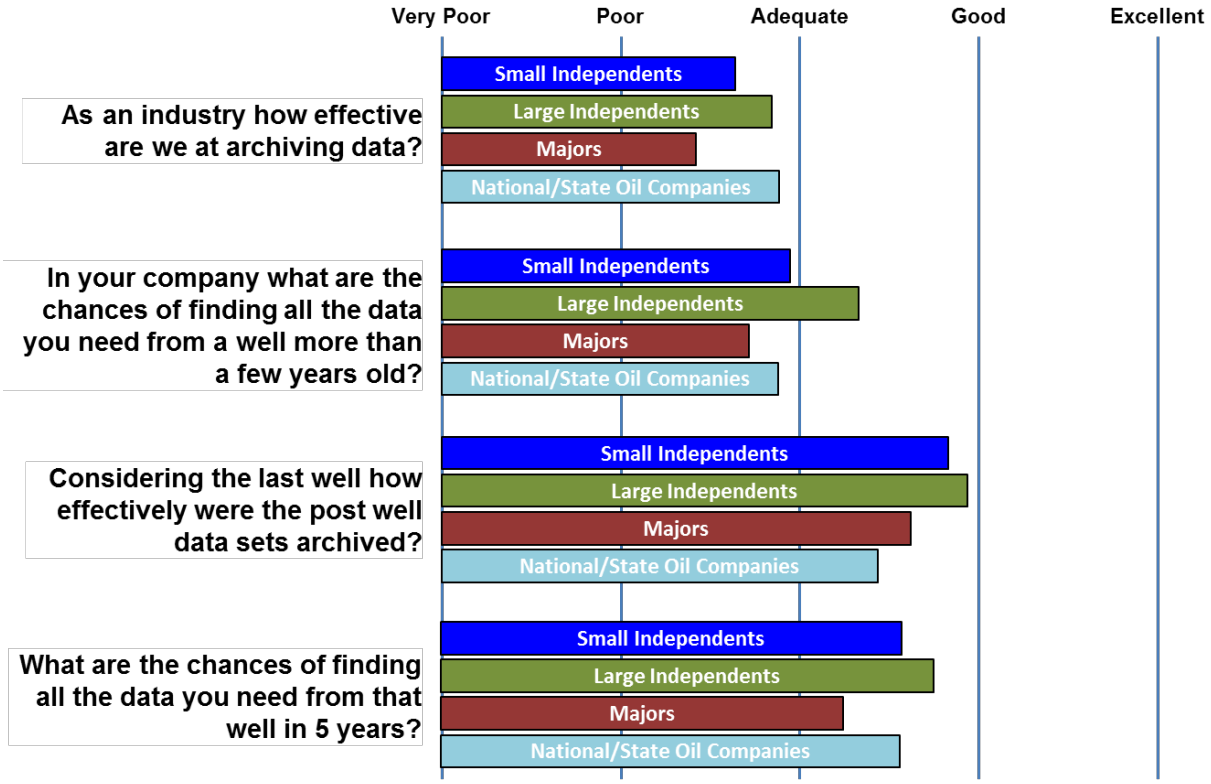



***Figure 22: Data archiving***

Some individual responses describe excellent archiving, some very poor and there will obviously be some variation due to individual company process and personal feeling. But, as Figure 22 illustrates, on average, the respondents think that, for the industry and for historic data, data archiving is only poor to adequate. There is a little more confidence when considering the last well but that would be expected as it is the respondents that have partly performed the archiving! Even they are less confident about finding the data in five years. With respect to individual company types respondents from the major oil companies are much less confident about data archiving.

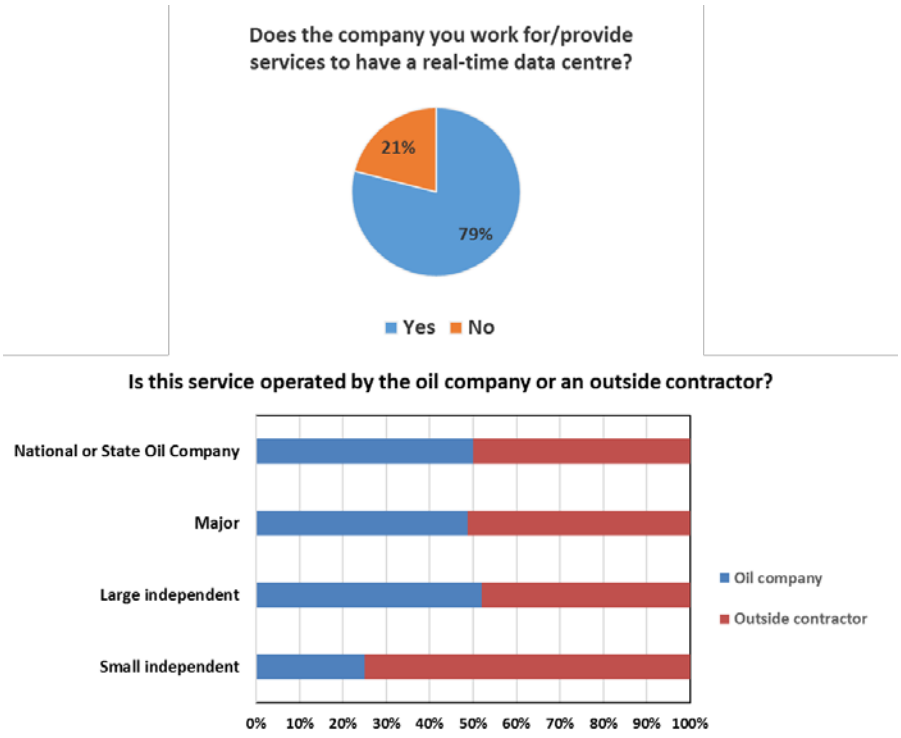



***Figure 23: Real-time Data Centres***

The advent of fast communications has resulted in the possibility of real-time data transmission and the development of real-time data centres.

Figure 23 illustrates the results of the survey questions regarding these. Nearly 80% of companies now have a real-time data centre with a 50/50 split between company own or use of a contractor. This is the same for all types of company apart from small independents who, understandably, tend to use an outside contractor to manage their real-time data.

The transmission of all this real-time data raises some interesting questions. It means that the operations geologist can now monitor the well real-time when, previously this was not possible and was exclusively the realm of the wellsite geologist. Increasingly companies have experienced personnel monitoring the real-time data in data centres. Is the shift of monitoring real-time data from wellsite to office a welcome development?

There is also a requirement for the real-time data need to be managed and archived correctly (see below).

