Diversity in STEMM: Establishing a Business Case

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WESTMINSTER BUSINESS SCHOOL

Diversity in STEMM: establishing a business case

Report of research by the University of Westminster for the Royal Society's diversity programme
'Leading the way: increasing diversity in the scientific workforce'
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UNIVERSITY OF WESTMINSTER

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EXECUTIVE SUMMARY

Background

This report sets out the results of research commissioned by the Royal Society as part of their BIS-funded programme entitled 'Leading the way: increasing diversity in the scientific workforce'. The research explored whether there is a business case for diversity in STEMM occupations (scientific, technical, engineering, mathematical and medical roles) and whether diverse teams are more likely to do 'good' science. The research focused on three of the nine protected characteristics in the Equality Act 2010: gender, ethnicity and disability.

The research was conducted in late 2013 and included:
- A review of existing empirical data on diversity
- Examination of quantitative data regarding the diversity of the UK and STEMM workforces
- Focus groups discussion with individuals in STEMM occupations
- Interviews with organisational representatives of employers with substantial STEMM workforces

The definition of the scientific workforce used in this research is taken from the Royal Society's diversity programme: 'For the purposes of the project, the 'scientific workforce' is taken to comprise all those for whom scientific knowledge, training, and skills are necessary for the work that they do'. This research used the Royal Society's diversity programme classification of STEMM occupations using Standard Occupational Classification (SOC) codes. These were then added to the Royal Society's 'possibly STEMM' category to create a broader one called 'STEMM+' which has been used for the purposes of this research.

The research explores what diversity means to people in the sector, examines the fundamentals of the business case, describes diversity policies and initiatives used by organisations, and considers the issues and difficulties of measuring diversity and performance. The conclusions summarise what we know, what is new, what we have learnt and what is missing from research regarding the business case for diversity.

Findings

As expected the business case is complicated, subtle and highly contextual. However, the research presents some interesting insights into the potential business case for diversity in

the scientific workforce along with some useful recommendations on how to increase and promote diversity in STEMM.

Interviews and focus groups revealed that the discourse on 'diversity' has moved away from 'equal opportunities', and is now associated with inclusiveness, with recognising, valuing and respecting differences. The global nature and reach of science provides a specific context within which diversity has distinct meanings for those in STEMM occupations: for the participants in this research, 'diversity' is a broad and complex concept, with a strong 'international dimension'.

In STEMM diversity initiatives tend to focus on gender equality and there is a general lack of visibility of ethnicity. Ethnicity is seen in global, nationality terms rather than in UK-based minority ethnic terms. Disability issues also have little visibility in the sector, outside of the health service.

Fundamentals of the Business Case

- Research participants were unanimous in their acknowledgement of a moral and social case for diversity, arguing that the moral case is part of the business case. The business case derives from recruitment and retention of talent and the range of perspectives arising from diverse, as opposed to homogeneous teams.
- Potential business benefits of diversity can be classified as 'external' and 'internal'. 'External' benefits include reduced costs, improved resourcing of talented personnel, better products and services, and enhanced corporate image; 'internal' benefits are where a greater range of perspectives leads to increased creativity, innovation and problem-solving.
- Defining and measuring diversity in a consistent way across organisations, and measuring meaningful business outcomes that demonstrate a business case, is difficult.
- Research indicates that diversity within teams could lead to business improvements, however, effective team collaboration not only depends on the diversity of team members but on how well they understand and communicate with one another and, crucially, on how the team is organised and led.
- The potential benefits of diversity are highly contextual and it is unlikely that there is a uniformly relevant business case for all organisations. This means that simple copying of diversity strategies utilised by other employers will not guarantee success.
- Effective leadership and the role of men are paramount to changing culture with respect to diversity.

- There are problems of definition in what constitutes 'good science' and 'good performance' that need to be overcome to build a convincing measurable business case for diversity and many employers do not systematically collect, or use, reliable diversity or performance data. In the absence of definitions and measurements, it will be difficult for STEMM employers to calculate a business case for diversity, or to definitively state that diverse teams do better science. However, inability to conceptualise and measure does not equate to the absence of a business case for diversity, merely the absence of quantitative data.

The UK STEMM Workforce

- Compared with the EU and the USA the UK STEMM workforce is less diverse. 'Vertical' and 'horizontal' segregation is evident in the STEMM sector in terms of gender, ethnicity and disability, where these under-represented groups cluster in particular occupations and lower levels in organisations.
- The health sector is much more diverse than other parts of the STEMM workforce with regards to the employment of women, minority ethnic groups and people with disabilities. This sector also has more policies and practices that encourage diversity, for example, encouraging female staff to return from maternity leave and minority ethnic and disabled applicants to apply for jobs. Some NHS employers measure and benchmark diversity and use the idea of 'inclusion' to signify a strategic intention to build a workforce representative of the community served.

Individual and Organisational Perspectives of Diversity

- For focus group participants, barriers to entering STEMM careers operated from childhood and continued through education with a dearth of relevant role models for girls, the tendency for employers to recruit graduates from specific ('high class') universities, and the stereotypically male associations with certain occupations and work environments (e.g. engineering and surveying) that made professions appear unattractive or unobtainable.
- Barriers to progression included the absence of part-time roles and flexible working arrangements, the disproportionate use of fixed term contracts for women and minority ethnic academics, opaque promotion processes, long-hours' cultures, operation of the 'old boys' networks', the difficulty in balancing parenthood with a career, inadequate provision for individuals requiring physical adjustments to the work environment, organisational cultures and expectations unattractive to members of minorities, and the

absence of effective networking, mentoring and 'sponsorship' between, and of, individuals.

- Diversity initiatives, although positive, are often just gender-related, with fewer focused on ethnicity and, outside the health sector, on disability.

- Focus group participants were often critical of these organisational diversity policies, highlighting a range of organisational factors getting in the way of increased diversity in STEMM, including senior management and employee involvement, and problems integrating diversity values into organisational cultures.

- Diversity needs to be integrated strategically into business, however this is context specific and not a simple process; whilst some private sector organisations view diversity as a strategic means to successfully deliver carefully targeted products and services to customers, in the public sector there are broader social or community diversity objectives. In all sectors the diversity mindset of the (mainly) white male leaders of organisations is crucial to successful change.

Moving Diversity Forward

- Overall, the findings support a business case for diversity, though one founded more on conviction than organisational evidence, with potential 'external' and 'internal' benefits recognised but difficult to measure.

- The research indicates that 'external' benefits related to skills and clients/users and customers have relevance in STEMM. While diverse teams and collaborations are valued in positive terms, for the potential creativity and innovation they bring, the dynamics of communication and leadership of teams are recognised as either constraints or enablers of positive outcomes.

- There is some evidence that the STEMM sector (outside of the health service) is taking fewer actions to improve diversity, via diversity polices and processes, than organisations outside STEMM. More flexible employment practices, including shorter working hours, greater employment security (implying less use of fixed term contracts which have an adverse diversity impact) and attention to child care responsibilities can help to redress these.

- While integration of diversity issues with the organisation's business strategy is seen as important to success in some contexts, it is not the only essential factor; cultural and leadership factors and management systems inhibit progress to diversity.

- Many of the key change agents in organisations, in the STEMM sector and in society as a whole, are white able-bodied men. Without their commitment to change organisational

cultures, strategies and practices, and their desire to lead the change process, the STEMM workforce will remain largely as it is.

Leaders with a diversity mindset can break away from traditional patterns and model inclusive thinking and behaviour; doing this, they are instrumental in modifying norms, values and expectations embodied in organisational cultures. Training interventions for organisational leaders are therefore considered an essential part of the journey to increased diversity.

Recommendations

- More strategic central co-ordination of both initiatives and information on diversity in STEMM is required.
- A consistent and comparative benchmarking framework needs to be developed that is relevant for different sectors across the STEMM community.
- Increased monitoring of information on employment practices and career progression such as the use of fixed-term contracts, flexible working arrangements and requests, and the progression of different groups through the organisation.
- Creation and encouragement of social networks accessible to people working or aspiring to work in careers in STEMM, as well as sponsorship and mentoring opportunities, will facilitate entry and progression in STEMM careers.
- Increased development and use of retention policies such as making reasonable adjustments in the workplace to account for disabilities, enhancing flexible working opportunities to achieve better work-life balance, encouragement for women to return after maternity leave, and offering better development and networking opportunities.
- Encouragement to employers to foster (or make visible) employment opportunities to potential recruits studying at universities not routinely targeted by employers.
- Monitor and evaluate training programmes and share across the sector when training interventions are effective, this would be particularly helpful to SMEs.
- Increased co-operation and coherence of diversity initiatives between professional bodies operating in STEMM professions to increase communication and awareness of diversity issues.

1 INTRODUCTION

This report sets out the results of research commissioned by the Royal Society as part of their programme entitled 'Leading the way: increasing diversity in the scientific workforce'. This research explored whether there is a business case for diversity in STEMM occupations (scientific, technical, engineering, mathematical and medical roles) and whether diverse teams do 'better' science; it focussed on three of the nine protected categories in the Equality Act 2010: gender, ethnicity and disability.

The research was conducted in late 2013 in a three phase programme by a multi-disciplinary team from the University of Westminster using a mixed method approach. Although research on the business case for diversity in both Human Resources (HR) practitioner and academic literature is not new, the research conducted for this project offered a novel perspective on the topic as it included: a review of existing empirical research on diversity; examination of quantitative data regarding the diversity of the UK and STEMM workforces; focus group discussions with individuals in STEMM occupations; and interviews with organisational representatives of employers with substantial STEMM workforces.

A 'Phase 1: Interim Report' was submitted to the Royal Society in October 2013 which established the context for this research project by exploring pre-existing diversity literature in relation to STEMM occupations in different countries and organisational contexts. It also identified themes arising from preliminary research interviews conducted with managers in the STEMM sector with particular regard to the implementation of measures of diversity and team performance. The interim report identified that the research was likely to encounter two key issues when trying to establish a business case for diversity and to discover whether diverse teams are more effective:

- The absence of benchmarking mechanisms to facilitate the measurement and comparison of work outcomes with diversity, both within and between organisations, and that account for the complexity of different STEMM workplaces.
- The nature of work carried out in STEMM occupations implies that 'internal' business benefits of diversity (improved creativity and problem-solving) are of particular relevance and interest to STEMM employers.

On the basis of phase 1 research, these and other key themes identified were subject to detailed investigation during Phases 2 and 3 of the research programme.

The 'Phase 2: Focus Group Findings' report was submitted to the Royal Society in November 2013. This summarised the major themes arising from focus group discussions

with individuals working, or aspiring to work, in STEMM occupations. Analysis of the focus group transcripts indicated that our participants had raised issues that could be grouped into twelve major themes:

- the meaning of diversity for individuals;
- perceived barriers to diversity including discrimination;
- early career choices and opportunities;
- career transitions and progression;
- the importance of networks and networking;
- social class;
- enabling the achievement of greater diversity;
- organisational context and diversity policy;
- good practice examples;
- teamwork and collaboration;
- good and bad science;
- the business case and performance measurement.

A further report was submitted to the Royal Society for review in January 2014; this integrated the analysis of quantitative data from the Quarterly Labour Force Survey (LFS), January-March, 2013, and the 2011 Workplace Employment Relations Survey (WERS) with themes derived from literature on diversity.

This final report builds on these interim reports; it draws on the qualitative and quantitative data collected and sets out the key findings and analysis from the whole research process. A first draft of this paper was submitted to the Royal Society in February 2014 and was discussed with the Royal Society Policy study working group before amendment to this current form.

The sections that follow this introduction provide contextual information regarding diversity in the STEMM sector, explore definitions of 'diversity', and outline the quantitative reality of the UK STEMM workforce. An overview of the research methodology precedes discussion of data collected (both qualitative and quantitative) in relation to existing empirical work identified in the literature review. The discussion explores what diversity means to people in the sector, examines the fundamentals of the business case, describes diversity policies and initiatives used by organisations, and considers the issues and difficulties of measuring diversity and performance. The conclusions summarise what we know, what is new, what we have learnt, and what is missing from research regarding the business case for diversity.

Recommendations propose that the Royal Society progress the 'Leading the way: increasing diversity in the scientific workforce' programme and that a central, strategic approach is adopted by key stakeholders that addresses the difficulties identified by this research.

2 DIVERSITY: CONCEPTS AND DATA

2.1 Definition of diversity

The scope of diversity covered in this report encompasses three of the nine protected categories in the Equality Act 2010. Though the concern of the legislation is to outlaw discrimination rather than to actively promote diversity, the categories chosen by the Royal Society provide a useful starting point as gender, ethnicity and disability are clearly defined under the law. The concept of diversity itself can be regarded as having a more positive intent than that enshrined in more narrowly defined legal definitions of discrimination. The basic concept of managing diversity as defined by Kandola and Fullerton (1998: 7)

> '…accepts that the workforce consists of a diverse population of people. The diversity consists of visible and non-visible differences which will include factors such as sex, age, background, race, disability, personality and work style. It is founded on the premise that harnessing these differences will create a productive environment in which everyone feels valued, where their talents are fully utilised and in which organisational goals are met'.

Within the literature, especially the practitioner literature, there has been a distinction between diversity and equal opportunities; a difference expressed in a number of ways. Some writers (e.g. Armstrong et al*.,* 2010) suggest that equality and diversity are at opposite ends of the same continuum, and see diversity as a progression in developing equality in organisations (McDougall, 1998); others (e.g. Malvin and Girling; 2000) argue that such a distinction is not useful. They contend that diversity is a 'repackaged' version of the same set of policies and practices and that this is not useful to practitioners because it could create confusion and lessen potential for strategic impact. Subeliani and Tsogas (2005: 832) contend that diversity:

> 'positively values difference and thus provides a radically new approach to the question of difference at work (…) Managing diversity seems to be a proactive strategy [with] the aim of maximizing the utilization of employees' potential'.

In contrast, Monks (2007) argues that it is legislation that shapes the way in which diversity is managed, while Ozbilgin and Tatli (2011) suggest that diversity has been offered as an alternative to equal opportunities and reflects significant moves towards liberalisation and deregulation in both the United States of America (USA) and the United Kingdom (UK).

In practice, the distinction between equal opportunities and diversity tends to be more one of emphasis than of substance, with diversity in step with a more individualised way of

managing people in the workplace. As Ozbilgin and Tatli (2011) suggest, diversity management rather than equal opportunities might be more appropriate for the private sector, because of the emphasis on financial performance, but there is little evidence to support this contention. Public sector organisations tend to focus on social responsibility (and indeed have obligations under the Equality Act 2010 to promote equality and tackle social exclusion), although their increased use of the language of diversity might be associated with an emphasis on value for money phrased in business terms. While equal opportunities focus on protected disadvantaged groups that are demographically different, diversity tends to focus on valuing all people and hence encompasses a broader definition of difference.

Diversity can also be conceptually linked with 'intersectionality' (Browne and Misra, 2003), a concept that has origins in political science (see Collins; 1999) and which recognises that people may not fit neatly and exclusively into one of the 'protected' categories. There is considerable emphasis in the current academic diversity literature on intersectionality, which tends to focus on the distinctive experience of individuals who fit into more than one category, for example, black women.

