Geoscience skills needs of UK industry

For The Geological Society of London

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Skills needs of the UK geoscience industry

For The Geological Society of London

Prepared by TBR's Skills and Labour Market Team

Enquiries about this report can be addressed to:

Michael Johnson, Senior Research Consultant

Martin Houghton, Senior Associate

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Suite One Top Floor, Burgess House,
93-105 St James Boulevard,
Newcastle upon Tyne, NE1 4BW

Telephone: +44 (0) 191 279 0900
Fax: +44 (0) 191 221 2220
Email: michael.johnson@tbr.co.uk
www.tbr.co.uk

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1. Introduction

Over the last few years the Geological Society of London has become very aware of discussion and debate that industry lacks the skills and expertise required to address the wider needs of society. For example, in securing energy sources, addressing the effects of climate change or building stable and long lived structures. There is well-documented demand for science, technology, engineering and mathematics (STEM) skills in the current UK economy. Estimates from the UKCES suggest that 58% of all new jobs in the UK economy will require a high level of STEM skills (at least Level 3 or 4). The CBI's 2011 Education and Skills Survey states: "employers expect growing difficulty in finding STEM-skilled staff over the next three years. Overall, over half (52%) of businesses will struggle to recruit staff with STEM skills."

The Society has sought to bring together; industry, academe and government to further this debate and develop a foundation based on objective evidence rather than hearsay and myth. As part of this work the Geological Society commissioned TBR to undertake some work to explore these apparent gaps on an independent and objective basis.

This report sets out the findings of the research undertaken by TBR. While the document provides some conclusions from the research and recommendations for further work, it does not seek to offer proposals on how the Society should respond to the findings. The brief was clear in articulating a need to provide evidence and grounding to enable the Society to decide how best to respond.

1.1 Background

The Geological Society was founded in London in 1807. It is the UK national society for geoscience, and the oldest geological society in the world.

The Society provides a wide range of professional and scientific support to over 10,000 Fellows (members), about 2,000 of whom live overseas. More than 2,000 Fellows are also Chartered Geologists. The society acts as both the registration body and as a learned body for geologists. The Society also has 14 regional groups in the UK and 1 in Hong Kong.

Despite the fact that geologists form a relatively small part of the overall workforce and may be associated with processes that took place over aeons, geological skills are key to many activities such as oil and gas production, civil engineering as well as providing water for living.

As such, a number of specialist applications of geology have arisen. These include:

- Hydrogeology and environmental issues
- Engineering geology
- Economic geology
- Petroleum geology
- Mining geology

The focus of this work is on all of these but mining geology.

1.2 Objectives

The project sought to:

- Provide evidence about the demand for geosciences skills from industry and in particular whether there are any specific gaps or shortages.
- Provide insights and objective opinions from industry about any gaps in the availability of specific skills and/or experience.
- Provide grounding for the Society to determine 'what to do next'.

The resources available to undertake the study were limited and it is acknowledged that the evidence collected can only provide a starting point. The majority of the information provided is based on qualitative research and that any quantitative analysis is intended to be supportive and contextual, rather than relate specifically to the demand for geosciences skills.

This work focused on four areas of geosciences activity:

- Hydrogeology
- Environmental geology
- Engineering geology
- Oil and gas.

The project is being overseen and will report back to a panel of four members of the Society; three Council members including the President and the Head of Strategy and External Relations.

1.3 Methodology

The work involved four key stages:

Stage 1: Scoping discussions

Discussions were held with panel members to gain insights into their perspectives of the four sectors and possible shortages of skilled staff. These meetings provided valuable background information into the various aspects of geology as well as their application to commercial activity.

Stage 2: Desk research

Desk research was undertaken to gain an indication of the extent of employment of the geosciences across the economy. This utilised a number of data sources. However, the geosciences are inexactly defined[1] by the Standard Occupational Classification scheme, so a precise estimate of the workforce was not available.

Stage 3: Interviews with employers

Interviews with employers and other industry commentators were held to gain feedback from those with firsthand experience of the labour market for geoscience skills. All four sectors were covered:

Table 1: Sectors of respondents

Sector	Number
Engineering	10
Environment	1
Hydrogeology	2
Hydrogeology/environment	1
Mining	1
Oil and Gas	5
Cross sector	1
Grand Total	**21**

[1] Code 2113 includes physicists, geologists and meteorologists. However, many geotechnical engineers are likely to be classed as civil or design engineers under codes 2121 and 2126.

The interviews were primarily carried out by telephone though some were completed face to face or by email. An aide memoire was used to ensure that key topics were covered consistently but that adequate scope was provided to explore issues as they arose. Consistency was enhanced further as one person undertook most of the interviews.

The interview was split into five key question areas:

1. Initial information about the business and the number of geoscientists employed.
2. They types of geoscientist employed, profile of the workforce and the importance of chartered status.
3. Skills gaps, knowledge of specific shortages and impact on the business.
4. Recent experience of recruitment and whether there is any reliance on workers from overseas.
5. Anticipated recruitment and perceptions about qualifications.

Stage 4: Review of the evidence

Finally the evidence was assembled and reviewed. The interviews with employers and industry commentators were transcribed into a spreadsheet and arranged by question to enable comparison of responses received. The data were annonymised to ensure confidentiality of the respondents.

The data were considered and reviewed across a range of themes and topics. To assist this process the themes are presented as a mind map. A truncated version is provided within the report and a full account in the appendices.

A full set of findings are set out in text format using numbered paragraphs. The latter is intended to make referencing straightforward.