Figure 24 illustrates the results of survey questions relating to real-time data

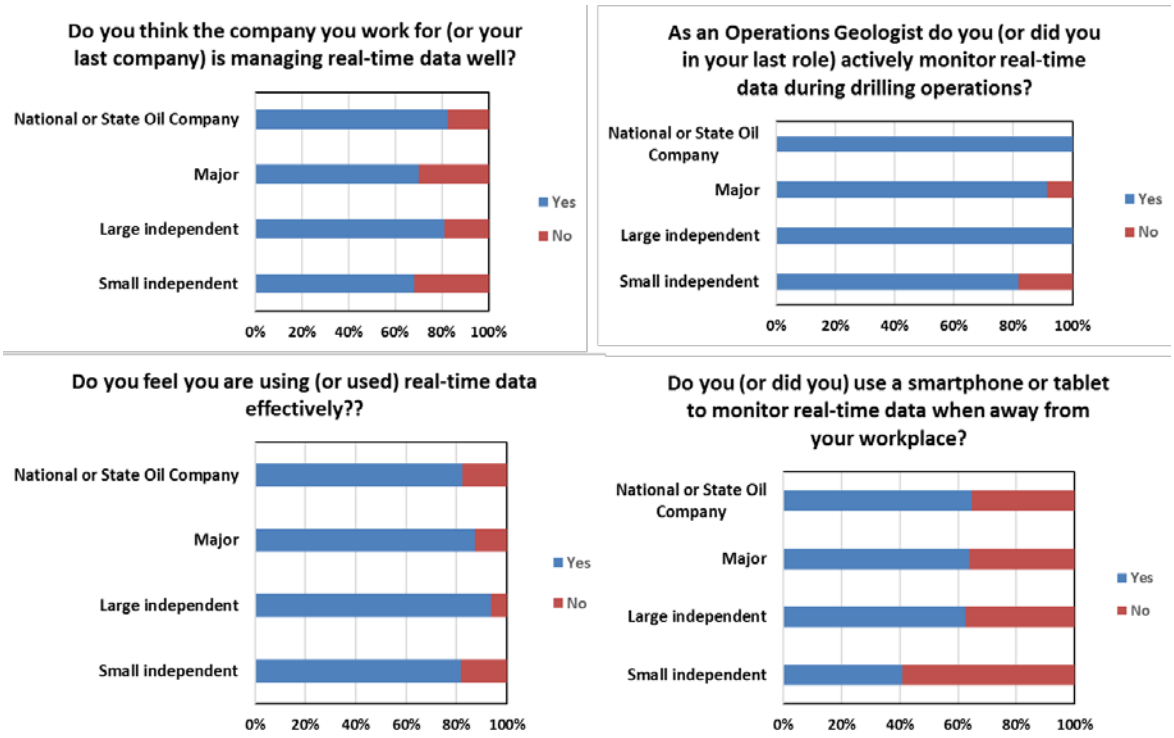



***Figure 24: Using Real-time Data***

Monitoring the real-time data was once not an option for the office-based operational geoscientist but, clearly, now it is. Virtually all respondents actively monitored the data and over 80% felt that they were performing this effectively. Over 60% of respondents used a smartphone or tablet at some point, to monitor the data, but this dropped to 40% for operational geoscientists in small independent oil companies. On the whole real-time data are being effectively managed by all company types which, to some extent, contradicts the findings of the data archiving questions described above.

The responses to a question regarding social media tools indicated that take-up was not high. Messenger seems to be actively used in some companies and many used LinkedIn but otherwise uptake seems low. This echoes the results of the Stag operations geology survey (Gardner & Fagg, 2016).

## Expertise and Skillsets

One of the questions on the survey asked the respondents to gauge their proficiency in a number of operational geoscience tasks. Figure 25, below, illustrates the responses sorted on 'expert' level. Where the bar graphs fall short of 100% this is where the respondents consider they have no expertise at all.

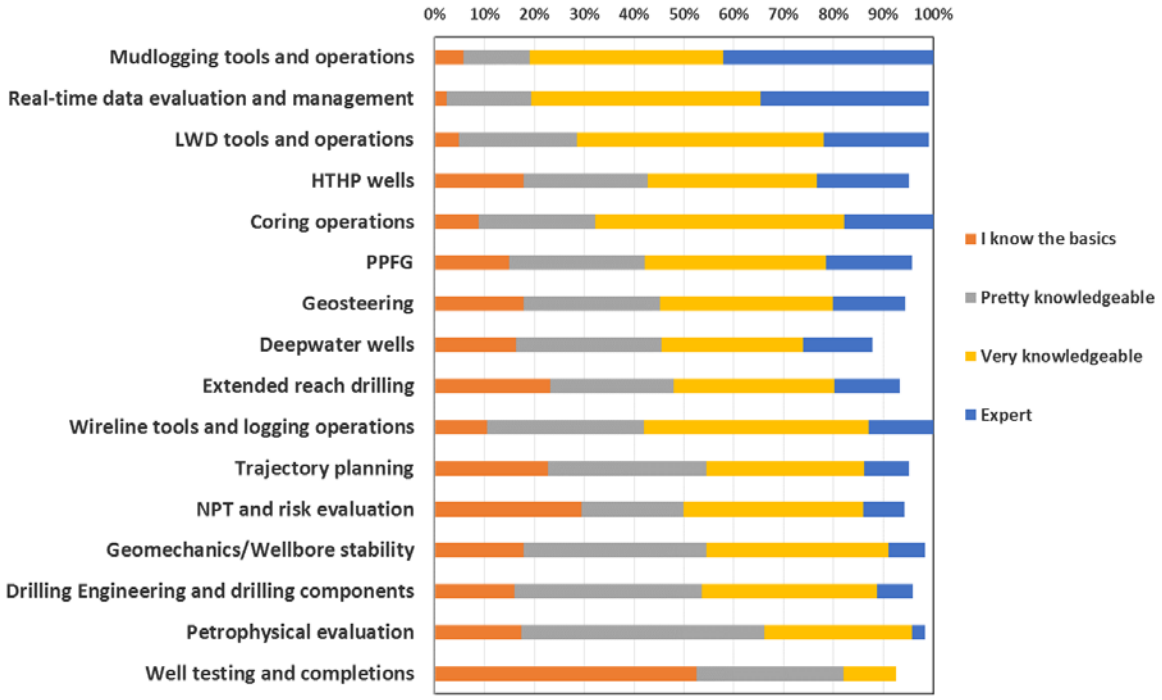



***Figure 25: Respondents proficiency***

Most of the high scorers are the general day to day tasks that you would expect operational geoscientists to be expert or very knowledgeable about. Unsurprisingly, based on the number of ex-mudlogger respondents, over 40% of them consider themselves expert in the service. Apart from deepwater wells, over 90% of respondents had some degree of knowledge of all the topics. No one considered themselves an expert on well testing and completions, maybe because it is so rarely performed or monitored by operations geoscientists. Petrophysical evaluation and drilling engineering are also low on the list in terms of expertise, more evidence, perhaps, of the decline in its importance as a key operational geoscience skill.

One aspect of this, however, is how good is the discipline at self-assessing its expertise? How do you know if you are an expert? What is the difference between pretty and very knowledgeable? Some people are more self-effacing than others and may not consider themselves an expert when others may consider that they are. At the 2014 operations geology conference a paper was presented (Herrett et al, 2014) which discussed the need for competency assessment so that there was a much clearer and independent assessment of proficiency. A mandate was given by the conference for a small steering group to investigate the instigation of a single competency management system for operational geoscience which could be used by the industry. This process is still ongoing but has identified this as a key issue to be resolved.

A question in the survey asked how the respondents they would prove themselves competent. Essentially, there were 6 main threads in the responses, (Figure 26, below). Over 50% of the respondents suggested wide, on the job, experience and reputation within the industry.

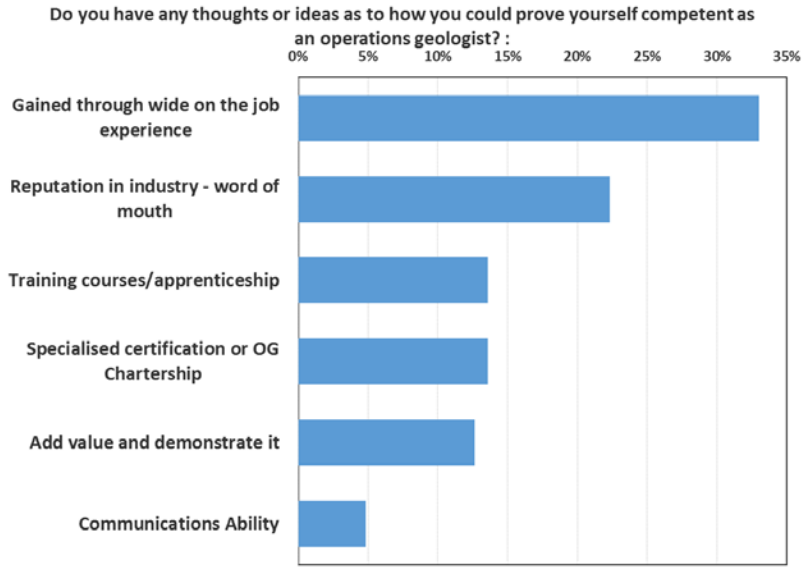



***Figure 26: How do you prove competency?***

This accurately reflects the current situation where, certainly as consultants, jobs are obtained through recommendation by consultancies, CV presentation and word of mouth. However, in a litigious world, this may not be good enough to stand up in a court of law. This has implications not just for the individuals but also higher-level management.