2.2 Definition of STEMM

For the purposes of this research on diversity within STEMM, the STEMM workforce has been defined by drawing on the Royal Society's own definition, as applied in its BIS funded diversity programme "Leading the way: Increasing diversity in the scientific workforce":

> '… the 'scientific workforce' is taken to comprise all those for whom their scientific knowledge, training, and skills are necessary for the work that they do. This includes scientists, technologists, engineers and medical practitioners...' (The Royal Society, http://royalsociety.org/policy/projects/leading-way-diversity/).

Such occupations represent the core STEMM workforce. There are other occupations included in the Royal Society's full definition of the scientific workforce, which are referred to as 'possibly STEMM'. In the quantitative analysis of this research, the term 'STEMM+' is used to denote STEMM and 'possibly STEMM', thus STEMM+ comprises STEMM and:

> '…school teachers, nurses, surveyors, actuaries, economists, programmers, statisticians, technical sales staff, pilots, divers, scientific administrators, journalists and others.' (The Royal Society, http://royalsociety.org/policy/projects/leading-way-diversity/)

Details of the particular occupations, as described by their Standard Occupation Classification codes, covered by these definitions are set out in Appendix 1.

Participants in this research were all engaged in STEMM roles or oversaw STEMM employees; most of the organisations interviewed (for details see Table 2 in Appendix 2) are substantial employers of STEMM occupations. The exception was the participant organisation labelled 'Surveying' which employs people principally in STEMM+ roles.

2.3 Quantitative analysis of diversity in STEMM

This section of the report compares and contrasts the diversity of STEMM workforces in different parts of the world using data derived from quantitative surveys. Unlike in countries such as the USA which publishes data every two years (see National Science Foundation, 2013), there are no regular statistical series in the UK that cover numbers employed and patterns of employment within STEMM by gender, ethnicity and disability. Hence a range of statistical sources are presented to give a picture of the STEMM workforce. The Standard Occupation Classification (SOC 2010) system is used to classify workers into STEMM and Non-STEMM groups; the categories used are listed in Appendix 1, along with a further category of 'possibly STEMM' that includes, for example, teachers in secondary, further and higher education.

2.3.1 The gender dimension in STEMM

Largely because of variation in those occupations included in definitions of STEMM, there are different estimates of the proportion of women employed in the UK STEMM workforce, at around 13% (eg Botcherby & Buckner; 2012). The number of women studying STEMM subjects in the UK has increased (see for example Botcherby & Buckner; 2012), but this has been slow to translate into improved employment participation, a picture largely echoed across the EU.

Earlier comparative data indicate that the UK has a lower proportion of women in STEMM careers than in many other European Union (EU) countries. Engineering UK (2011) and the Association of German Engineers (2010) reported that, while a few East European countries have around 20% women in STEMM, the West European percentage is lower (17%) and the UK (9%) is close to the bottom of the league table. Using a different definition of STEMM, Kirkup et al. for the UKRC (2010:74) reported that: '…only 5.3 % of all working women were employed in any SET occupation, compared with 31.3% of all working men'. While there are differences between the estimates it can nevertheless be concluded that there are significantly fewer women in STEMM than men and that, in this respect, the UK compares unfavourably with other European countries.

The EU publishes indicators on women in Science and Innovation on a three yearly basis using a "restricted" definition of the scientific workforce. Their most recent publication based on 27 countries in 2010 (European Commission, 2013: 15) reported that:

- Just 38% of that subgroup of UK "Scientists and Engineers" were female.
- Female PhDs equalled or outnumbered men in all broad fields of study in the EU, except in the two fields with the highest overall number of PhD graduates, these being 'science, mathematics and computing' where 40% of PhDs were female and 'engineering, manufacturing and construction' where 26% of PhDs were female. In the UK, the proportions of female PhDs in these fields were slightly lower than these EU averages, at 38% and 22% respectively (European Commission, 2013:5).

Data from the Labour Force Survey (LFS) offer more detail on gender diversity (see Appendix 2 for information about the LFS). Chart 1 (overleaf) presents an overview of gender diversity for those working in the UK as a whole, and within STEMM occupations. In the UK as a whole ('All')[1], employment is split almost equally between men (53%) and women (47%); in contrast only 16% of those employed in STEMM occupations are women, rising to 26% if the definition of STEMM is expanded to include the teaching professions (STEMM+).

Charts 2 and 3 (overleaf) provide further detail by separating out those individuals working in the health sector from other sectors of the UK economy. Using the same STEMM and STEMM+ categories, Chart 2 focuses solely on the UK health sector. Here women predominate, constituting 79% of those employed overall, though only 53% of them are working in STEMM subjects and 54% in STEMM+; nevertheless this is closer to a 50/50 split between men and women.

In contrast to the higher levels of representation of women in the health sector identified in Chart 2, Chart 3 shows that outside of the health sector the proportion of women drops to 42% across all non-health sectors of the economy, with only 12% of individuals working in STEMM, and 24% in STEMM+ occupations.

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[1] More specifically, the category of 'all' in LFS charts represents all those self-employed and employees working in UK companies, whatever the occupation they are working in. The second 'STEMM' column in the charts only includes individuals employed in occupations that are considered by the Royal Society as being 'STEMM'. All LFS figures are weighted to the population as a whole, so these are actual proportions representative of the working population as whole.

Chart 1: Gender diversity of individuals employed in UK STEMM and NON-STEMM occupations
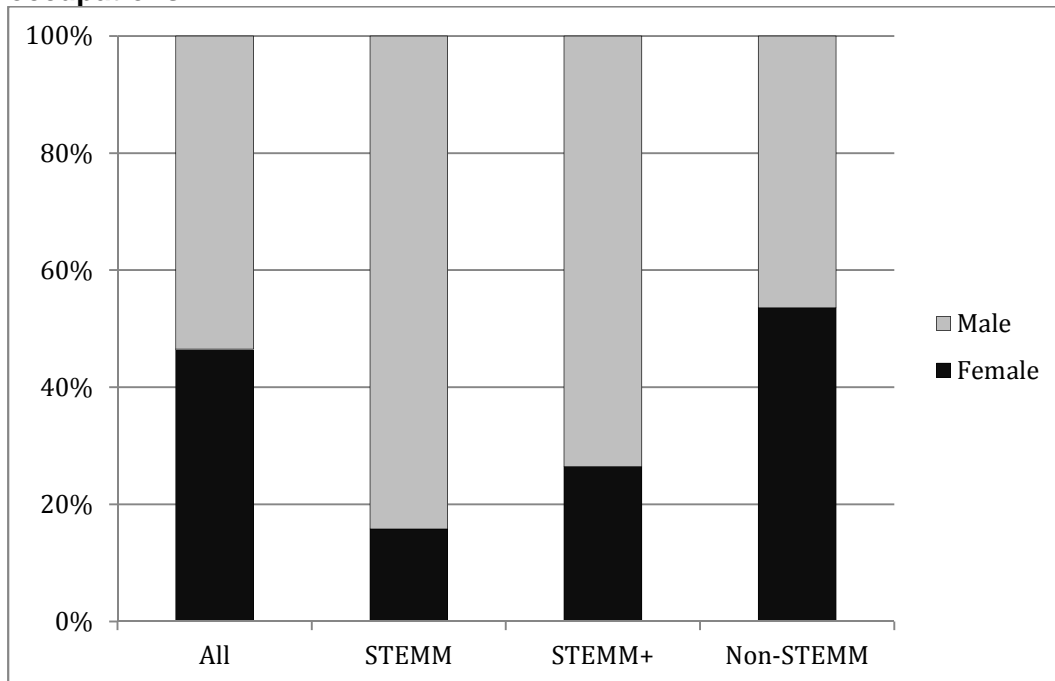
Source: *Quarterly Labour Force Survey, January-March, 2013*

Chart 2: Gender diversity in UK STEMM and NON-STEMM occupations: health sector
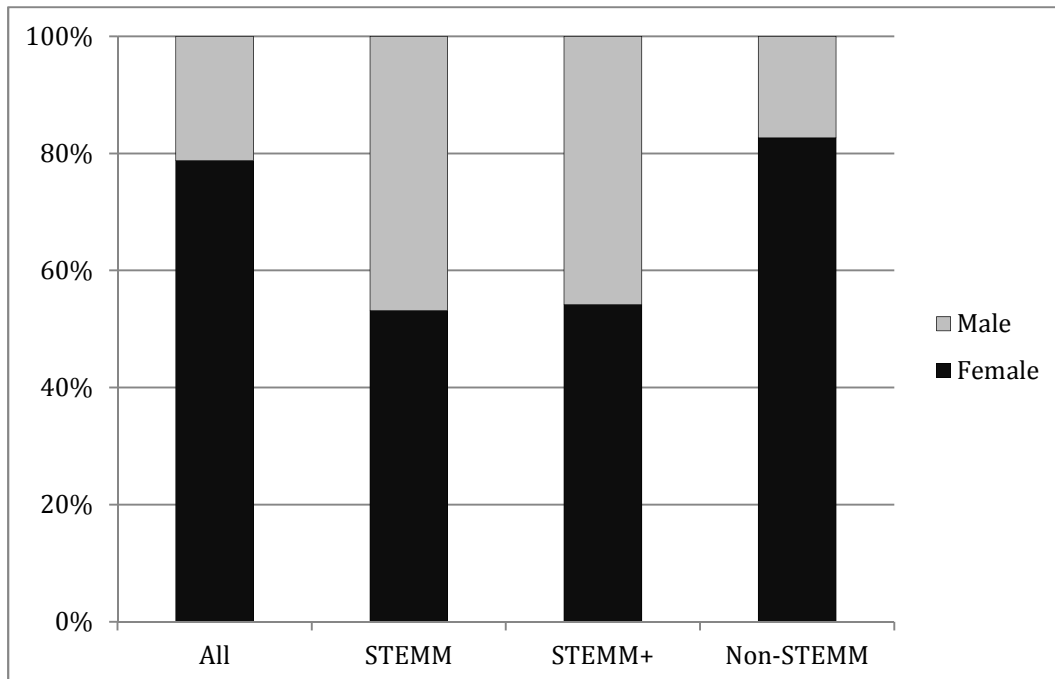
Source: *Quarterly Labour Force Survey, January-March, 2013*

Chart 3: Gender diversity in UK STEMM and NON-STEMM occupations: non-health sectors
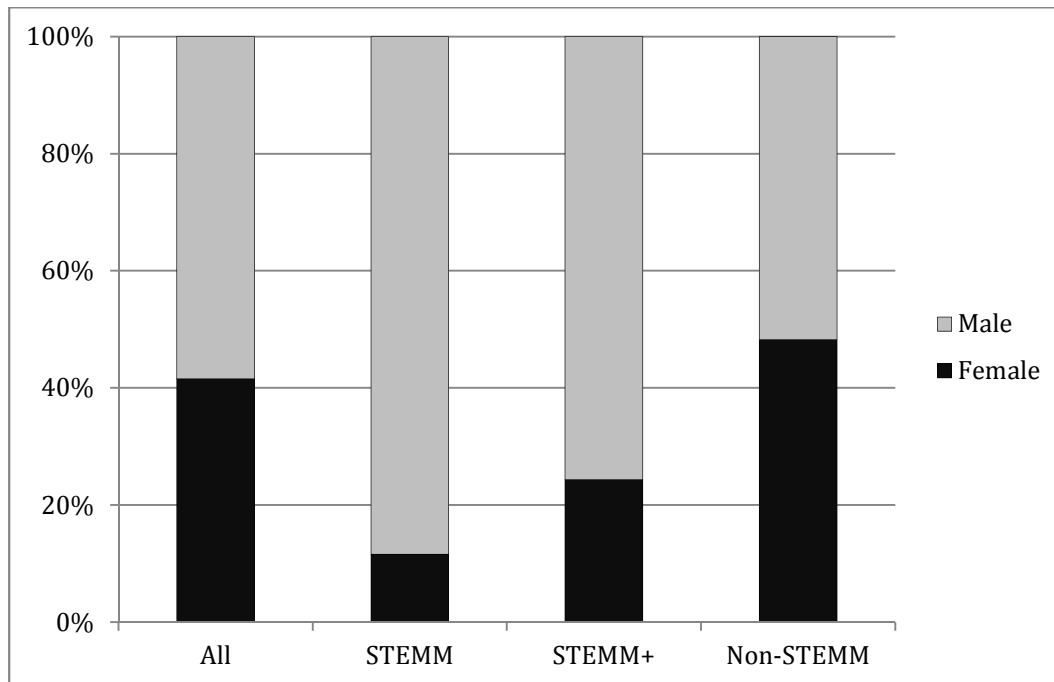
Source: *Quarterly Labour Force Survey, January-March, 2013*

In sum, it can be clearly seen that the health sector employs a much higher proportion of women compared to other sectors of the economy, and a higher proportion of women in STEMM occupations.

2.3.1.1 Gender: vertical and horizontal segregation

It is important to consider whether women work in all occupations (horizontal segregation) and at all levels of seniority in organisations as there may be a higher degree of diversity at junior levels and in some types of jobs that is not translated into greater representation at higher levels and all occupational roles (Urwin et. al., 2013). Vertical segregation (where women are clustered in the lower grades or lowest-paid occupations) is strong in academic careers, especially in science and engineering. For example, EU data show that only 11 % of grade A academics (the highest grade at which research is performed) in these fields are female compared with 20% of grade A academic staff across all academic disciplines. In the UK, the proportion of women in grade A science fields is lower than the EU average lying at: 9% in the natural sciences; 7% in engineering and technology; and 12.4% in agricultural sciences. The medical sciences have bucked this trend, 23.2% of these UK grade A academics are women (European Commission, 2013: 93).

2.3.1.2 Career progression and retention of women in STEMM

Hart and Roberts' (2011) research on losses in female employment indicates that the UK science and engineering sectors 'lose' (i.e. leavers from the workforce) their female workforce at a much higher rate than other sectors. They suggest that a major contributing factor to this loss is the lack of part-time work opportunities, which is at its most extreme in the engineering sector and less extreme in medical and related professions because of the flexible work arrangements offered in the National Health Service (NHS). In 2010, only 12% of female engineering professionals worked part-time and 25% of general science professionals compared with 42% of all UK female employees. Hart and Roberts (2011) tracked a sample of women scientists as they entered the labour market between 1975 - 1990 and followed their career progress until 2001. Examination of this panel data show that, of 95 full-time female scientists at the start of the sample, just over one-third 'survived' as full-time scientists (i.e. these women in their panel remained in employment); Hart and Roberts contrast this with the 261 full-time females who entered medical and related professional occupations, of whom 57% were still in full-time employment in 2001 (Hart and Roberts, 2011: 6).

The lack of work-life balance opportunities as a key element in explaining female retention problems has also been highlighted by the EU (European Commission, 2013), which refers to not only the 'glass ceiling' (a concept that describes gender inequality in senior management; see Barreto, Ryan & Schmitt, 2009) but also the 'maternal wall' (barriers faced by mothers at work or seeking work, see Swiss & Walker, 1993) hindering women's progression in science. That such barriers exist is not always corroborated: conflicting evidence emerges from studies conducted in the USA. A limited scope study by the USA's National Science Foundation/National Center for Science and Engineering Statistics (2013) of biology, chemistry, civil engineering, electrical engineering, mathematics, and physics disciplines within major research universities concludes:

> 'For the most part, men and women in the faculty of science, engineering, and mathematics have enjoyed comparable opportunities within the university, and gender does not appear to have been a factor in a number of important career transitions and outcomes.' (p.*7)*

Such a finding in the USA contrasts with the earlier work by the National Research Council (2010) in the UK which concluded that 'women who are interested in science and engineering careers are lost at every educational transition' and that 'evaluation criteria contain arbitrary and subjective components that disadvantage women'. (p.6)

There is anecdotal evidence (Lako and Daher, 2009) that the combination of factors concerning both work-life balance and the stage of a woman's career could inhibit her progression in science. Lako and Daher's interview with a prominent woman scientist is indicative (p. 763):

> '...I think there's really no right time to have kids. I was lucky that I already had tenure when I had kids, and I had a reasonable sized lab by that stage, so I had more control over my time. I suspect it's really difficult to have kids while you're setting up your lab. And the other strategy, of having children while you're a post doc or Ph.D. student, has pros and cons as well.'