2. Quantifying the geoscience workforce

There is no previous research which quantifies the size of the geoscience workforce. This is, in part, due to the complex nature of national statistics which cannot draw out geoscience workers in all sectors. As such, estimates of the workforce size currently rely on previous skills gaps and membership research.

Using Office of National Statistics (ONS) data the research suggests that the geoscience workforce is 30,570. A core and peripheral definition was used to create this definition, with the core geosciences workforce around 24,670 and a peripheral workforce of 5,890 (Table 2)[2]. The Geological Society of London estimates that the workforce is between 15,000 and 20,000 people. It is assumed that the workforce is likely to be between these two figures.

There has also been work on the composition of the geoscience workforce by employers and employer bodies. Work by The Environment Agency provides an indication of the size of the geoscience workforce within the organisation. The Environment agency employs 12,500 staff and is the largest UK employer of hydrogeologists, the second largest employer of geoscientists and one of the largest employers of Geography, Geology, Earth and Environmental Sciences graduates. The Agency employs around 350 geoscientists, 1,200 field officers and 160 science and research staff as well as others in hydrology, hydrometry and geomorphology related roles[3].

Ground Forum, the umbrella group for the ground-engineering sector, has also produced work on the size of geoscience (in relation to engineering) workforce. Work by the organisation suggests that there are around 6,000 geo-engineers across the membership, with some research noting that there has been a small decline between 2007 and 2010, although it is not known whether this is due to methodological issues or sector difficulties.

Table 2: Geoscience workforce estimates, 2011[4]

	Geoscience sectors				Geoscience Industry
	Engineering Geology	Environmental geoscience	Hydrogeology	Oil & Gas	
Core	21,590	1,585	445	1,055	**24,670**
Peripheral	290	0	0	2,600	**5,890**
Total	**21,880**	**1,585**	**445**	**3,655**	**30,565**

Source: TBR analysis of APS 2011: Data in the table is rounded to the nearest 5 to ensure compliance with data protection legislation.

[2] This definition was reached having restricted ONS Annual Population Survey (APS) data by both industry and occupation. Only three occupational groups (Physicists, geologists and meteorologists; Laboratory Technicians; Building and civil engineering technicians) were considered, and those only if they fell within a narrow selection of industries.

[3] http://www.gees.ac.uk/planet/p19/ct.pdf

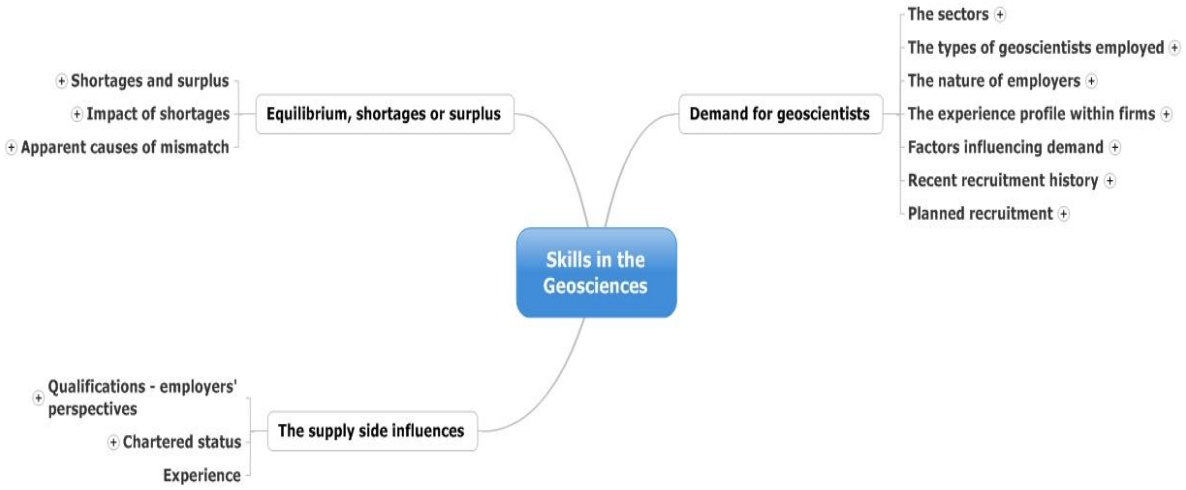
[4] The geoscience industry total exceeds sum of four sectors, this is because some geoscience workers fall outside the four sectors.

3. Emerging qualitative themes

We have sought to organise and present the data so that it is easy to assimilate and assess. As such, we have chosen to set out our findings in two ways; first as a 'mind map' overview (Figure 1) and then in detail using standard text. A more detailed mind map is provided in Appendix 1. Paragraphs have been numbered to help identify specific text.

Note this report should be read in association with the Evidence Compendium (MS Excel workbook).

Figure 1: Schematic View



Exploring the data in more detail, we see that the demand for geoscientists being driven by a range of factors:

3.1 The sectors

1. Demand for skills is affected by the sectors and their specific nature. The research sought to investigate four specified sectors:
   - Oil and gas
   - Engineering
   - Environment
   - Hydrogeology

2. The brief explicitly omitted Mining and quarrying due to the relatively small scale of UK operations.

3.2 The types of geoscientists employed

3. Each of the sectors tends to employ a specific subset of geoscientists, though there is a degree of overlap.

Oil and gas

4. Within oil and gas or the petroleum sector, staff are categorised into three groups:
   - Exploration
   - Production
   - Specialists

5. Employers report that within exploration and production they employ:
   - Geologists with some form of petroleum related specialism
   - Geophysicists
   - Engineering

Engineering

6. Both contracting companies and consultants indicated that they employ:
   - Engineering geologists
   - Geotechnical engineers
   - Hydrogeologists

7. There was relatively little evidence to suggest that there is any pronounced demarcation between engineering geologists and geotechnical engineers. In fact a significant number of interviews noted that they carry both Chartered Geologist and Engineer status (ICE or IMMM).