With respect to the 'wide on the job experience' suggested in Figure 26, another question in the survey, previously discussed, asked how many regions (defined as basins and sub-basins) have the respondents worked in (Figure 4). In excess of 50% of the respondents have only worked in 1 to 4 regions. This is at odds with the most popular response here. But, again, it is a question of what people perceive as 'wide on the job experience'.

Returning to Figure 26, the next two ideas were the use of training courses/apprenticeships and the creating of a specialized form of certification for the discipline. In fact, these two are probably linked and could form strong components of any competency management system that might eventually be put in place. Some companies such as BP (McBeath and Herrett, 2014) and Exxon do have long term processes in place to train and give experience to their geoscientists in the operational geoscience discipline.

Training is obviously an important aspect of competency. Figure 27 illustrates what sort of formal training the respondents have taken.

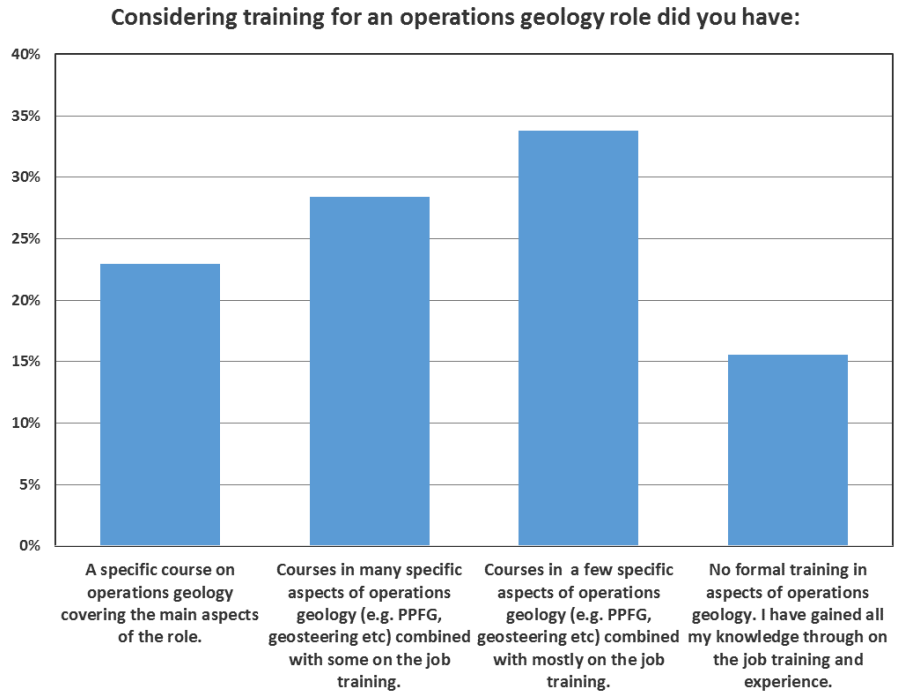



***Figure 27: Operational Geoscience Training***

Over 85% of respondents have had some type of training, some more than others. However, 15% have had no training whatsoever apart from 'on the job' training. Gaining experience this way has proved to be acceptable in the past but whether this is sustainable in the future is open to question. Also, of those who have had training, was this recent? Processes, techniques and software change. Should training be performed regularly to keep up to date? Some operators and service companies have personal development processes in place which address these issues but others don't. Any industry wide competency management system for operational geoscientists should address this issue.

It should be noted that lecturing in basic operational geoscience, providing a good introduction to the subject, is performed at MSc level at a number of Universities (e.g. Telford and Archer 2016). It is hoped that this will encourage young graduates to become operational geoscientists.

The respondents were also asked to rate 20 operational geoscience skills on a scale from 'not essential at all' to 'very essential', see Figure 28, below. As it turned out there was only one response from a single respondent saying that knowledge of geophysical interpretation was not essential at all. For that reason, this option has been omitted from the bar chart on Figure 28. This graph is sorted on the 'very essential' response and clearly shows that wellsite experience is seen as the most essential skill, supporting the results of the question regarding the most appropriate career path question (Figure 10).

Three of the top five skills (and five of the top fourteen) were what are regarded as 'personal leadership skills' – managing people, interpersonal skills and the ability to stand up for yourself. Despite their importance, it is these essential skills that, with some notable exceptions, the discipline gets little, if any, training in.

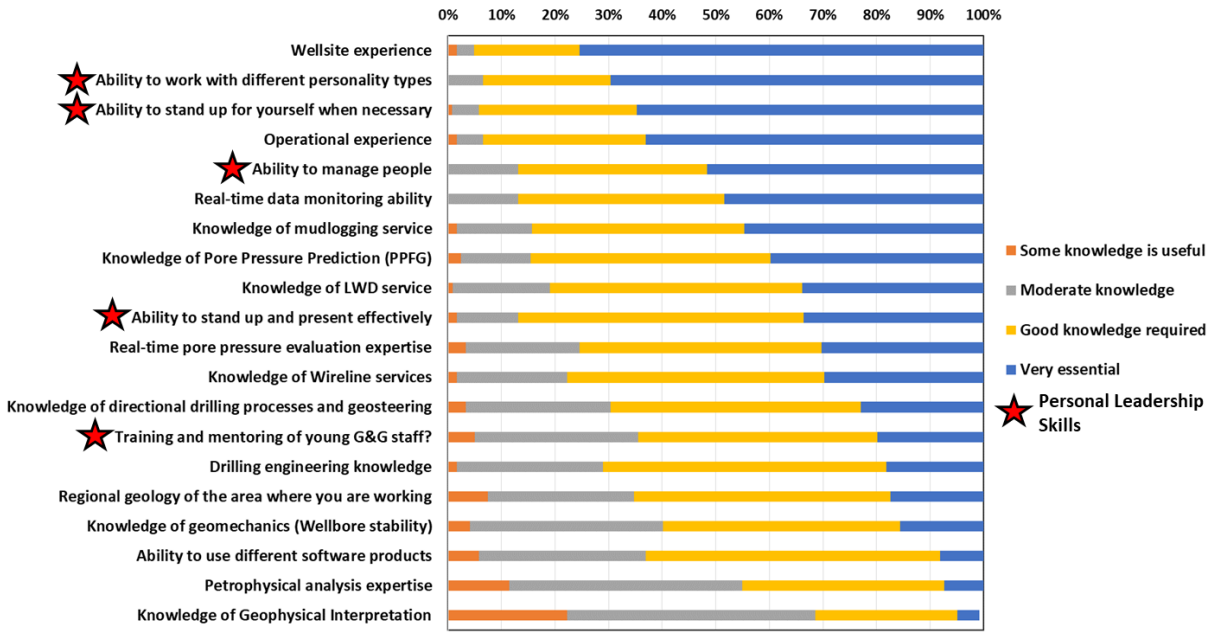



***Figure 28: How essential are these skills?***

Operational experience ranks fourth highest. This is an operational geoscience skill that can't be acquired through training alone. It requires that wellsite experience, where most of the other skills are learned and reinforced, to be able to manage an operation successfully. Petrophysical analysis, based on these results, is viewed as less essential, in keeping with previous results.

## Discipline Health

This section deals with working practices and ultimately whether operations geoscientists have a good work-life balance. It also addresses the main challenges and frustrations of the role and whether we are appreciated. Finally, there is consideration of what is fulfilling about the role.

What is immediately obvious about the results is their sheer variation which is unsurprising given the different company types, working environments, roles and countries involved. There are common threads, however, and some broad conclusions are apparent.