Embedded assumptions about the nature of organisations and careers have been shown (for example, Wajcman, 1998) to affect the patterns of gender diversity observed in employment. Hence, it has been argued that traditional career patterns and trajectories may contain gendered assumptions, for example, penalising non-full-time work patterns, or the taking of career breaks, when promotion decisions are being made.

2.3.1.3 Social exclusion and gender

While not specifically focused on STEMM environments, it is useful to consider the work of Singh and Vinnicombe (2004) and Sealey and Vinnicombe (2012) on the paucity of women directors in the UK. They eschew some possible explanations put forward for the phenomenally low number of women on boards of directors, such as women's lack of ambition, lack of experience and lack of commitment; instead they contend that social exclusion may provide an insight into this phenomenon.

Research on 'elites', those people involved in decision-making on important issues in UK business and political contexts (such as politicians and board directors) has shown that women who reach influential positions in public life are of a higher class background than comparable men (Liddle & Michielsens, 2000). This suggests that social class could also play a part in the career progression of women in STEMM, particularly concerning progression to most senior levels where jobs have both a corporate and public role.

2.3.2 Ethnicity in STEMM

One of the challenges faced when considering ethnic diversity is that in many surveys the number of individuals from minority ethnic backgrounds can be low. In 2005 Jones and Elias suggested that there can be a very mixed pattern of participation in the UK STEMM workforce. While the 'Indian' and 'Chinese' ethnic categories are, for example, 'over-represented' compared with the 'White UK' category, the 'Bangladeshi' group is under-

represented with Bangladeshi women and Black Caribbean men particularly under-represented in UK science.

In this research the LFS was used to update the earlier findings of Jones and Elias (2005) but because of sample sizes, it was has been necessary to adopt broad groupings of 'Black', 'Asian' and 'Other'. Yet analysis of the labour market by Crawford et al (2008) suggests that individuals grouped in the same ethnicity category (for example, those of Pakistani background, combined with those of Indian or Chinese background) can have very different experiences. Chart 4 provides an overview of ethnic diversity for those working in the UK as a whole, and within STEMM occupations.

Chart 4: Ethnic diversity of employees in UK STEMM and NON-STEMM occupations
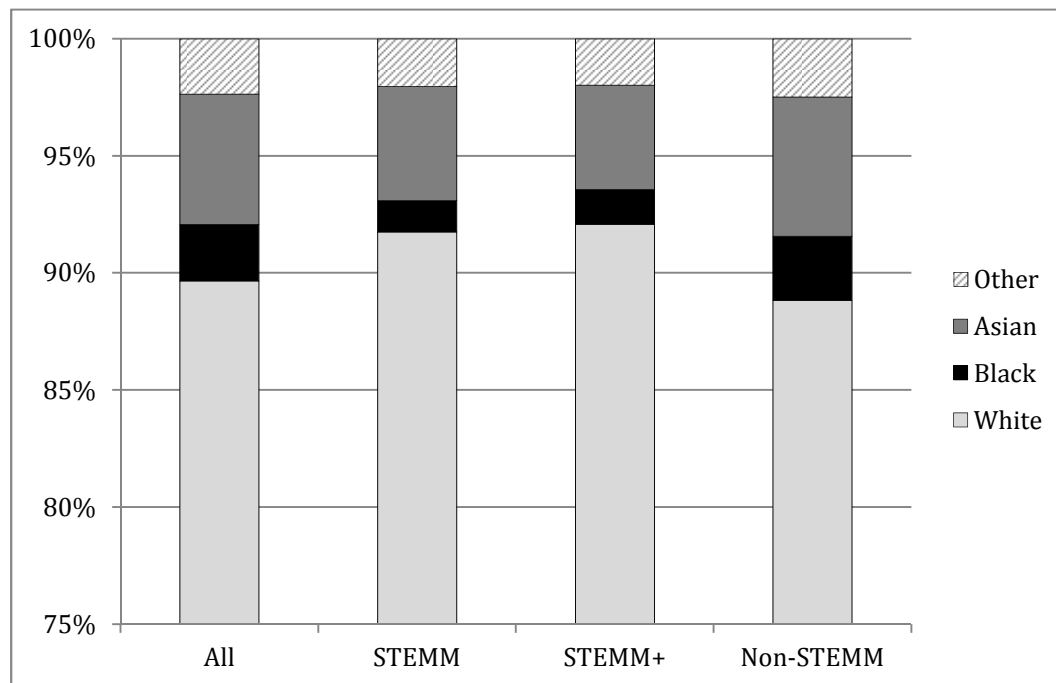
Source: *Quarterly Labour Force Survey, January-March, 2013*
To aid exposition the vertical axis has been truncated to 75%.

The chart shows that in the UK as a whole ('All'), just over 10% of individuals in employment are from an minority ethnic background, of this group 6% are Asian, 2% are Black and 2% are in the 'Other' group (which includes individuals of mixed race and those who categorise themselves outside of Census categories). The chart also reveals less ethnic diversity in both the STEMM and STEMM+ occupational groups, with only 8% of individuals in these groups from an minority ethnic background.

Charts 5 and 6 demonstrate how the overall STEMM/Non-STEMM comparison changes when individuals working in different sectors are considered. In the health sector as a whole a greater proportion of individuals from an minority ethnic background are employed (14%) and is substantially higher in occupations categorised as STEMM (21%) and STEMM+ (20%). However, whilst there is a particularly high representation of 'Black' individuals across the health sector as a whole (5% in the 'All' column), this is not the case in the STEMM and STEMM+ occupations where fewer individuals are 'Black' (3% and 2% respectively). In contrast, the relatively high level of minority ethnic representation in health sector STEMM occupations reflects that 14% of those included in the STEMM category of occupations are from an Asian background.

Chart 5: Ethnic diversity in UK STEMM and NON-STEMM occupations: health sector

Source: *Quarterly Labour Force Survey, January-March, 2013*
To aid exposition the vertical axis has been truncated to 75%.

In conclusion, Chart 4 suggests that, in the labour market as a whole, there is less ethnic diversity across STEMM occupations. However, chart 5 shows that when only the health sector is considered, the proportion of individuals from an minority ethnic background is higher. Furthermore, STEMM occupations within the health sector include a higher proportion of some minority ethnic groups (particularly those from an Asian background) than is the average for the health sector as a whole. In contrast, chart 6 shows that in the non-health sectors of the economy there are the lowest levels of ethnic diversity (just under

10% of individuals employed in the sectors) with even fewer minority ethnic employees working in STEMM and STEMM+ occupations (just 7% in each category).

Chart 6: Ethnic diversity in UK STEMM and NON-STEMM: non-health sectors
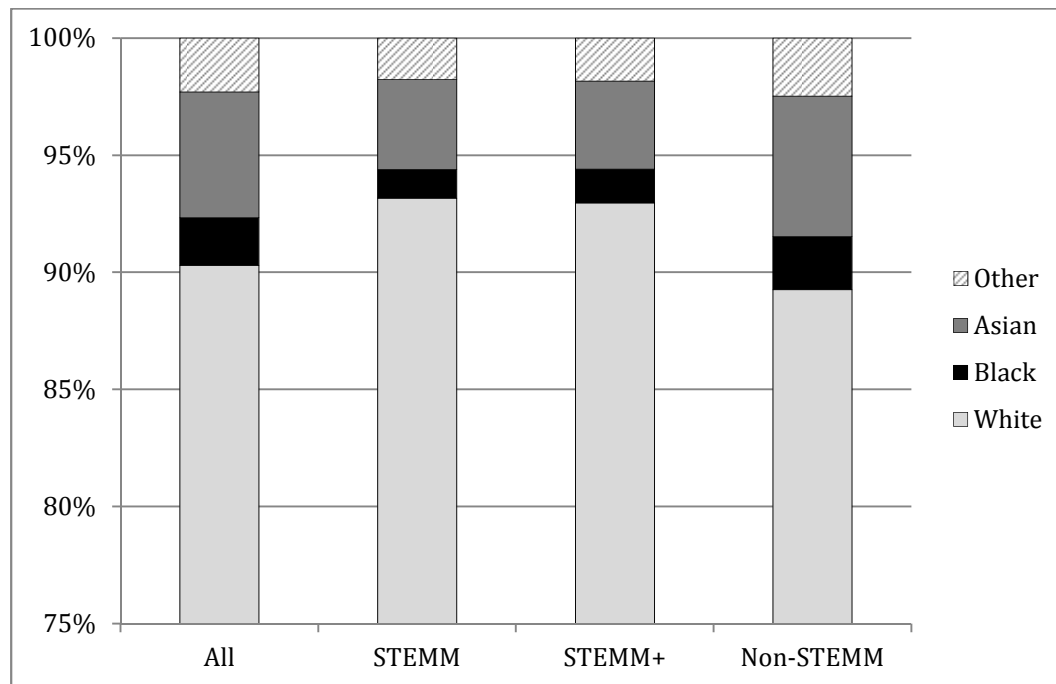
Source: *Quarterly Labour Force Survey, January-March, 2013*

To aid exposition the vertical axis has been truncated to 75%.

2.3.3 Disability in STEMM

As was the case with ethnicity, the number of individuals reporting some form of work-limiting or DDA disability in surveys can be low and this also creates challenges when considering statistics regarding disability. However, Labour Force Survey (2013) estimates show that 13% of individuals in employment in the UK report having some form of disability that falls within the Equality Act 2010 definition. Chart 7 (overleaf) sets out the LFS overview of disability for those working in the UK; it shows the proportion of disabled workers in the whole UK workforce ('All') at 13% and indicates that there is less disability diversity in both STEMM and STEMM+ occupational groups (11% and 10% of individuals respectively).

Chart 7: Disability diversity of UK STEMM and NON-STEMM occupations
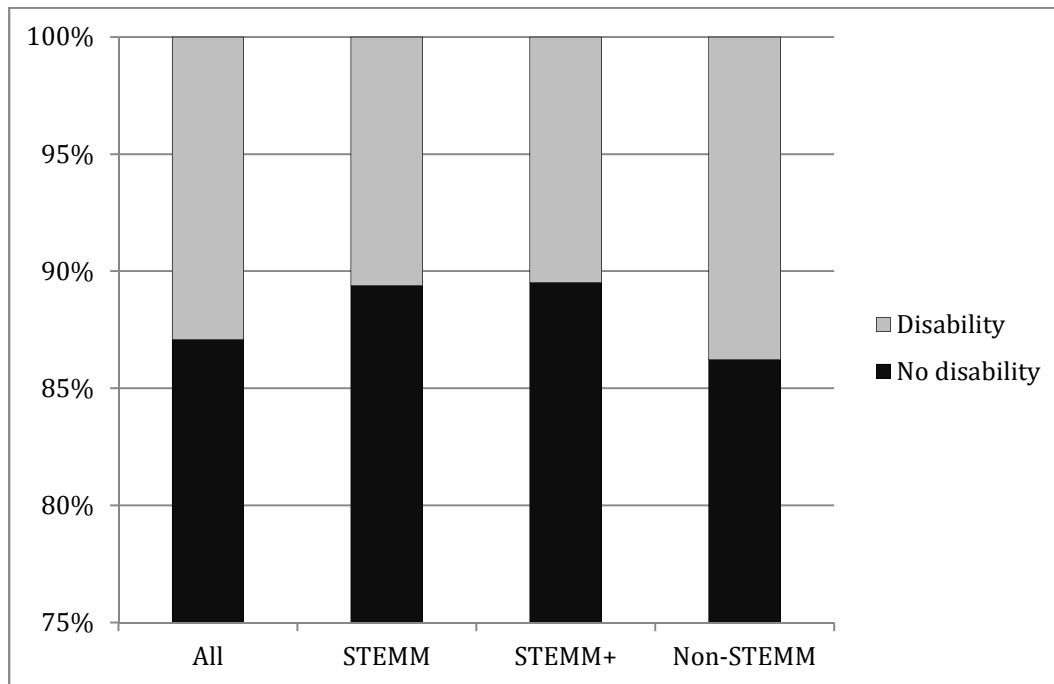
Source: *Quarterly Labour Force Survey, January-March, 2013*

To aid exposition the vertical axis has been truncated to 75%.

Chart 8 shows how this overall STEMM/Non-STEMM comparison changes when we consider individuals working in different sectors. The health sector as a whole contains a higher proportion of individuals reporting some form of disability (up by 2% to 15%), compared to the picture in Chart 7 of all UK employment sectors. However, the opposite is true for those working in STEMM and STEMM+ occupations in the health sector, where the proportion of disabled individuals is one to two percent lower at only 9% in both occupational categories.

Outside of the health sector, the proportion of individuals in STEMM and STEMM+ occupations reporting some form of disability, whilst lower at 11%, is closer to the average for those employed in the UK as a whole (12%).

