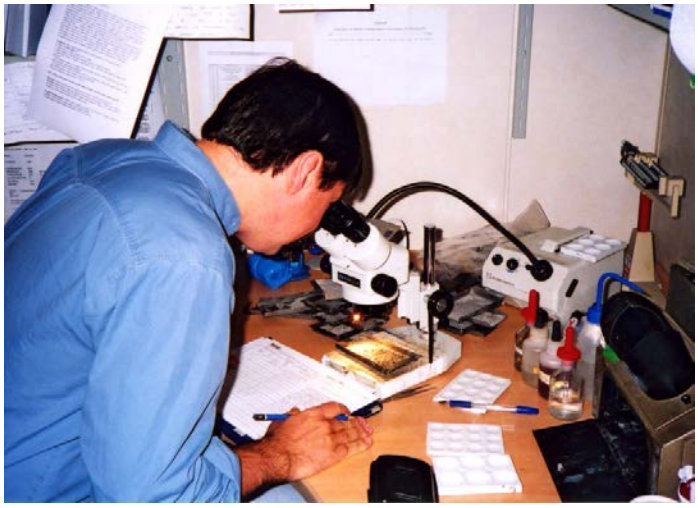
Results of the 2017-18 Wellsite Geology Survey

Tim Herrett, Tim Herrett Ltd.



Note that this paper has not been peer reviewed and is essentially a presentation of all data with some limited comment and analysis from me.

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Abstract

Following the success of the operational geoscience survey in 2015, the respondents of which were mainly operations geologists, it was decided a second survey should be created aimed mainly at wellsite geologists.

Most people involved in operational geoscience know what wellsite geologists do and the results of the survey gave no particular surprises in terms of their job profile. However, one objective of the survey, conducted anonymously using a commercial online website, was to replace conjecture about the discipline with hard data.

Approximately 165 people from 47 countries fully completed the survey and, indeed, the respondents gave confirmation of the technical challenges and the safety critical nature of the tasks that are sometimes performed by wellsite geologists.

The demographics of the discipline are generally healthy in most areas of the world with 50% under 44. The low percentage of females (7%) is disappointing. Personal leadership skills are thought of as important as technical skills, mirroring the findings of the operational geoscience survey.

As might be expected, the career paths into the discipline were similar to those of operations geology with more than of 50% of the respondents having mudlogging as a starting point. Most, but not all, respondents confirmed this as the preferred career path together with a strong preference for a geoscience degree as a starting point.

The discipline works long hours, probably too long but, in general, are well remunerated for it and have a good work-life balance. The issue in these days of recession is that rates have decreased significantly, and work is more difficult to come by. A majority, when asked about the future of wellsite geology, were negative about work prospects.

Most wellsite geologists feel appreciated in their role, but some feel that there is a perception gap between what people think they do and what they actually do. This survey hopes to address this.

Genesis of the Survey

The success of the operations geology survey at the previous conference prompted the 2018 conference convening committee, at my suggestion, to agree to follow it up with a survey of wellsite geologists, both staff and consultants. The aims of the survey were to:

- Raise the profile of the wellsite geology discipline
- Provide hard data on the discipline, clarifying exactly what wellsite geologists do through the lifetime of a well.

- Provide information that can be used as a reference and guidance by procurement services and other disciplines linked to operational geoscience.
- Compare with the results of the operations geology survey helping to give confidence in the data for both surveys.

What do we mean by the term Operational Geoscience? The core of this discipline are obviously the operations and wellsite geology roles which are inextricably linked and both of which have gradually evolved over the years. This survey takes a snapshot of the wellsite geology role as of 2017.

Operational geoscience also consists of other roles which provide both vital support and, in some cases, have evolved into specialisms from operations and wellsite 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.
- Operations geology – the hub around which all of these other roles revolve. Nowadays the operations geologist is involved through much of the lifetime of a well, becoming a key staff role in operating companies.
- PPFG (pore pressure fracture gradient) – 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.
- Operations geology management – Senior operations geologists who manage and support an operations geology team.
- Mudloggers – generate a lot of the geological data at the rig site. They are the rootstock for both wellsite and operations geology as well as giving invaluable foundation of rig-site experience.
- LWD and Wireline – providers of key formation evaluation, formation pressure and drilling data.
- Shallow Hazards – Play a key role in well planning which can be safety critical.

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

- Who are wellsite geologists?
- What are their demographics and gender?
- What is their background?
- Staff or consultant?
- What do they do? What are their skillsets?
- How much do they work?
- How much autonomy do they have?
- What are their main challenges and frustrations?
- What fulfils them?
- Are they appreciated?
- What do they earn, are they adequately rewarded?
- What factors do they consider when pursuing a job in operational geoscience?
- What is the future of wellsite geology?

A total of 45 questions were asked 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 27th June 2017, was distributed via:

- The Geological Society of London (GSL) through their print media, website and e-mails to their members.
- Use of periodic postings of links to the survey to LinkedIn. These proved successful and boosted the international reach of the respondents
- 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. This was performed in Excel which allowed some manipulation of the data to allow presentation of the data against different criteria.

Results and validity

As of February 19th, 2018, when the survey was closed, a total of 285 people had responded to the survey. Of these approximately 165 (58%) had completed the survey fully and a further 50 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. The average completion time for the survey was 28 minutes.
- Not completer finishers!

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

The timing of the survey (June 2017 to February 2018) is significant as the oil industry gradually transitioned from its nadir to a slight upturn which was reflected in the answers to the survey – ranging from no hope to slight optimism for the future.

Please note that all the survey results have been presented in this paper. This obviously makes it very long with many diagrams, but this allows anybody who participated in the survey to review all the results.

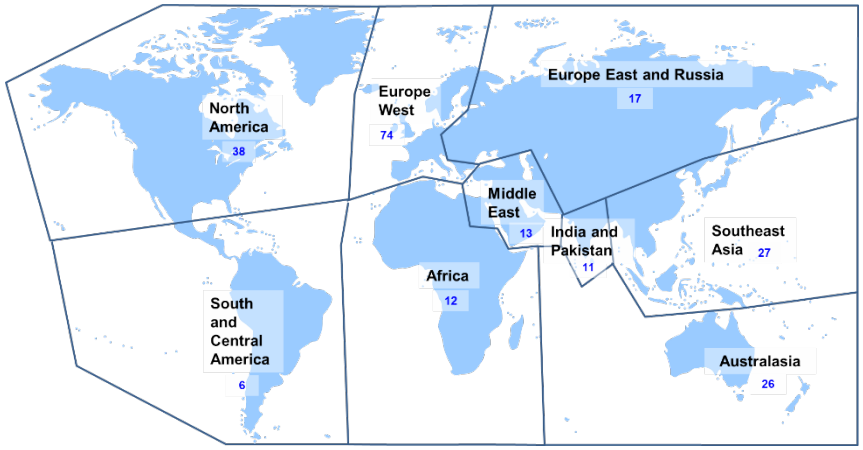


Figure 1: Regions used to present data giving numbers of respondents in each (full or nearly full responses)

With the total number of respondents, the results are generally statistically robust. Respondents from 47 countries participated in the survey allowing the data to be split regionally as shown in Figure 1. The number of respondents from India and Pakistan, Middle East, Africa and South America was quite low so that results from these areas are indications only.

Many of the results show similarity to those of the operations geology survey which gives more confidence in the results of both surveys.

About the Respondents

The response to the survey, as hoped, was international, from a total of 47 countries. Figure 2 shows the countries of origin and where those same people are working.

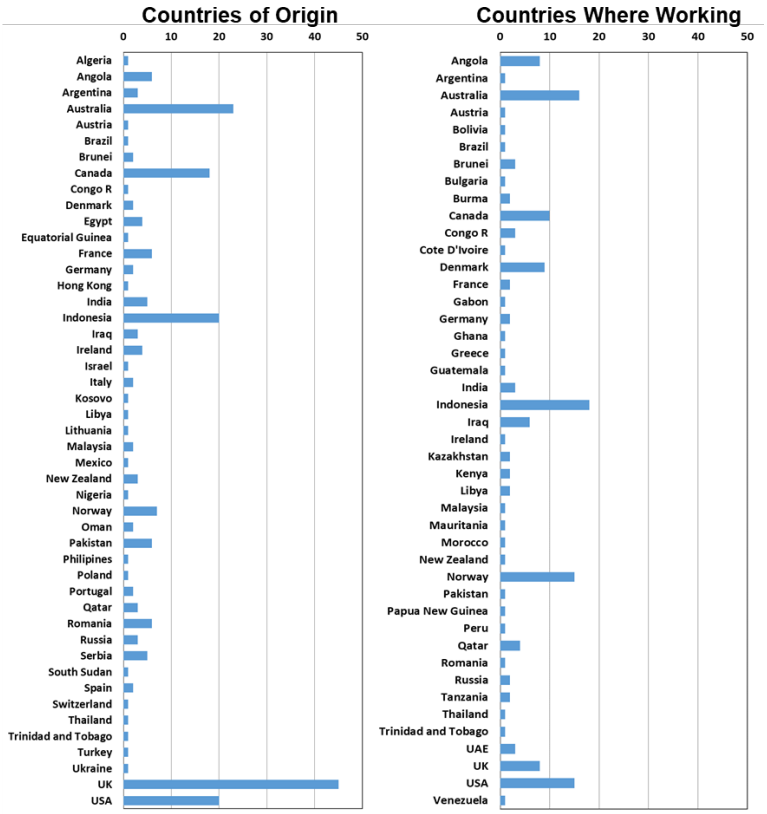


Figure 2: Plots of numbers of respondents showing country of origin and where they are working

The top 5 countries of origin are UK 18% (compared with 55% in the OG Survey), Australia 10%, USA 9%, Indonesia 9% and Canada 8% providing over 50% of the respondents between them. On a worldwide basis 55% of respondents were working in countries where they lived (73% in the OG Survey) but there were some marked regional differences as illustrated by Figure 3.

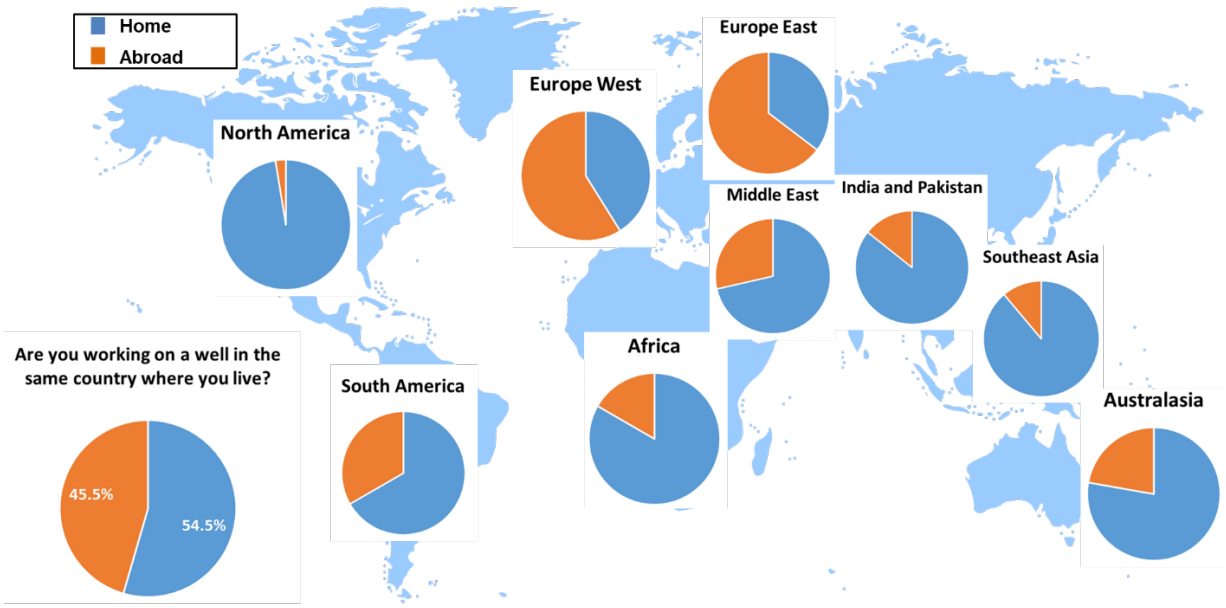


Figure 3: Are you working in the country where you live?

The most mobile work forces are from Europe where 60% of the workforce work abroad whereas 97% of North Americans work at home. Historically mudloggers, certainly from the UK and Ireland, worked worldwide and then became wellsite geologists worldwide too, being prepared to travel anywhere for work including North America. With time, mudlogging companies and operators hired more locally and, while the majority now work locally, up to a quarter work abroad. Interestingly, those that travel do not always go to countries close by. Australians work in Norway, Africans work in Brazil and South Americans work in France. The most diverse travellers are from the UK as illustrated in Figure 4.

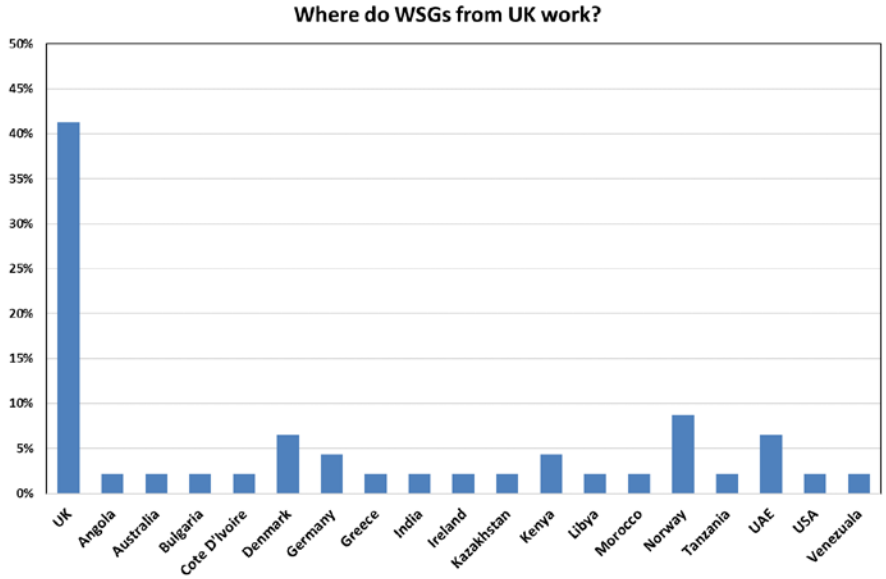


Figure 4: Where do respondents from the UK work?

Apart from the UK, wellsite geologists work in 18 different countries around the world and the results mirror the geographical spread of operations geologists (Herrett 2016).

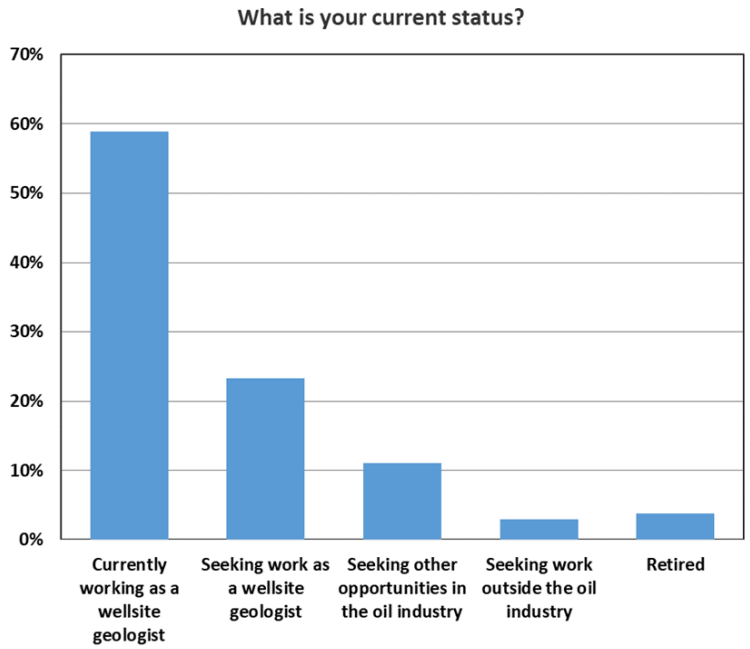


Figure 5: Current status

Figure 5 illustrates the respondent's current work status. Given the state of the industry at the time of the survey (late 2017) the number of people still gainfully employed seems surprising, as is the fact that only a few are seeking work outside the industry.

Looking at the data in greater detail (Figure 6) reveals that more people over 40 are looking for work and

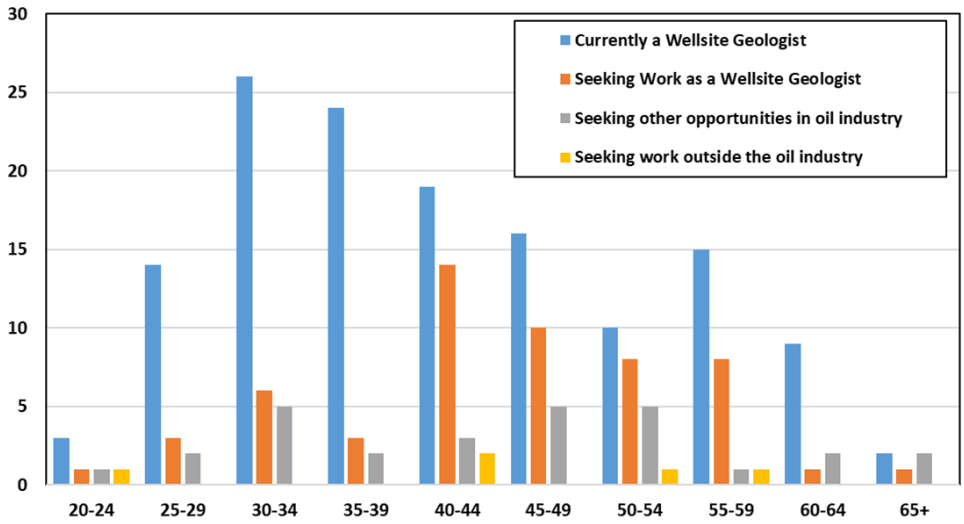


Figure 6: Current status

that employment is better in the younger age groups below 40. The reason for this is unclear although younger age groups may be prepared to work more flexibly and for lower rates. There was insufficient data to split the data regionally and these worldwide results are heavily influenced by Northwest Europe. At the time of the survey there were still many experienced people seeking work or working sporadically.

Figure 7 illustrates how many regions (defined as basins and sub-basins) the respondents had worked in.

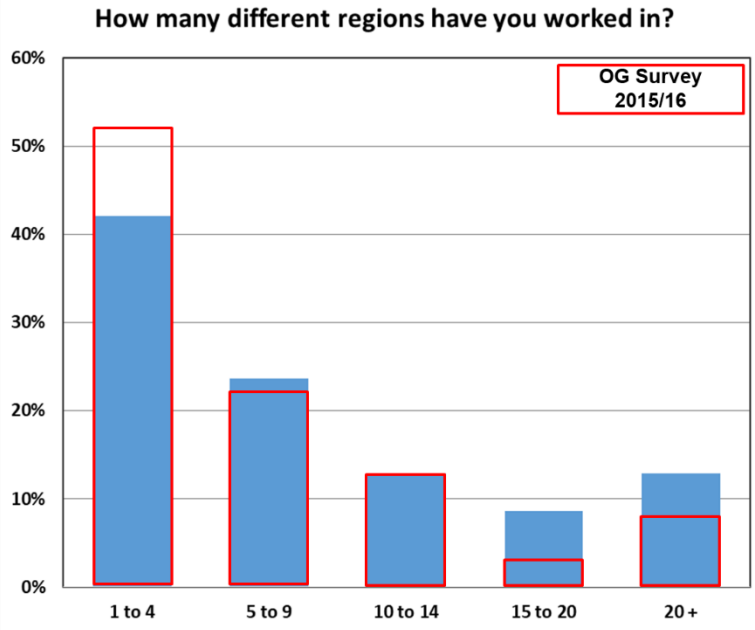


Figure 7: Number of regions worked

Compared to the operations geology survey (red outlines in Figure 7), wellsite geologists have generally worked in more basins, but the overall numbers are not too different. As Figure 8 shows, consultants tend to have a wider experience than staff, not surprisingly as staff are more typically constrained to the country they are working in.