Environment

8. Within the environment sector professional staff tend to be identified as:
   - Environmental engineers
   - Geologists
   - Contaminated land specialists
   - Hydrogeologists
   - Geochemists

Hydrogeologists

9. By definintion all staff were classified as hydrogeologists. However, there was some indication that the term 'hydrologist' is in use to signify that surface water is also considered and for marketing purposes. The latter relates to overcoming a lack of familiarity with the term hydrogeologists with some client groups.

Specialisms

10. There was no further mention by the respondents of detailed specialisms other than those mentioned above.

3.3 The nature of employers

11. Clearly not all employers are the same. A range of factors were identified that appeared to have an impact on the recruitment and employment of geoscientists. Details are outlined below.

12. There are clear differences associated with sector.

Oil and gas

13. The oil and gas or upstream petroleum sector is typified as being highly demanding in terms of the calibre of staff and working conditions. This is compensated for by equally attractive remuneration. The sector tends to attract and recruit people with the appropriate characteristics.

14. Businesses within the sector tend to be grouped as either integrated oil companies or service providers.

15. By their very nature integrated companies such as BP, Shell and to some extent BG are large and span a broad range of activities. Service providers tend to be smaller than the integrated companies as they specialise in specific areas of activity. However, there are major service companies operating worldwide, eg Haliburton with nearly 70,000 employees across 80 counties.

16. There is evidence that, at present, the large integrated oil companies take pre-eminence in the sector, pay premium rates and have the prime selection of candidates.

Engineering

17. The engineering sector can be split by function: construction and consultancy and by the degree of specialisation. Specialist firms tend to be much smaller than multidisciplinary companies.

18. There is some evidence that the consulting companies are regarded as the premium employers and demand higher calibre staff than the construction businesses.

Environment

19. There is evidence that the environment sector is segregated into two regarding skills and employment. On the one hand, many staff choose to work in the area primarily for ideological reasons and do not necessarily posses rigorous scientific skills or qualifications. Typically these people are engaged in relatively routine activities. Whereas, environmental consultants also employ staff with strong scientific credentials that include geosciences.

Hydrogeology

20. There is little evidence to suggest that hydrogeology exists as a sector in its own right. It is better characterised as a specialist area of the geosciences. Hydrogeologists tend to work in either the engineering or environment sectors.

Public versus private sector

21. While we were unable to speak directly to any public sector employers (we spoke to a number of former employers), there was some evidence to suggest that there are differences for geoscientists working in the public and private sectors.

22. There were suggestions that expertise and credentials had to be demonstrated more overtly in the private sector. This related particularly to areas that involved regulation, and their interpretation. Without being able to demonstrate the robustness of a schema, and the credentials of the designer it was suggested that conditions and regulations would be imposed and enforced dogmatically. Whereas, where a track record and expertise could be shown then there was room for negotiation.

23. There were also indications that the variety of work is greater within the private sector compared to the public sector. This means that the potential for on the job training is relatively limited within the public sector.

Nationality

24. The businesses we spoke to can be characterised as:
    - UK owned and based in the UK
    - Previously UK owned now part of a foreign owned group
    - Foreign owned with operations in the UK

25. There was some limited evidence that foreign owned companies are more inclined towards training than UK owned businesses. The attitude toward training appears to be an outcome of the general ethos of a business, rather than something that is self-contained.

Size of business

26. Businesses can be characterised in three ways:
    - Large integrated businesses or multi-disciplinary consultancies
    - Focused operations
    - Small niche operators including sole professionals

27. As expected the larger businesses tend to have formal systems in place which include training schemes, where these exist, eg graduated development programmes. The focused operations are less formal and may or may not have training programmes in place. Small niche operations tend be based around individuals who are already highly trained (and are trading off this acknowledged expertise). However, many use mentoring as a mechanism to guide the development of younger colleagues.

3.4 The experience profile within business

28. Businesses tend to identify three groups:
    - Recent graduates with up to five years' experience
    - Mid career professionals with 5-15 years' experience
    - Established senior professionals with over 15 years' experience

29. A number of firms had an even spread across all three groups. However, there were exceptions.

30. Employers in oil and gas and engineering noted that their staff demonstrated a bimodal distribution; with significant numbers of young graduates and those nearing retirement, but with relatively few mid career professionals.

31. Environmental and hydrogeology firms noted that their staff tend to be relatively young reflecting the nature of the sectors/specialism.

3.5 Factors influencing demand - sectors

32. We found a number of factors influencing the demand for staff, some of which are discussed above.

33. The sectors are a significant factor in influencing the demand for geoscientists. This derives from the nature of the sectors and the drivers of demand/state of the economic cycle that influence them.

34. Oil and gas operates within the commodities market and is directly linked to the state of the world economy. Thus the oil price (and to a lesser extent the gas price) is key in determining the buoyancy of the sector and hence demand for geoscientists.

35. The oil and gas sector operates towards the extreme end of the risk/return continuum. High levels of risk are compensated for by equally attractive returns. This results in a feast or famine regime with demand for skills being determined by the current and anticipated oil price.

36. In 1998 the average price of crude oil was less than $12 per barrel compared to over $35 in 1981. This collapse in price had a major impact on investment including skills.