Chart: 8 Disability diversity in UK STEMM and NON-STEMM occupations: health sector

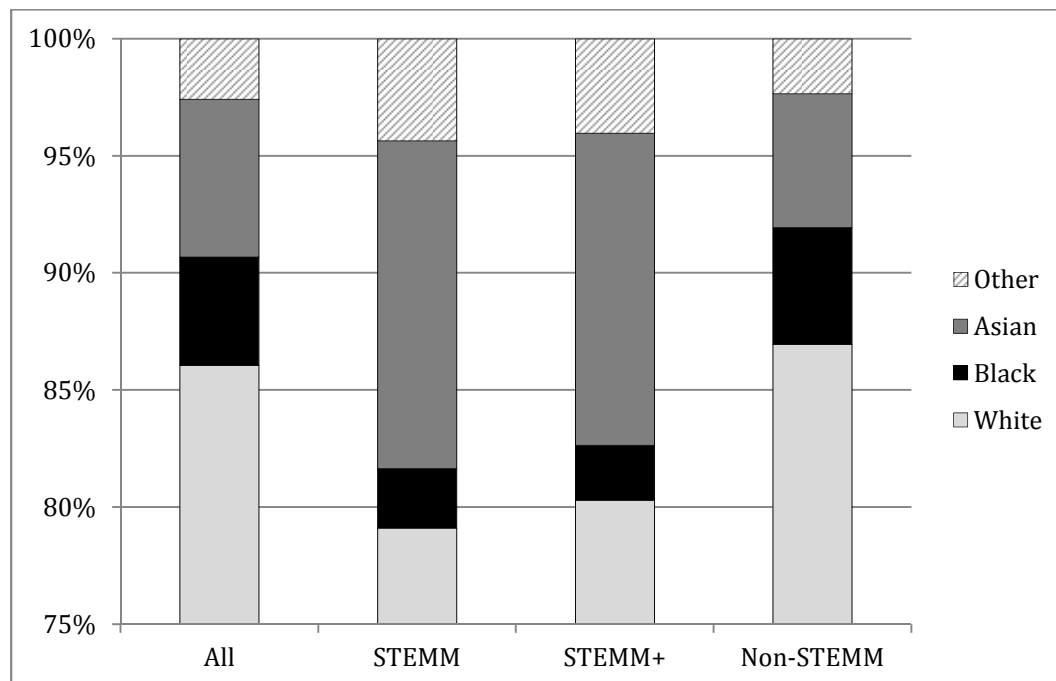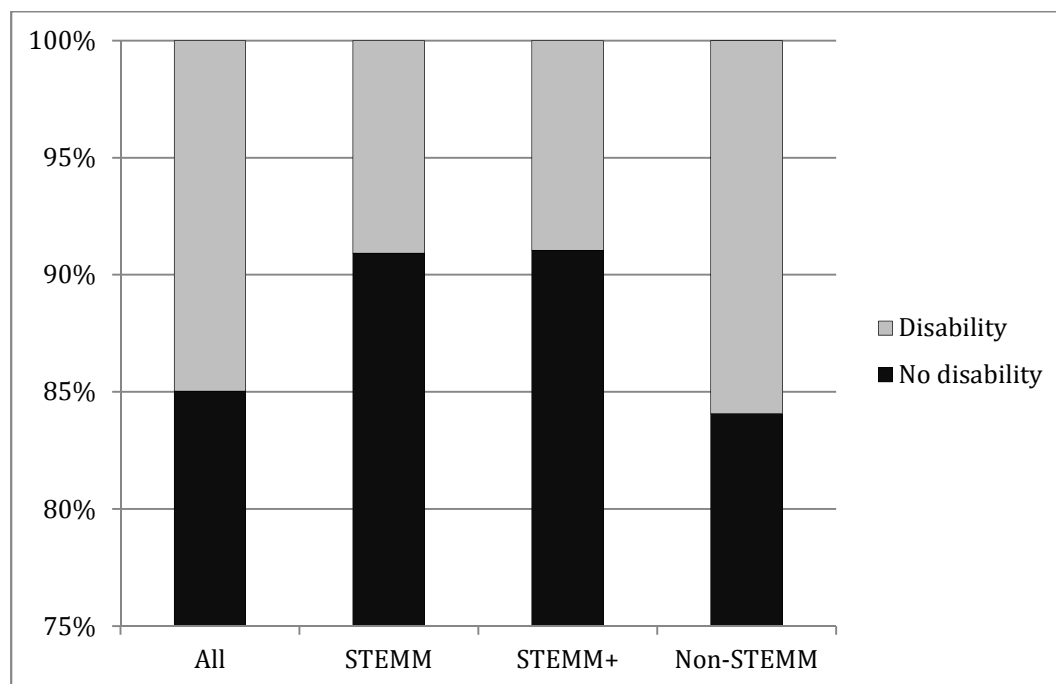Source: *Quarterly Labour Force Survey, January-March, 2013*

To aid exposition the vertical axis has been truncated to 75%.

2.4 Conclusions from quantitative analysis of diversity in STEMM

This section of the report has drawn on sources from the EU and the USA to compare and contrast with the UK STEMM occupations. In the UK, there is no one clear, specific and regular survey of workforce diversity focussing on STEMM occupations in different employment sectors. Hence, this research has drawn on an analysis of data from the Labour Force Survey which, whilst not perfectly matching the needs of the Royal Society, represents a reasonable estimation of diversity in the UK workforce.

The analysis presented suggests that STEMM and STEMM+ occupations are less diverse than the whole UK working population, and that the UK STEMM workforce is less diverse than that in the EU. The evidence from pre-existing empirical work and LFS data indicates that there is both vertical and horizontal segregation in the STEMM sector with respect to gender, ethnicity and disability and that there are notable sectoral differences in levels of diversity. The health sector is more diverse than the non-health sector in terms of gender, ethnicity and disability; once the health sector is removed from the analysis a less diverse picture of the UK STEMM workforce emerges. Explanations for these sectoral differences are not given by pre-existing research and are explored in the qualitative research in this project. Later sections of this report also explore ways in which diversity enabling policies

and procedures of different employers have facilitated entry and progression within STEMM careers for under-represented groups.

3   RESEARCH METHODOLOGY OVERVIEW

The project began with two research questions:

1. What evidence is there that establishes the business case for diversity in the scientific workforce?
2. Are diverse teams more likely to do good science?

The research design for this study addressed these questions in three phases which are summarised in this section of the report. The project team for this research was multi-disciplinary and multi-ethnic and team members worked together to design and deliver a comprehensive and in-depth study drawing on research and techniques from their respective disciplines as scientists, social scientists, economists and human resource management specialists. This enabled the team to create and deliver a mixed-method research methodology comprising strong qualitative methods combined with quantitative analysis. Further information about the research methodology is set out in Appendix 2, where details of the research team, interviewees, focus group participants, interview and focus group topic guides, key themes in qualitative data collection, and an overview of quantitative variables are provided.

3.1   Phase one

This phase was carried out in August - September 2013. It included summarising the existing evidence on the diversity business case. Semi-structured interviews with four diversity and science managers in organisations employing significant STEMM workforces were conducted. These interviews with key stakeholders aimed to identify appropriate measures of diversity and the performance output of scientists working within the contexts of academia, industry, and the voluntary sector.

3.2   Phase two

Phase 2 was conducted in October - November 2013 and involved collecting qualitative multi-level primary data from people working (including PhD students) in STEMM fields through:

1. *Focus groups.* Five focus groups were held with STEMM scientists, two focussed on the gender issues experienced by women, one on disability issues, another on ethnicity, and the men-only focus group discussed diversity in relation to gender and other diversity strands. The topic of social class was discussed in each focus group. A total of eighteen participants took part. The data from the focus group

transcripts were analysed using key themes identified in the literature review and the pilot organisational interviews from Phase 1.

2. *In-depth interviews.* Interviews were held with organisational representatives including HR managers who have a diversity role, and/or science line managers; one to two interviews were held within each participant organisation. The interviewees were accessed via the Royal Society and the research team's STEMM networks and were chosen to represent the broad variety of the STEMM sector: academia; industry; voluntary organisations; public and private organisations, health and non-health sectors. In total seventeen interviews were conducted (in some cases science line managers, and/or HR/Diversity Managers and/or the strategic level interviewee were present for the same interview).

Interviews were held face-to-face or by telephone and each lasted between sixty and ninety minutes; the majority were recorded and transcribed. The data captured in each interview were based on a set uniform topic list, though the interviews themselves were largely open-ended.

Verbatim focus group and interview transcripts were analysed by the research team. Manual coding of the qualitative data was considered preferable to using software due to time constraints and because the number of transcripts was manageable. Through an iterative process of coding, mostly inductive, a thematic analysis was developed.

3.3   Phase three

This last phase was conducted during November - December 2013 and included five strategic level interviews and a descriptive quantitative analysis of diversity related issues in the STEMM sectors, using the Labour Force Survey, Q2 2013 and The Workplace Employment Relations Survey, 2011.

4 THE BUSINESS CASE AND MEANING OF DIVERSITY

4.1 Fundamentals of the business case for diversity in STEMM

The research questions of this study imply that the lack of diversity within STEMM might be ameliorated through finding and disseminating tangible evidence that supports a business case for increased diversity in the STEMM workforce. The suggestion of a business, as distinct from a moral, legal or social case, for increasing equality in organisations was first put forward in the early 1990s (Ross and Schneider, 1992; Kandola and Fullerton, 1998). Since then, despite arguments that the 'business case' is beset with both conceptual and practical weaknesses, a number of studies have sought to show the link between diversity and performance (Noon, 2007; Dickens, 1999). Dickens (1999), for example, argues that, for greater equality to be fully realised, a combination of measures should be used, including more effective legal regulation, action by the social partners (trade unions and employers) and voluntary use of the business case by employers. In relation to ethnic diversity, Noon (2007) highlights the fundamental weaknesses of a business case built on the needs of the labour market, since these are susceptible to recessionary effects.

A study of diversity measures implemented in large London-based service companies highlighted that, while performance evidence might be minor, managers believed in the positive impact of diversity on performance and productivity (Michielsens et al*., 2008). Despite the conflicting evidence that has been collected in previous research, a business case for diversity has been made in various sectors and contexts. In January 2013, the Department for Business Innovation and Skills and the Government Equalities Office (BIS/GEO) published a systematic review of the academic literature on the business case for equality and diversity (Urwin et al., 2013). This identified quantitative studies giving evidence of the possible productivity and performance impacts of diversity, particularly in quasi-experimental studies carried out in team settings (see for instance, Stahl et al* 2009, for a meta-analysis of such studies). However, in some settings diversity is shown to impact negatively on performance, perhaps arising from problems with communication and co-operation (Homan et al., 2007).

An earlier study based on a review of the literature (Cox and Blake, 1991) proposed six main business benefits of a diverse workforce:

1. *Cost*: the cost of doing a poor job in integrating workers is increasing, so those who manage diversity will gain a cost advantage.

2. *Resource-acquisition*: adopting a diversity–management approach will develop favourable reputations for the organisation as prospective employers for women and ethnic minorities, so these organisations will attract the best personnel.
3. *Marketing*: multi-national corporations (MNCs) will obtain insight and cultural sensitivity from having members with roots in other countries, and this will improve marketing.
4. *Creativity*: the presence of diverse perspectives, and less emphasis on conformity to past norms, should improve creativity.
5. *Problem-solv*ing: heterogeneity in groups potentially produces better decisions and problem-solving through a wider range of perspectives.
6. *System flexibility*: the system becomes less standardised, and therefore more fluid, which creates greater flexibility to react to environmental changes.

At face value, there are some benefits to organisations in the STEMM sector from promoting greater equality, both in terms of increased access to a scientific or technical career, and in improved progression once women and people from minority ethnic groups have entered STEMM occupations. The classification of business benefits into either 'External' or 'Internal' given in the recent BIS/GEO report (Urwin et al., 2013) provides a useful starting point. 'External' benefits (p. 9) are expressed through the following arguments:

- As demographic diversity increases, the costs associated with poor worker integration rises.
- Firms can only ensure that they attract the best personnel by selecting from the widest pool. Adopting a diversity management approach will attract more talented women and those from minority ethnic and other groups, than would otherwise be the case.
- There are potential marketing gains to be derived from improved insight and cultural sensitivity arising from employing staff with roots in other countries. Consumers are becoming more diverse and firms need to reflect this or they will lose out on important markets.
- When firms and workers comply with equality legislation, there are savings to be made from fewer employment tribunals and reductions in other workplace costs.

In contrast, 'internal' business benefits are identified as resulting from improved operations within the firm; the suggestion is that diverse teams embrace a greater range of perspectives and that this can improve creativity and problem-solving, leading to improved business outcome.

Overall, evidence on diversity's positive impact on performance remains mixed, possibly because it is context specific (Ozbilgin and Tatli, 2011; Kochan et al., 2003). With notable exceptions (e.g. Herring, 2009), much of the evidence on workplace diversity and business performance is qualitative and/or of case-study in nature (Monks, 2007; Shen et al., 2009). The context-specific nature of the linkages between diversity and performance shown by these workplace studies therefore provides conflicting evidence of the systematic business impacts of diversity (Kochan et al., 2003). This existing evidence-base was reviewed and summarised in the recent BIS/GEO report (Urwin et al., 2013) and concludes that the effectiveness of the business case in tackling inequality may be highly contextualised and is moderated by organisational culture and management processes.

Thus, the literature is not clear how a business case for diversity can be translated at the level of the firm, let alone those specifically within the STEMM sector. Two surveys on diversity carried out by the Chartered Institute of Personnel and Development (CIPD) (2006, 2007) show that 'legal pressures' followed by labour market considerations ('recruitment and retention' and/or 'being an employer of choice') were the important aspects of the business case for diversity made by organisations in the surveys. Legal issues could be at the fore due to the potentially negative impact of bad publicity if the circumstances of a discrimination case are reported in the press, and hence the corporate image and brand damaged. 'Improving products' and 'creativity and innovation' were comparatively low down the list of benefits cited by respondents. However, the samples in these CIPD studies were largely derived from service organisations and the voluntary sector, not from industry, nor specifically from the STEMM sector.

As has been shown, the contextual nature of the business case for diversity means that any consideration of diversity and performance across firms and workers in STEMM areas needs to include both the 'internal' and 'external' business benefits hypothesised, and focus on benefits that are most relevant to workers and firms in the STEMM area.

Cox and Blake (1991) and Dickens (1999) imply that 'external' benefits related to new market opportunities and innovation are most likely to form a business case within industry rather than in the service sector. Despite this paucity of systematic evidence, if diversity within STEMM occupations has the capacity to add demonstrable value within the respective organisation then a business case is more readily made. Indeed, the findings of Hamdani and Buckley (2011) suggest that the success of firms might lead to diversity, rather than vice versa, since, as they grow in size, increasing workforce diversity is seen as a way of gaining 'legitimacy'. Conceptually, this could be defined as a form of 'isomorphism', a term which

recognises that firms often behave in similar ways despite their differences. Powell and DiMaggio (1983) argue there are three types of institutional isomorphic change: 'coercive', resulting from political influence; 'mimetic', stemming from standard responses to uncertainty; and 'normative' linked to managers wishing to be seen as professional. It is this latter type of isomorphism that could be important to interpreting trends in and the meaning of diversity within organisations.

4.2 The meaning of 'diversity' within STEMM

Recognising that the business case for diversity may be context specific (Ozbilgin and Tatli, 2011), it is important to explore the nature of the relationship between diversity and performance in STEMM. In both the focus groups and organisational interviews conducted as part of this research, participants were questioned on this relationship and on their understanding of the meaning of diversity, both at an individual and an organisational level. The data collected from the research participants indicated clearly that 'workplace diversity' can be defined in a variety of ways within the sector. The global nature and reach of science provide a specific context within which diversity has perhaps distinct meanings for those in STEMM occupations. Our research participants indicated that diversity is a broad and complex concept, with every organisation and individual developing their own notion of it depending on their role, the extent to which diversity management has been implemented; and on the business strategy, sector, and market. Some participants stressed the 'international dimension' of diversity, whilst others focussed on the 'representation of society' dimension, or the link between a diverse workforce and diverse products or ideas. Despite differences, diversity was firmly linked in most interviews and focus groups to the concepts of 'respect', 'valuing of differences' and 'inclusion'; it was less linked to 'equal opportunities'. Those interviewed as representatives of their organisation considered their organisation's position to be enhanced by being diverse and indicated inter-linked moral and business components in the drive towards diversity. These themes and ideas are illustrated in this next section using quotations from research participants (for an explanation of who made specific comments see Appendix 2 for details).

4.2.1 **Valuing differences: links to recruiting and retaining the 'best talent'**

The importance given to the business case for diversity was particularly clear in relation to the recruitment and valuing of talent: 'valuing the difference' was considered important in order to attract and keep the best possible talent, especially in sectors with tight recruitment (such as the oil and gas industry). Through valuing and respecting differences, employees would feel more 'included' and therefore stay. 'Representation' (of society and/or client/customer base), 'recognition of differences', 'inclusion' and 'respect' were referred to in

a number of interviews as important to achieving diversity. The following comments and quotes from the focus groups and interviews demonstrate this.