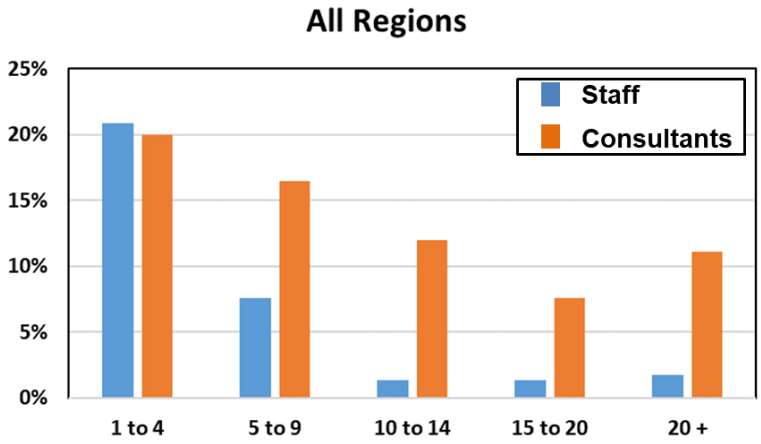


Figure 8: Number of regions worked, staff versus consultants

Gender and Demographics

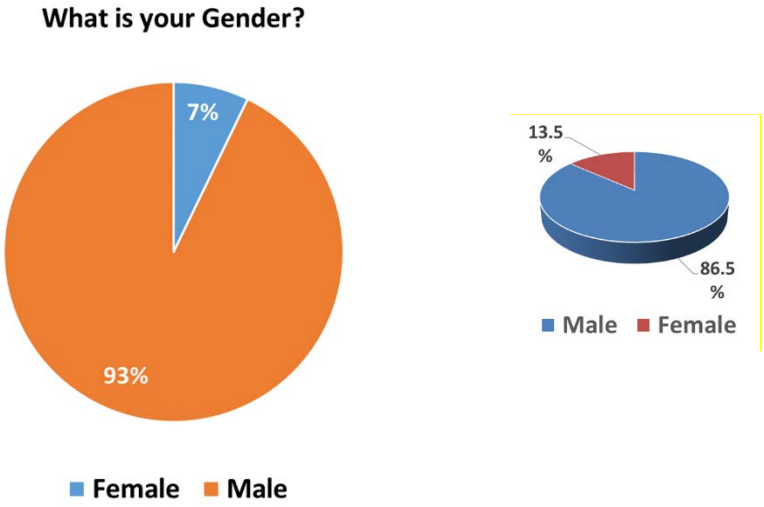


Figure 9: Gender distribution

Of the 278 respondents who answered the question on gender, only 7% were female (Figure 9 left) This compares with 13.5% of female respondents in the operations geology survey (on the right). This compares unfavourably with the oil industry average which is 22%. (*Untapped Reserves: Promoting Gender Balance in Oil and Gas - A collaboration between the World Petroleum Council and The Boston Consulting Group*).

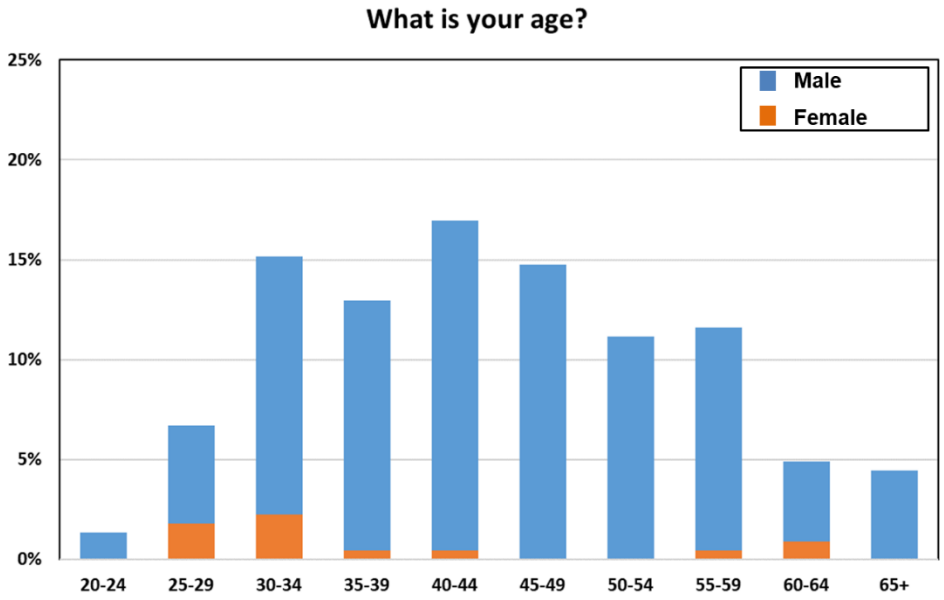
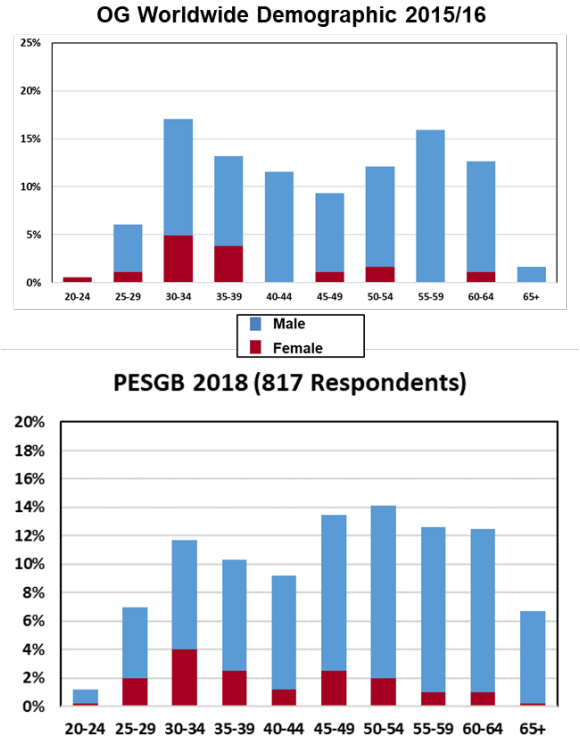


Figure 10: Gender distribution versus age

Figure 10 illustrates the worldwide wellsite geology demographic including the male/female split which is similar to the those found in the operations geology survey and PESGB Membership and Salary survey (2018) (Figure 11).

Figure 11: Worldwide operational geoscience demographics including male female split (left) and comparison from demographics from the PESGB annual salary review.



There are obvious similarities between all of these plots, as might be expected, with the operational geology plot having more accentuation at the young and old end of the scale. The demographics of the operations geology discipline were a worry as, particularly in Europe, the majority (60%) were 55 or older. The wellsite geology data seems quite healthy in terms of demographics with plenty of young practitioners who will be ready to move up to operations geology in the future.

In the wellsite geology survey there are a higher proportion of females in the younger age groups and, in a similar fashion to the operations geology and 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.

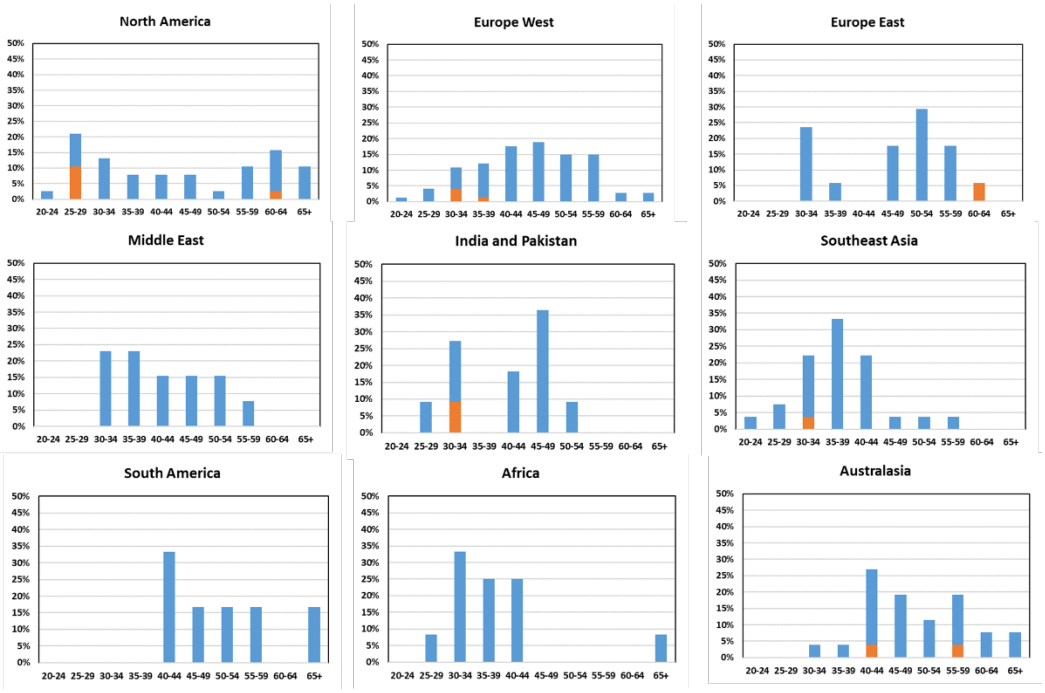


Figure 12: World Regional Demographics

There are some regional differences in demographics (Figure 12). Southeast Asia (mainly Indonesia) has a fairly young demographic while Australasia is much more mature, similar to Eastern Europe. North

America has a binomial distribution similar to that seen in the operations geology demographic with 35% over 55 and 35% under 35. Europe West has a healthy spread of wellsite geologists through the age ranges with experienced people hopefully ready to make the step up to operations geology.

Figure 13: UK Gender distribution versus age

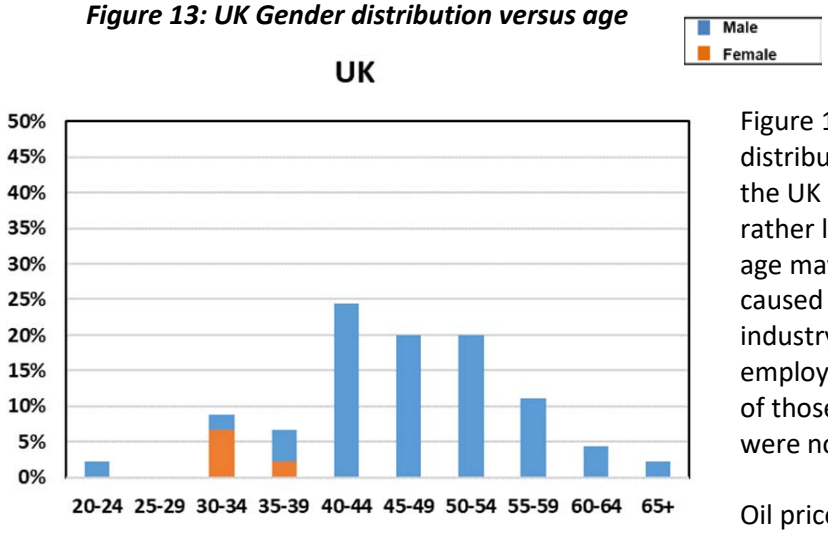


Figure 13 shows the demographic distribution of wellsite geologists from the UK (46 respondents). There are rather low numbers under 40 years of age maybe reflecting the lack of activity caused by the recent recession in the industry. This is at odds with the employment status data in Figure 6. But, of those, almost 50% are female. There were no female respondents over 40.

Oil prices made a recovery in 2018 and although they dipped again towards the end of the year, prices have again stabilised at a comfortable level for operators. The question is, are there enough wellsite geologists to cope with an expected upturn? The answer is probably a qualified yes in most areas if the upturn is moderate. However, knowing that the operations geology demographic from the 2015/16 survey indicated many will be retiring, then a number of the currently practising wellsite geologist will be needed to replace them.

In fact, 38% of wellsite geology respondents worldwide had worked as operations geologists for a while before the industry downturn so will be ready and waiting to step back up again. But who will replace them? In some areas the number of young wellsite geologists are low and with the mid-range stepping up to operations then a strong upturn may result in a manpower and experience gap.

Figure 14 presents two graphs summarising the types of companies the respondents worked for and the types of wells they were involved in.

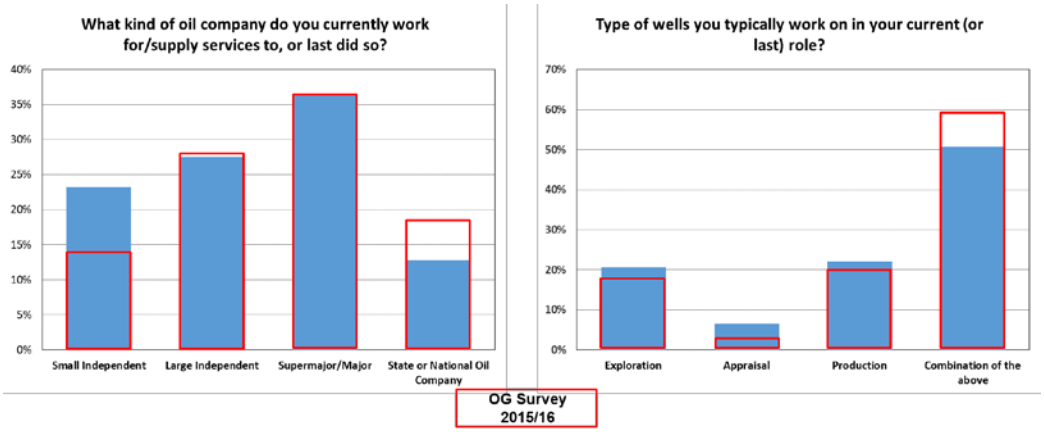


Figure 14: Types of companies and types of well.

These results are very similar to those of the operations geology survey (red outlines) and, again, helps to give some sort of validation to both data sets. While the low number of respondents working purely on exploration and appraisal wells is a bit of a surprise it is probably a reflection of the recession in the industry and the requirement to drill commitment wells only.

Career Path and Role

The wellsite geology survey contained a question on career paths which was almost identical to that of the operations geology survey. The results were broadly similar with a couple of key differences.

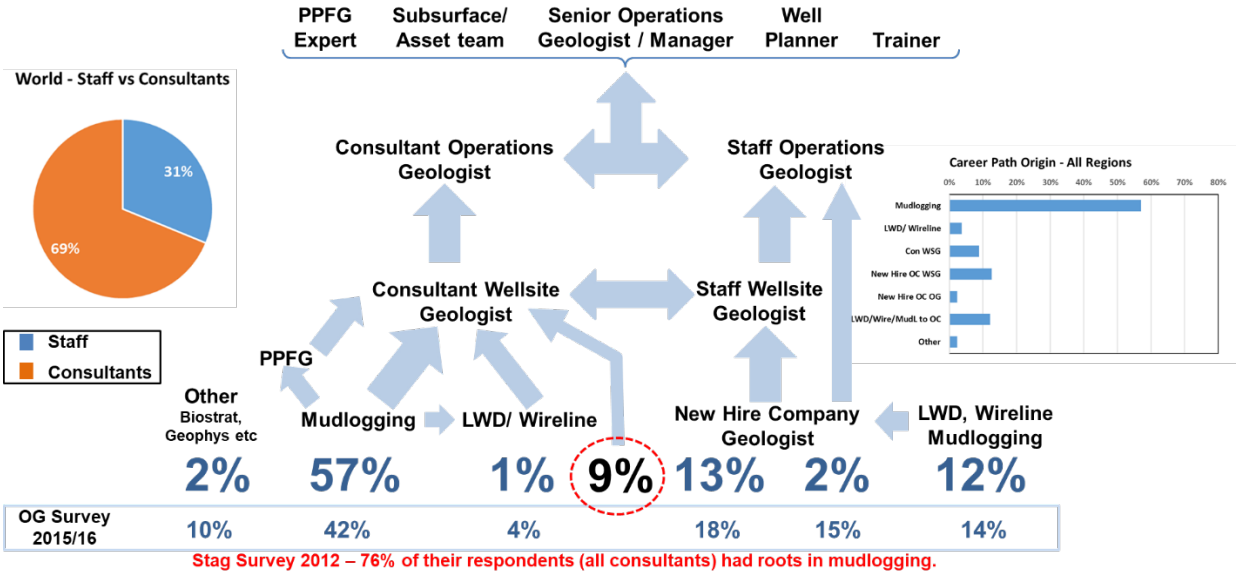


Figure 2: Career paths

Figure 15 illustrates these career paths. Note that the results of the operations geology survey are in the box at the base of the figure. The most common route into the industry, by far, is via mudlogging, progressing up to become consultant wellsite and operations geologists. Approximately two thirds have followed the mudlogging route which is slightly higher than the operations geology survey with far fewer coming through the 'other' route. 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, industry activity levels and remuneration. There are subsequent opportunities to move into operator or service sector management or become specialists,

Another key difference between the wellsite and operations surveys is the fact that 9% went direct to a wellsite geology role from college or another unrelated job. Most of these were in North America, all had at least a basic geology degree and have a range of experience levels, so it is not a recent phenomenon. It is, of course, possible that they had experience in some related job such as mudlogging

and did not declare it. Some people, for example, seem surprisingly ashamed of their mudlogging origin and seek to hide it.

Figure 16 illustrates the regional differences in career path origins. Mudlogging is by far the most common starting point in Europe and Australia and not quite so dominant in other areas. Note how consultant wellsite geologist is a starting point in most areas but not in great numbers apart from North America where it is about 25%.

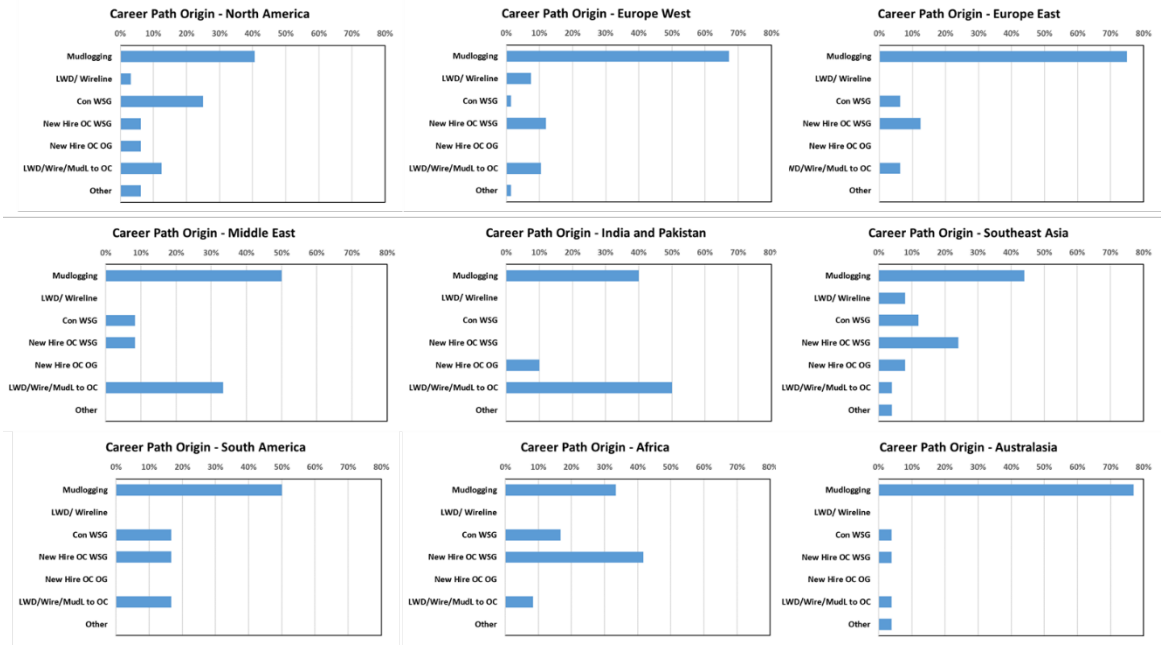


Figure 3: Regional Career Path Origins

It reflects on the state of the industry at the time of the survey that 38% of respondents had worked as an operations geologist at some point. Also 22% of respondents have had one or more times out of the industry in such diverse jobs such as IT professionals, Core analysis, management roles, biostratigraphy, petrophysicists, coal and minerals exploration.

Some returned to education to either change career direction or take a related course. A number of university Petroleum Geoscience MScs now have an Operations Geoscience module included in their

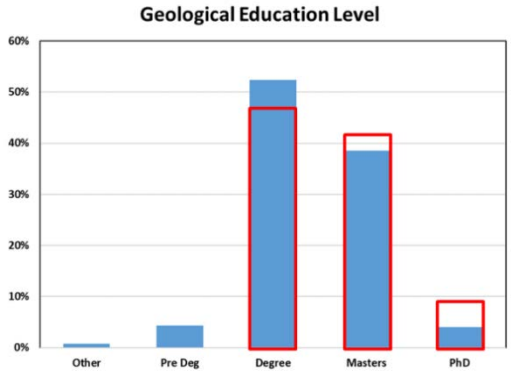


Figure 4: Education level

curriculum (Telford and Archer, 2016). Numbers have been falling on these courses, however, and the general supply of geologists may be drying up.

Figure 17 shows a plot of the respondent's highest education level. The results tally with those of the operations geology survey (red boxes) with a slight bias to higher degree levels with the latter. The plot on the left of Figure 18 illustrates the type of degree gained by age of respondent with very little variation. On the right of Figure 18 is a plot of the type of degree by region. Eastern Europeans have more higher-level degrees and North America has the highest number at pre-degree level.