37. A number of the geosciences related MSc programmes closed in the late 1990s early 2000s.

38. Fossil fuels are a finite resource, with many of the known reserves in areas that are technically challenging or controlled by hostile/unreliable governments. This is driving exploration to new geographies, e.g. East Africa and alternative forms, e.g. unconventional gas. Both have an impact on the demand for geoscientists.

39. The engineering sector operates as a service to capital projects, especially infrastructure. Thus demand for engineering based geoscientists is dependent of the overall state of the economy and government spending.

40. The geosciences tend to be engaged at the start of any major projects, e.g. feasibility, ground investigation and design of foundations. As such they tend to be a leading indicator for the economy. The corollary of this is that there are few, if any, early warnings for what the engineering sector should be doing in terms of planning for skills requirements.

41. The environment sector is largely influenced by legislation. While attitudes to issues such as global warming and sustainability may drive sentiment and public opinion, legislation and regulation tend to determine investment. As such demand for geoscientists is linked to government policy.

42. The recent drought has highlighted the importance of water resources and role of hydrogeologists. However, the demand for hydrogeologists from UK based activities is unlikely to be subject to major changes.

Competing markets

43. The labour market for geosciences skills is international. Furthermore many of the skills are transferable between sectors. Thus competition for skills is not constrained within the sectors or the UK.

44. We found a number of instances where staff left in order to move abroad. Since the rapid upturn in the commodities market there has been substantial demand for geoscientists from Australia. Attractive remuneration packages and the lure of a tropical climate make this highly appealing for geoscientists with five or more years' experience.

45. The oil and gas sector, the integrated majors in particular, are able to pay premium rates for good quality geoscientists. This, coupled with confidence that the high oil price will remain buoyant, has meant that oil companies have been able to commit to graduate recruitment early and secure the best students.

46. Over the last 15 years the finance sector has also been an attractive destination for geoscience graduates with five or more years' experience.

3.6 Factors influencing demand - Other factors

47. Other factors affecting demand for geoscientists include:

Position within the value chain

48. Geoscientists tend to be engaged in establishing the feasibility of many investments. This work is associated with high levels of risk and responsibility. As such, it demands high levels of skill and expertise. High calibre geoscientists involved in exploration for oil and gas and assessment of sites are in demand.

Role of substitutes and barriers to entry

49. Hydrogeologists and geophysicists noted that they are subject to competition from non geoscience professionals.

50. For hydrogeologists it appears that routine work involving environmental impact assessments is often undertaken by civil engineers. Qualified hydrogeologists tend to be called in if, and when, problems arise. The key reason for not using geoscientists appears to be the routine nature of the work, which is often considered 'boring'.

51. In the case of geophysics, the data collection associated with near surface land surveys is often undertaken by unqualified staff. The relatively undemanding work of *'dragging a piece of kit along and pressing a button at the right time'* can be undertaken by unqualified personnel with only limited training.

52. Regulations that require qualified personnel clearly influence demand and influence price/fees. The engineering consultants placed significant emphasis on the role that chartered status plays in setting fee rates.

Recruitment planning

53. As mentioned above, geoscientists tend to be at the early stages of projects, making resource planning difficult and subject to change. As consequence, some employers act cautiously and seek to recruit only against established projects. This leads to peaks and troughs in demand for skills.

54. The geosciences tend to be associated with large capital projects. The programme for these tends to be lumpy, exacerbating the variable nature of demand for geosciences skills.

3.7 Skills planning

55. Many of the factors influencing the demand for geoscience skills identified above are independent of individual firms. At this point we seek to identify how employers respond to these pressures.

Skills and experience – make or buy?

56. We found that the majority of employers are committed to recruiting and training graduate geoscientists. The key issue is one of quantum and whether this is adequate to cover future demand.

57. However, a significant element of demand is for already experienced staff to either cover the replacement of staff who leave or to address new work. Unless the latter is part of a planned development, then the period of warning is limited to three to six months.

Coping with variable demand

58. Competitive pressures demand that employers keep employment costs under strict control. This has lead firms to adopt a range of strategies when responding to periods of variable demand:
    - A hire and fire regime that seeks to match the payroll to current demand – only one clear example of this.
    - Keep good quality staff, no matter the cost – the majority indicated that they tried to do this, to a greater or lesser extent.
    - Maintain a core capability and outsource the majority of the skills resource – no direct examples but appears to be the approach adopted by a number of public agencies.

59. There are clear consequences for the labour market from firms adopting these strategies, or, as you sow, so shall you reap.

60. The recent recession and drop in the oil price in the late 1990s meant that during these periods the size of the geosciences workforce fell. Specifically, staff left, retired or were made redundant. Furthermore, they were not replaced by new graduates as recruitment was curtailed or stopped completely. While some of those that left the sector have since come back (as in oil and gas), the consequences are still being felt in a lack of personnel with experience.

Recruiting for experienced staff

61. Several businesses noted that they 'were looking for senior, experienced' staff. However, it was apparent that the nature of this demand and rationale behind the desired expertise was not always the same. Two distinct drivers emerged:
    - Where there was an immediate demand to work on or lead specific projects or initiatives and where time was an issue.
    - Where the demand was more developmental and the expertise was needed to bolster an establish team, help mentor young staff or, in one instance, look to take over the business.

3.8 Recent recruitment history

62. Of the 15 employers that we spoke to (excludes the sole practitioners and sector organisations); 11 reported that they had taken on new staff in the last 12 months. The split was even with five noting that they employed both recent graduates and those with experience, three only new graduates and three only those with experience.