Representation:

> '.....in banking ...the people are mainly rich and wealthy... (diversity is)… having many groups of people from different backgrounds...For me, it's clear representation of different kinds of people.' (FG1femBW)

> 'Diversity refers to different types of groups and making sure they are represented. When I used to work for the bank, they were keen that in different areas, the people they employed matched the ethnic diversity of the area they were employing from.' (FG5malBW)

> 'My perspective is that you get representation from all the under-represented groups, ideally at the level...in society. You don't have equal numbers from any one group. You have to incorporate all forms of under-representation.' (FG1femCW)

> 'It means having a workforce that reflects the broader population.' (Consultancy A)

Recognition:

> '…recognise differences between individuals such as nationality, gender, disability and class ... covers categories related to gender, people with disabilities, different age groups and nationalities… class - more in the UK but not in Norway and the Netherlands. Diversity is directly related to one of the three core values of the company which is respect.' (Oil and Gas)

> 'It's more about overcoming our unconscious bias.' (ConsProductCo)

> 'Diversity means difference and this means difference in ethnicity, belief, gender, disability, but also education, socio-economic status, background, learning styles, communication styles etc.' (Health 1)

Inclusion:

> 'You need to have trust and integrity and respect for everyone and the uniqueness they bring in order to release that diverse talent for the challenges we have and the problems we have to solve. Otherwise, talent will come in and then leave again because those individuals don't feel like they belong, so inclusion is critical.' (ConsProductCo)

> 'It's about everyone coming to work and feeling they are diverse and valued for the unique skills they bring. We want to be in a position where we attract and retain the best talent, they feel at home here and welcomed and don't feel that they need to leave because there are obstacles to their progression. In my personal view, we talk about diversity and inclusion because you can have one and not the other. So I suppose that diversity inclusion is about having the right blend and mix for people for the type of work that we do.' (Consultancy 2)

4.2.2 The focus of diversity

Most of the discussions in focus groups and interviews on what diversity means to individuals and organisations did not refer to specific groups but, if they did, the focus was generally on gender (women). This focus was apparent too when diversity strategies were detailed.

> 'Workplace diversity means trying to move us to an organisation that has greater gender balance, that has more women in senior positions and where women have a chance to fulfil their potential.' (Consultancy 1)

> 'We are doing a massive piece on maternity.' (Surveyors)

> 'Our [corporate] values are clearly stated as passion for women, integrity, leadership, ownership and trust and everything is underpinned by respect for the individual.' (ConsProductCo)

4.2.3 Transition of 'equal opportunities' concept

The discourse on diversity seems to have moved away from 'equal opportunities', a concept that may be considered passé, or too narrowly focused on the law:

> '[The Project] had an EO policy from 1996 but in 2011 the new CEO and HR/Diversity specialists extended this to be a diversity strategy that moved from the 'more legalistic' EO policy ...which aimed to create a 'level field' to make project 'optimally diverse.' (Physics)

4.3 Organisational perspectives on the business case

Data collected in the research interviews for this project implied acceptance of a business case for diversity in the context of the STEMM sector. As in the earlier study by Urwin et al (2013), both 'external' and 'internal' benefits of diversity were identified by organisations in this study. External benefits were mentioned in relation to ameliorating the rising cost of poor integration of workers, resulting in higher turnover:

> 'We are not measuring a lot of this but things like 'regretted' leavers, the cost of someone leaving the firm at different levels, the loss of skills, recruiting someone new etc., if we can prevent one person leaving, for reasons related to diversity and inclusion, then that in itself is a massive benefit.' (Consultancy 2)

Attracting and retaining employees with the relevant skills and selecting from the widest pool of potential candidates, were identified as priorities in some private sector organisations:

> 'If we can fix that gender imbalance...that would mean that there would be a much bigger take-up in engineering and science subjects and that would allow us to solve our skills crisis.' (Consultancy 1)

Optimising talent resources was not the only business benefit mentioned; diversity was seen to play a crucial role in optimising client attraction, especially when it was taken into account in a tendering process and influenced the winning of contracts:

> 'We have to be as diverse as our clients and talent comes in all sorts of forms.' (Surveyors)

Consumers and service users are becoming more diverse and the organisations appreciated that they need to reflect this if they want to maintain a competitive edge:

> '… in [company name], the business case is the clients. If the Board wants to know why this affects their business, which is all they want to know, it's because the clients are asking for it. To better service our clients, they want to see more women in these positions, they want to see us as a firm that better helps and supports this… So people have now accepted that a more diverse team is more appealing to a client.' (Consultancy 2)

Relating the diversity of staff to the diversity of service users was seen as a particular priority in the public sector:

> 'We have a diverse staffing group and diverse groups of people and services and if we don't understand the various differences and capture this and amplify our understanding of the various needs that people have, then we're not going to deliver responsibly as a health care organisation.' (Health 1)

The potential for marketing gains, derived from improved insight and the cultural sensitivity arising from employing staff with roots in other countries, was clearly recognised in the private sector:

> 'When we think about designing products, packages and services for consumers around the world, it is self-evident that we will do better at that if we have a more diverse organisation… we are using our African ancestry groups that said that you are not meeting our needs through the products you make…' (ConsProductCo)

Regarding the 'internal' benefits identified as resulting from improved operations within the organization, interviewees were in accord with Urwin et al (2013) that diverse teams include a greater range of perspectives, which can improve creativity and problem-solving and lead to improved business outcomes. For example:

> 'How likely is it that a monoculture is going to make better decisions? It's pretty unlikely. Wisdom comes from looking at issues from different angles. If you are looking at problems through one lens, then you're not going to make better decisions.' (Consultancy 1)

> 'The evidence is overwhelming that diversity out-performs and out-innovates homogenous teams.' (ConsProductCo)

4.3.1 Creativity, innovation and 'diversity of ideas'

Increasing diversity was seen as important for the long-term success of an organisation because a diverse workforce could be instrumental in creating an environment that fosters creativity and innovation. This diversity was not restricted to association with certain demographic categories but was taken in its widest sense, as evidenced by the following quotes:

> '(We are) optimally diverse' to tap into the 'creativity that comes from bringing people together'. This new policy aims to create a 'work environment' that is conducive to collaboration... The current [CEO] believes in the value of diversity ...fostering collaboration and creativity (and the) 'the meta-value' of diversity in achieving 'excellence' by fostering collaboration.' (Physics)

> 'If you have to work with people, and a lot of the things delivered through organisations lies in collaborating with people, you need a bit of diversity so that people aren't blind-sided to run straight into the same issues and problems because they see things in the same way.' (Health 1)

> '… (diversity is) not necessarily where the person is from. They might be of the same gender but have different perspectives.' (FG2femANW)

> 'Diversity is not about all these different categories but ... the way people approach work and life.' (FG3femAWDD)

> 'In relation to the workplace, I feel that, despite whatever capacity a person is active in, the only measures for being there is that they have the experience and skills required for the job.' (FG3femBNWDD)

4.3.2 Strategic level perspectives on diversity

Five senior STEMM managers interviewed from both the public and private sectors showed they were well aware of the challenges posed by the lack of diversity; they also revealed different approaches to increasing diversity in STEMM organisations and the sector. In the existing literature on the business case (for example, Kandola and Fullerton,1998) the concept of diversity and the business case are fundamentally bound up with the business strategy. The notion of the 'diversity mindset' of an organisation is used to describe whether its senior executives view diversity as integrated into the business strategy or not. In some of the private sector organisations interviewed in this research, there was evidence of executives integrating diversity into the strategic plans. For example, the representative of a consultancy organisation posed the question:

> 'Does the way we do business and are our policies and processes in line with what we want to achieve?' (Consultancy 2).

The picture in the public sector is more complex. Representatives of the large NHS Trusts

participating in the research saw the Trusts' role in relation to diversity as spanning both inside of the organisation, in relation to employees and service users, and into the 'wider community' (Health 1) as well, an approach they called 'Inclusion'.

Such differences in approach imply both broad and narrowly-focused strategies designed to achieve more diversity, with the need to: 'tackle this problem as an industry and society' (Consultancy 2). The broadest strategies aimed to attract and recruit a diverse workforce and entailed changing peoples' perception of STEMM roles to make them more attractive to young people, and using 'softer' language in recruitment advertisements to make them more appealing to women. This approach included replacing the word 'engineering' with an alternative that has fewer stereotypical and potentially off-putting connotations. More fundamentally, the tactic in some of the organisations participating in this research was on changing the brand image of STEMM roles to attract a more diverse workforce.

In contrast, there was also an argument made for a 'focus and simplicity' (CMO) in the STEMM sector. The Chief Medical Officer (CMO) interviewed proposed that a good starting point for increasing diversity is to address the problem of poor levels of female progression, because this has a significant economic impact and there is a clear economic argument for doing so:

> 'How can we afford to waste half our best brains? This is not right for the country.' (CMO)

At the strategic level in the health sector, there was recognition of a fragmentation of responsibilities in terms of access to STEMM occupations, with '…..employers, universities and professional organisations' (Health1) all having a part to play in this. Such fragmentation is linked to the nature and content of diversity policies in the sector, as are debates about strategic coherence. For instance, employers may seek to influence entry to STEMM professions but they have limited control, and while they may have diversity policies which seek to encourage school-age children from diverse backgrounds, hoping they will aspire to these occupations (see also section 5.4 'Increasing Diversity and Inclusion – Access to STEMM Careers'), employers have no control over whether children actually make these choices.

4.4 Conclusions on the business case and meaning of diversity

A review of the literature on diversity identifies conflicting evidence on whether there is a business case to support its positive contribution to organisational success. At a conceptual level, it is possible to identify potential benefits accruing from a diverse workforce; these can be grouped into 'external' benefits of reduced costs, improved resourcing of talented personnel, better products and services, and enhanced corporate image; whilst 'internal' benefits can be envisaged where plurality of perspectives leads to increased creativity, innovation and problem-solving (Urwin et al, 2013). Whether these potential benefits can be achieved, and which ones would be valued most by an organisation, also appears to be a relevant consideration (CIPD, 2006, 2007); the evidence suggests that there is no one uniformly relevant business case and that contextual difference is a significant factor in determining this. Thus organisational tendencies to follow the crowd and adopt strategies employed by other employers (isomorphism) will not guarantee success in increasing diversity or demonstrating a convincing business case for it.

Our research participants associated a range of meanings to 'diversity', informed by features such as the global nature of STEMM, their personal experiences and their organisation's responses and approaches to diversity. However, diversity was described as being a bigger concept than 'equal opportunities' and was imbued with wider values such as respect, inclusion and 'valuing difference'.

Organisational representatives in the research implied acceptance of the case for benefits of diversity, mentioning both 'external' and 'internal' benefits. Some private sector STEMM organisations had built diversity into their strategic plans in recognition that it would make them better able to achieve strategic goals. An NHS Trust identified how diversity was encapsulated in the idea of 'inclusion', which spanned the boundary between organisation and service users. The Chief Medical Officer interviewed promotes practical and focused action, where there is plenty of scope for change so preventing the undeniably significant loss of women from the STEMM workforce. Yet the range of parties (employers, universities and professional organisations) that might influence recruitment, loss or retention, are fragmented in their approach to diversity. Arguably, until a coherent and integrated approach is developed and adopted, the problem will not be alleviated effectively and systematically.

Whilst these debates and approaches operate at a strategic level, organisations also described practical initiatives, such as taking care over the words used in recruitment campaigns to increase the likelihood that under-represented groups apply.

This report now turns to the policies and practices in use; these could be considered when planning or evaluating diversity interventions.

5   DIVERSITY STRATEGIES AND POLICIES

This section of the report combines analysis of Workplace Employee Relations Survey (WERS, 2011) data with comments made by the participants in this research regarding the strategies and policies used in organisations. WERS has been used to examine UK employment policies that may impact diversity; charts display results to relevant WERS questions consistent with the Royal Society's focus on STEMM.

5.1   Diversity policies within the STEMM sector

WERS provides evidence that fewer STEMM workplaces have formal diversity policies than in the some other parts of the economy, although it is important to acknowledge that policy statements do not necessarily reflect practice (they could be 'empty shells' as shown by Hoque & Noon; 2004). Chart 9 (overleaf) shows that, while 91% of 'STEMM Health' workplaces have a specific written policy addressing gender, only 76% of 'STEMM, Not-Health' workplaces do[2].

The literature review indicates that organisational policies addressing issues of diversity range from equality policies designed to ensure legal compliance, to those positively encouraging diversity through proactive policies aimed at recruiting and retaining a more diverse workforce (Armstrong, et al., 2010; McDougall, 1998). Organisational diversity policies designed to encourage diversity were discussed both in the focus groups and with representatives of the participating organisations. These policies varied in terms of which 'protected categories' were covered, gender being the one most frequently mentioned.

The long-hours' cultures was considered by the focus groups, and in particular the women's focus groups, to adversely impact on diversity, including through personal accounts of how careers had had to change. A computer scientist who had worked in investment banking for fourteen years recounted how she gave up her job to escape from a long-hours' culture:

> 'I have two young children. I am attempting to be self-employed as a computer programmer' (FG1femBW).

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[2] When analysing WERS data, workplaces were selected according to whether they are considered to be STEMM or otherwise (see methodology in Appendix 2 for more detail). For instance, in Chart 9 the first column relates to all firms that can be considered as working primarily in STEMM areas; the suggestion is that amongst these firms 91% have a formal written policy. The second column relates to all firms that are not STEMM, but are engaged in the Health sector; the suggestion is that only 88% of these firms have such a policy. The figures for WERS have been weighted to account for possible response bias.

Chart 9: Does the workplace have a formal written policy on diversity/equal opportunities, on the grounds of gender?
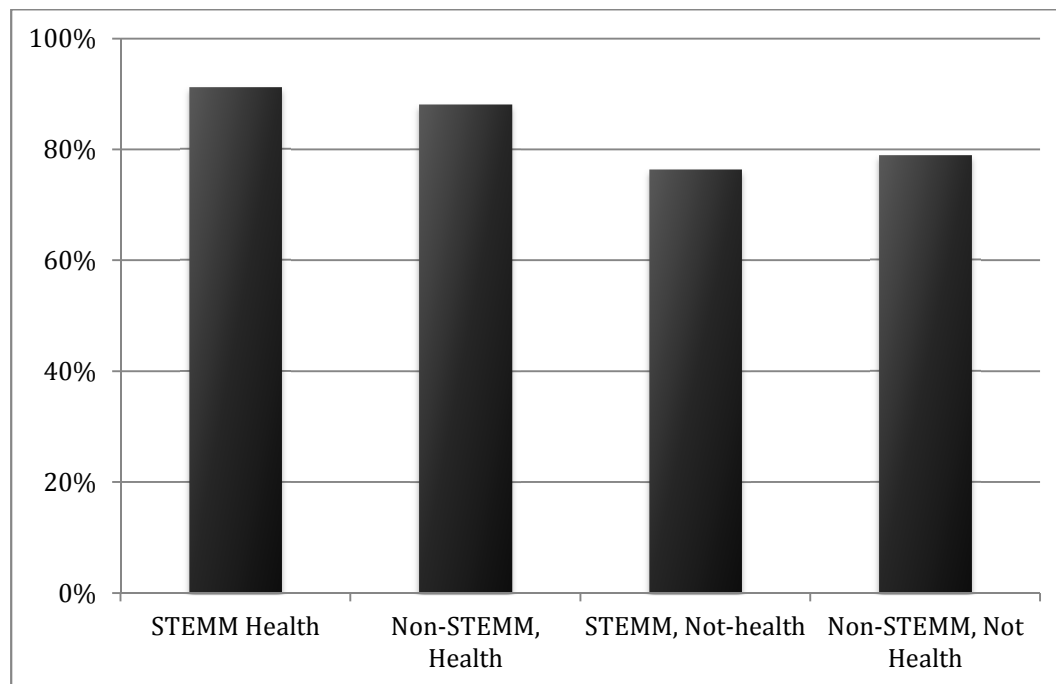
Source: *Workplace Employment Relations Survey 2011*

5.1.1 Career progression for women

Career progression was also discussed in the focus groups and gender barriers were noted. An engineer reflected on career challenges for women with children and other participants echoed her views:

> 'Earlier in my career it seemed quite easy but as you get promoted, you go up in the organisation. The barrier for me was having children. I had them and took time off and when you get back in the hierarchy, you are at the bottom and everybody else has been promoted. You are then catching up.' (FG2femEW)

Organisational representatives concurred that there were 'challenges' for employers when, and after, women took maternity leave, and that women returners' careers tend to plateau or change as a consequence:

> '...we tend to see a drop off in gender diversity …when employees have been in the company for 10 years … After 10 years, women are typically starting families or having children.' (ConsProductCo)

The WERS data, shown in Chart 10, confirm this difficulty, indicating that the majority of employers do not have policies and practices designed to encourage women to return after maternity leave. The health service is ahead of most other employers in this regard: 17% of

'STEMM Health' workplaces reported procedures in place to encourage applications from women returners, compared to 13% of 'Non-STEMM Health' workplaces; this falls to a low of 8% for the 'STEMM, Not-Health' category.