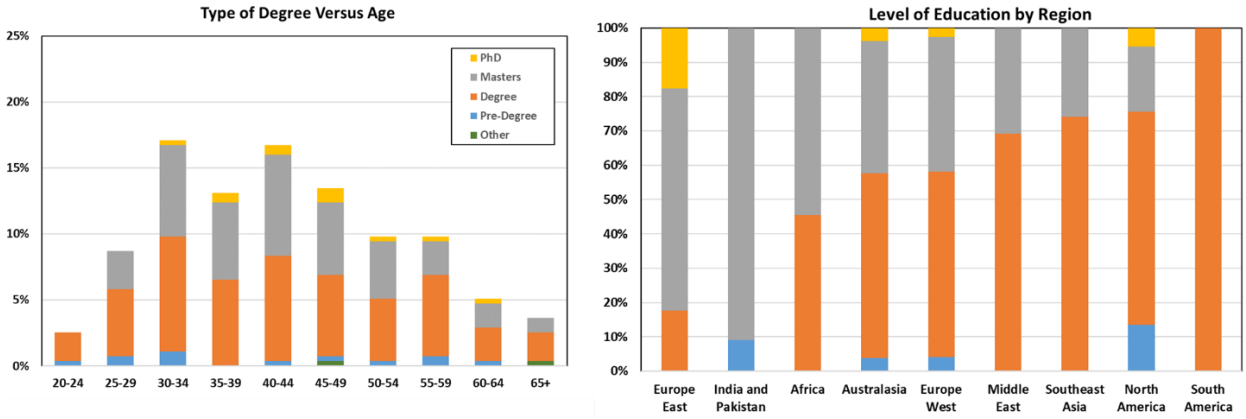


Figure 5: Type of degree by age and by region

An interesting feature of the operations geology survey (Herrett, 2016) was the larger than expected percentage of staff compared with consultants (59%/41%). Perceived wisdom was that operations geology was mainly a consultant role, but the results showed otherwise, and that operations geology is a key staff role with involvement throughout the lifetime of a well.

The results from the wellsite geology survey summarised in Figure 19 show that 35% of respondents were staff which is again a little higher than expected.

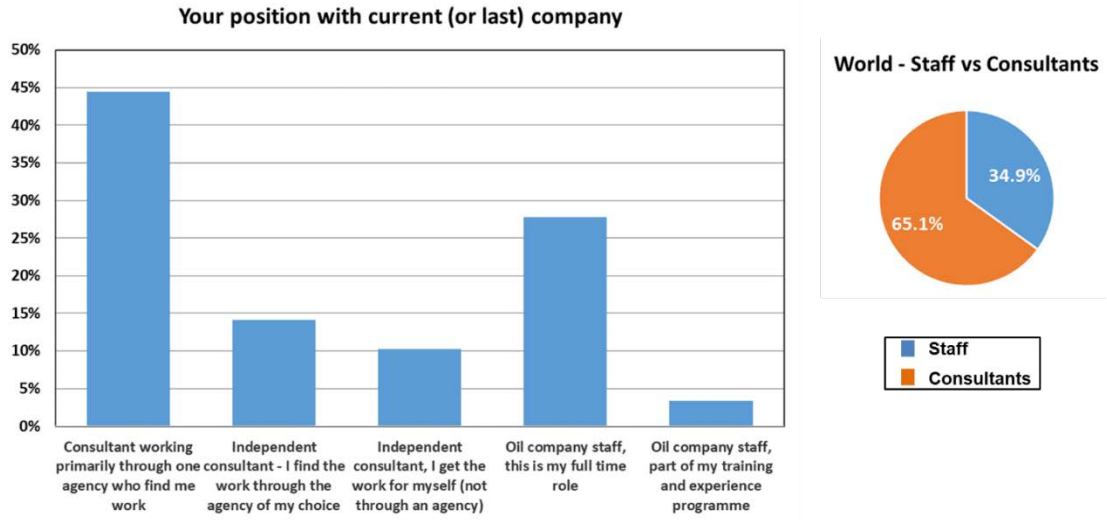


Figure 6: Staff versus Consultants

The vast majority of consultants work through one agency although there is a significant minority who find the work for themselves. There are some regional variations with staff making up an average of 50% of respondents from the Middle East, India and Pakistan, Africa, Southeast Asia and South America as illustrated in Figure 20 while elsewhere staff make up 25% or less. In western Europe 50% of the staff are from two operators in Norway and France.

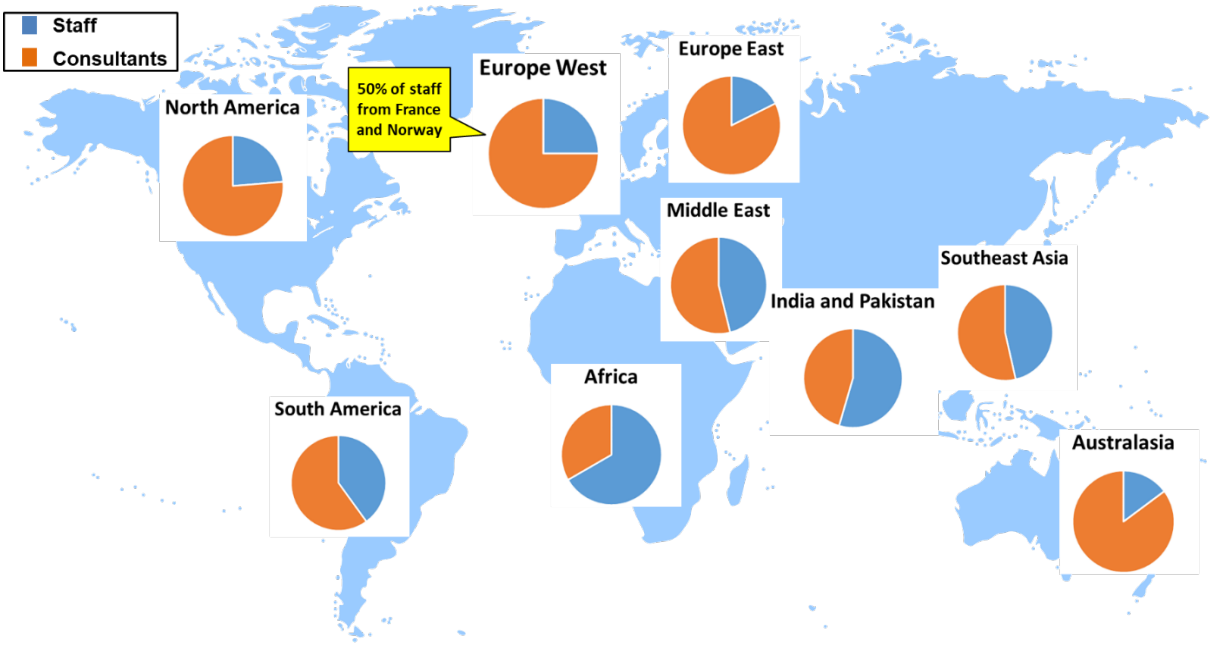


Figure 7: Consultant versus staff regional variations

When asked further about their role in terms of a full time or rotational position the ratio of staff to consultants varied depending on the type of work schedule as shown in Figure 21, below.

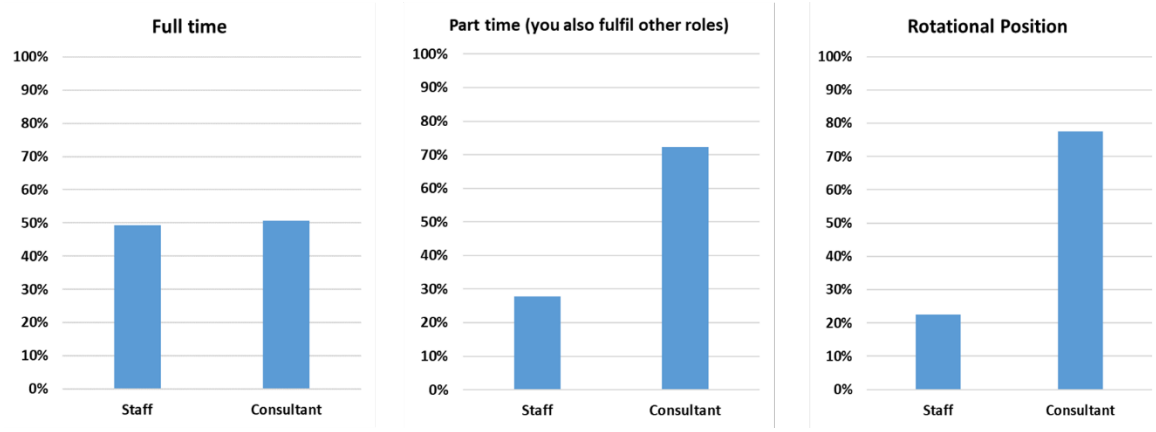


Figure 21: Full-time or Rotational

Consultants dominate rotational schedules as might be expected but staff and consultants are almost equal in full time roles.

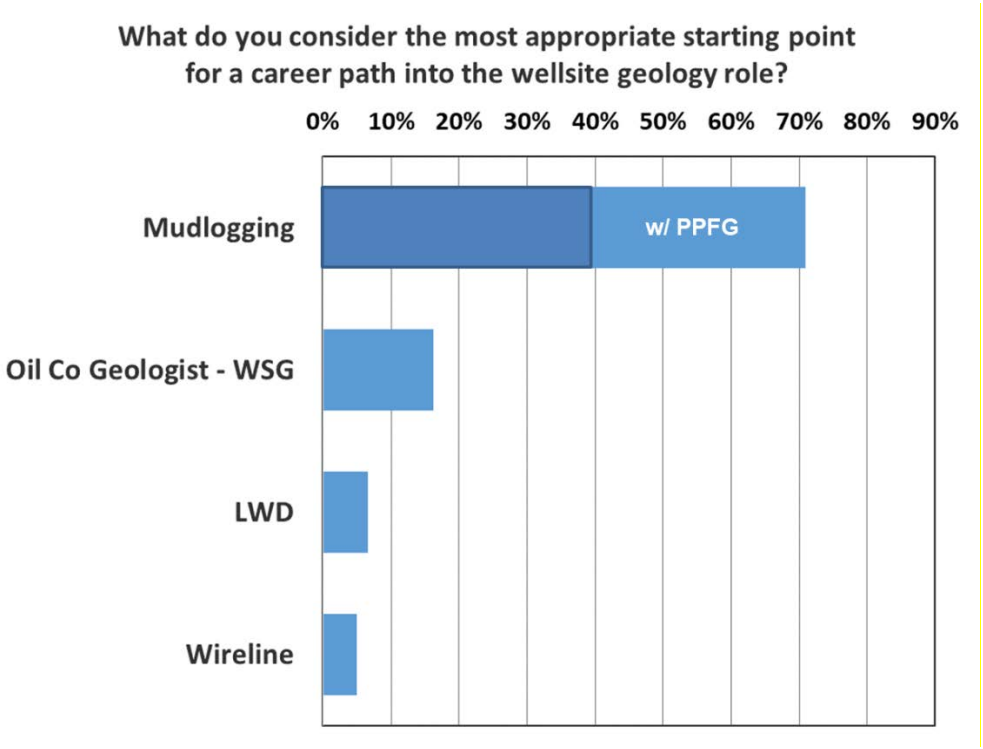


Figure 22: Most appropriate career path

Figure 22 shows the results of the question regarding the most appropriate career path into the wellsite geology role. This was a multi-choice question and why the total percentages add up to slightly more than 100%. In the majority of cases the respondents first choice was the route they themselves took in the industry. The results very much reflect those from the operations geology survey with mudlogging being by far the most popular first or second choice, especially with pore pressure engineer (PPFG) as an additional skillset.

What do Wellsite Geologists Do?

One of the main aims of the wellsite geology survey was to give hard data on what wellsite geologists do. Most people within the operational geoscience discipline know what they do as they have performed the role themselves or have worked alongside them. However, anecdotal evidence from within the specific industry and comments in this survey would seem to suggest that people from outside our discipline do not understand the wellsite geology role and the safety related, sometimes safety critical, tasks they perform.

Three well phases were chosen:

Pre-Spud – Generally involved in final well preparations and pre-spud meetings.
Execute – Drilling and evaluation of a well, sample description, data collation, QC, distribution and management.
Review – Post well report and log finalisation, contractor performance and risk review.

For each phase a number of specific common tasks were listed, and the respondents had to decide between no involvement, contributing or responsible.

Over 60% of respondents participated in all the pre-well activities listed in Figure 23, some of which they are directly responsible for.

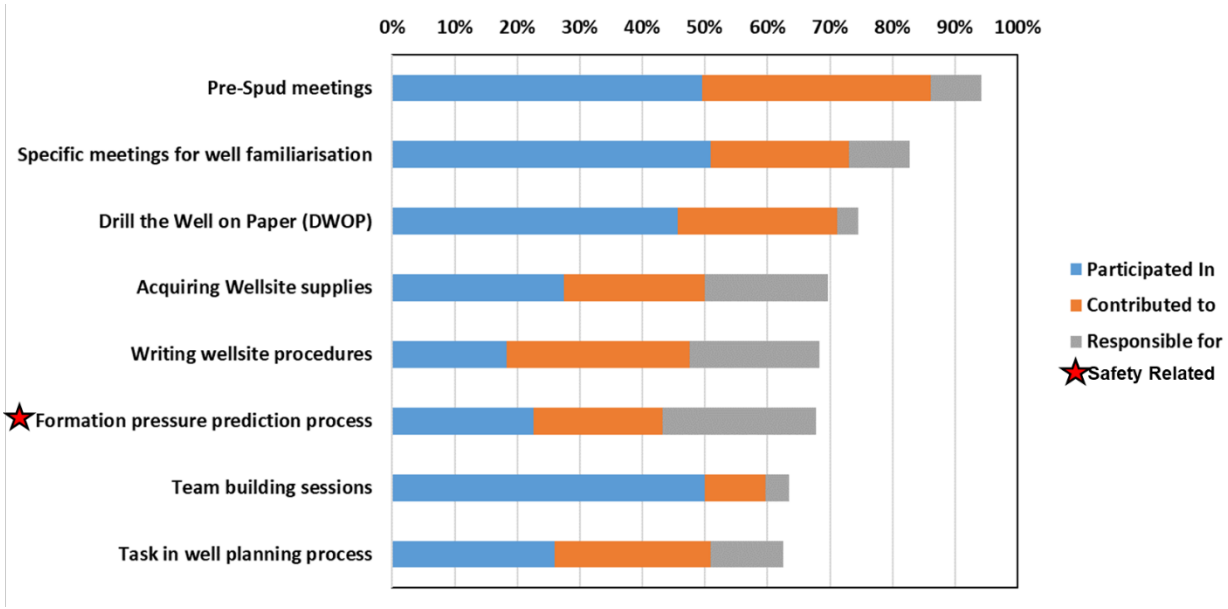


Figure 23: Pre-spud tasks

No real surprises here, nor in Figure 24, below, which reviews tasks during the execution or drilling phase of a well.

Note that the top two tasks are communication related and as such are not technical but personal leadership skills which will be touched on later. There are also quite a number of these tasks which are either safety related or safety critical (red stars).

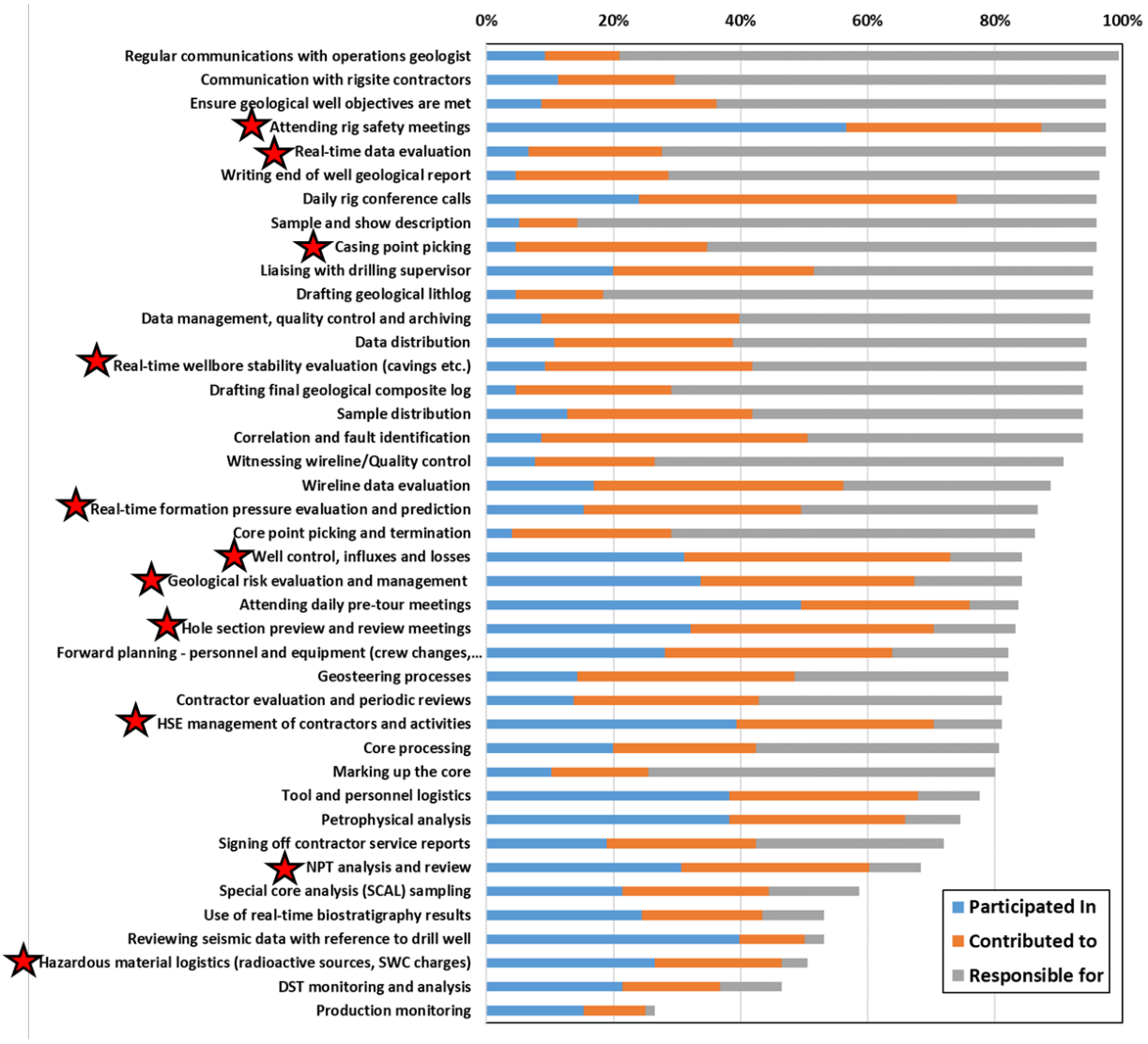


Figure 24: Execute phase tasks

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

As with the operations geology survey, petrophysical analysis is directly performed by relatively few of the respondents, perhaps a consequence of the ability to transmit data directly from the rig site and for a specialist petrophysicist to analyse it.

Not every respondent will be expected to perform all the tasks as it very much depends on company type, well type and experience levels but wellsite geologists participate in, contribute to or are responsible for over 80% of tasks listed in Figure 24.

Figure 25 shows the post-well tasks performed by wellsite geologists.

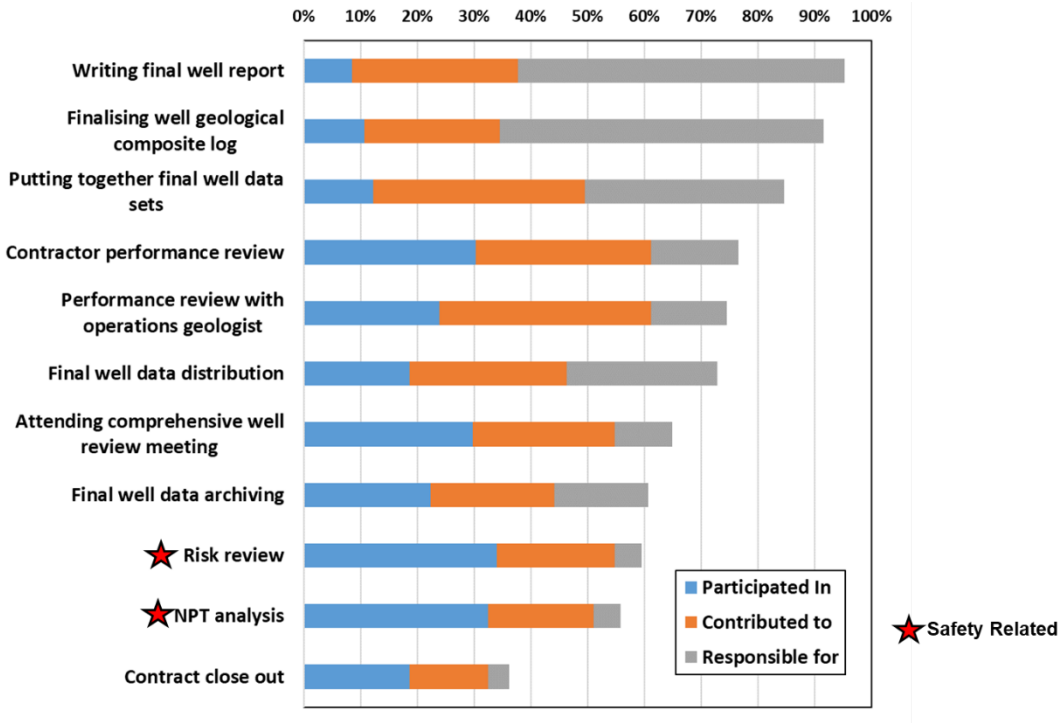


Figure 8: Post well tasks

Again, no major surprises although over 50% get involved with NPT analysis and risk review. It is encouraging to see so many being involved in the post well work and not just being sent away as soon as the well is finished. It helps with continuity and transition to operations geology.