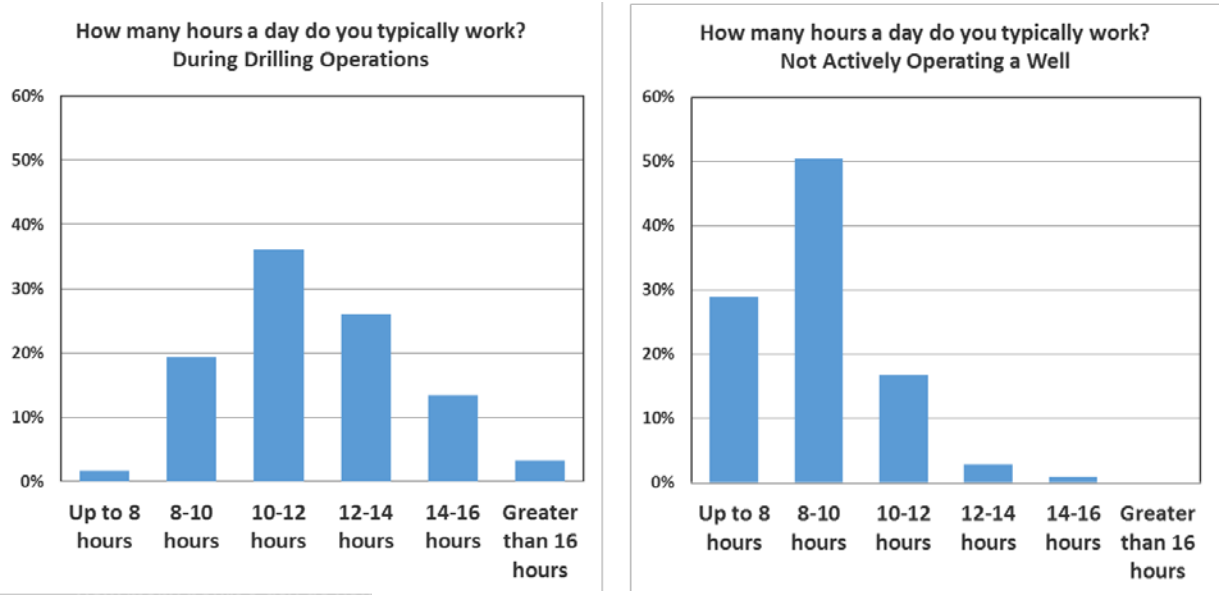



***Figure 29: Hours worked a day***

A regular office-based job is typically an eight-hour day. Operational geoscientists typically work much more than this, certainly while a well is being operated, with the majority working much more than this as illustrated in Figure 29 (above). The graph on the right shows the results when not actively operating a well and the hours are much more agreeable.

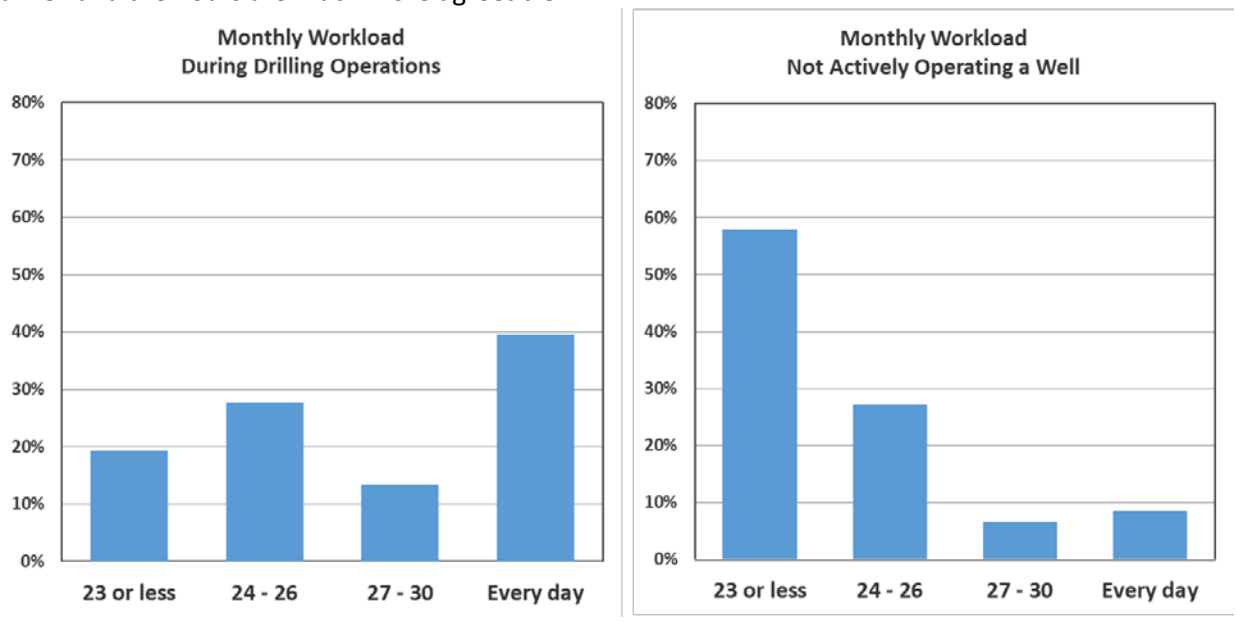



***Figure 30: Days worked per month***

Similarly, with days worked, a normal office job would be 23 days or less per month. Figure 30 shows that operational geoscientists work much more than this when a well is operated (left) but much less when no operations. Almost 40% work every day while operating a well and this, when taken with the hours worked would amount to an excessive workload indeed.

On the other hand, most operations geoscientists are accepting of the necessity for the long hours as this is what the job is all about. And, as described later, most get well remunerated for their hard work.

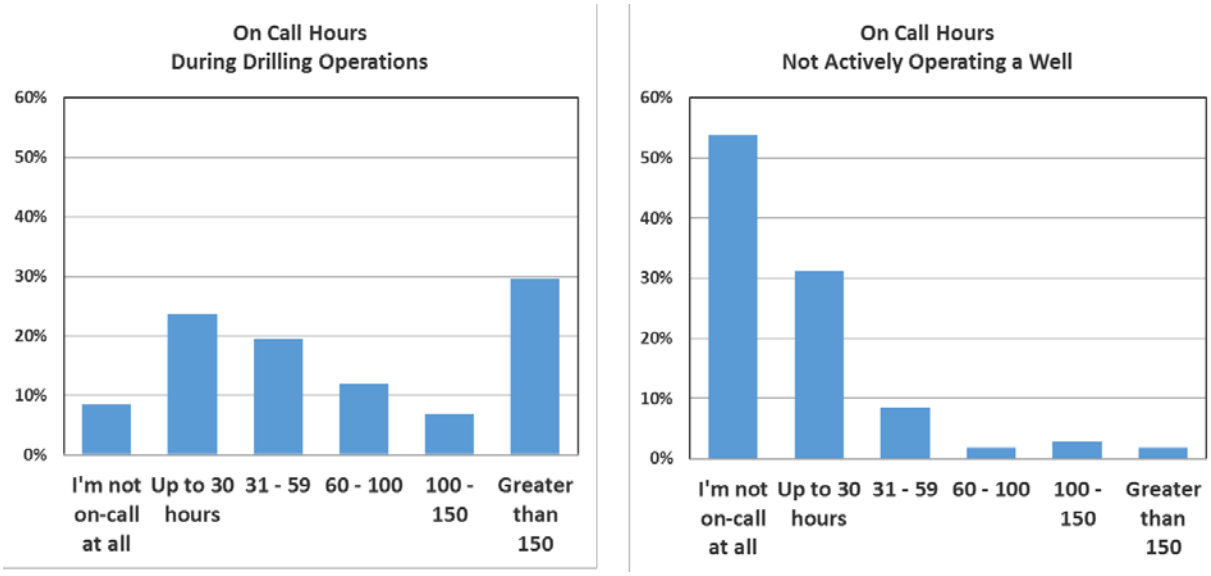



***Figure 31: On-call hours***

Another aspect to the workload are the 'on-call' hours illustrated in Figure 31, during drilling operations on the left and when not actively operating on the right. How you define 'on-call hours' is a little open to interpretation but if you are designated on-call when out of the office it soon adds up to a considerable amount per month.

Under British law the regulations state that you can't work more than 48 hours a week. However, the offshore oil and gas industry has a 52-week average reference period for this so, taking into account non-operating periods then the 48-hour week may not be exceeded. However, working long hours, day after day, for several months without a break does happen and it may be an HSE issue. Should we as a discipline be more regulated in the hours we are asked to work?