Chart 10: Do you have procedures to encourage job applications from women returners?
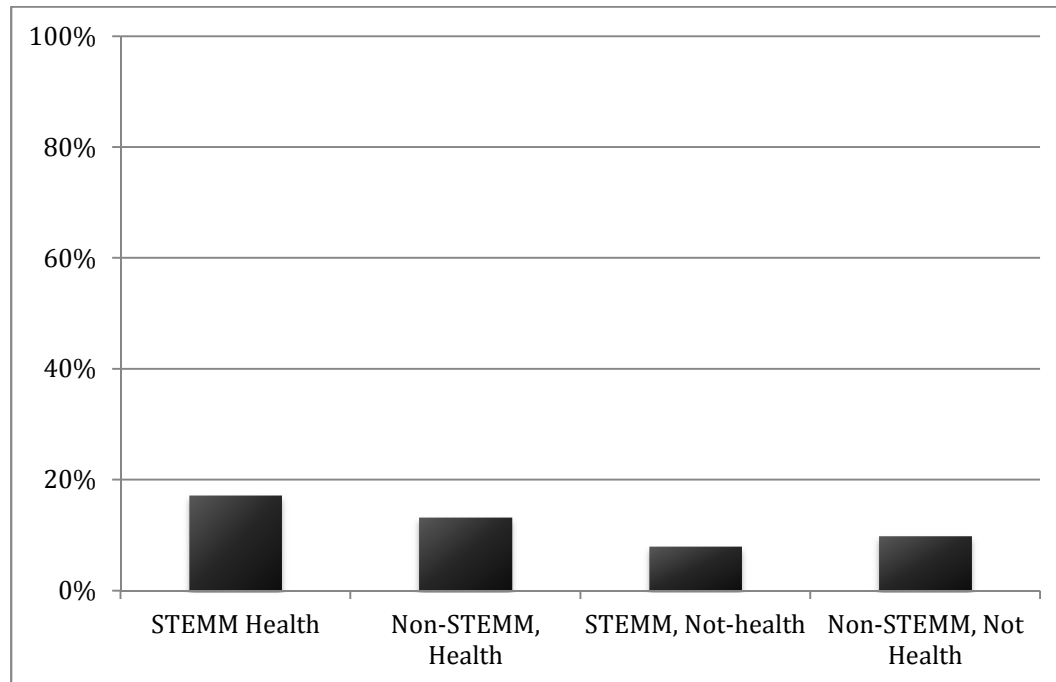
Source: *Workplace Employment Relations Survey 2011*

Lack of clarity and transparency about the criteria for promotion and progression were also cited as inhibitors to diversity by those individuals taking part in the gender, disability and ethnicity focus groups.

Policies aimed at addressing some of the issues raised in the focus groups were described in the organisational interviews. Whilst some of the organisations taking part in the research are currently non-diverse (in terms of gender, disability, class and ethnicity), such as 'Contractors' and 'Surveyors', others have seen some success in achieving diversity, albeit mainly in terms of gender ('Consultancies 1 & 2', 'Physics', 'Health 1', 'ConsProductCo'). There were policies to address the long hours' culture, including more possibilities for part-time working, flexible working, home working, compressed hours, or having 'location-free' jobs; but, as the 'Oil & Gas' recruitment manager pointed out: 'people tend to work many more hours than they are paid for.'

In the very male dominated environment of surveying there was also recognition that failure to tackle the 'traditional' long hours' culture is an impediment to the progression of women:

> 'The industry is very traditional and old school ...and we have this whole culture where it's about face time.' (Surveying)

5.1.2 Fixed-term contracts

The evidence from organisations classed as 'Research', 'Physics' and 'University' is that scientific research is populated by:

> '…quite a transient population of post-doctoral research fellows ...recycled every three to four years. I think in the university system they can stay on longer….Our graduate students stay usually for four years and then leave.' (Research)

Employment for such 'post-docs' typically comprises fixed-term contracts to begin with, offering poor job security to researchers. Participants in the gender and minority ethnic focus groups reported a prevalence of the use of fixed-term contracts for 'women of childbearing age' (FG1femCW) and minority ethnic staff in the university sector. The law[3] prevents renewal of fixed term contracts beyond four years, unless there is a legitimate and genuine business objective. Concerns were expressed in the focus groups that fixed-term contracts could potentially be used effectively to limit maternity leave rights, particularly if employers enforced breaks in service between fixed-term contract periods..

A university in the study, with a large proportion of academics in the STEMM area, published data on its use of different contract types by gender, ethnicity and disability. This data indicated that, while the use of fixed-term contracts was roughly equal between men and women (27% of women, compared with 29.1% of men), fewer women academic staff held established posts than men (81% compared with 92.8%), demonstrating that women are more likely to be in posts without tenure. This same data also showed that a higher proportion of academics of a BME ethnic background are on fixed-term contracts than white academics (40% against approximately 20% respectively). In addition, while just 2.9% of academics disclosed a disability, 15% of these disabled staff were on fixed-term contracts.

Overall, the data collected in this research project indicate a picture of lower job security for women, minority ethnic and disabled staff, associated with the use of fixed-term contracts and other less permanent contracts. This is the case in the university and science research areas of the STEMM sector, but there was less evidence from other sectors.

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[3] The Fixed-term Employees (Prevention of Less Favourable Treatment) Regulations 2002 (SI 2002/2034) which implement the provisions of the Fixed-term Work Directive (1999/70/EC) into UK law and The Fixed-term Employees (Prevention of Less Favourable Treatment) (Amendment) Regulations 2008 (SI 2008/2776

5.1.3 Diversity policy effectiveness

The focus group participants were generally critical of the effectiveness of organisational diversity policies, though they reported some sectoral differences:

> 'I think in business we are lagging behind the university and research sector. You may have a policy but business comes first.' (FG2femBW)

> 'I think it differs from one sector to the other. People in the computer games sector are notorious for doing a lot of overtime and you don't have as many women working there. The women that do are usually younger. Whether that's essential to the nature of the industry or that's just the culture and there's not enough pressure to change it, I don't know. A lot of that work can be done at home. It might be partly because it's still a relatively immature industry that hasn't been around that long and it's dominated by men.' (FG2femEW)

In contrast to this picture, some of the organisations in the research operated more developed and holistic employment 'strategies' that took a diversity perspective and were implemented to improve recruitment, retention and workplace relations:

> 'We took the approach of tackling the diversity challenge from a systems perspective…[…]…We have a communications strategy internally, aimed at increasing people's awareness about diversity and encourage people to talk about it, and externally to position and market ourselves.' (Consultancy 2)

In other organisations, the initiatives reported were more fragmented; some activities targeted leadership, others recruitment or retention.

5.1.4 Leadership and development

Good leadership, good management skills, and the presence of a diverse management were identified as important factors, both by the focus group participants and some organisational representatives interviewed. Leadership team behaviours can be strategic because of their contribution to a 'diversity mindset' (Hopkins et al, 2008) which is central to increasing diversity.

Managers of STEMM staff were considered crucial to staff retention because they can influence retention levels through the creation (or not) of a positive work environment. Consequently, several of the organisations taking part in this research (in the medical field, health service, surveying and consultancy) emphasised the importance of developing their line managers. For these organisations leadership development programmes, in which diversity features centrally, have become a priority:

'…ensuring our leaders have the right skills and they are leading in a way that nurtures and creates more diverse teams'. (Consultancy 2)

The consumer product company participant ConsProductCo reported that a half-day of the annual year-end two-day meeting of the executives is spent on 'Diversity and Inclusion' activities. This session includes information collected through consumer surveys on products, ideas on creating inclusive environments and research-based evidence on diversity and performance.

'Surveying' represents a sub-sector of STEMM+ that lacks diversity; a high proportion of chartered surveyors are male, white and middle class. One of the few women at a senior level in this field commented that a factor inhibiting diversity was unconstrained 'big personalities' amongst top managers:

'…here we are so personality-driven and dominated by alpha males.' (Surveying)

5.2 Training about diversity

Diversity training is an important part of diversity strategy for the organisations interviewed; 'unconscious bias' and 'diversity and inclusion' are at the core of much of this training which is delivered both online and face-to-face. In recent literature, especially that derived from the USA, discrimination in STEMM employment and recruitment is being linked with the concept of 'unconscious bias' (for instance see Raymond, 2013; Mervis 2012). The term originates from social psychology and seeks to describe the impact of subconscious presumptions about people's characteristics (such as being female, non-white, disabled) on recruitment and performance management. Awareness of one's own biases can help with recognition and the potential reduction of the impact of this implicit bias (see for example, Devine et al, 2012). An increasing number of employers use 'unconscious bias' awareness training as a tool to increase diversity and inclusion because of its capacity to raise self-awareness and allow self-correction in thinking patterns and decision-making. UKRC WISE (Women in Science and Engineering), for example, organises training 'which addresses the relationship between the implicit associations, stereotypes and individual attitudes towards apprentice recruitment' (see http://www.ukces.org.uk/news/Articles/2012/Oct/cogent-technical-apprenticeship). 'Consultancy 1' commented how and why the organisation use this concept and terminology:

'We have now called it unconscious bias. If you run something called diversity awareness, everyone glazes over but when you call it unconscious bias it makes a big difference. We've given unconscious bias awareness training to our senior leadership teams. We have a big

company with a UK Board and eight businesses but we still go through this training with all the senior people so that they get it. That's now threaded through all our line manager programmes and any general programme of development that we provide has unconscious bias training in it, from senior management development programmes to line manager training.'

As increasing numbers of STEMM employers organise this type of awareness training and, the diversity discourse in organisations has become homogenised. This is encouraged by the common practice of 'benchmarking', a human resource management activity which inclines organisations towards "isomorphism" (Farashahi et al., 2005, DiMaggio and Powell, 1983).

Over and above training for organisational leaders and managers who shape and oversee strategy development and policy implementation, some organisations provide particular development training opportunities to certain 'protected characteristics' groups. 'Consultancy 1' noted the positive impact of such programmes on the retention and progression of women in the organisation, intended to ensure 'their experience is positive'.

> 'Within that we have our diversity networks and particular training for certain groups…' (Consultancy 1)

5.3   Recruitment

Some organisations reported the recent introduction of more proactive policies aimed at attracting and recruiting more diverse staff members. In the international 'Physics' organisation, a new CEO and HR/Diversity specialist had developed a policy designed to create a 'work environment' conducive to collaboration, and hence to translate into improved and more diverse recruitment. The organisation has also established a Talent Acquisition Group within its Human Resources department, tasked with improving the distribution of under-represented nationalities. Similar efforts were underway to achieve greater gender distribution in recruitment for all professional roles. Another tactic used by organisations seeking to increase diversity through the recruitment of diverse new staff was to make diversity policies visible to potential applicants.

'Consultancy 1' gave an example of how a policy had changed and how this had been made visible in recruitment advertising:

> 'We've enhanced our policy on flexible working and from last week you can search our website for flexible jobs. You don't have to look for the job and then find out if it's flexible, you just look for flexible jobs. The last count, there were over 100 jobs like that.' (Consultancy 1)

Fewer initiatives specifically targeted at recruiting minority ethnic candidates were mentioned, a finding consistent with WERS (2011), though there were exceptions, such as:

> 'We make sure that, when we're using online and physical materials, that we have both genders and a variety of visual characteristics where you can see people are from different parts of the world, different ethnicities etc.' (ConsProductCo)

Chart 11 (below) shows that outside the health sector only a few workplaces have arrangements in place to encourage applications from minority ethnic candidates.

Chart 11: Do you have procedures to encourage job applications from minority ethnic candidates?
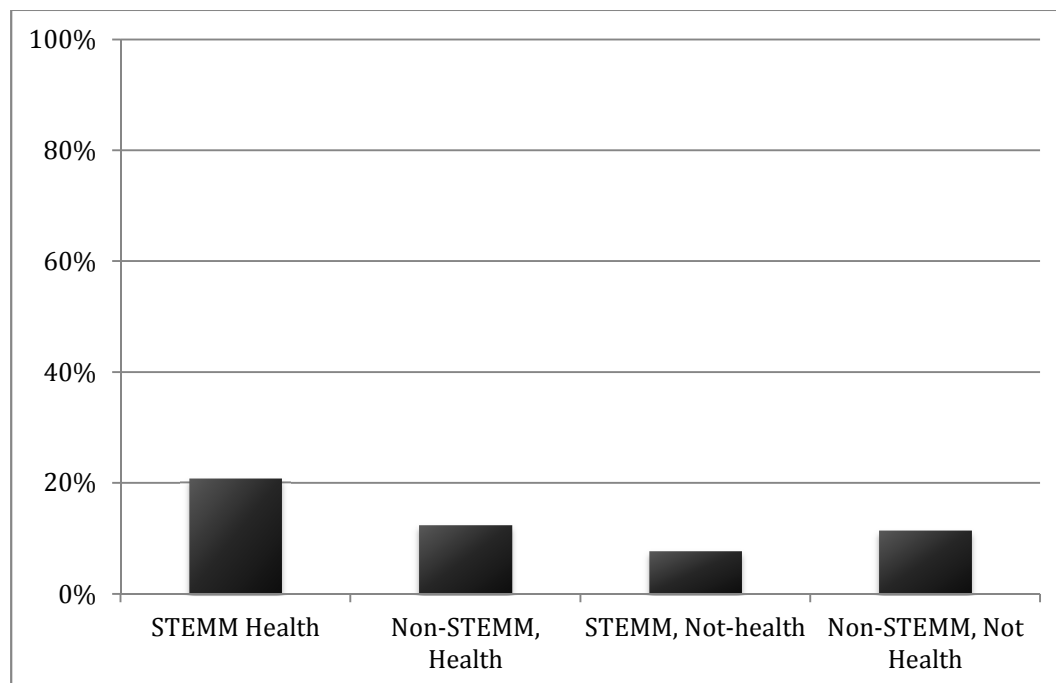
Source: *Workplace Employment Relations Survey 2011*

In contrast to data on procedures in place to attract applications from minority ethnic candidates, WERS (2011) suggests that a higher proportion of workplaces have procedures in place to attract disabled candidates. There are a substantially higher proportion (58%) of workplaces taking such measures in the 'STEMM Health' category compared with the 'STEMM, not-Health' category (only 11%). Making the interview process more accessible to disabled candidates was also considered a priority.