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 26, below, illustrates the responses sorted on 'expert' level.

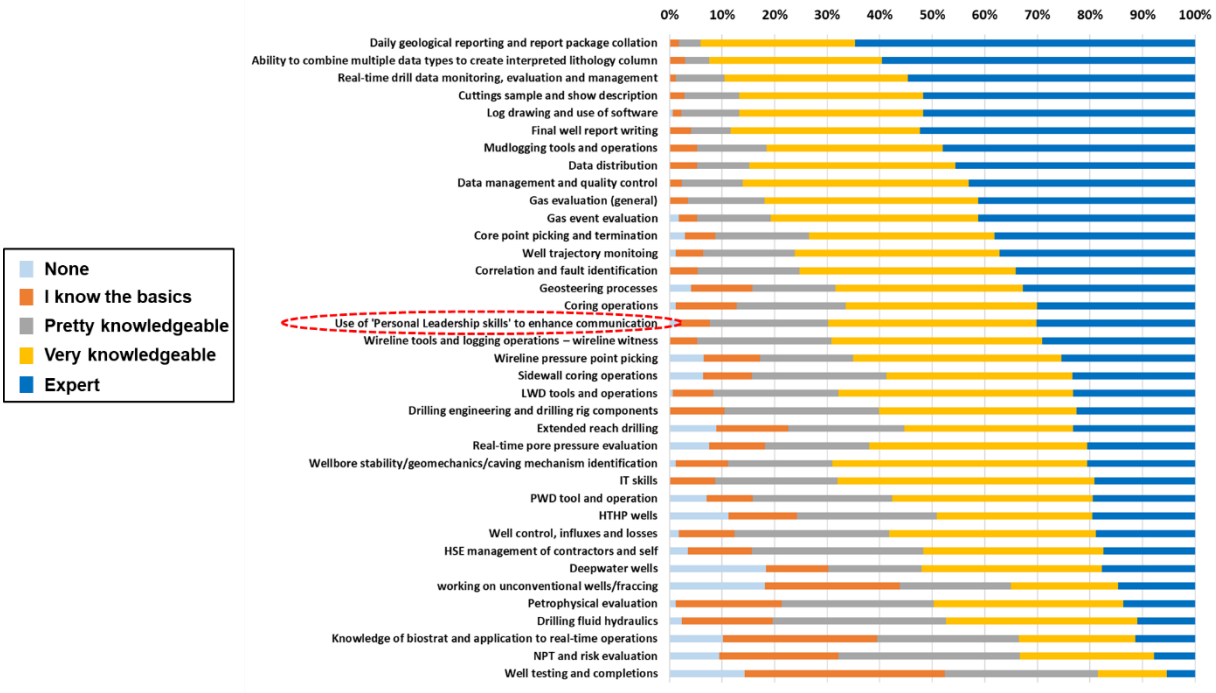


Figure 26: Respondents proficiency

Once again, there is a parallel with the operations geology survey although they had a slightly different taskset. Most of the high scorers are the general day to day tasks that you would expect wellsite geologists to be expert or very knowledgeable about such as log drawing and report generation.

Over 80% of respondents had some degree of knowledge of all the topics and almost 50% considered themselves either expert or very knowledgeable. But, 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.

Note that the use of personal leadership skills is one of the tasks that the respondents felt reasonably proficient at (highlighted on Figure 26). However, it is something we, as a discipline, get the least training in and we will return to this topic later.

A question in the survey asked how the respondents would prove themselves competent. The same freeform question was asked in the operations geology survey and the 6 main threads in the responses

were the same on both surveys (Figure 27, below). Nearly 60% of the respondents suggested wide, on the job, experience and proving your knowledge to client or company were the best ways to prove competence.

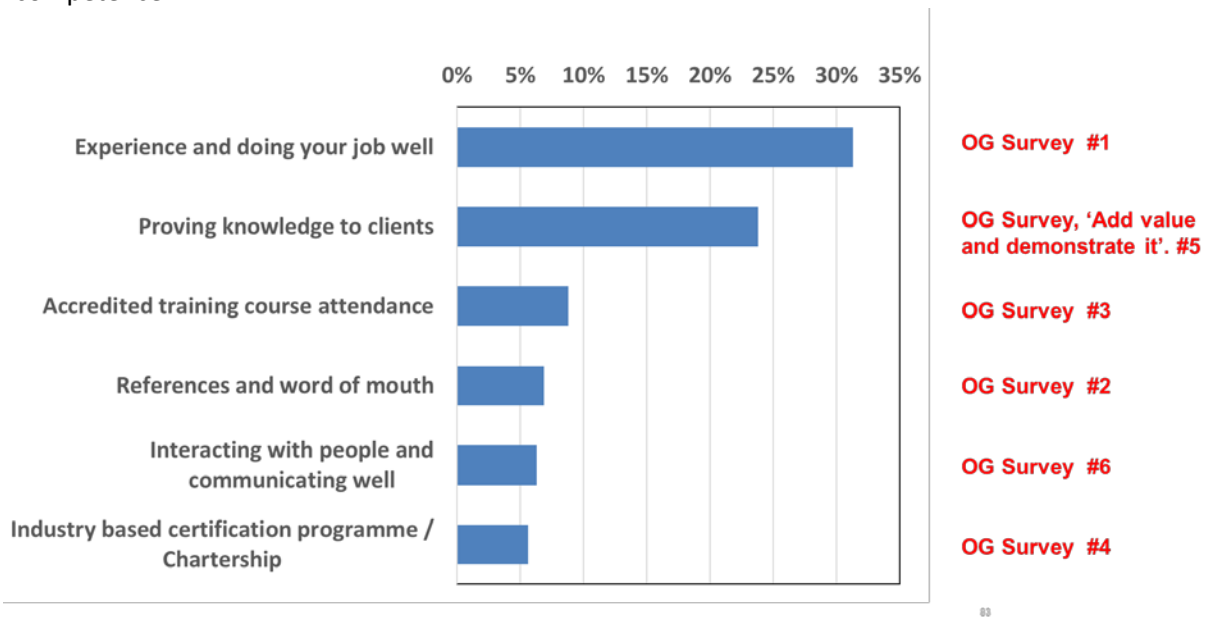


Figure 27: How do you prove competency?

The wellsite geology survey also reflects the results of the PESGB Membership and salary survey (Pickering and Skilliter, 2018) which indicates that personal referral is the most successful method of recruitment. Wellsite and operations geology 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.

While some companies do have internal competency processes most independent consultants do not. UKOGC, based on a remit from the early operations geology conferences embarked on developing a more robust competency process. OGICA, a not-for-profit LLP organization, has subsequently developed an on-line skills assessment which is both independent and, more importantly, objective. It will give a much better benchmarking of the competency of individuals, whether employees or consultants.

Training is obviously an important aspect of competency. Figure 28 illustrates what sort of formal training the respondents have taken. Note that the questions were multiple choice so respondents may have chosen multiple answers.

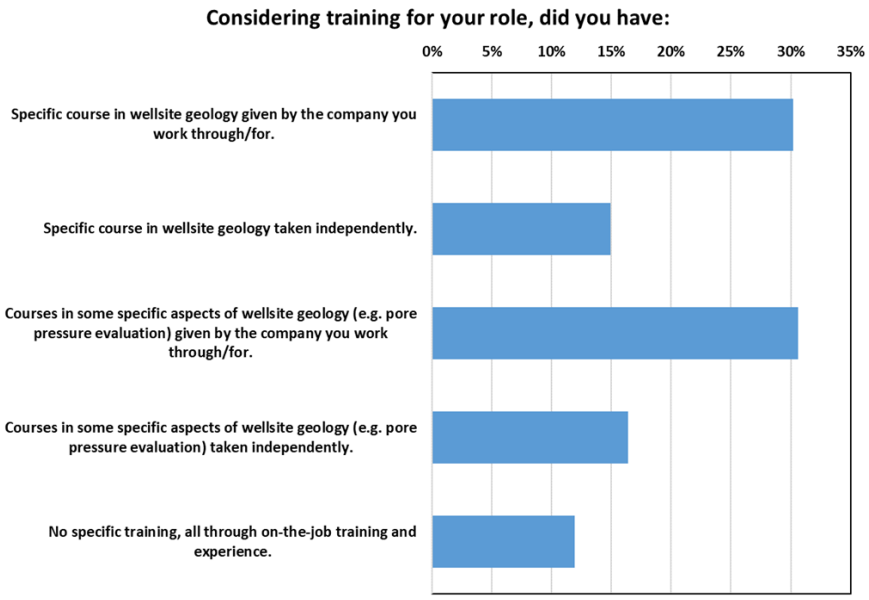


Figure 9: Operational Geoscience Training

Over 85% of respondents have had some type of training with the vast majority (60%) having been on a specific wellsite course and/or on specific aspects of wellsite geology. Most people were given courses by the companies they work for (this might be operator or service company) which they may be encouraged to do as part of their assurance or competency management system. However, 12% have had no training whatsoever apart from 'on the job' training, which compares with 15% from the operations geology survey. There are regional differences (Figure 29) with, for example, over 40% of the respondents from Australasia having no specific training.

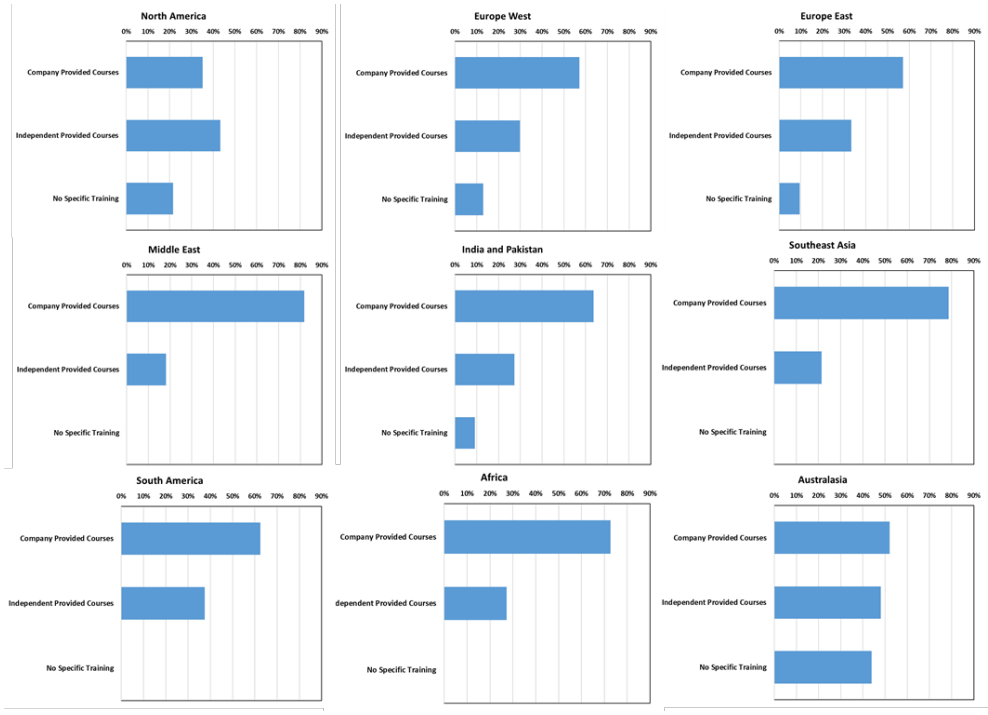


Figure 10: Regional Differences in Training

When the respondents were asked about their attitude to training (Figure 30), then the majority, almost 70%, stated that a combination of a basic course and/or advanced training in specific topics would be best. More than 15% said that they did not need any specific training and that on-the-job training with experience was sufficient.

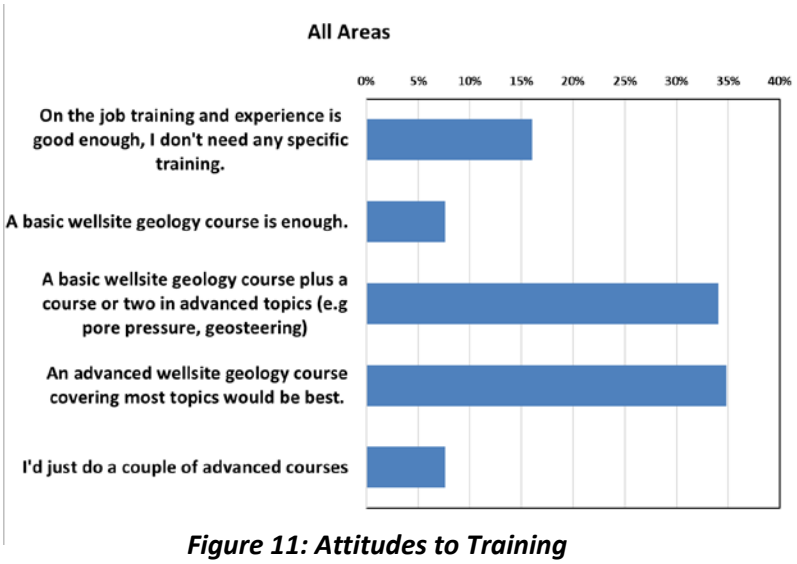


Figure 11: Attitudes to Training

Lack of formal training was acceptable in the past but whether it should be acceptable now, given the safety critical nature of some of the tasks, is open to question. Of course, experiential learning is vital, but training is also a way of keeping up to date with the latest processes and procedures and should not be viewed as a one-off event.

Some operators and service companies have personal development processes in place which address these issues, but others don't. This is especially so for independent consultants. Any industry wide competency management system for operational geoscientists would address this issue.

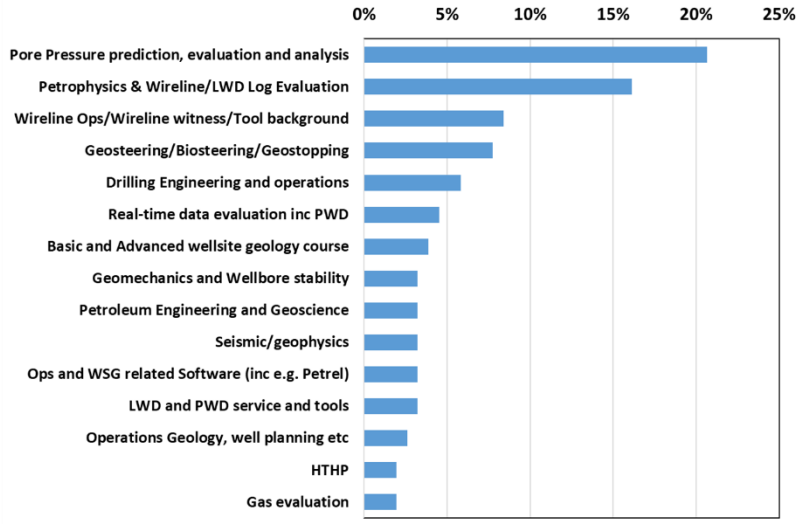


Figure 12: Requested Training Topics

Figure 31 shows the top 15 requested training topics. All the top 6, making up nearly 70% of the total responses, are specialist topics and are pretty much as expected. Only 4% wanted a basic to advanced

generic wellsite geology course. Only 2 people requested a course on personal leadership/communications skills which, given the results of the 'essentiality' question discussed below, seems very low.

The respondents were asked to rate 30 technical and personal leadership skills and experiences pertinent to wellsite geology on a scale from 'not essential at all' to 'very essential', see Figure 32, below. This graph is sorted on the 'very essential' response and gives a meaningful representation of decreasing essentiality. This graph is from the 174 responses worldwide although the regional subsets do not vary greatly.

As with the operations geology survey, three of the top five skills (and in this survey, seven of the top fifteen) 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.

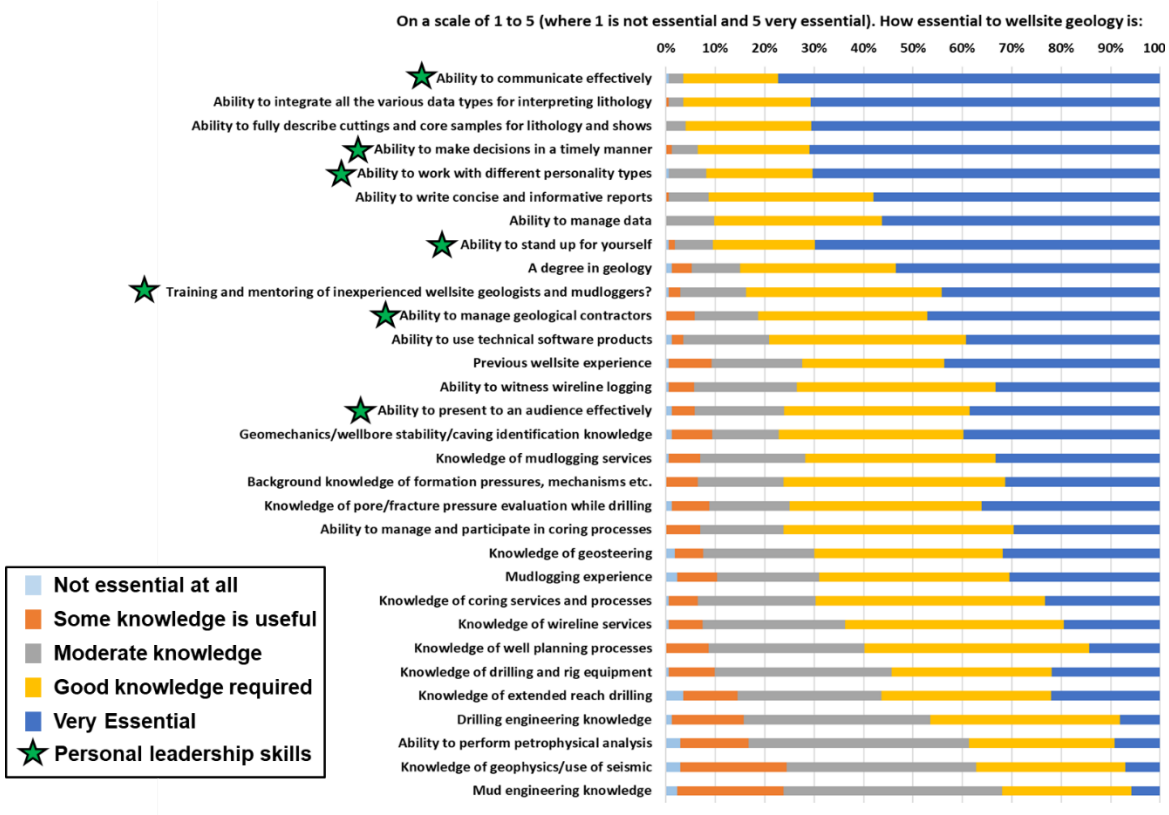


Figure 32: How essential are these skills?

The technical skills are generally as expected but knowledge of mudlogging and mudlogging experience were ranked surprisingly low as were knowledge of drilling and mud engineering. Petrophysical analysis, based on these results, is also viewed as less essential, in keeping with previous results and the operations geology survey. It is rarely, if at all, performed at the rig-site anymore.

There was generally a good consistency between 'world average' when compared it with regional results. There were some differences which are summarized in the table below. Note that the regions

presented here are the ones where there are enough numbers of respondents to make it statistically significant.

Region	Less Essential than average	More Essential than average
Australasia	Ability to use technical software. Ability to present to an audience. Previous wellsite experience. Ability to manage geological contractors.	Ability to stand up for yourself. Training and mentoring of inexperienced WSG and mudloggers.
Europe East	Previous wellsite experience. Ability to manage data. Ability to communicate effectively.	Training and mentoring of inexperienced WSG and mudloggers. Ability to present to an audience. Knowledge of coring services and processes.
Europe West	Ability to fully describe cuttings and core samples for lithology and shows. Ability to witness wireline logging. Ability to present to an audience effectively.	Ability to stand up for yourself. Background knowledge of formation pressures. Geomechanics/wellbore stability/ caving. Knowledge of pore/frac evaluation while drilling.
North America	A degree in geology. Ability to witness wireline logging. Background knowledge of formation pressures. Knowledge of pore/frac evaluation while drilling. Geomechanics/wellbore stability/ caving.	Ability to use technical software products. Knowledge of geosteering. Ability to manage and participate in coring processes. Knowledge of coring services and processes.
Southeast Asia	Geomechanics/wellbore stability/ caving. Knowledge of geosteering. Ability to stand up for yourself. Ability to manage and participate in coring processes. Ability to use technical software products.	Ability to fully describe cuttings and core samples for lithology and shows. A degree in geology. Ability to witness wireline logging. Knowledge of well planning processes. Training and mentoring of inexperienced WSG and mudloggers.

Undoubtedly, these regional differences are the result of local work practices and culture. For example, personal leadership skills are thought less essential in Southeast Asia than in other areas. The respondents from North America see knowledge of real-time pore/fracture evaluation as the least essential skill they require together with background information on formation pressures and geomechanics. A degree in geology is also thought less essential. Conversely, skills in geosteering, the ability to use technical software products, coring and extended reach drilling are thought much more essential. Given the preponderance of unconventionals, certainly in the USA, this is not surprising.