Again, most operational geoscientists call this as part of the job and some take pride in always being in touch and knowing what is happening 24/7. This is much more possible now with modern communication tools which, from the results discussed above, we are using more frequently. Is this new-found ability to monitor well activities meaning we are working longer hours as a consequence? Is the traditional role of the wellsite geologist monitoring the well being watered down?

Figure 32 summarises the answers to a survey question about work-life balance.

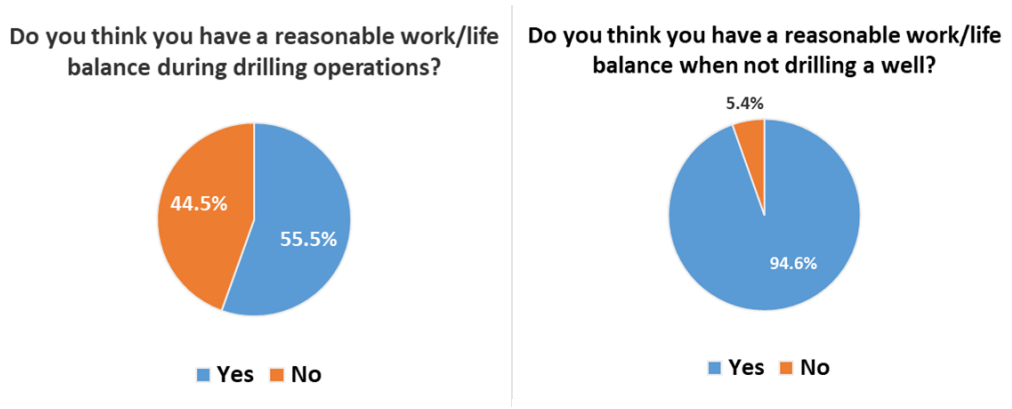



***Figure 32: Work-Life balance***

A little over half (55%) of respondents thought they had a reasonable work-life balance when operating a well which increased to almost 95% when not operating a well. There is a little variation in these figures by company type when considering the work life balance during drilling operations with only 50% of respondents saying they had a reasonable balance from large independents rising to 70% in National or State oil companies.

When considering the main challenges and frustrations of the operational geoscience role then work-life balance did actually not register very highly. These two questions were freeform in terms of replies so the top ten themes were picked out from the replies. Some respondents replied with more than one challenge.

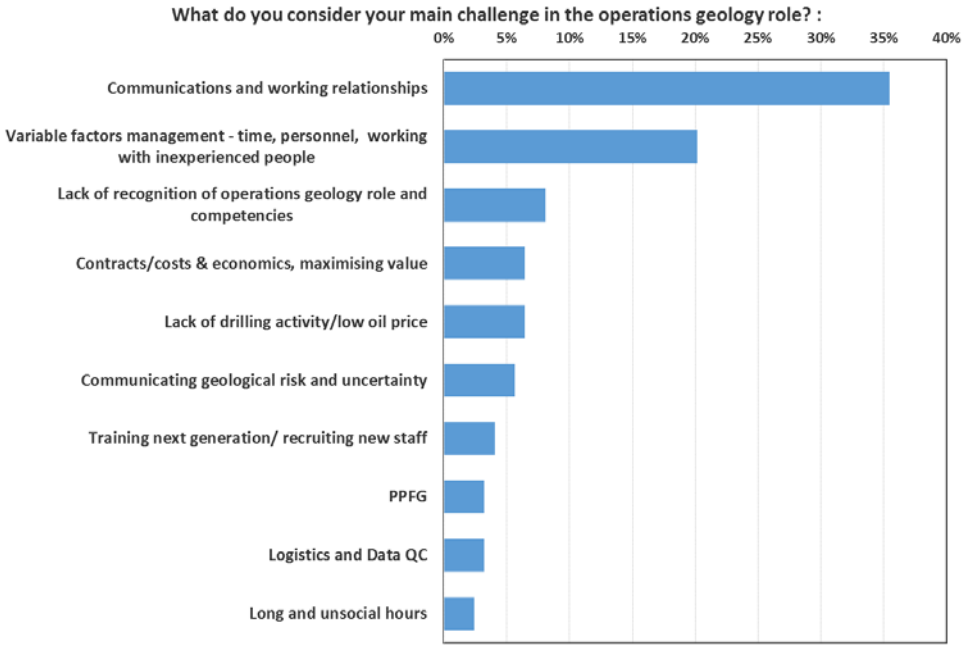



***Figure 33: Operational Geoscience challenges***

The bar chart in Figure 33 illustrates what the respondents consider the main challenges in their roles within operational geoscience. By far the biggest challenge is communications and working relationships, not only talking with drilling personnel but also subsurface teams (sixth on the list is also a specific communications issue). This topic, while not a big surprise, is something the discipline gets the

least training or mentoring in and is something developed naturally or not as the case may be. The second biggest challenge is working with inexperienced management and co-workers and not being given enough time to complete tasks due to lack of understanding by management. This will definitely be a bigger issue in the future as industry activity picks up again.

Third on the list is lack of recognition of the operational geoscience role and associated competencies by management, drilling or subsurface personnel. This would appear to be confined certain companies or individuals.

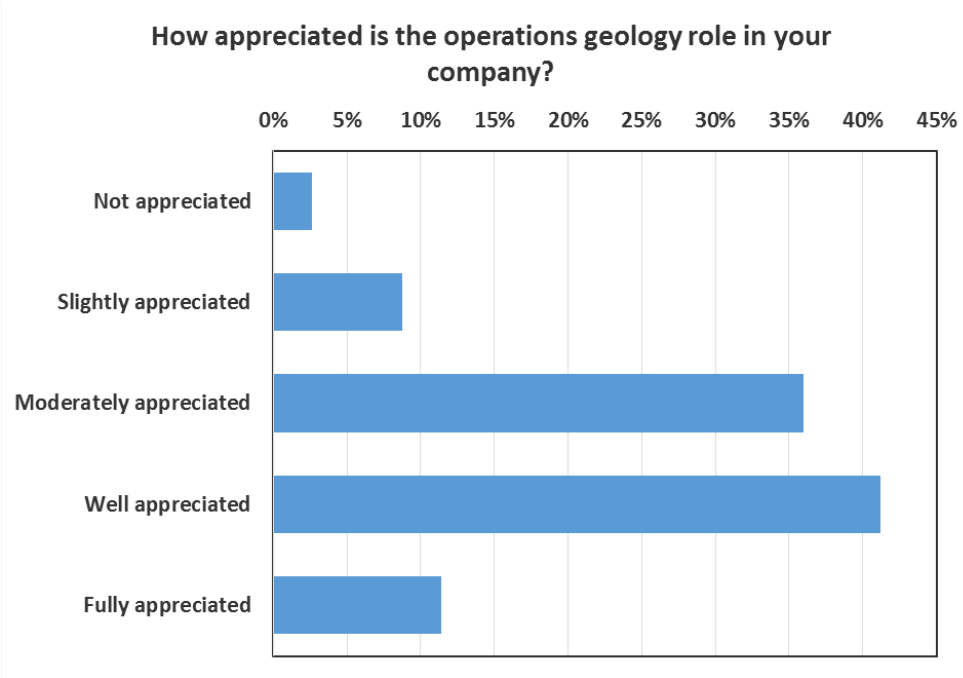



***Figure 34: Appreciation of role***

Figure 34 indicates the results of the survey question specifically asking how appreciated the role is and, in general, the answer is 'well appreciated'. There is insufficient data to analyse any trends within this data set but there would appear to be less appreciation for younger age groups in major and national oil companies. The 55-59 age range appears to be particularly well appreciated.

Referring back to Figure 33, several items reflect the severe drop in oil price in late 2015 and early 2016 as the survey was under way. Economics, maximizing value as well as the lack of drilling activity/low oil price were both seen as challenges as was the recruitment and training of new staff. Given the ongoing low oil price these three items may have been more popular choices had the survey been distributed later.

A survey question regarding the frustrations of the operational geoscience role highlighted similar issues to that of the challenges. See Figure 35.