Similarly, Chart 12 (below) indicates that only a small minority of organisations in STEMM and STEMM+ outside the health sector actively encourage disabled job applicants.

Chart 12: Do you have procedures to encourage job applications from disabled candidates?
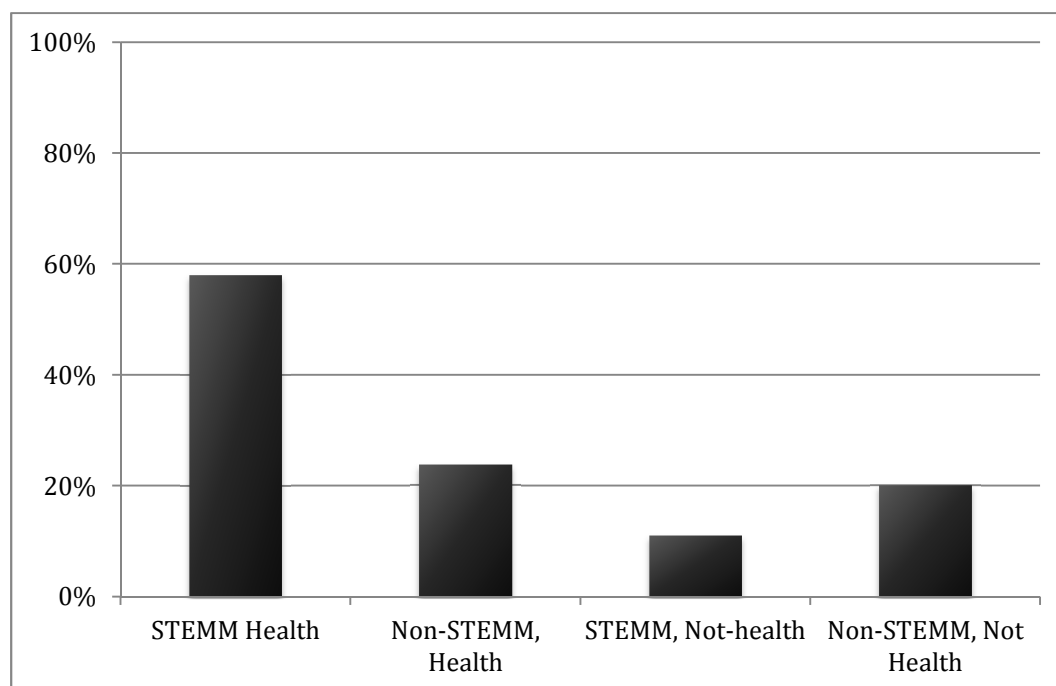
Source: *Workplace Employment Relations Survey 2011*

5.4 Increasing diversity and inclusion – access to STEMM careers

All participants in this research highlighted the importance of early career choices and opportunities. Crucial career-related decisions are made by girls at a young age and the female focus groups participants regarded the lack of encouragement, and absence of role models available for young girls considering science or mathematics, were key factors in the under-representation of women in STEMM occupations. They considered that early career choices are affected by a range of influences, including: lack of good career advice; appropriate role models; media depiction of science; lack of toys and play materials available to girls; and the barriers faced by those from working class backgrounds without the access to options and possibilities available to those from more privileged backgrounds:

> 'Part of it is career guidance particularly for children who come from the not so wealthy end of the spectrum. Children that come from middle class families will know scientists, or their parents will. Therefore, they will know what is available. However, a child who doesn't have access to those networks, unless they have good career guidance, they are not going to choose those careers.' (FG2femEW)

> 'The role model is very important but we still have a very male image of scientists. The Big Bang Theory has been great to promote science and physicists but it's still male characters. People like Brian Cox have been good at getting students into physics but he's still a male role model. So

it's about getting more female role models out there and they don't have to look like the typical scientist because everybody is normal. Getting that at a young age is important.' (FG2femCW)

Some of the organisations taking part recognised the importance of these early career choices and of recruiting from a larger talent pool and were working with a larger range of schools and universities than had been the case in the past. Many such initiatives, some long-standing, were aimed at attracting girls and women into STEMM occupations traditionally seen as male domains:

'[Our organisation] used to run activities where we go to graduate camps and present activities to children, between the ages of 12 and 13, before they did their GCSEs and the idea is to get them so interested in maths, physics and other science related subjects. They run the events at big places like [name] football grounds and they get hundreds of schools in and ask them at the beginning of the day how interested they are in science. At the beginning it's about 10% but by the end of the day it goes up to 70%. We have the [name] Fair which is aimed at attracting girls into STEMM subjects. [...] Last year they got 55,000 young people attending it. It cost us about £50,000 because we have to invent something for the kids to do.' (Consultancy 1)

The links between social class and ethnicity were discussed in the focus groups. The participants agreed that 'class matters' and referred to the importance of social structures, such as the 'class' of particular universities. In both 'Surveying' and the electrical contracting industry there are attempts to develop apprentice programmes as a way of attracting a more diverse range of young people to these industries. The surveying apprenticeship initiative is linked to widening out the universities from which it recruits graduates to train as professional surveyors; the organisation identified that the narrowness of its recruitment of trainees from a small number of 'middle class' institutions could be a barrier to achieving increased diversity.

While these initiatives are still at an early stage in surveying, some limited success in increasing class and ethnicity diversity has been reported in electrical contracting.

5.4.1 External links or outreach
External links referred to by the survey participants included work with research bodies, professional associations, student associations, schools and universities. Campaigns and outreach activities were informed by market research and were cited as examples designed to 'generate interest'. For example:

'We're looking to work with 85% of schools to bring health science careers to their doorstep and have created an e-mentoring programme where professionals in the trust are mentoring people in local schools. In December we had a fair with 130 young kids between the ages of 15 and 17 and mentors that came to 20 different career stalls. Those mentors are matched with young people.' (Health 1)

5.4.2 Women into science and engineering (WISE)

The initiatives of WISE were discussed by the research participants in relation to its work promoting to girls the idea of careers in STEMM. A representative of WISE was interviewed, her comments about what WISE aims to achieve, and how it does this, are presented in the pages that follow.

Women into Science and Engineering (WISE)

WISE was established in 1984 following the Finniston Report on the future of engineering in the UK, which emphasised the need for a broad talent pool of scientists and engineers; thirty years on WISE has also incorporated the UK Resource Centre of Women in Science (UKRC).

Since its inception, WISE has contributed to campaigns to raise the profile of women and girls in STEM. WISE's mission is to achieve greater gender balance in the UK's STEM workforce by increasing the number of female employees from 13% to 30% by 2020, and WISE's services are designed to build and sustain the pipeline of female talent in STEM, from classroom to boardroom (WISE, 2014). A member of the WISE team was interviewed to discuss the services provided by WISE and associated challenges; her comments are reported below.

WISE intends to reach the goal of 30% women in STEM in 2020 using a 'three-pronged approach':
1.   To get 'the' message across to girls and employers.
2.   To increase the recruitment or build a pipeline.
3.   To look at the workplace culture.

The first approach, changing attitudes amongst girls, entails running events in schools where role models can meet girls to share the opportunities that are available to them and change their perception of science and engineering; employers can be there too. WISE recognises the important role that is played by parents:

> "Parents can be a key influence, because they actually put girls off, dissuade them from choosing these subjects even if they are interested in them. The workshops that we've had, we invite parents to come as well. They are very interested, because it opens their eyes. Teachers as well and science teachers don't realise the range of opportunities there are."

The second approach concerns supporting companies in their recruitment:

> "We launched membership last year and companies, universities and women who want to be role models can sign up to be members of WISE. And then we will work with them… supporting people really to access female talents. Whether they are putting adverts through the WISE website or whether we've put on events for careers and to meet role models. We organise meetings where they can share good practices with each other."

SME companies represent a particular challenge:

> "The first thing is to get that message across more broadly, why it's important. They may have benefits in terms of having a more diverse team and making better decisions and being closer to their customers and the retention maybe better as well. The issues, if you talk to people

and drill down as to why, it's the cost. One usually tends to go beyond that. The benefits outweigh the cost. It's what we would argue."

The third area is looking at the workplace culture, which will address the retention and progression of women:

"If you have more women, there is a more senior role in science, then it would be more attractive to girls as a proposition to work. So how we would look at the retention and progression is by giving guidance to employers about what good practice looks like. Helping them to identify, diagnose what the issues are within that company, which might be through transcripts or surveys, and then looking at support networks for the women, mentoring or other networking opportunities. Because often they will be isolated. That's why we go to the membership. We can join up what people are doing and share what works. Organised events might be in a region where different ones can come together. The girls share good practice with their peers. People don't have to reinvent the wheel or work alone on issues."

5.5 Retention

Staff retention policies listed by focus group interviewees included: making reasonable adjustments in the workplace to take account of disabilities, enhancing flexible working opportunities to achieve better work-life balance, and offering better development and networking opportunities. Pro-active positive action to address issues associated with disability was also referred to by the organisations:

> 'In all of our buildings we think through issues of access. There's currently an issue around IT facilities for visually impaired people. We're pretty sensitive to those things when we are aware of them. What worries me is that I don't think we have as many disabled people among our work population. We haven't looked at that in any detail.' (Consultancy 1)

A representative from an NHS Trust commented on the potential impact of people working until they are older than the current norm. Employees will be more likely to develop disabilities and employers will need to find ways to retain these individuals in the workforce:

> '…that does have a bearing on the cost of reasonable adjustments but what's reasonable and what does the business deliver?' (Health 1)

The NHS Trust was therefore undertaking a piece of work called 'Referral Access to Work' that:

> '…looks to get people back into work. So if you have a disability and you are off work, they will provide reasonable adjustments for you to get back into work. We don't utilise that as best as we could as an organisation. [...] So we are doing a big communications campaign. However, there's still a fair way to go with regards to what is reasonable adjustment and in general, what's reasonable.'(Health 1)

Employee turnover rates monitored by some organisations vary according to gender or ethnicity, as evidenced by 'Consultancy 1':

> 'Overall, our company staff turnover is 10% and in Energy it's more than 14%. That's because it's a hot area at the moment. So the skills we want are in demand. Therefore, there's a high turnover. We measure the difference in turnover rates for men and women and it's slightly better for women.'

Increased 'churn', created by employees leaving their employer, represents a substantial employment cost. If differences in retention rates could be demonstrated systematically in STEMM, this would contribute to the business case for diversity built on the basis of reducing employment costs.

5.6 Networks and mentoring

Both organisational interviewees and focus group participants discussed the role of networks in either promoting or constraining diversity. Focus group participants stressed the importance of networks and noted the continuing prevalence of the 'old boys' network' in limiting diversity:

> 'It is all about networks - the old boy's network works – and how do you break into that?' (FG4maleANW)

A senior female chartered surveyor indicated how the prevalence of the 'old boys' networks' in her industry excluded women and people of lower socio-economic status:

> 'I was told years ago that I was doing well although I don't play golf. I couldn't believe it. Therefore, the girls are not going to be promoted to a certain level and get the big deals because they're not going to be on the golf course.' (Surveyors)

Professional/diversity networks, for example women's or LGBT (lesbian, gay bi- and trans-sexual) networks, were recognised as having a positive value by organisations that took part in this research:

> 'We have seven corporately recognised and funded groups….In our women's network, there are more than 60 groups and that's just the ones I know of. We know there are many more.' (ConsProductCo)

> 'I think the networks have been really successful. We had anecdotal feedbacks about people who considered leaving but they found a network that helped them to see that they were not alone. There were other LGBT staff members that were struggling but they're making progress and we're fine.' (Consultancy 2)

An NHS Trust had experience of using both BME and disability networks:

> '… for their insights into policy on different organisational issues and consultations... (there have been) some challenging issues which networks have helped to unpack.' (Health 2)

A focus group participant (a physicist) talked in positive terms about an informal network comprising 'women researcher lunches' set up at her university:

> 'If I experienced anything like that [negative attitudes], I could go to them and say that this has happened, could you give me some advice. The woman that leads it is very approachable and enthusiastic and she used to be head of the school, so she has experience managing the politics of the department.' (FG2femCW)

While there was evidence of STEMM organisations using networks positively to promote diversity, these networks tended to be composed of similar people using the network for mutual support and, as in the case of 'Health 2', as a form of pressure group. Ibarra (1995) noted that social networks can aid advancement of the (ethnic) 'minority managers', but she identified that networks spanning across ethnic and social boundaries, and including white people, were shown to be more effective in facilitating advancement of minority ethnic managers. This research investigation for the Royal Society did not find evidence that organisations were actively promoting heterogeneous networks.

5.6.1 **Mentoring and sponsorship**

Mentoring relationships can develop when people network with each other and mentoring was evident in organisations seeking to improve diversity at the entry level of STEMM work. However, there was little evidence of mentoring or sponsorship to aid progression through organisations once women and those from ethnic minorities have entered STEMM occupations. While mentoring has been shown to be effective at entry levels, it is 'sponsorship' that is most effective in facilitating progression (Ibarra et al, 2010). Classical models of mentoring combine 'psychosocial support' with career help, but in order to progress in organisations, women and those from minority ethnic groups need senior manager 'sponsors' who will give 'their 'protégés exposure to other executives who may help their careers' (p.85). Sponsors can also:

> 'Make sure their people are considered for promising opportunities and challenging assignments….protect their protégés from negative publicity or damaging contact with senior executives…(and) fight to get their people promoted' (p.85).

5.7 Diversity initiatives – successes and failures

The benefits and desirability of achieving a diverse workforce were well recognised by the individual and organisational research participants who took part in this project. As this report has set out, a range of strategies were described, such as targeted recruitment, measures to improve access to STEMM careers, encouragement of awareness and belonging amongst staff, mentoring programmes, establishing networks, and flexible working hours. Most of these focused on increasing gender diversity, although some of our organisations did have ethnicity and disability initiatives, especially those employers with a broader clientele base. Even so, despite drives over recent years to increase the representation of women in STEMM, the effectiveness of such initiatives must be questioned because statistics indicate that there are still too few women working in STEMM occupations.

The role of award schemes such as Athena SWAN and the Juno Award in universities was also discussed by in both focus groups and in organisational interviews. Some women scientists in the focus groups had direct experience of the schemes and considered that they were effective in promoting change:

> 'When they (Universities) get it, it makes a difference because it gives the woman the permission to comment if the situation wasn't good before. It gives us permission to come out of the woodwork and for us to say that we don't agree to this. There is credibility and legitimacy. It is important that departments buy into it because otherwise, they are paying lip service.' (FG1femCW)

Another female scientist with experience of Juno also commented favourably:

> 'I've seen in my university the Juno Award for the physical sciences and they were awarded for the policy they had and the flexibility they have with different genders and working hours. So they got this award that said that they are a good place to work.' (FG2femCW)

There were concerns that such schemes might be:

> '…A 'tick level' thing where high level people are signing up but it's not filtering down.' (FG2femANW)

However, our research did indicate the effectiveness of the statement made by the Chief Medical Officer (CMO) in 2011, that an Athena SWAN award should be a factor included in the decision-making process of the Medical Research Council when determining future funding of research in NHS/universities:

> '…We do not expect to shortlist any NHS/ University partnership where the academic partner has not achieved at least the Silver Award of the Athena SWAN Charter for Women in Science.' (CMO)

Indications that currently a third of the applicants for the Athena SWAN award are failing 'because they just want the badge' (FG1femCW) suggest that the scheme could achieve some change in universities because:

> '….Poor employment practices particularly disadvantage women but good employment practices benefit everyone….. You will find that the undergraduate courses will get better applications from women and universities will actually improve their undergraduate pool…(without it) the mathematicians wouldn't have done anything.' (FG2femCW)

There are no similar schemes that promote diversity in terms of ethnicity and disability, contributing perhaps to a lack of visibility and attention paid to increasing diversity in relation to these other minority groups.