One of the essentialities listed above is a degree in geology. There has been some debate recently on this particular topic as some of the latest generation of mudloggers are being employed without a geology degree. As mudlogging is a key rootstock for wellsite and operations geology the question is can a person without a geology degree go on to fulfill these roles?

This question was specifically asked in the wellsite geology survey, but a more general 'geoscience' degree was used in the question. The results are illustrated in Figure 33.

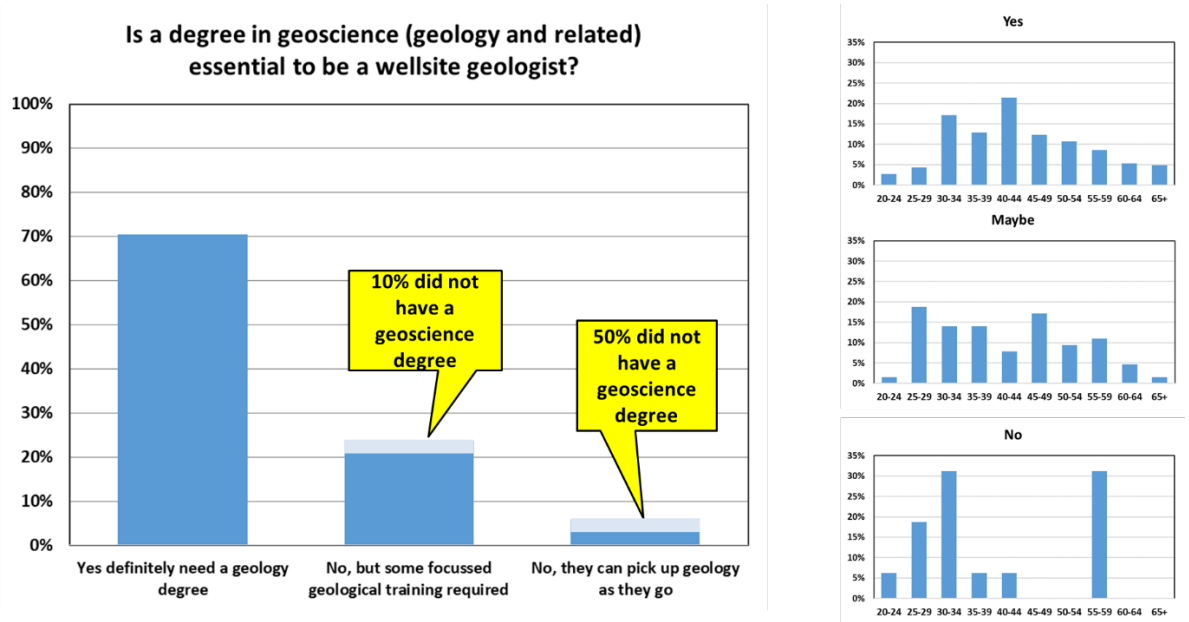


Figure 33: Is a Geoscience Degree Essential?

The results were not as conclusive as might be expected.

- 70% said yes, a geoscience degree is essential
- 24% said no, but focused geological training was required – of these 10% did not have a geoscience degree themselves
- 6% said no, they can pick up the geology as they go along – of these 50% did not have a geology degree.

It is reasonable to assume that those respondents who did not have a geoscience degree would of course say that a geoscience degree is unnecessary. Most of these were in the younger age brackets although there seems to be an 'outlier' in the data from the 55-59 age bracket. There is broad support from all age ranges for the other two categories.

Not having a geoscience degree is not necessarily career limiting, although some service providers insist on their wellsite geologists having one. When dealing with specialisms such as pore pressure and geomechanics then surely a deeper level of geological understanding is required?

Discipline Health

This section does not deal with the health of individual wellsite geologists but with working practices, work hours, hitch lengths and whether wellsite geologists have a good work-life balance. The discipline is changing, wellsite autonomy for example is being lost and so one of the aims of the survey was to examine what is the present and possible future of wellsite geology.

In terms of workload one of the basic questions is are wellsite geologists working equal time, do they have less time off or more time off? The survey results show a huge variety of schedules and the worldwide average is shown in Figure 34.

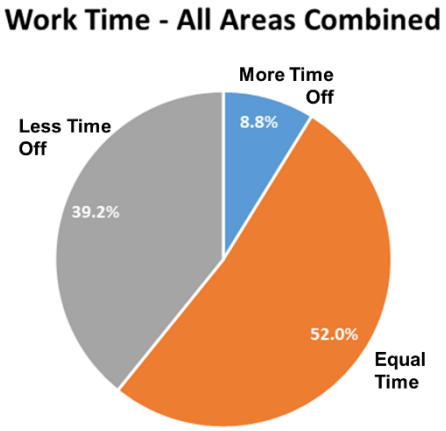


Figure 13: Hours worked a day

On average around 50% are working a roughly equal time schedule which can vary from 1 week on/1 week off up to many weeks on and the same off. It depends on the location, length of well, travel time and, sometimes, personal preference. Almost 40% are working with less time off which is surprising as equal time was instigated in the late 1970s. However, sometimes work schedules are described as 'ad-hoc, working when required and this may mean being at the rig site for a number of days and off for shorter period. It depends on work activities.

During a downturn much of this is driven by the operator's desire to save money forcing service contractors to work long hitches, the whole well or being on the rig only when rig activities dictate.

A much lower percentage have more time off. The obvious example here is Norway, where a 2:3 (2 on, 3 off) and then a 2:4 schedule was pushed through by the unions. However, some of this is again driven by ad hoc working whereby wellsite geologists work short intervals and then have a long time off, which is unpaid, waiting for the next activity where they are needed.

There are some regional variations as illustrated in Figure 35.

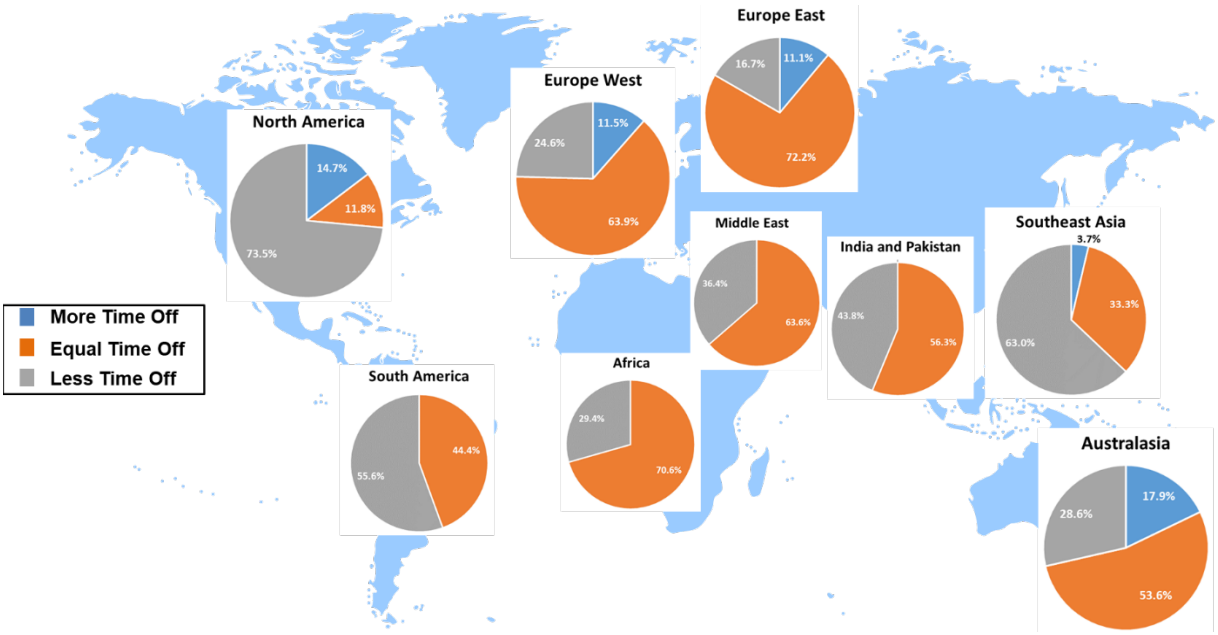


Figure 35: Regional hitch length

The main points of note are:

- In most regions the majority work an equal time schedule apart from North America, Southeast Asia and South America (low respondent numbers here though).
- The number of respondents having more time off is essentially in four areas with Australia having the most, at nearly 18%. This may be partly due to work schedules of working only when required.

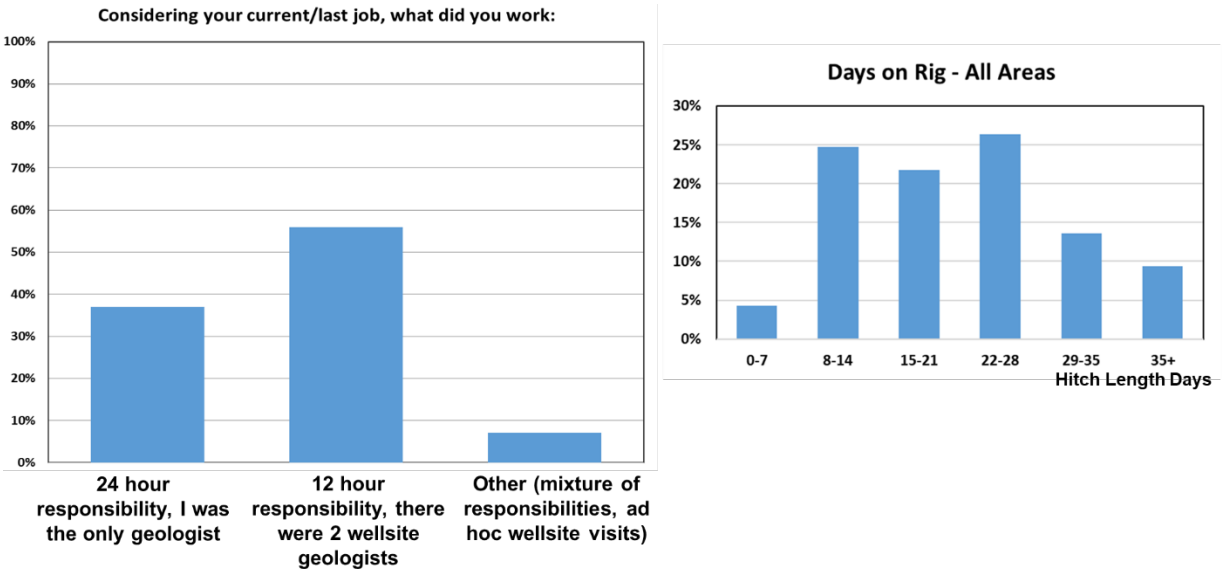


Figure 36: Work Hours and Hitch Length

Figure 36 gives an overview of both daily work hours and typical hitch lengths from all respondents. Before analyzing these data in more detail, it is instructive to see a third of respondents are working 24 hours responsibility and 50% of respondents are working hitches of 3 weeks or more. Even though

drilling efficiency has increased with faster penetration rates and shorter 'flat-spots' and the volume of data to manage has also increased exponentially, wellsite geologists are still asked to work long hours and long hitches. Is this acceptable today when HSE is deemed so important?

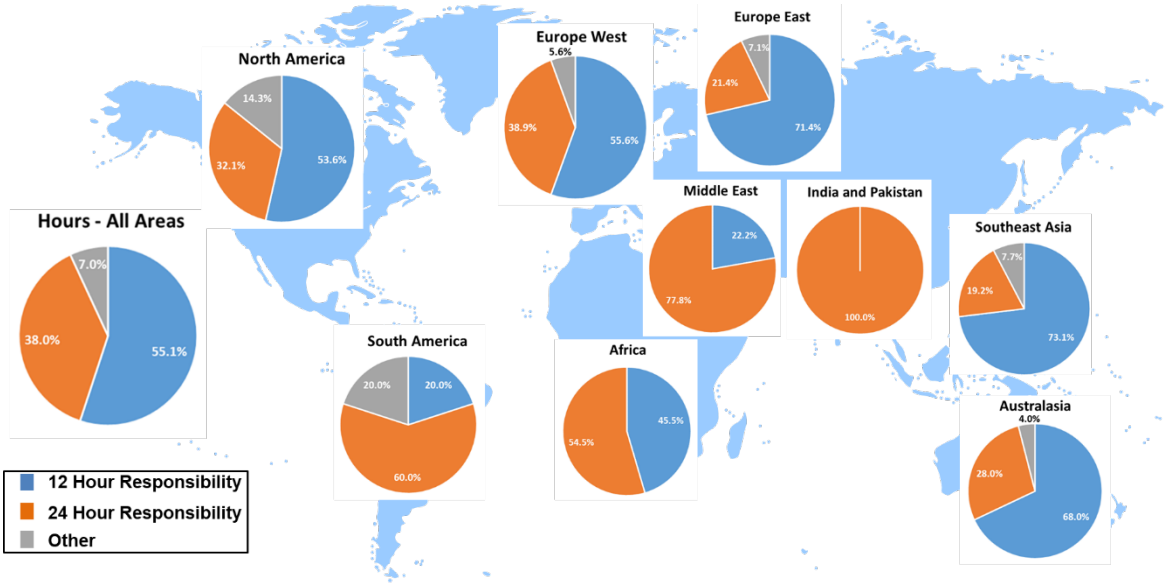


Figure 37: Work Hours - Regional

Regionally it can be seen from Figure 37 that 24-hour responsibility is predominant in India and Pakistan, the Middle East, Africa and South America although the number of respondents from these areas is quite low. Even so, in all areas there are significant numbers who work with 24-hour responsibility. In reality some people prefer this way of working, having total control of the wellsite geology job and, indeed, it does depend on the type of job too.

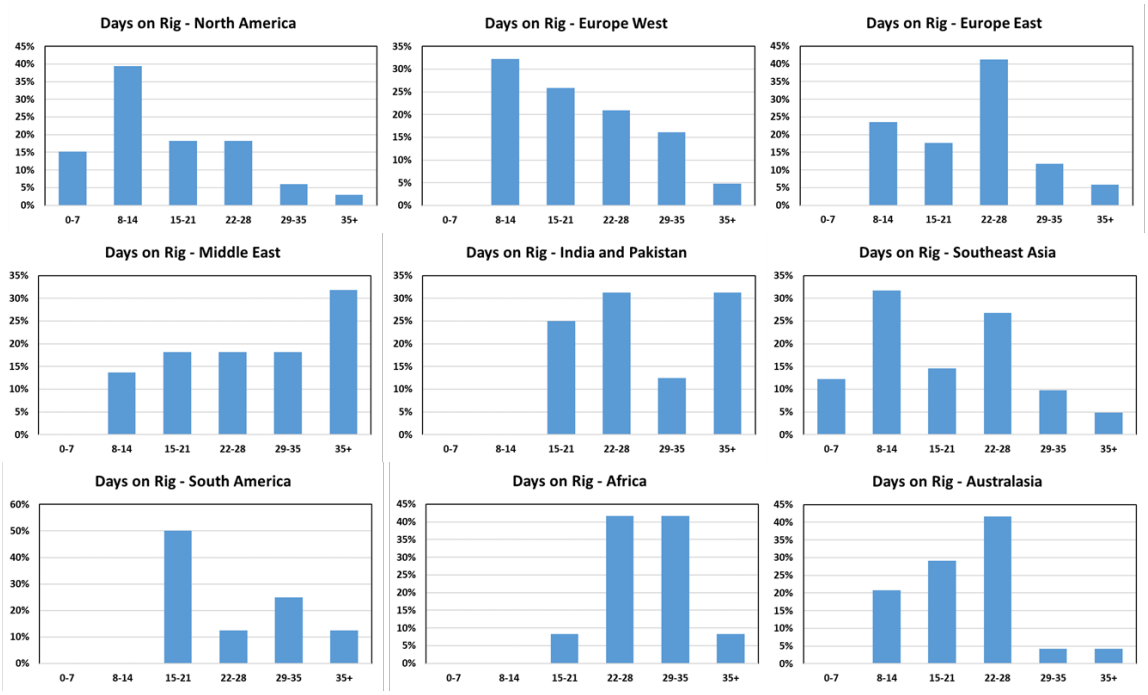


Figure 38: Hitch length - Regional

Figure 38 shows regional hitch length. In all areas some of the respondents work 35 days or more, which is maybe excessive, but some people like to work these sorts of hitches, sitting the whole well for example. Due to the downturn in the oil market others may be forced to work these long hitches rather than have no work at all. Additionally, those commuting long distances to work, with associated travel costs, will also probably work longer hitches.

Interestingly, the regions that work predominantly 24-hour responsibility, in India and Pakistan, the Middle East, Africa and South America, also generally work longer hitches.

One of the survey questions related to hours worked during various operations and Figure 39 illustrates the results.

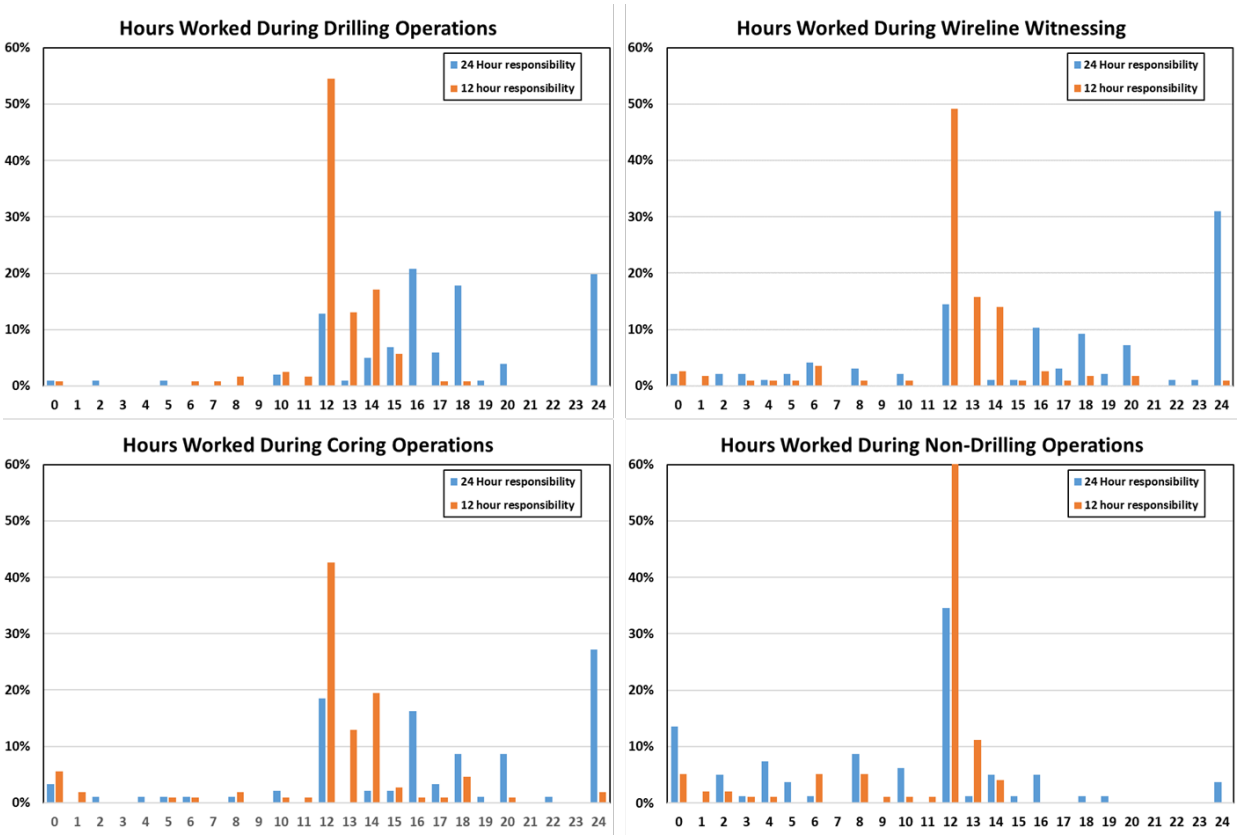


Figure 39: Hours worked by operation 12/24 responsibility

What the results show is that is that those working 24-hour responsibility generally work significantly longer hours than those with 12-hour responsibility, as might be expected. There does seem to be a relatively large percentage working 24 hours, and this may be due to people inputting their hours of responsibility rather than their actual work hours. Even so, it is highly likely that some respondents have in fact worked 24 hours straight. Even those with 12-hour responsibility often worked longer hours, usually an hour or two more, which might be expected for some operations and to ensure good communication at shift changes.

Typical freeform comments made in response to the work hours question were that those working 12-hour responsibility and were the most experienced often started earlier and finished later to support and mentor junior colleagues and that they would also cover all critical operations. This is good working

practice and should be seen as acceptable. Those working 24 hours tended to work as required but did work excessive hours.

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 time off then the 48-hour week may not be exceeded. However, working long hours over a long hitch is most likely an HSE issue. Should the wellsite geology discipline be more regulated in the hours they are asked to work? Should 24-hour responsibility be banned?

Some companies recognize that there is an HSE issue and recommend that personnel should not work more than 16 hours and then should have a minimum of 8 hours rest. However, these are only guidelines, are not legally binding and cannot be enforced. One of the questions asked in the survey was whether maximum working hours per day should be legally imposed?