Difficulties in recruiting staff

63. Graduates with undergraduate degrees (BSc/MSci) in the geosciences appear to be available in adequate volume. However, there are issues with the calibre of the output. There is a concern that quantity is being used to overcome a lack of good quality entrants into geosciences degrees. One employer coined the term 'delayed disappointment' to describe the outcome of the process of not allowing students to fail or enabling them to gain apparently good degrees (2:1 or 2:2). The respondent indicated that there was a perception that the education system was too accommodating and that proper advice was not provided until students came up against employers whose standards were uncompromising. It was suggested that by providing more robust feedback earlier in the education process that students could be saved significant disappointment and rejection when it came to looking for jobs. The increase in the number of undergraduate students and competition between institutions for fees were cited as contributory likely factors.

64. Employers identified a range of attributes that they look for:
    - A 'get up and go mentality'
    - Intelligence
    - Confidence
    - Outgoing personality
    - Potential to acquire supervisory skills
    - Report writing skills.

65. The key area of difficulty in recruiting was for experienced staff. Specific examples given were:
    - Processing geophysicists – 10 to 15 years' experience
    - Experienced petroleum geochemist – 15 years' experience

- Senior geotechnical engineer – experience of large marine structures.

3.9 Supply side influences

66. We received comments regarding three key areas relating to the nature and supply of candidates:
    - Qualifications
    - Chartered status
    - Experience

Chartered status

67. The attitude of employers toward chartered status was directly influenced by the nature of their sector.

68. Oil and gas, have to date, been indifferent to chartered status. In some cases it is even deemed irrelevant especially where other organisations are already established.

69. There is some evidence that this is changing and that C Geol may provide a useful measure of competence.

70. Within the engineering sector, C Geol is highly valued and deemed a pre-requisite for anyone seeking progression.

71. Respondents were consistent in the benefits they attached to attaining C Geol:
    - It provides a clear demonstration of competence.
    - It enables employers to charge premium rates for staff.
    - It is a mark of a commitment to personal development.
    - It may lead to a pay rise or bonus.

72. Chartered Geologist is deemed to be the equivalent of Chartered Engineer, though the latter is longer established and more prevalent. A significant number of geoscientists have achieved both (C Eng though ICE or IMMM).

Qualifications

73. The majority of employers have clear views about geoscience qualifications.

74. BSc in geology. This is regarded as a standard benchmark for an undergraduate degree. While necessary, it is not always sufficient.

75. MSci (mainly by research with a limited taught element) is, at best, unknown by employers or considered an inferior degree. One major company only recognises it as an undergraduate degree, whereas others suggest that it does not even match the standard of a three year BSc as it allows students to take an extra year to catch up while carrying out a limited piece of research, "*MSci is the worst of all worlds as the fourth year is wasted on nebulous research that is likely to be of limited or no value. This degree is seen as an easy way for universities to make good margins on full fees with little or no teaching input. It is only useful for creating more researchers."* However, in one case, an employer indicated that if the research project was relevant it may offer 'an edge' over a candidate with a BSc. It is certainly considered inferior to a BSc with MSc (taught). The research element is seen by some as providing a useful launch pad for PhD students.

76. MSc (taught) is the defacto standard for employers seeking high calibre graduates. There are a range of combinations and permutations of geosciences and related degrees, eg geology with engineering, vice versa, geology with petroleum studies.

77. A number of respondents indicated that they had a preference to recruit geotechnical engineers over engineering geologists (the exact reasons for this were not mentioned but there was an inference that graduates with an engineering background were closer to the work being done and were more likely to have some relevant geosciences expertise, e.g. soil mechanics).

78. A shortage of young geotechnical engineers meant that a number of companies were looking to take on and train engineering geologists.

79. PhD is considered ideal for those seeking to specialise, though one employer felt that PhDs lacked dynamism and chose the doctoral route by default rather than positive choice. We gained indications that there is a shortage of relevant, good quality doctoral students in the geosciences. As a consequence employers are seeking PhDs in related subjects and providing additional training. Examples include:
    - Electronic engineering
    - Cosmology
    - Physics.

80. There was ample evidence to suggest that there is inadequate dialogue between industry and academe. The comments about the perceived value of MSci courses highlight a gap between the demand and supply sides of the labour market.

3.10 Equilibrium, shortages or surplus

81. It is clear that the labour market for geoscience skills is not homogenous, though there are common threads. Thus it is not possible to consider the market as a whole, rather specific segments need to be addressed individually.

82. The segmentation of the labour market is reflected in the industrial structure. A review of the SIC/SOC analysis shows that geologists and related occupations[5] are spread fairly evenly across a number of sectors.

Shortages and surplus

83. There appears to be evidence that there are adequate numbers of students graduating with first degrees in geology (BSc/MSci). However, there are questions about the quality of these graduates when they are faced by employers demanding exacting standards. See previous comments relating to 'delayed disappointment'.

84. There is some evidence of unemployment among recent geosciences graduates. This was raised by academics and recruitment specialists.

85. As expected, there is demand for high quality students at BSc, MSc and PhD levels.

86. There is evidence to suggest that, until recently, there was reasonable balance between supply and demand for MSc graduates. However, there are major concerns now that the Natural Environment Research Council (NERC) has withdrawn its support for MSc programmes. Typical costs of £20-25k per annum are likely to preclude all but the wealthiest or most confident students. As mentioned above, there is industrial support

[5] AS mentioned previously, geologists are grouped with physicists and meteorologists.

available for some students on petroleum related courses but no evidence of similar help for those studying engineering related Masters.

87. There is ample evidence of a shortage of experienced (10 years+) geophysicists in the oil and gas sector. There is also some indication of shortages in specific specialisms such as geochemists.