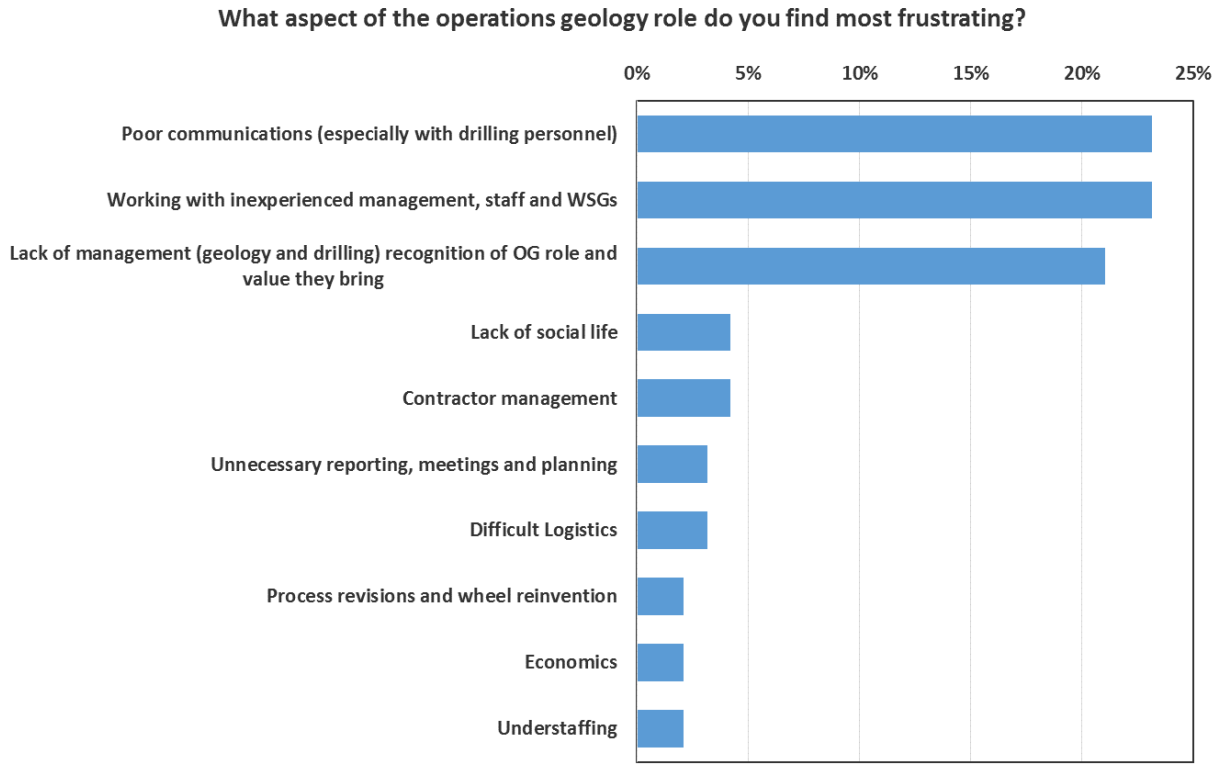



***Figure 35: Operational Geoscience frustrations***

Three topics dominated:

- Poor communications, (especially with drilling personnel)
- Working with inexperienced management, staff and wellsite geologists
- Lack of management recognition of the operational geoscience role.

This latter is puzzling and a little contradictory when the majority of respondents said they felt moderately to well appreciated in the role (Figure 35). However, for some respondents it is still an obvious issue and could be related to individuals or companies. There may be a relationship to the second point where inexperienced management and staff do not understand what the operational geoscience role is and what it can do. The contraction of the industry being experienced at the time of the survey may make this worse.

The communication issue with the drilling personnel is nothing new but is improving and is an issue where communication skills need refining on both sides of this divide.

Many of the other frustrations will be familiar to operational geoscientists and will remain given the state of the industry.

In answer to an open question on what makes the operational geoscience role most fulfilling (Figure 36) the top three of the ten most common replies were all to do with just doing the job well. By far the most popular reply was along the lines of creating an operations geology plan, following it and successfully delivering a well.

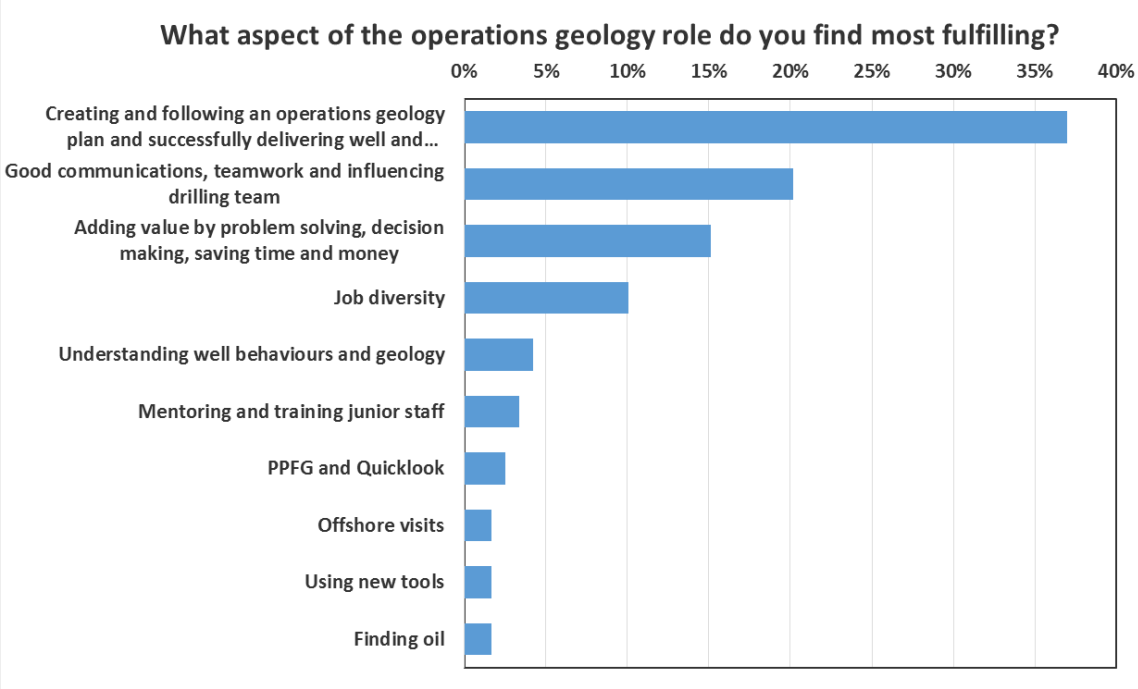



***Figure 36: Operational Geoscience fulfillment***

The second and third items were similar in style, with good teamwork, ability to influence the drilling team and adding value. All the other items would be familiar to operational geoscientists. Rather gratifyingly, remuneration does not appear in this top ten list. It came thirteenth.

## Remuneration and Reward

When the survey was first being designed there was much discussion whether a section on remuneration should be included. This is always a sensitive topic, and respondents may not wish to volunteer about how much they earn. In the end it was decided that as survey input was anonymous and there was an option 'not to declare' then it would be included.

Almost half the respondents (98 in total) answered the questions on remuneration and, of these, only five declined to answer. There are obviously some caveats with the data that follows. The question asked was '*Approximately what was your gross income for the last year you worked (for staff include a good estimate of benefits such as pension, bonuses, training, medical and cars etc)? NB: Please convert to GB£.*'

There are always comparative difficulties even when bonuses, benefits in kind and pensions are taken into account. This has long been the subject of arguments between staff and consultants so the results should be taken as rough approximations. Most of these results reflect remuneration rates prior to the oil price crash in 2015 and will no doubt be subsequently much reduced.

There will also be variations due to the number of respondents from different countries who have varying standards of living and obviously their remuneration will reflect this.