Figure 40 illustrates the worldwide results.

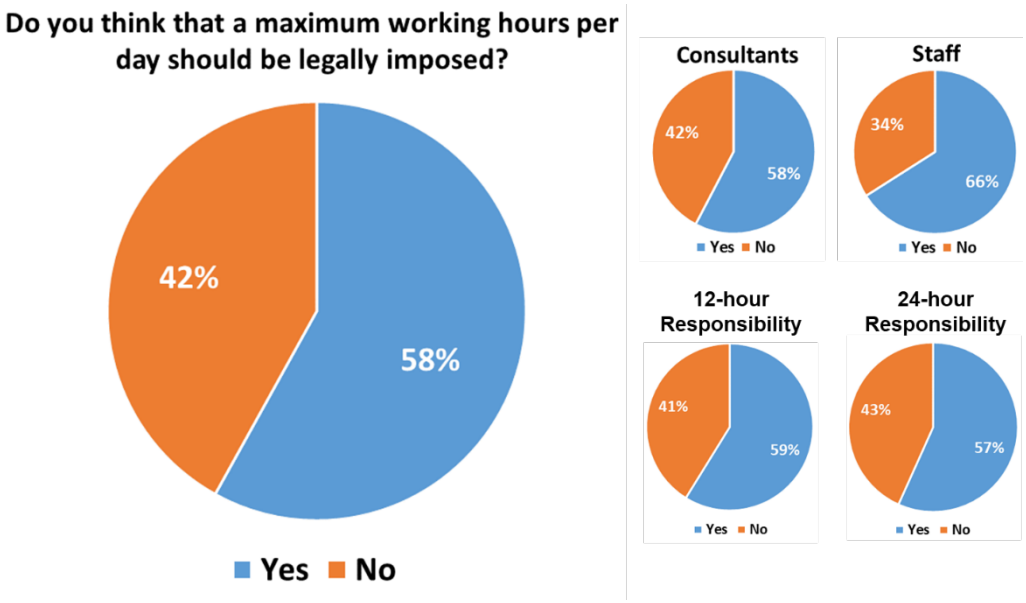


Figure 40: Should maximum working hours be legally imposed?

On the face of it there is a uniformity of results with about 60% in favour of legally imposed maximum working hours leaving a sizeable proportion against. Slightly more staff than consultants support the imposition and there is almost no difference in opinion between those working 12- and 24-hour responsibility.

However, when looking at the data regionally in Figure 41, there is one striking feature. Generally, all the regions are for the legal imposition of maximum working hours with India and Pakistan and Southeast Asia particularly in favour with 89% and 81% respectively. North America, on the other hand, are 80% against the legal imposition. The reasons for this are probably partly cultural but also due to the particular working practices in the region. Here, personnel are paid by the hour rather than on a 'day rate' (personal communication Mark Tomlinson, Dynaview) and so they would want to work long hours as they get extra remuneration. Any restriction would be counterproductive for them. Should all wellsite geologists be paid on an hourly basis to recompense for long hours worked? Or would that be open to abuse?

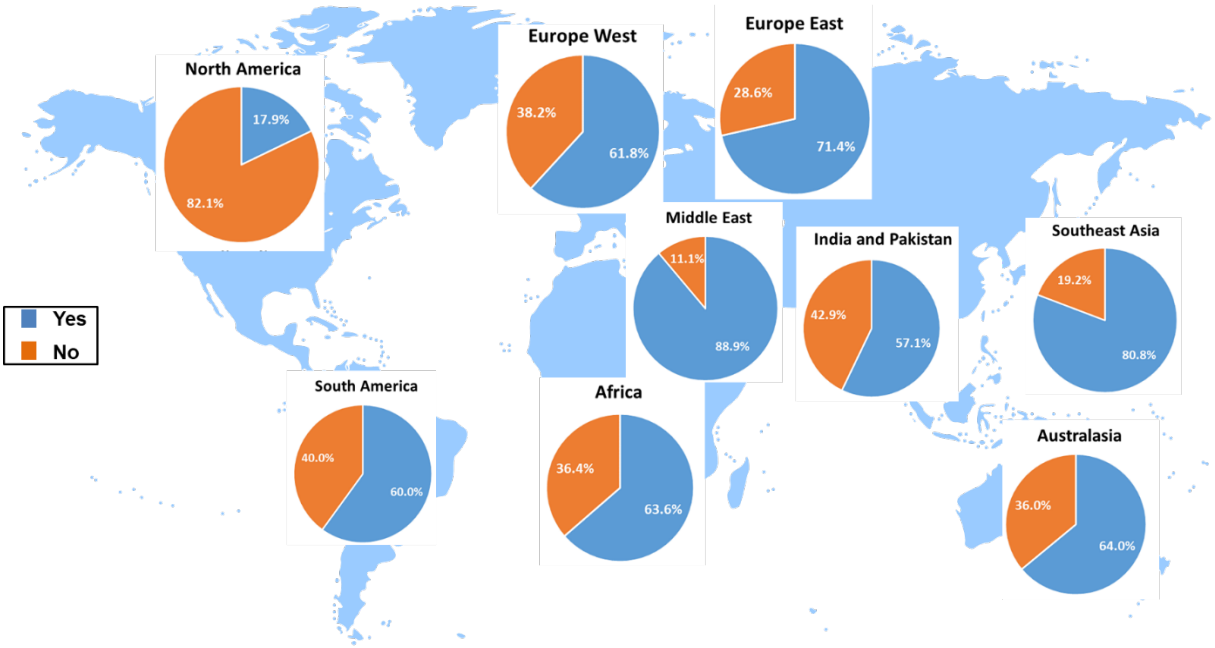


Figure 41: Should maximum working hours be legally imposed? – Regional view.

The survey gave respondents the opportunity to suggest what the maximum working hours should be as a freeform entry. Only 51 respondents took the opportunity to make a suggestion with the maximum being 16 hours. Some commented that this was already in place in the location where they worked – but only as a recommendation and not supported in law.

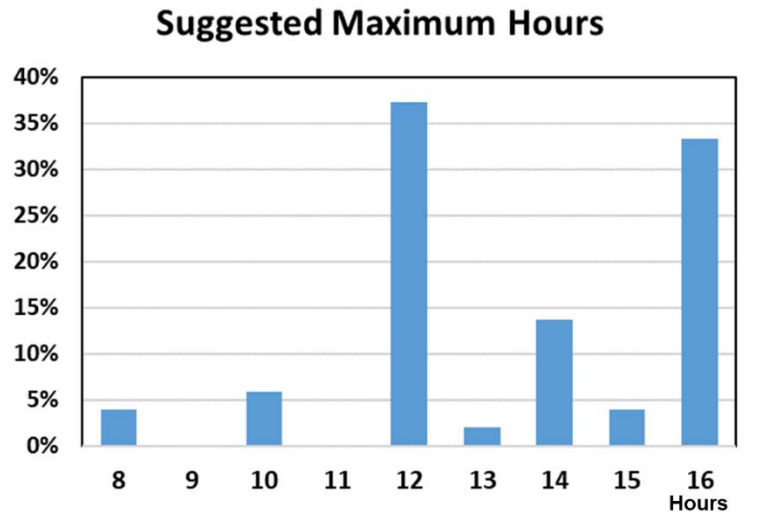


Figure 42: Suggested maximum working hours

Only 2 from 28 made any suggestions from North America and these were for 12 and 16 hours. There were a number of free-form comments made regarding maximum work hours and some of these are captured below.

- “12 hours maximum. The Wellsite Geologists role is (or should be) considered a safety critical role. Unfortunately, I believe that many Wellsite Geologists are not competent - particularly for HPHT work and this has impacted on the Wellsite Geologists brand. I believe both Wellsite Geologist and Operations Geologist need to be certified.”
- “Working hours are dictated by operations. There are always quiet days when a WSG can catch up on sleep.”
- “The rig has this policy, one cannot exceed a certain numbers of hours per day followed by at least 8 hrs rest. The major company always work with a day senior WSG and a night junior.”
- “I've made poor decisions with lack of sleep”.
- “Definitely when work flows extend longer than expected. Have been involved in several incidents where is was up continuously for three days with two - three-hour naps. This was annoying when the programme clearly indicated that there would be this level of activity.”

Clearly, most people would like some limitation on hours worked as it can become an HSE issue, but others prefer to have the freedom to work when and for how long they want. In some circumstances this is fine as long as it is not abused. Wellsite geologists should not have to continuously work long hours, especially when working 24-hour responsibility.

Part of the problem is that procurers and operating companies are simply not aware of what wellsite geologists do or their workload with the sheer volume of data to manage and the speed of drilling processes. Years ago, it was acceptable to have just one wellsite geologist on board as drill rates were lower, trips frequent and data volume was a fraction of what it is today. Unfortunately, some think that this is still the case and that one wellsite geologist is perfectly adequate. On certain jobs this may still be acceptable but in most cases it is not.

Travel time and whether individuals are paid for it is another thorny issue and was addressed by the survey. Figure 43 shows a breakdown of the travel times that the respondents provided.

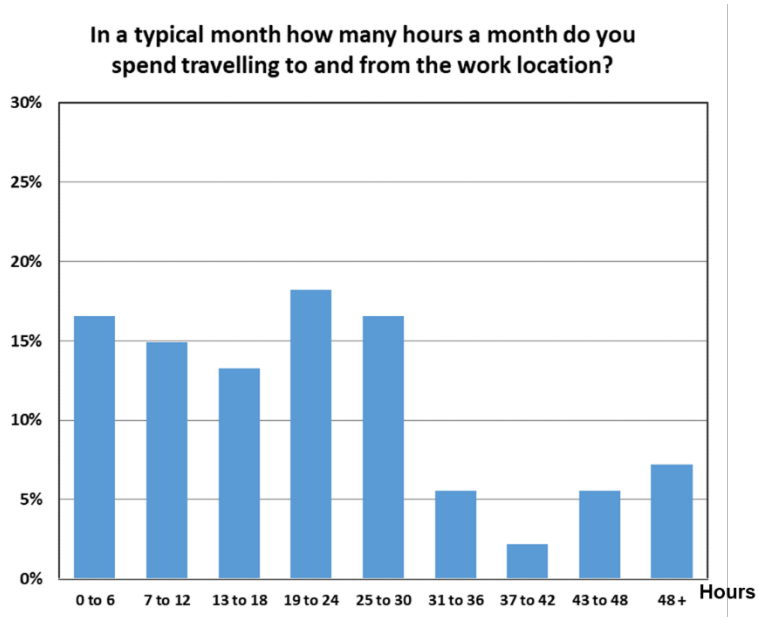


Figure 43: Travel time hours

Approximately 80% travel 30 hours or less and there was not too much statistical variation between the different areas. Obviously, those involved with intercontinental work will have long hours of travel.

Figure 44 addresses whether the respondents travel time was paid.

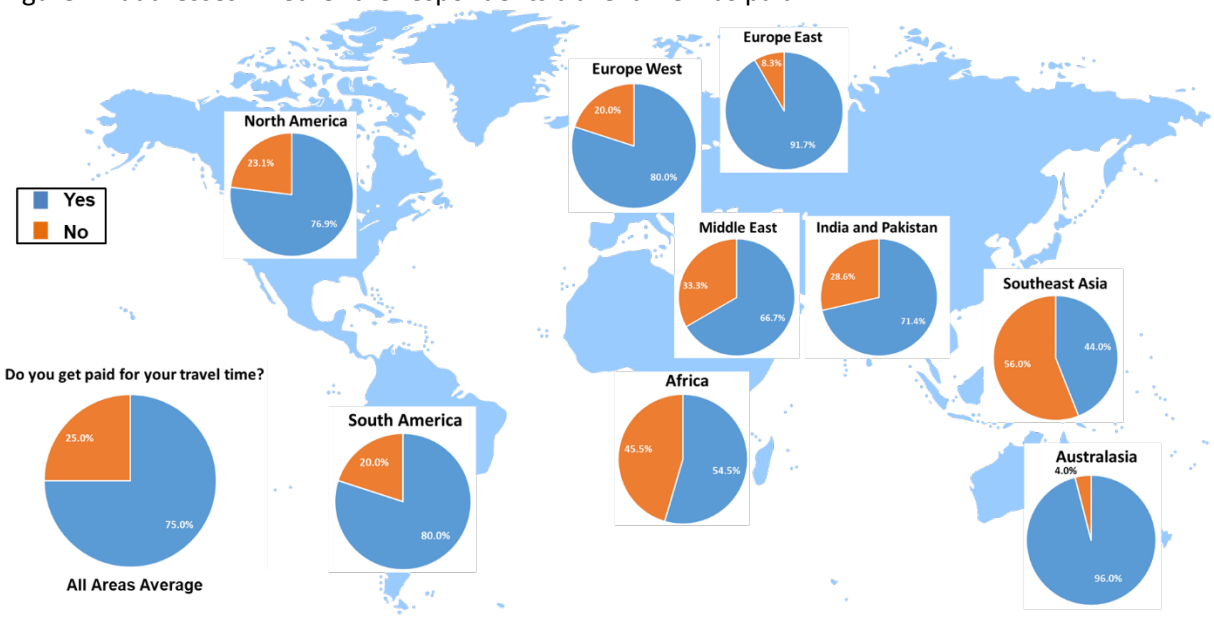


Figure 44: Travel time paid – Regional variations

On average, worldwide, 75% of respondents were paid for travelling although there were some regional variations. In Australasia over 90% were paid for travel time while in Southeast Asia over half were not.

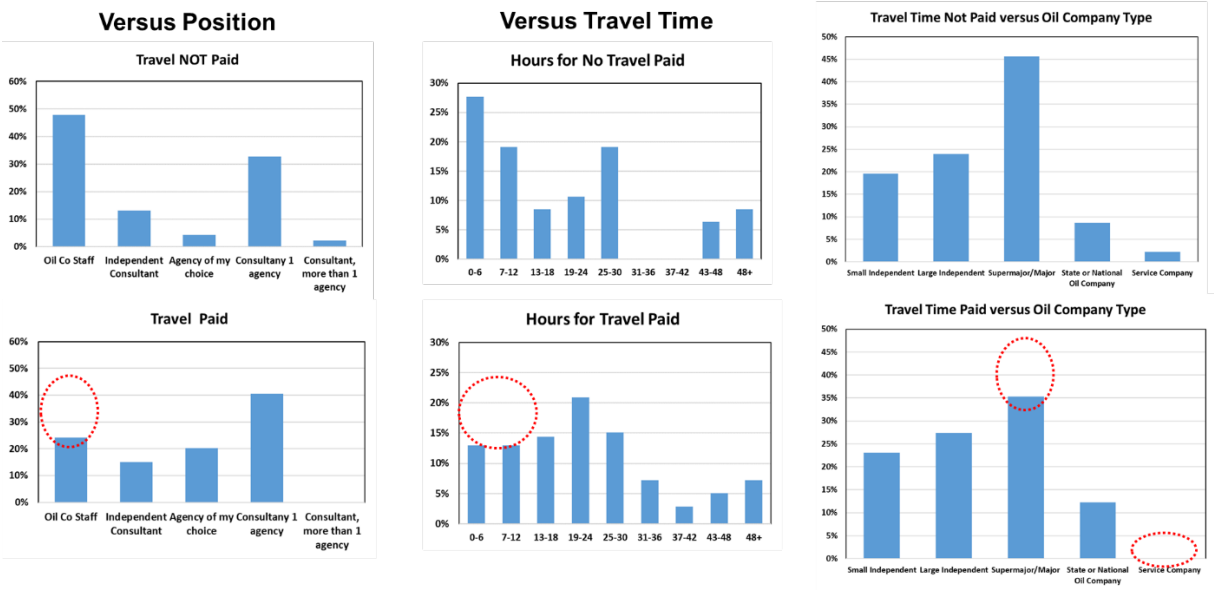


Figure 45: Travel time paid – Regional variations

An attempt was made to analyze the data and it would appear that oil company staff were less likely to be paid for travel (but as staff surely you are paid a monthly wage?). Travel time is not paid as much for

short travel times and supermajor/major oil companies and service companies are less likely to pay travel expenses. (Red rings highlight where differences occur)

Figure 46 summarises the answers to a survey question about work-life balance.

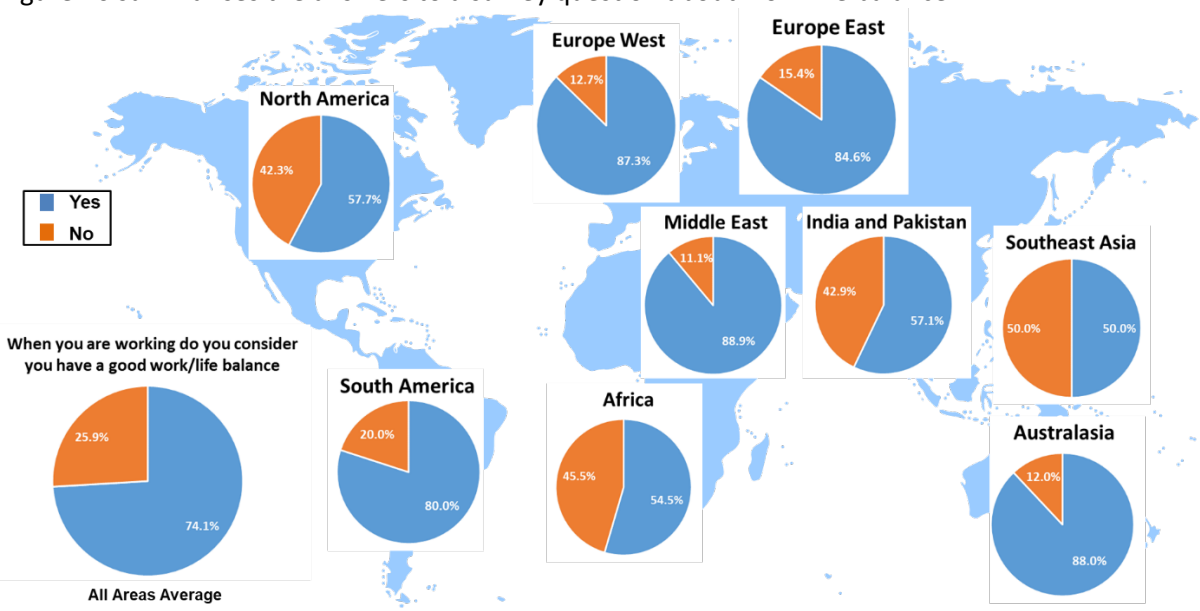


Figure 14: Work-Life balance

Given all of the above on average almost three quarters of respondents said they had a good work life balance, compared with 55% in the operations geology survey. The noticeable exceptions to this are Southeast Asia, India and Pakistan, Africa and North America. The reasons for this appear to be subtly different for each region but include unequal time off (more time at the wellsite), excessively long hitches and a relatively youthful work force.

The areas where the respondents said they had a good work life balance generally had an older work force. Time off was much more positive, and hitches tended to be shorter.

However, these conclusions are very simplistic and there are probably other factors relating to local work practices and culture that are not captured at all by the survey.

How do Wellsite Geologists Feel about their Discipline?

This section reviews what the respondents see as the main challenges and frustrations of the role and whether wellsite geology is appreciated. The questions that relate to this section were freeform in nature, respondents could write anything, so the top themes were picked out from the replies. Some respondents replied with multiple issues and these were all taken into account.

As it turned out the responses of the questions regarding the main challenges and main frustrations were very similar and so were combined as one in Figure 47.

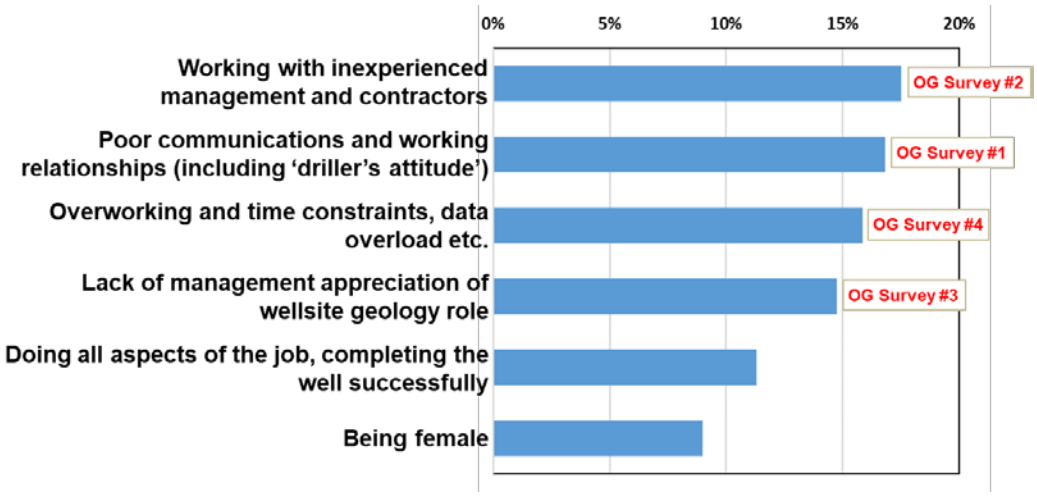


Figure 15: Operational Geoscience Challenges and Frustrations

The first thing to note is that the first four challenges and frustrations were very similar to those in the operations geology survey from 2015 showing the situation is pretty much the same for both wellsite and operations geologists. These first four challenges and frustrations probably contribute to the fifth, being able to do the job properly. None of these are unexpected and they reflect long standing issues of overwork, poor communication and lack of appreciation and knowledge of what the wellsite geologist does.