88. There is ample evidence of a shortage of experienced (10 years+) engineering geologists and geotechnical engineers.

89. There is also some evidence of a shortage of experienced hydrogeologists.

90. We received feedback that there is no shortage of qualified people wanting to work in the broad area of environment. However, only a portion of these can be classified as geoscientists, i.e. they posses at least one degree in a recognised geoscience, the majority possess degrees in environmental sciences or some form of biology.

Impact of shortages

91. Employers indicated that shortages were usually evidenced by an inability to fill vacant posts or that the recruitment process took a long time (>6months).

92. Businesses reported that the inability to recruit staff had the following impacts:
    - Danger of not delivering projects on time
    - Having to use more junior staff and so incurring additional time in supervision
    - Constraining growth
    - Management time is stretched
    - Senior staff (technical) are overloaded
    - Staff are unwilling to travel
    - Unable to win work
    - Work is delayed or not done
    - Unable to put time into training and mentoring young staff.

93. Firms are generally coping in the short term, but in some cases it is constraining the ability to compete for work.

94. The main strategies for coping are:
    - More active resource management (a standard activity for most geoscientists)
    - Recruiting non UK nationals
    - Forcing existing staff to take up the workload
    - Subcontracting to smaller firms/sole practitioners who do not compete for lead projects.

Causes of the shortages

95. There are four aspects to the reported shortages:
    - A lack of availability of experienced professionals
    - Shocks to the system that have disrupted the demand/supply equilibrium
    - Cyclical variations in demand
    - A lack of supply.

96. At present the almost all the shortages in skills relate to experienced personnel. The only shortages associated with young, inexperienced people involve inadequate numbers of high

quality people graduating with geosciences degrees and too few PhDs with interests in relevant areas.

97. The shortage of certain geosciences disciplines relate to; too few graduates being recruited and trained in the past and increased demand from competing sectors and geographies, e.g. mining in Australia.

98. As indicated earlier, the collapse of the oil price in the late 1990s and the 2008 economic crises led to a sharp fall in demand for geoscientists, which disrupted the prevailing state of supply and demand. Two effects were; the closure of a number of MSc programmes, e.g. MSc in hydrogeology, University of East Anglia, and the lack of graduate recruitment resulting in a cohort of geosciences graduates being completely lost.

99. Even in the absence of specific shocks, the natural ebb and flow of economic cycles means that there will always be periods when skills are in relative under or oversupply. High commodity prices are responsible for a significant number of experienced geoscientists relocating to the southern hemisphere.

100. Within engineering the situation is exacerbated by the large and discrete nature of projects and apparent absence of any central planning, even for government infrastructure.

101. Several respondents indicated that they were anticipating a shortage of graduate geoscientists entering the market. The two causes were; the withdrawal of funding for MSc courses by the NERC and the increase in undergraduate fees to £9k per annum.

102. While there is clear evidence of employers providing support to students undertaking MSc programmes related to the oil and gas sectors, it was not apparent elsewhere. This was succinctly put thus; *"There is no chance that industry will sponsor students through MScs as it does not have the cash, whereas the oil companies do."*

4. Conclusions

Having considered the evidence of demand for geoscience skills against employers' experiences in recruitment, we set out a number of conclusions.

103. There are clear indications that the demand for skills in some areas of the geosciences exceeds supply.

104. However, this situation is very partial and does not affect all sectors or aspects of the geosciences.

105. The shortages relate primarily to work experience, rather than qualifications or other attributes. Employers have identified those with 10 to 15 years' experience as being in greatest demand and least supply.

106. The key elements of the geosciences which employers identified as demonstrating shortages are:

- Geotechnical engineering and engineering geology
- Geophysics.

107. A number of causes for the shortages have been identified. These include:

- Periods of reduced recruitment and consequent training.
- Competition for geosciences skills from a number of sectors and geographies.
- A wide range of factors which influence demand. At present demand is seen as healthy across most sectors and likely to rise further.
- Closure of relevant MSc programmes.
- Demand for geosciences expertise being lumpy due to the large, capital nature of the work.
- A implicit lag time of nine years to generate a geoscientist with five years' experience.

108. While the shortage in skills is having an impact on businesses to the point where some believe that they are unable to compete for work, most firms indicate that they are coping.

109. There is good evidence to suggest that businesses are investing in skills by recruiting and training graduates. However, this follows a period of around five years during which graduate recruitment was all but cancelled. Therefore, it is likely that in five years' time there will be a further shortage of engineering geologists with 5-10 years' experience.

110. There is significant concern that shortages may arise in the future due to the increase in undergraduate course fees and the withdrawal of support for MSc courses.

111. The argument about who should bear the cost of training (the geosciences are seen as a vocation) is unresolved. Within the oil sector there appears to be room for accommodation, as the returns available to both employers and individuals are great enough to cover the costs. Within engineering, margins preclude either employers or individuals taking similar unilateral action.

5. Recommendations

The brief was explicit in setting out the need to deliver an evidence base on which the Geological Society could consider 'what to do next' and excluded the need to provide any recommendations. However, we believe that a number of recommendations can be made without prejudicing the deliberations of the panel and whatever conclusions it may reach.

These focus primarily on gaining further insights and building links between industry and academe.

112. Despite the relatively small size of the geosciences workforce and reasonable reach of the Geological Society's membership, much is still unknown. As such a more detailed 'footprint' analysis should help quantify the size of the workforce and how this is changing. This is seen as being important given employers' demand for MSc graduates, possible closure of courses and the key role that the geosciences play in sectors such as energy, infrastructure and water. Without reliable data on the size of the workforce and the numbers exiting each year, there is no reliable evidence to support investment in higher education. Furthermore, making the arguments to either employers or government to fund postgraduate education will be compromised by the lack of data.