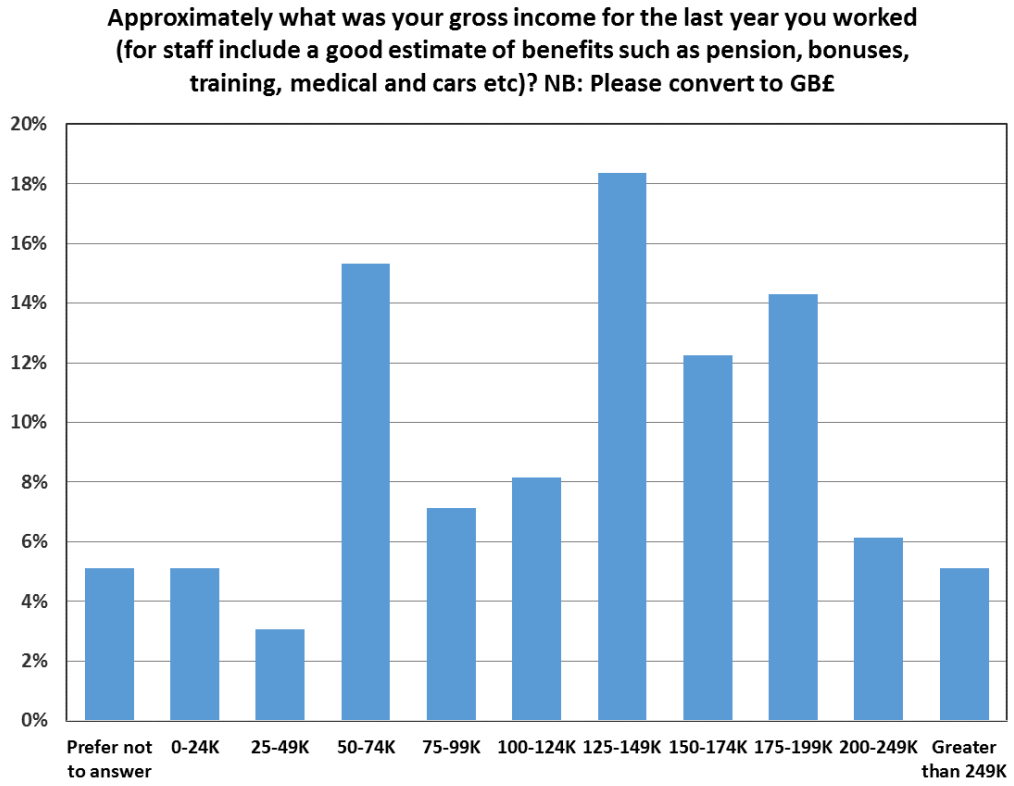



***Figure 37: Gross remuneration, all respondents***

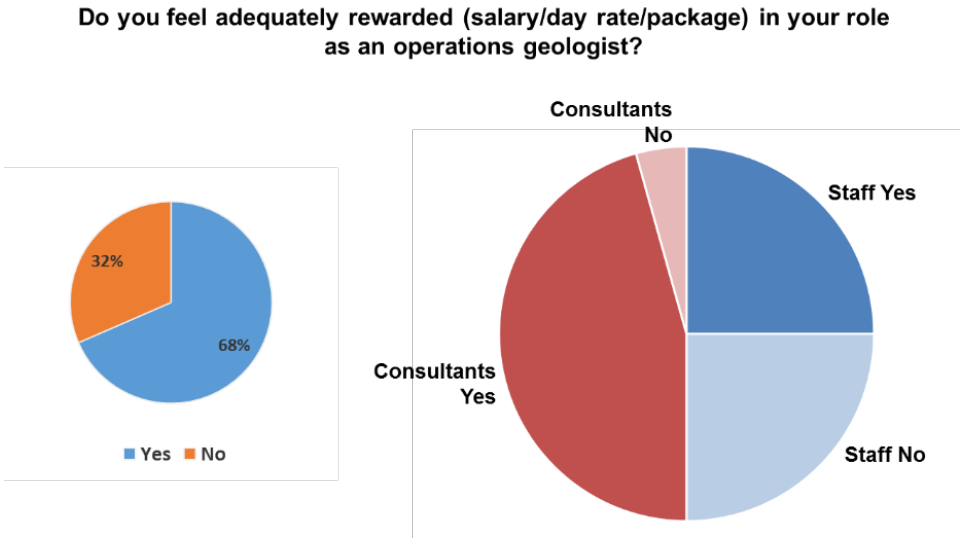



***Figure 38: Adequately rewarded?***

Figure 37 simply plots the percentage of respondents versus remuneration ranges. There is an underlying distribution curve with two or possibly three spikes. An attempt was made to interrogate the

data in more detail and although results were obtained they are probably not very statistically robust given the sizes of the populations involved.

Figure 38 presents two pie charts regarding whether the respondents feel adequately rewarded in their role as an operations geologist. The pie on the left covers all respondents indicating that approximately 32% thought they were not adequately rewarded. However, on 'drilling down' into the data it can be observed from the pie chart on the left that 50% of staff think they are not adequately rewarded compared with a small percentage of consultants. Further analysis would seem to indicate that those outside Europe are even less satisfied than their European counterparts.

Whether the dissatisfaction is to do with the role itself, conditions for staff in those companies or remuneration is difficult to say. Certainly, looking at Figure 39, then remuneration could be part of the issue.

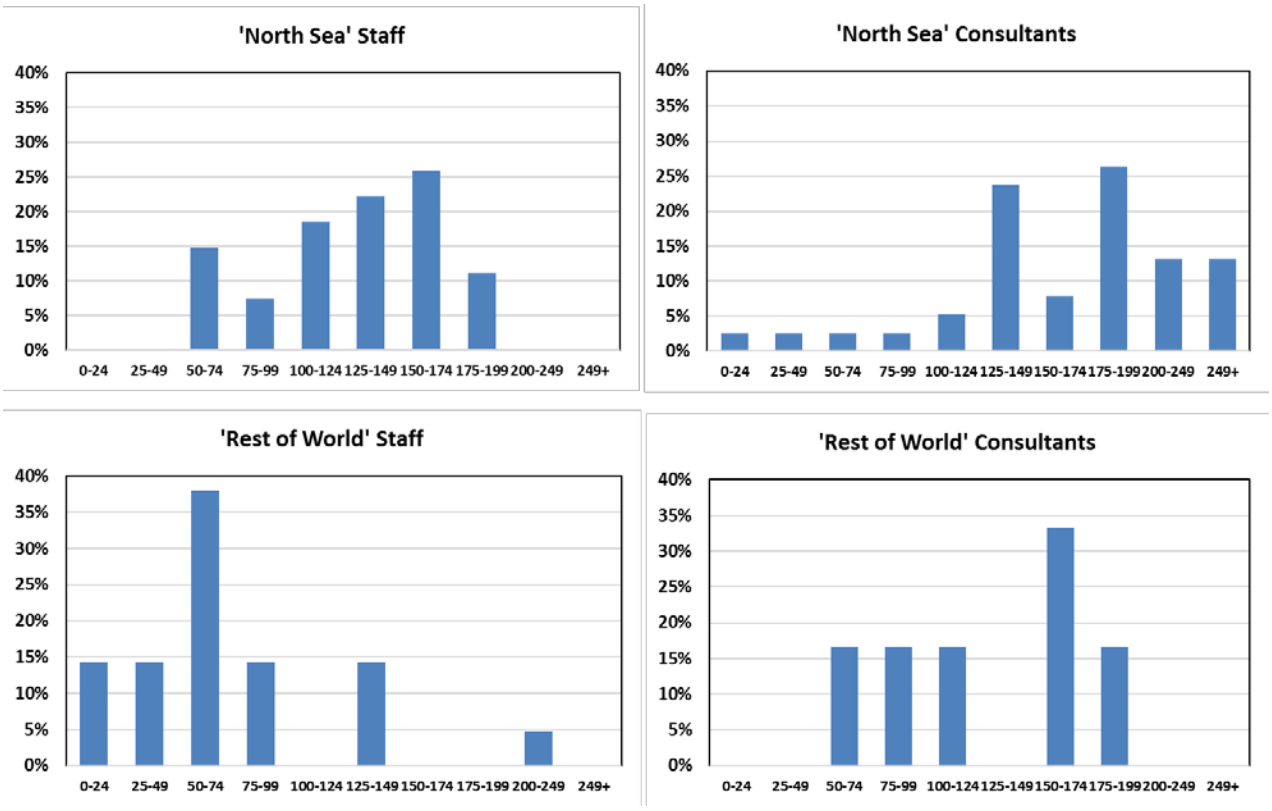



***Figure 39: Remuneration levels, staff vs consultants***

Figure 39 has been split between two populations, the 'North Sea' countries (top) and the rest of the world (bottom). The rest of the world data are more for reference as there is just too little data for really meaningful results. The higher remuneration levels here are essentially from the USA and Australia (though not exclusively) where rates are comparable to the 'North Sea' arena.