The sixth ranking challenge/frustration was 'being female'. Obviously, no males thought this was an issue! But the percentage is based on the number of females who stated that this was an issue in their answers. As we saw from Figure 9 which showed that only 7% of the respondents were female there would seem to be a long way to go to get semblance of equality or to even catch up with the industry average of 22%.

Having given these responses, as with the operations geology survey when asked how appreciated they felt, then the wellsite geology respondents seemed more positive (Figure 48).

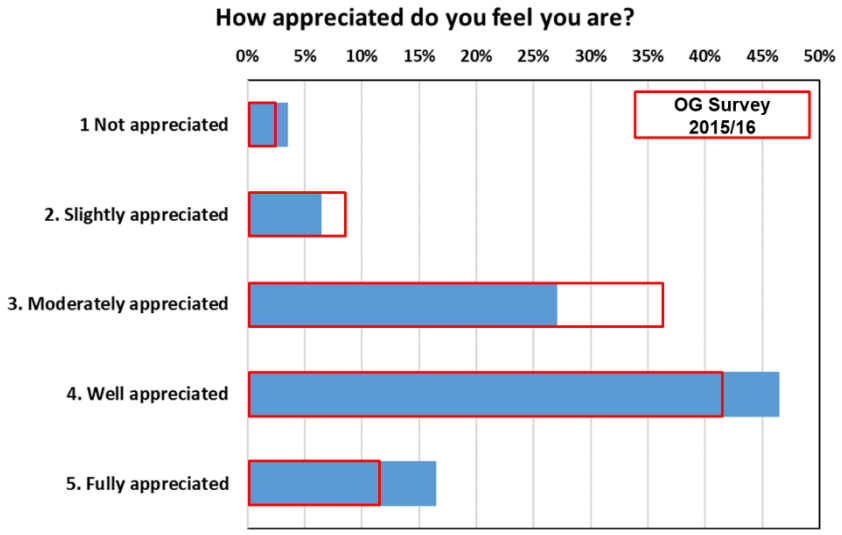


Figure 48: Appreciation of Wellsite Geology Role

The operations geology responses are shown with a red box and it would appear that wellsite geologists appear more appreciated and, overall, 'well appreciated'. The apparent difference between the lack of appreciation in Figure 47 and being 'well appreciated' in Figure 48 is probably down to the fact that wellsite geologists are appreciated by operations geologists but not so much by management with whom they have a more distant relationship. It may also be that certain companies have a better appreciation for the wellsite geology role than others.

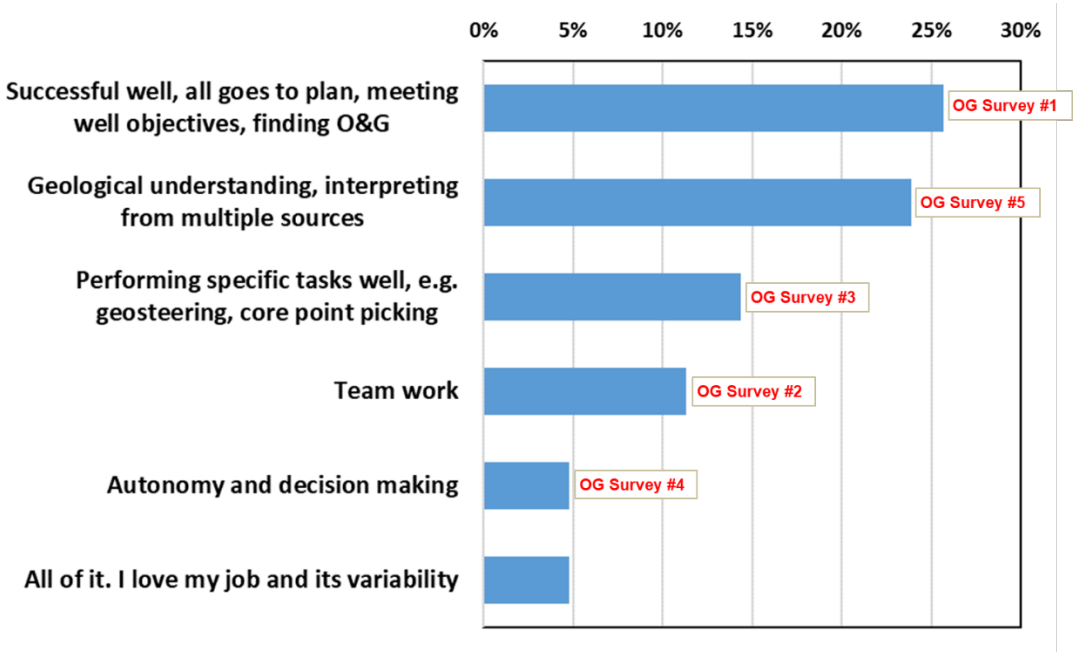


Figure 16: Wellsite Geology Fulfillment

There is also a good correlation between the results of the wellsite geology and operations geology surveys when it comes to aspects of fulfillment of the role, although there are slight differences in order (Figure 49). Essentially, over 60% of the responses are about doing the job well and contributing to a successful well and some people just love doing the job. The ability to make decisions and have some degree of autonomy is ranked low and this will be discussed later in this paper.

Remuneration and Reward

The results of the operations geology survey showed that respondents were prepared to share data about their remuneration as long as it was anonymous and the same question was asked in the wellsite geology survey - '*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£.*'

Of the 150 who responded to this question, only 18% preferred not to answer.

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 after the oil price crash in 2015. 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.

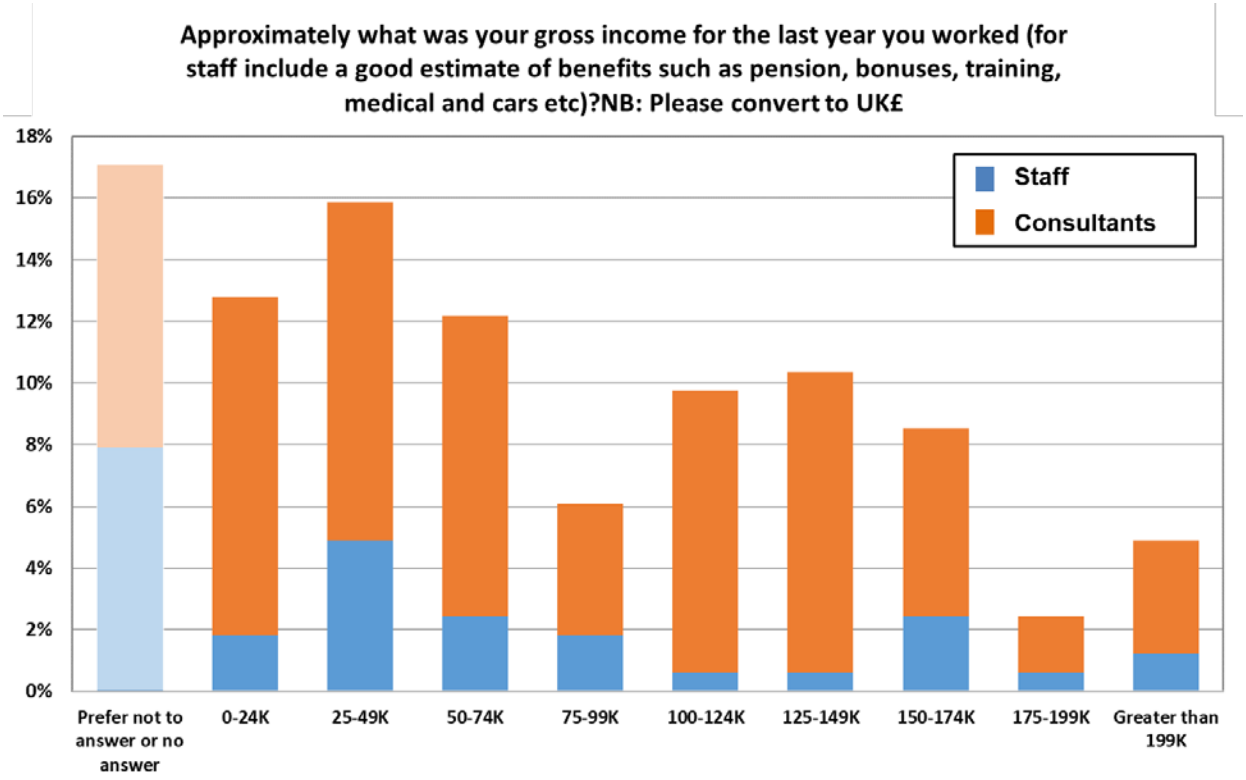


Figure 50: Gross remuneration, all respondents

Figure 50 simply plots the percentage of respondents worldwide versus remuneration ranges and staff versus consultants. There is an underlying distribution curve with two or possibly three spikes. Figure 51 splits the remuneration rates versus world area

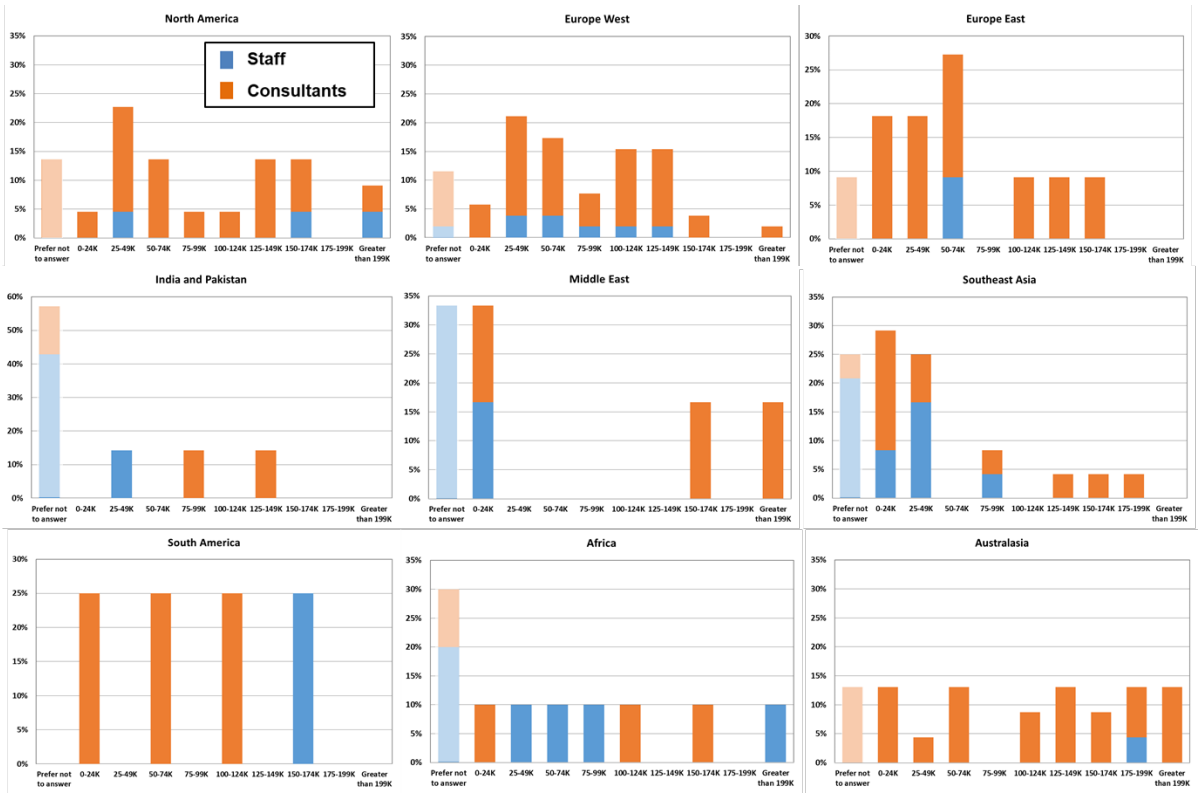


Figure 17: Adequately rewarded?

Although they are presented the graphs for India and Pakistan, the Middle East, South America and Africa are not statistically robust as the numbers of respondents are less than 10 each and some of these preferred not to answer (the leftmost bar in each graph). It was also these countries plus Southeast Asia and minus South America who the most reluctant to divulge their remuneration

For the other areas there was a wide range of remuneration for both staff and consultants with consultants edging the higher values, not being constrained by corporate wage structures. In Europe East and Southeast Asia remuneration was predominantly on the low side influenced by local pay and conditions and less by 'international rates'. Some remuneration rates seem quite high in a time of recession (£199,000 plus per annum), but some of the respondents worked as operations geologists (or other jobs) for part of the time as the market started to recover.

There was a general decrease in remuneration rates caused by the recession in the oil industry. While one or two lucky people had seen rate increases most either had a rate decrease or no job at all. The average rate decrease was approximately 33% although 20% of respondents actually stayed on the same remuneration rate. (Figure 52)

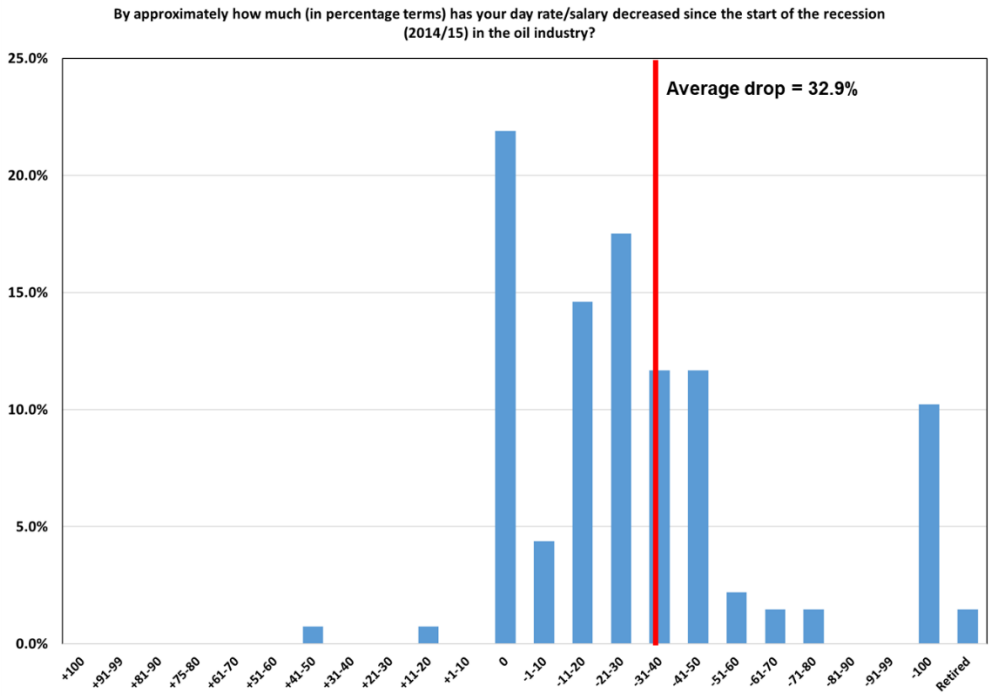


Figure 182: Remuneration Rate Decrease Worldwide

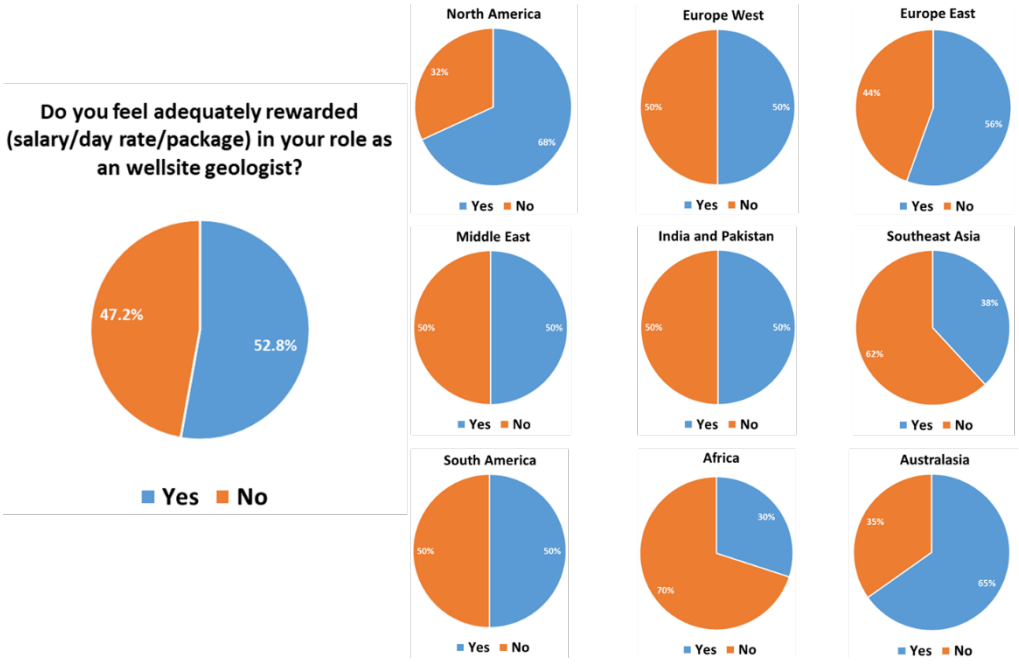


Figure 53: Are you Adequately Rewarded Financially

Figure 53 presents pie charts of respondents' answers to the question 'Are you adequately rewarded in your role as a wellsite geologist'. The pie chart on the left covers all respondents indicating that just under 50% thought they were not adequately rewarded. This is much higher than in a similar question in the operations geology survey, but the wellsite geology survey was taken at a different point in the downturn when, overall, rates were lower.

Further analysis did not indicate a great deal of difference between the views of staff and consultants but there were some regional differences. Those respondents from Australasia and North America felt much more adequately rewarded than average and Africa and Southeast Asia felt much less adequately rewarded. Over 50% of respondents from Southeast Asia were on the lowest two pay divisions in Figure 51 so this seems to have influenced this response.

When the responses regarding adequate financial reward were plotted against income there was an interesting result (Figure 54).

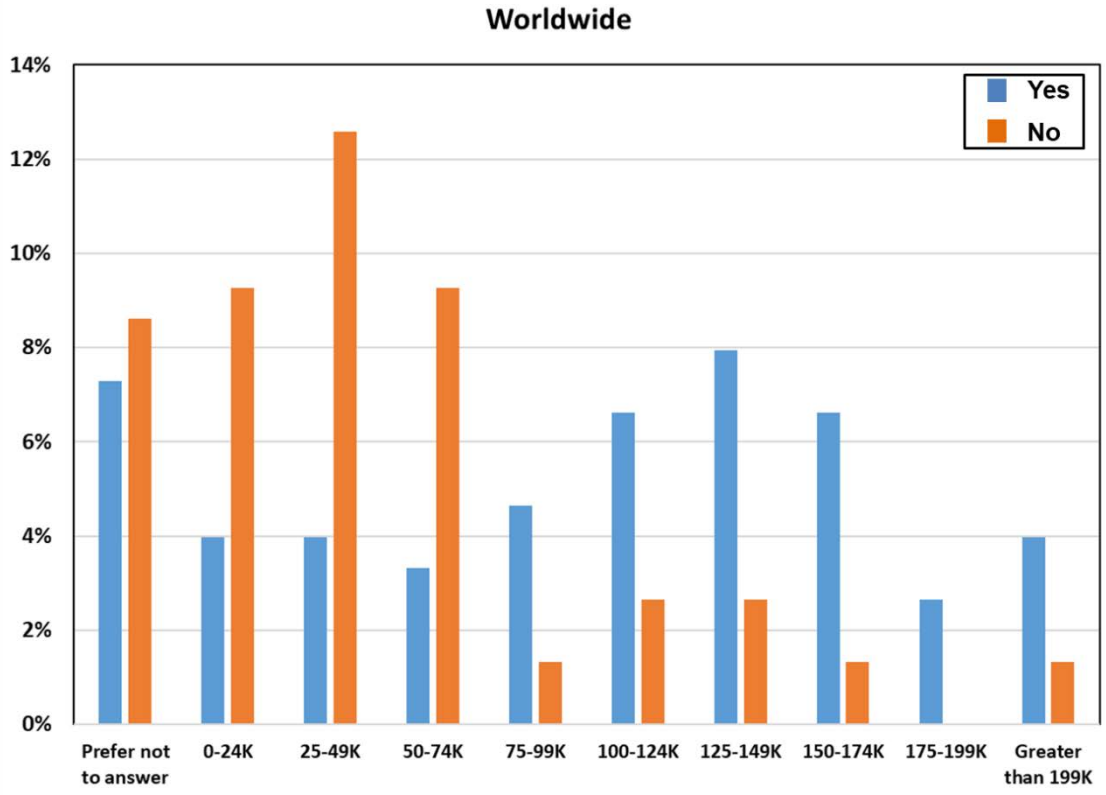


Figure 54: Are you Adequately Rewarded Financially? Worldwide versus income bands

There is a clear crossover point at about GB£75,000 where general satisfaction levels with financial income flip from no to yes. Some people are happy with lower levels of income and at least one respondent was apparently dissatisfied with an annual income greater than GB£199,000! It will obviously vary with region and standards of living. Splitting these data up into regions did not work very well as there were not enough meaningful responses in most areas.