113. Efforts to bring industry and academe together must be encouraged if the labour market is to work more effectively. A comprehensive review of undergraduate and post graduate courses in the geosciences would complement the footprint study suggested above. Taken together, these would help both academe and industry plan more effectively.

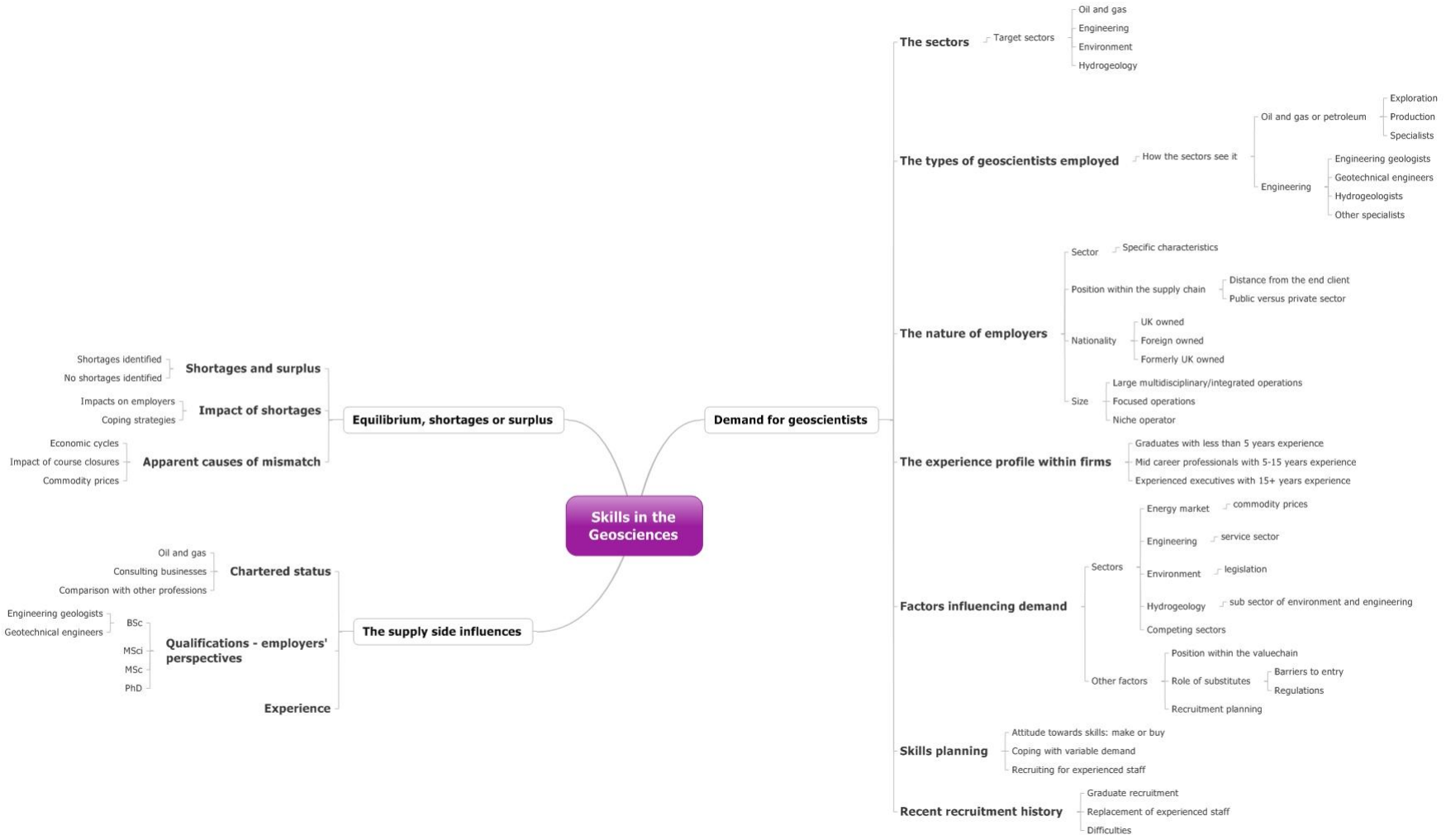
114. While there is evidence that there are enough graduates with first degrees in geology, there was feedback concerning quality. However, the limited nature of this work has meant that we were only able to capture a partial view of what attributes employers are seeking in young recruits. Further work would enable more detailed and relevant feedback to be provided to universities in the hope that this may be reflected in how students are prepared.

115. Practically all employers noted that they either preferred or demanded that new employees be qualified to MSc level. It could well be in employers' interest to work together to set out common standards or expectations. This information, if suitably disseminated through careers advisers and course leaders, would enable students to take more informed decisions leading to better prospects for both applicants and employers.