The 'North Sea' data are a much more statistically viable population. There is a general trend for remuneration to increase with age, which is what might be expected. Some of the lower levels of remuneration are from the younger age groups or from the wider operational geoscience community and part time consultants.

The staff data reflects this a little with a fairly tight distribution presumably constrained, at the upper and lower ends, by corporate pay level structures. The 'North Sea' consultants show a wider range but with a much higher top end with 25% earning in excess of £200,000 per annum. Mostly these are 'full time consultants' embedded long-term within oil companies. There are also two sharp peaks which, I assume, are related to 'going rates' although there is insufficient data to investigate more deeply.

There is obviously evidence to suggest that some consultants earn considerably more than staff.


***Figure 40: Remuneration based on career origin***

There are enough data on a worldwide basis to plot remuneration versus career origin, Figure 40, above. (See Figure 10 for career pathways). Most of the really high earners do have an origin in mudlogging (upper left) but, then again, many of these will be that '70s/'80s mudlogging generation who are about to retire. Take these away and the data distribution would not be much different to the new hire staff wellsite geology origin (upper right). Note that some of these new hire staff have subsequently crossed over to become consultants at a later date, presumably for the high day rates.

The comparatively low levels of remuneration in the new hire staff operations geologist plot (lower left) reflects the prevalence of this rate outside of Europe where salaries are much lower. To a certain extent this also affects the LWD/Wireline/Mudlogging to new oil company hire plot (lower right), but it is also affected by the relatively low numbers who have gone this route. The distribution is not too different to that of the new hire SWSG origin.

Do these results indicate that an early career in mudlogging is advantageous? Possibly, but the future may be very different if the operational geoscience role increasingly becomes an in-house staff position.

Is money the over-riding factor when it comes to pursuing a job in operations geoscience? Figure 41 illustrates the results of a survey question regarding this. An average rating was calculated for eight different pre-selected factors and plotted as a bar graph.

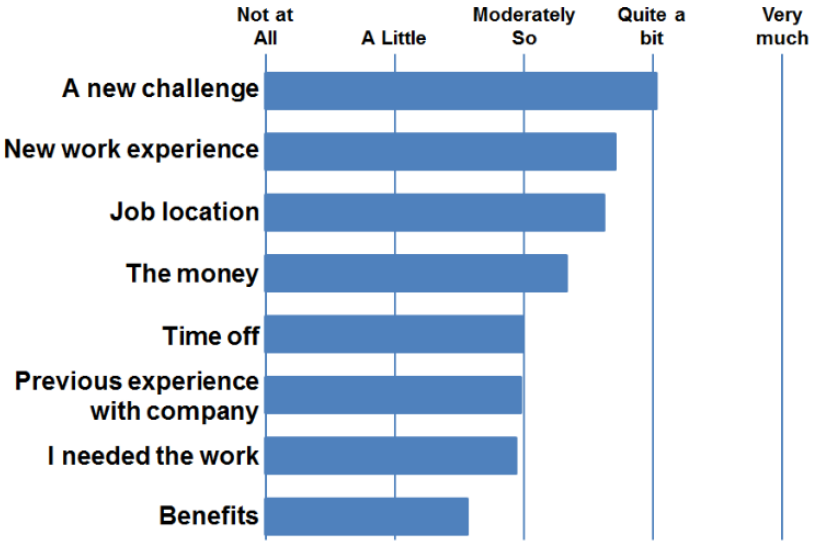



***Figure 41: Factors when pursuing a job in operational geoscience***

Money, it turns out, is not the be all and end all and it was only fourth. It would appear that something new is what we crave, whether it be a challenge or a work experience. Despite earlier results which indicated that a minority had worked a wide variety of basins it would appear that people are happy to work where they want to work. Job location was deemed an important factor.

Finally, what is the next career step in operational geoscience? Figure 42 summarises these results in answer to what, again, was a freeform question

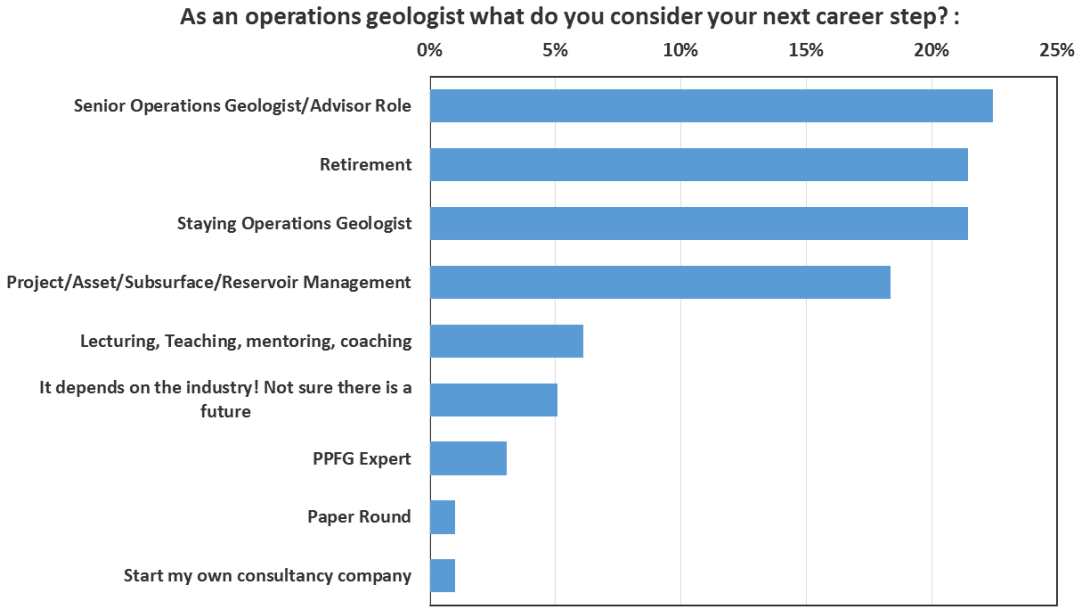



***Figure 42: Next career step***

Over 40% of those who responded were either going to stay as an operations geologist or become a senior operations geologist/manager/advisor role. Given the demographics it is no surprise that a significant number said they will be retiring and this may be accelerated by the 2015/16 downturn in the industry. Some are very pessimistic about the future while others see a future teaching/mentoring or in an expert role.

## Conclusions

This was the first major survey of the operational geoscience discipline. Its aim was to find out, at a point in time, who we are and what do we actually do. The results on the whole confirm what we had surmised but now we actually have hard data to confirm these suppositions.

- Operational geoscience is a wide ranging, responsible and dynamic role encompassing safety critical functions through the entire life of a well.
- In Europe the discipline has an aging workforce with 60% of the respondents of the survey likely to retire in the next ten years. There will be an evident skills and experience gap in the next few years.
- More effort needs to be made to attract and retain women in operational geoscience.
- Wellsite experience, of at least a year, is seen as vital by nearly all respondents.
- Mudlogging is still an important rootstock for the discipline, although maybe not as important as it was.
- Soft skills, communication etc., are as important as technical abilities but, it is these skills the discipline has the least training for.
- Communications and working with inexperienced people are seen as the two main challenges and frustrations of the role.
- Generally, operational geoscientists work too much on a daily basis and over the course of a month. This is an HSE issue.
- For the most part the discipline is well paid for working hard. However, remuneration is not the main driver in getting a job in operational geoscience, a new challenge or work experience is more important to most respondents.
- There is still an issue with the appreciation of what we do in some companies.

At the time of writing the industry is in a process of contraction. It will be interesting to survey operational geoscientists in, say, 5 years (2020) to see if there are any changes or new trends developing in the role.

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