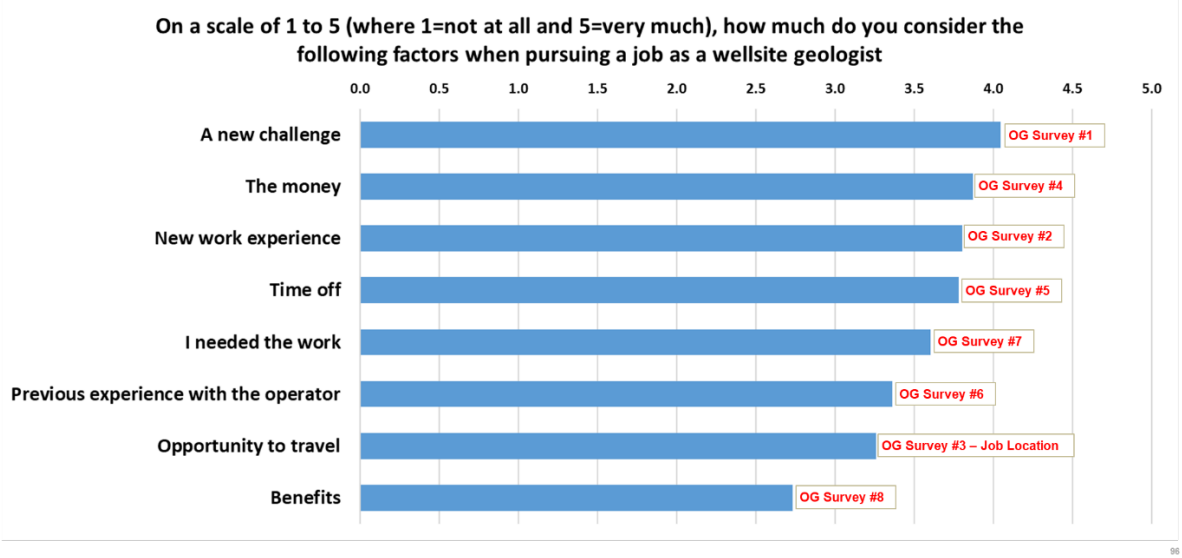


Figure 19: Factors when pursuing a job in wellsite geologist

Figure 55 summarises the responses as to the factors which influenced wellsite geologists when seeking a new job and also annotates what the results of a very similar question on the operations geology survey. Wellsite geologist maybe have less say over where they work than operations geologists, depending on if they are working as a less experienced consultants. Also, the state of the job market during the periods when the surveys were open may also influence the results. This is possibly why 'I needed the work' and 'the money' were slightly higher in the wellsite rather than the operations geology surveys. Otherwise the results of the two surveys for this question were similar.

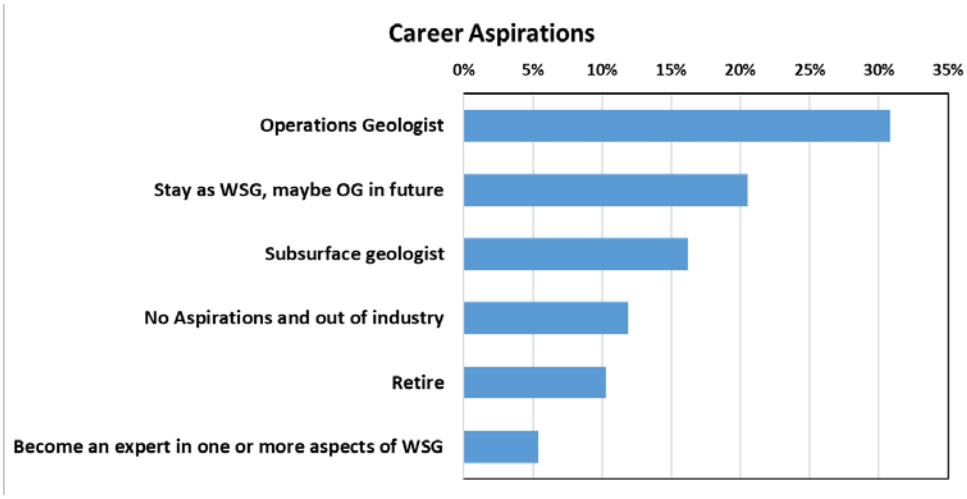


Figure 5620: Next career step

When asked about their career aspirations (Figure 56) over 50% of respondents said they would either get more experience and move on to operations geology or were already ready to move to the operations geology role. For some time, the wellsite geology to operations geology route has been the traditional career step so this is no surprise. Others wanted to gain expertise in certain aspects of wellsite geology.

Of interest was the fact that 20% were either leaving the industry or retiring. Given the state of the industry at the time of the survey it is perhaps surprising that only 12% were considering leaving the industry.

Past, Present and Future of Wellsite Geology

There is an ongoing debate about the future of wellsite geology. Anecdotal evidence suggests that decision making is being taken away from the wellsite geologist resulting in a gradual loss of autonomy. To a certain extent this is being driven by improved communications whereby the operations geologist and other office-based staff can see the vast majority of well data and the 'bigger brain' can make an informed decision. However, more worrying trends are becoming apparent with, in some cases, the wellsite geology role being much reduced in terms of scope and, in rare cases, done away with entirely by some operators. The reasons for this are cost reduction and HSE – having one less body in harms way at the wellsite. Clearly this is not on every well, but the trend is there, and the survey took the opportunity to explore this.

In the wellsite geology survey four questions were asked about decision making and autonomy and the results shown in Figure 57.

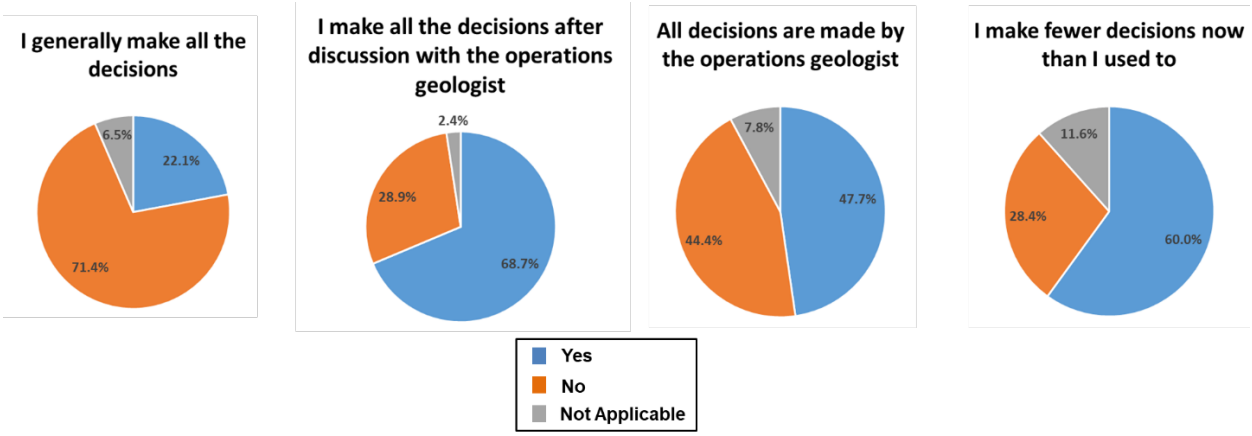


Figure 57: Autonomy Questions

In a snapshot survey such as this it is impossible to show a trend but the key question here is the fourth one summarized in the pie chart on the right. The majority of respondents said they are making less decisions then they used to and, from the other charts, it would seem that operations geologist is much more involved. This was hinted at in the operations geology survey with the review of real-time data one of their major responsibilities and the increasing use of real-time data centres with 24/7 monitoring.

There are some regional variations, but it is difficult to be certain about the exact reasons for this. Certainly, in the areas with younger, less experienced wellsite geologists the operations geologist tends to make more decisions which is what would be expected and would be the same for the less experienced wellsites in any area. But even the gnarly, old experienced wellsites are seeing their autonomy reduced and onshore support increasingly making more decisions.

The respondents were also asked “Do you consider you have autonomy in important operations geoscience decision making with real-time data?”. The results are in Figure 58.

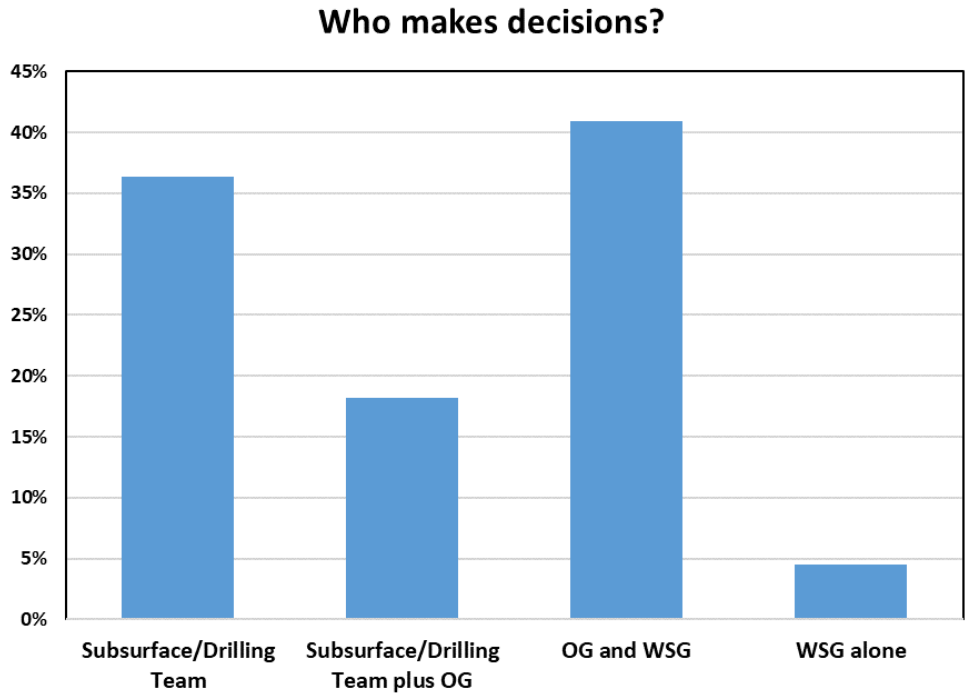


Figure 58: Who Makes the Geoscience Decisions?

As this is the first survey of its type it is impossible to tell if there is being a progressive shift away from rig-site decision making based on this question alone. Certainly only 4% of respondents said that they made geoscience decisions alone but, in recent years, any big decisions would be made in combination with the operations geologist or would have been pre-made based on a known set of potential scenarios or conditions (e.g. decision trees).

Possibly more concerning was that in almost 35% of cases the wellsite and/or operations geologist did not have a say in geoscience decision making with real-time data. In certain circumstances, such as drilling tool failure, for example, the operations geologist may not be involved but the question asked about geoscience decision making so this may be a concern.

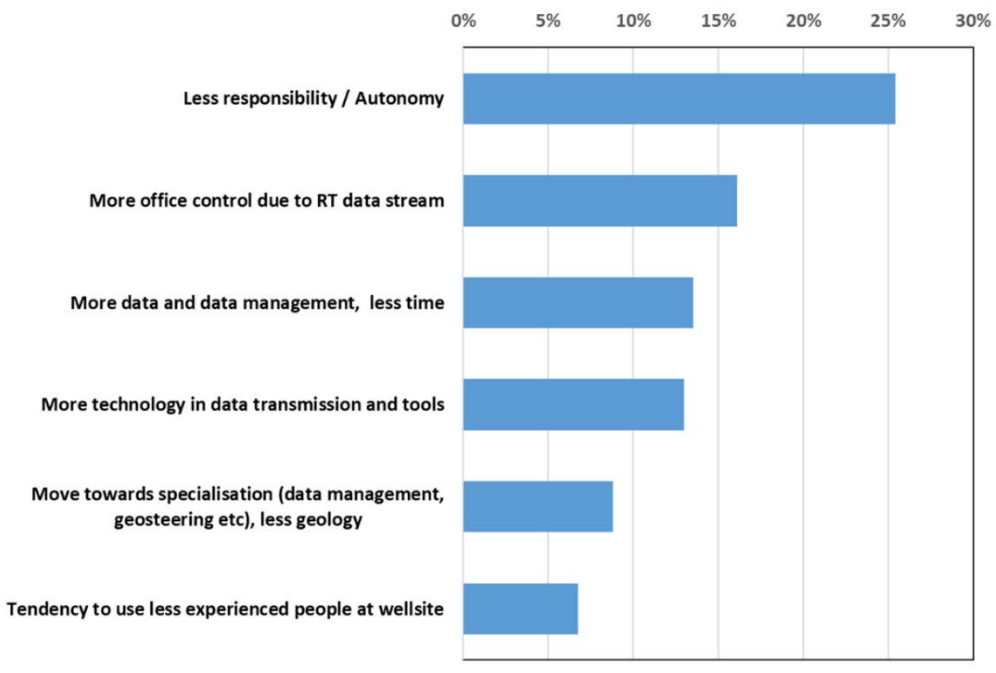


Figure 59: Recent wellsite geology role evolution

In response to a freeform question on how they see the recent evolution of the wellsite geology role the responses in Figure 59 were collated. It would seem that new technologies and enhanced communications are driving decision making away from the wellsite and that management sense that less experienced (and thus cheaper) personnel can be deployed at the wellsite. There is that common theme of more data, more work and data management seen in response to other questions in the survey. Some respondents suggested that specialisation was a way forward in topics such as data management, geosteering, pore pressure evaluation etc. but this would not be applicable to every well.

A further freeform question asked what the respondents thought was the future of wellsite and operations geology? The answers are summarized in Figure 60.

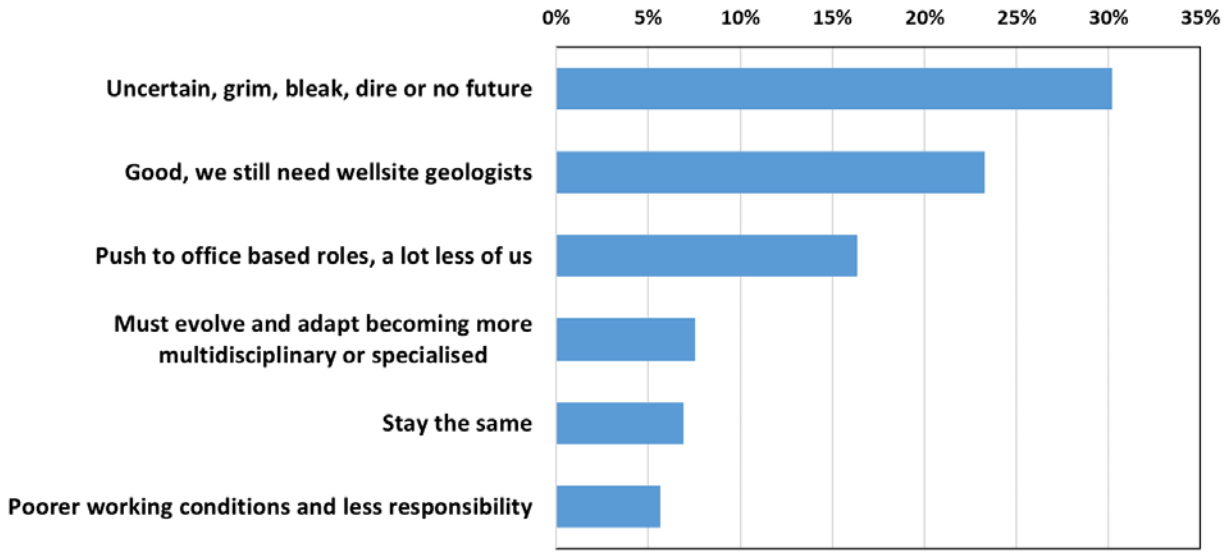


Figure 60: The future of Wellsite/Operations Geology

This question produced a mixed response but with a small majority saying that there was the future was 'bleak' or even 'dour' (their words). The question also allowed the respondents to input freeform their thoughts on this question. Many of the responses were made during the depths of the industry downturn and thought there was no future for them personally in the wellsite geology role. However, it was clear from other comments that they did feel that the wellsite geology role was gradually being diminished or cut out entirely due to technological changes and simple cost cutting.

When asked whether the recession in the oil industry has affected decisions on their future career path there was some uncertainty (Figure 61).

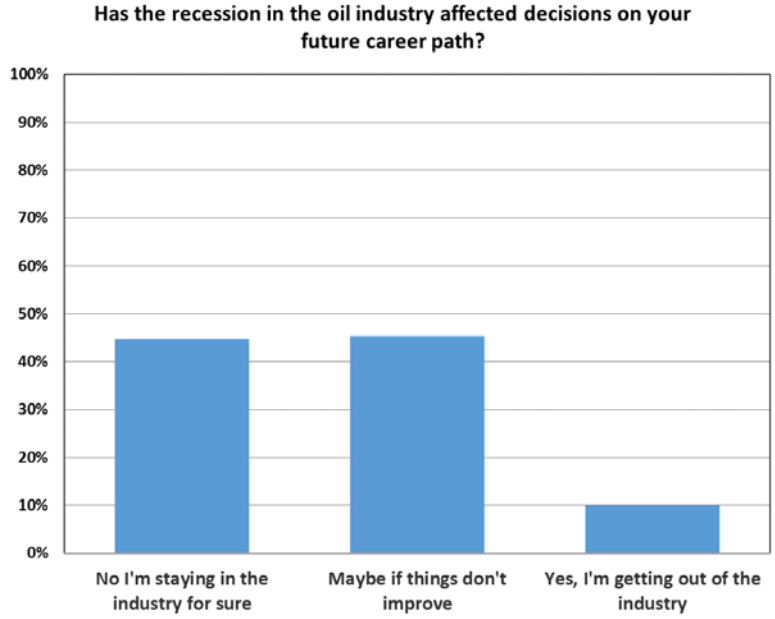


Figure 21: Has the recession affected your future career path?

Only 10% stated they were leaving the industry with 45% undecided, depending on whether things improve or not. When the survey closed, job prospects were just starting to improve and may have swayed a few to stay in the industry and increased their optimism about the future.

Conclusions

This was the first major survey of the wellsite geology discipline. Its aim was to find out, at a point in time, what the role is now and also how the future looks. There is now hard data to confirm previous suppositions. The main conclusions from the survey are:

- The wellsite geology role is still important, being a wide-ranging and responsible role, but it is rapidly evolving, driven by technological change.
- Compared with operations geology, wellsite geology has a healthier age demographic with a young workforce which will need to fill the void of the many operations geologists due to retire in the next five years.
- Generally, wellsite geologists are still working too long hours, but needs proper management to ensure it doesn't become an HSE issue.
- More effort needs to be made to attract and retain women in this and other disciplines of operational geoscience.
- Mudlogging is still an important rootstock for the discipline, although maybe not as important as it was. There is some concern about the employment of non-geologists at this level.
- A degree is geoscience still thought of as important by the vast majority of respondents.
- Personal leadership skills, communication etc., are as important as technical abilities but, it is these skills the discipline has the least training for.
- Poor communications and lack of recognition of the wellsite geology skillset are seen as the two main challenges and frustrations of the role.
- Working with inexperienced people who do not understand the wellsite geology discipline is becoming more or of a challenge. This paper hopes to help with that.
- For the most part the discipline is well paid for working hard. However, getting steady, long term work as a consultant is still an issue.
- Those who had work had an average 31% remuneration decrease in the recession. Many had no job, propelling them out of the industry.
- Money is not the main driver for getting a new job, a new challenge or work experience is seen as more important.
- There is still a lack of appreciation of what wellsite geologists do in some companies.
- Most wellsite geologists see the future of the discipline as uncertain. While a large minority not are not as pessimistic, change is coming, and the discipline needs to be prepared for it.

Many of these conclusions match with those of the 2015 operations geology survey which builds confidence in the validity of both surveys. Obviously, many of the same questions were asked in the operations geology survey so this might be expected, but even in the freeform questions, where respondents could write what they wanted, there was still a high level of consistency.

The biggest concern is the demise of the traditional wellsite geology role. While it may survive on high end wells where there needs to be some sort of 'hands-on' surveillance there is ample evidence of the role changing. The root cause of this is technological change, specifically the ability to transmit data and have office-based personnel drive the decision making. Also, more aspects of the role are becoming

'digitalised' and automated. There is also a financial and HSE incentive to move the wellsite geology away from the rig site or to get rid of it altogether. These are very strong drivers which will be difficult to resist.

The future of wellsite geology was debated at the 2018 operational geoscience conference and while some thought the role would survive in some form, others thought that future technological innovations will result in a further diminution of the role to where it no longer exists. Artificial intelligence, the use of 'big data' and data analytics in decision making is currently being trialed and is likely to be used in the future replacing decision making and automating even more traditional wellsite tasks.

Is there a future for wellsite geology? There is definite uncertainty, and it is up to the wider operational geoscience community to help to make it survive and shape the role for the future.

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