6. Appendices

6.1 Map of research findings

6.2 Aide memoire used for interviews with employers


Skills in the Geosciences
Demand for geoscientists
The sectors
Target sectors
Oil and gas
Engineering
Environment
Hydrogeology
The types of geoscientists employed
How the sectors see it
Oil and gas or petroleum
Exploration
Production
Specialists
Engineering
Engineering geologists
Geotechnical engineers
Hydrogeologists
Other specialists
The nature of employers
Sector
Specific characteristics
Position within the supply chain
Distance from the end client
Public versus private sector
Nationality
UK owned
Foreign owned
Formerly UK owned
Size
Large multidisciplinary/integrated operations
Focused operations
Niche operator
The experience profile within firms
Graduates with less than 5 years experience
Mid career professionals with 5-15 years experience
Experienced executives with 15+ years experience
Factors influencing demand
Sectors
Energy market
commodity prices
Engineering
service sector
Environment
legislation
Hydrogeology
sub sector of environment and engineering
Competing sectors
Other factors
Position within the valuechain
Role of substitutes
Barriers to entry
Regulations
Recruitment planning
Skills planning
Attitude towards skills: make or buy
Coping with variable demand
Recruiting for experienced staff
Recent recruitment history
Graduate recruitment
Replacement of experienced staff
Difficulties
Equilibrium, shortages or surplus
Shortages and surplus
Shortages identified
No shortages identified
Impact of shortages
Impacts on employers
Coping strategies
Apparent causes of mismatch
Economic cycles
Impact of course closures
Commodity prices
The supply side influences
Chartered status
Oil and gas
Consulting businesses
Comparison with other professions
Qualifications - employers' perspectives
Engineering geologists
Geotechnical engineers
BSc
MSci
MSc
PhD
Experience

6.3 Aide memoire used for the interviews with employers

INTERVIEWEE:
DATE AND TIME:
INTERVIEWER: Martin Houghton / Michael Johnson / Jon Guest

Pre-amble (c1 minute)

Hello. Thank you for taking the time to participate in this interview.

My name is [Martin/Michael/Jon] and I work for an independent research consultancy called TBR, based in Newcastle-upon-Tyne. TBR has been commissioned by the Geological Society of London to explore possible skills shortages faced by employers in four segments of the geoscience industry. These are:

- Hydrogeology
- Engineering Geology
- Hydrogeology
- Oil and gas

TBR has produced a concise economic profile of these segments and is now undertaking approximately fifteen individual depth interviews with employers such as you to generate new, rich qualitative data. In addition to the specific issue of possible skills shortages, I'd also like to get your views on skills of your current workforce and the recruitment outlook for your business.

This interview will take approximately twenty minutes to complete. I have some questions sketched out to guide our conversation, but the intention is that the themes and content will be determined more by you than by me.

I will be making notes as we go through, but this interview will not be recorded and/or transcribed. All of the information you provide me with will be treated confidentially and in accordance with data protection legislation. In the event that you encapsulate an issue in a sentence that we would like to quote verbatim, the content and the form of attribution will be agreed with you in advance.

Characteristics of the business

QUESTION 1: MAIN QUESTION **To start off with, please tell me a bit about your business and your role within it.**
QUESTION 1: POSSIBLE PROMPTS • For how many years has the business been trading? • Approximately how many people does the business employ? • How many of these are geoscientists? • Does your business routinely sub-contract any of its activities to external contractors? Conversely, does your business act as a sub-contractor to any larger firms?
NOTES:

Characteristics of the current workforce

QUESTION 2: MAIN QUESTION **What are the principal skills required by your current workforce?**
QUESTION 2: POSSIBLE PROMPTS • What types of geoscientists do you employ; eg geotechnical engineers, hydrogeologists - refer to list. Please indicate how many you employ of each category. • What is the age profile of your current workforce? Does this vary significantly by roles within the business? • How important is continuous professional development to your workforce? • What emphasis do you put on CGeol?
NOTES:

Specific Geoscience skills gaps

QUESTION 3: MAIN QUESTION **Are you experiencing any skills gaps related to geosciences?**
QUESTION 3: POSSIBLE PROMPTS • Are you experiencing any skills gaps in the geosciences? • What gaps do you have – please be specific? • Specialism: • Level: • Experience (years): • Repeat if multiple gaps • How are the gaps apparent, e.g. unfilled posts • What impact is this having on the business, losing work, having to employ contractors? • How did this shortage arise, e.g. emigration, lost to another firm in the UK that is paying premium rates?
NOTES:

Recent experience of recruitment

QUESTION 4: MAIN QUESTION **How would you describe your recent experience of recruiting?**
QUESTION 4: POSSIBLE PROMPTS • Approximately how many people have you recruited in the last 12/24 months? At what level have you been recruiting? E.g. Fresh graduates? Experienced professionals? • Have you experienced any recruitment difficulties? If so, are these recruitment difficulties skills-related? And at what recruitment level or in which specific geoscience discipline? • How has the composition of your workforce changed through international recruitment in recent years? Are you more reliant on international employees than previously?
NOTES:

Future recruitment intentions

QUESTION 5: MAIN QUESTION What are your recruitment intentions over the next 12/24 months?
QUESTION 5: POSSIBLE PROMPTS • What future recruitment are you planning to undertake? At what levels (e.g. CGeol/FGS, BSc, MSci, MSc, PhD etc) and in which geoscientist disciplines? • Would you forecast experiencing recruitment difficulties caused by skills in any particular sector or discipline? • What is the driver of your recruitment intentions? E.g. Workforce exits (retirements)? Workforce churn (staff leaving)? Expansion (business growth)?
NOTES:

Thank you and sign off

That is the end of the series of questions I have to ask. Is there anything you feel that has not already been covered in our discussion that you would like to raise with me? Alternatively, have you any questions for me in terms of the research process and the final output?

Lastly, I'd like to thank you very much on behalf of the Geological Society of London and TBR for participating in this research interview.

Good bye.

To discuss any aspect of this document further please contact:

Michael Johnson
Senior Research Consultant

DL: 0191 279 0908
E: michael.johnson@tbr.co.uk