Athena SWAN Charter

The Athena SWAN Charter evolved from work between the Athena Project, a forum collecting data on resources in the workplace, and the Scientific Women's Academic Network (SWAN). It was launched in 2005 to advance the representation of women in STEMM and membership is open to higher education institutions active in STEMM. Six principles represent the cornerstone of Athena SWAN; these recognise the unequal representation of women in STEMM and seek to address the consequent personal and organisational obstacles and implications. The Charter works on the basis that a department must have institutional support and underpinning institutional good practice, policies and processes in place in order to achieve and sustain an award. An institution must have achieved an Athena SWAN Bronze award before departments can obtain an individual award (Athena SWAN, 2012). University departments can apply for a Bronze, Silver or Gold award, depending on their progress and achievement in promoting gender equality; they apply to renew their award every three years on the basis of evidence of progress. There are currently 259 Bronze, Silver or Gold award-holding institutions and departments, including four institutions awarded Gold. A member of the Athena SWAN Steering Committee was interviewed to discuss the Award process and associated challenges; her comments are reported below.

Leadership and commitment

Although addressing gender inequalities requires commitment from everyone (Athena SWAN, 2012), in practice, leadership is of paramount importance:

> 'One of the key things is the head of department. They are absolutely key'… 'There has to be somebody championing at the highest level. If it's just seen as women's problems, then the other half or two thirds of the population won't take it seriously'… 'what's interesting is, if the head of department or the champion is male, that has even more impact'... 'what you can't do is make it work across a unit where there is no sense of belonging.'

Radical culture change

To tackle the unequal representation of women in science requires cultures and attitudes across the organisation to be changed (Athena SWAN, 2012). Those applying for the award simply to get the Award, rather than being willing to change the culture of the organisation, will be rejected:

> 'It's still clear when you read some of the submissions that people have done it because it is a process, rather than understanding the need for the culture change. But usually they don't get the award'. '… [medical schools] might be doing it because of the badge and because of the attachment to the money, because they are obliged to do it.'

Benefits from participation in the award programme can be seen in terms of culture changes, in recruitment, and in women's experiences of organisations:

'In those departments where they have had an award for a length of time, they report that they get more applications from women. They get more applications from female students as well, which is a good thing. The women themselves report better experiences. The challenge is to make the change 'stick': there are departments that don't show up a second time.... But because we have them on a renewal cycle, we can at least give them a kick.'

Key role of men

An attitude of fairness is considered important:

'Everything we do is actually open to everyone and absolutely nothing that we say women can have that men can't have. Men can now take extended maternity leave…this is actually looking to improve the employment conditions for everyone. We are trying to remove the long hours' culture for everyone, because nobody should be working 12 hours a day in the lab'... 'When men were going part-time, it then lost its stigma. And so going *only* part-time, which is terribly apologetic…now became something that is entirely respectable'.

Women's career progression

The loss of women in science is an urgent concern but is apparently not only observed in science. The loss can be attributed to attitudes among men as well as women, and perhaps depends on the history of the particular branch of science:

'The supervisors of ….PhDs was still old school…. of the opinion ….that women didn't make chemists and therefore were dismissive of their female PhD students who then would say, fair enough, I'm off. Microbiology is much more modern and far less likely to fall into unconscious bias. And so they did retain their women better.'

Athena SWAN is effective in giving women working in science a higher profile and in changing cultures in STEMM educational establishments:

'…There are many who get converted in the process, not all.'

However, challenges remain, including changing the culture in more universities, and changing the attitudes of parents of the next generation of scientists:

'If you don't have the parents on board, the girls won't be doing science.'

5.7.1 **Organisational culture**

Several participants spoke of organisation cultural factors as inhibitors of change and indicated the problems in tackling these 'difficult-to-define-and-manage' issues (as illustrated in for example, Bradley et al, 2007). Three of our research organisations had initiatives aimed at grappling cultural issues. The first, an NHS Trust that was experiencing difficulty in getting women and minority ethnic staff to apply for promotions, focused its attention on communication issues. The all-male executive culture with 'lots of rugby and drinking' was challenged because it was deterring women and minority ethnic staff from applying for promotion. These staff:

> '…were almost ready to be promoted into those positions but did not recognise this themselves until there was a dialogue…..There are simple ways that people notice...and it does not sit comfortably with them...
> We have to ask the question...what do we do that puts you off? (Health 2)

This NHS Trust (and other organisations too) demonstrated awareness that communication and use of language are important aspects of culture that can either promote or discourage diversity:

> '(People) need to have the opportunity for people to talk…in a non-threatening way.' (Health 2)

Another approach used in some organisations and particularly aimed at attracting job applicants from a wider pool was to attempt to change the image of the industry and the 'brand':

> 'One of the things we recognise is that we have a traditional engineering consultancy brand and that might not be as attractive to women with the image of hard hats and high-visibility jackets. We've changed the brand and used softer language. That's one area where we've developed the image.' (Consultancy 1)

A further example of seeking to change organisational culture focussed on flexible hours and its uptake. A number of organisations provide flexible hours opportunities, but employees do not always avail of them in fear of their career progression (e.g. Brandt and Kvande, 2001). Some focus group members suggested that uptake was low because of lack of communication about these opportunities in the organisation. In one global organisation interviewed for this research, the executive board had remedied the low uptake of flexible

working by seeking to change the organisational culture through storytelling, role modelling, and encouraging employees to take advantage of flexible working opportunities:

> 'We started with the very top of the company. We found out that one of our vice chancellors missed a board meeting because he had a child and wanted to stay home. He asked his boss permission, the CEO, and he gave him permission to miss the external board of director meetings. The more we talked about this, the more we found more compelling personal stories at all levels of the organisation. We started making sure we communicated different examples and it would be from the top across different disciplines.' (ConsProductCo)

The Athena SWAN award requires some cultural shifts in diversity mindset and, as illustrated in the discussion of the Athena SWAN scheme, these can prove very challenging in organisations. However, elsewhere, and in line with Brandt and Kvande (2001) and Burchielli et al's (2008) findings, the pressures of traditional patterns and expectations of working do limit employees 'uptake' of diversity initiatives such as flexible working:

> 'It was the working practice. It was a very big project and we didn't have a lot of staff. I like to succeed so if I had to do it myself, I just did.' (FG1fem2W)

Not all initiatives were perceived as successful, even when senior executives or employees were involved. For example, an enthusiastic, dynamic female president in the engineering sector set up a project to train unemployed and mature women to become electricians. The training programme was part-funded by a housing association and built around flexible working patterns because many scheme participants had children. Despite the female president's vision of other industries adopting the model, it has not been extended elsewhere:

> 'She saw a model that could be adopted by other industries but it hasn't been adopted.' (Contractors)

Some diversity initiatives do fail and, as Miller and Tucker (2013) observed, sometimes this is because firms do not see the importance of diversity, as apparent in the electrical engineering sector:

> 'The typical contractor will generally say that they could have a more diverse workforce if they tried but why would they want to? They're quite happy with the system that they're working with and they're not getting pressure to change their attitude. They have other things to worry about.' (Contractors)

Another initiative not integrated into the organisation's strategic plan was deemed of limited success despite early positive expectations:

> 'Although these projects seem to offer great opportunities, the length of time that someone is employed on a project ….is not very long.' (Contractors)

5.7.2 Success and failure – summary of experiences

The above examples suggest that STEMM organisations design and implement diversity initiatives, especially regarding gender, though fewer focus on ethnicity and disability.

Factors that may contribute to initiatives being successful in increasing diversity in STEMM are similar to those identified in other sectors. These include active senior and employee involvement, diversity as part of an organisation's strategic plan (e.g. Dobbs, 1998; Miller and Tucker, 2013; Stein, 2013) and the culture of the organisation (e.g. Brandt and Kvande, 2001). The lack of visibility of ethnicity and disability suggests that success is limited by organisation culture factors and by limited strategic integration into the business.

5.8 Conclusions on diversity strategies and policies

This section of the report used data from WERS 2011 to demonstrate that employers in the health sector are the most likely to have policies that facilitate diversity within their workforces. These policies include encouraging female staff to return from maternity leave and job applications from minority ethnic and disabled applicants. What this quantitative data does not indicate is whether these policies are 'empty shells' (Hoque & Noon, 2004), in other words, rhetoric rather than diversity being a deeply-held value which is then enacted through practice and behaviour.

The discussion revealed a range of workplace features that militate against diversity, such as male-dominated working environments, organisational cultures and expectations that make it difficult or unattractive for members of minorities to enter and progress within this environment. A range of strategies, policies and practices were discussed as to whether they hinder or advance the progress of individuals within STEMM workplaces. Particular employment practices, such as the use of fixed-term contracts, lack of flexible working opportunities, failure to make adjustments that accommodate different physical needs, and unclear career progression criteria, were considered barriers to both entering and progressing a STEMM career. Less tangible, but nevertheless influential, features were the presence of the 'old boys' network', and the absence of heterogeneous networking groups (as opposed to specialist ones for an under-represented groups) and career 'sponsorship' by senior executives.

Training was considered to play an important role in increasing diversity because it can underpin change and set new expectations. Pragmatic training on diversity can enlighten and inform people by increasing awareness and tackling in-built unconscious biases. Training or development programmes for specific under-represented groups can increase retention and aid progression of these individuals. Training can also aid organisational change by altering the way leaders think; it can assist them to adopt a fundamentally different mindset where diversity underpins organisational strategy and is seen as a key to achieving positive outcomes for a range of stakeholders. Leaders with a 'diversity mindset' can break away from traditional patterns and can change expectations through their modelling of inclusive thinking and behaviour, and they can help to modify norms and values that become embodied in organisational cultures (Bradley et al, 2007; Liff and Cameron, 1997).

Specific initiatives operating in the wider society and across the STEMM sector were also mentioned by the research participants. In order for the STEMM workforce to become more diverse, there needs to be greater interest in entering the sector from groups traditionally under-represented. Initiatives for children and students were discussed, including the need to create aspiration and access, provide links, attractive role models and real opportunities. For some of the organisational participants this was achieved through outreach activities, and for others it was about mentoring or expanding the net of academic establishments they looked to recruit from, for others it was about removing loaded language from descriptions of jobs and workplaces.

Figure 1 (see page 57) summarises key facets of diversity in relation to pathways into and progression within a career in STEMM.

Major initiatives such as the Athena SWAN and Juno awards have had some impact on the diversity of the STEMM workforce. In order to be accredited by the Athena SWAN scheme university science departments have had to change their employment practices; this has required cultural change led from the top of these organisations, changes that have not always been achieved by the mostly male leaders. However, insistence by national leaders, such as the Chief Medical Officer interviewed, that government funding is only available to those organisations that hold an Athena SWAN has focused the minds of decision-makers and the scheme is gradually creating change in one part of the STEMM sector.

Of all of the initiatives that seek to increase diversity in the STEMM workforce, most have sought to improve the gender balance; disability, ethnicity and social class remain more in the background, with social class particularly lacking visibility. Figure 2 (page 75) illustrates the nature and significance of their varying visibility.

Many of the key change agents in organisations, in the STEMM sector and in society as a whole, are white able-bodied men; without their commitment to change organisational cultures, strategies and practices, and their desire to lead a process of change, the STEMM workforce will remain largely as it is.

Figure 1: Pathways to a career in STEMM

School, Family & Community Networks

- Awareness of and access to 'good' science
- Encouragement by teachers
- Influence of parents & wider family & friends
- Community perceptions of science
- Choice of school
- School's approach to science
- Choice of science subjects
- Career guidance regarding opportunities in science

School to Work Transition: Perceptions & Choices

Facilitators for STEMM careers:
- Positive image / reputation of science
- Positive family views of science
- Encouragement to see beyond traditional career options
- Mentoring
- University choices leading to STEMM career

Barriers to STEMM careers:
- Absence of positive role models
- Traditional views on segregated roles
- Discouragement / no encouragement
- No mentoring
- Incorrect / poor career guidance
- Funding concerns

Employment Barriers & Enablers

Entry Level:
- Selection procedures & practices impact on diversity positively or negatively
- Traditional occupational roles by gender, ethnicity or class accepted or challenged
- Consistent or inconsistent actions on diversity by professional bodies

Career progression within STEMM:
- Invisibility / visibility of diversity
- Diversity mindset of leaders
- Diversity friendly or unfriendly organisational culture & practices
- Role of clients & research funders
- Diversity impact: post-doc choices
- Flexible work / hours in practice
- Career break availability & post-maternity support

6 TEAMWORKING IN STEMM AND DIVERSITY IMPLICATIONS

So far this report has sought to address the broader research question of whether a business case for diversity can be established. Addressing the second research question of whether diverse teams do better science was complicated by a research literature beset with methodological issues and the finding that organisations in this research project have not made systematic attempts to define and measure work features such as 'creativity' or 'innovation'. Some researchers, for example, Stahl et al. (2009), Watson et al. (1993), Cox et al. (1991), have argued these positive features are the possible result of having diverse team members. Some research studies have measured diversity in terms of different scientific disciplines, rather than in terms of demographic differences (eg Hiatt, et al.,2013; Hall et al, 2008); consequently these sources have limited value to this research project because it does not directly address the particular research questions set, where diversity is defined in terms of gender, ethnicity and disability.

6.1 Importance of contextual factors

A review of the literature on the impact of diversity within teams reveals that, though there may be business improvements from increased creativity and effectiveness arising from diverse teams, there is no clear-cut relationship. Many quantitative studies of 'diversity in teams' have been carried out in quasi-experimental settings, where causal impacts can be more confidently identified but the implications of organisational context either may not, or cannot, be explored. Indeed, building on both social psychology and artificial intelligence concepts, Hong and Page (2004) develop a mathematical framework demonstrating that more diversity among groups of problem-solvers raises their performance. Their model however, leaves out two crucial features of organisational life – communications and learning. Hubbard (2004:25) contends that the task of measuring the business case for diversity relies fundamentally on viewing diversity as an 'integral part of the organizational system', and yet there is little resemblance between the conditions assumed to exist in many diversity studies and those found in organisational settings (Watson et al. 1993; and Kochan et al., 2003).

6.2 Impact of contextual factors on the performance of teams

The measurement and methodological challenges in showing a link between team-working and diversity in STEMM based teams are considerable; few studies have been carried out in real organisations and fewer still use objective performance measures. Research from other sectors (such as the service sector) suggests that management might regard diversity in teams as a problem if there is an impact on the relationship with the client and the other

team members. For example, if a team member's contribution was restricted, (such as through working part-time) it would mean that they would not be accessible to a client at all times (Michielsens et al., 2014). Another issue is how authors define diversity. For instance, a study conducted to evaluate the impact of author-team diversity (where teams comprise individuals drawn from multiple institutes and nationalities) on scientific publications in a national science laboratory in the USA. However, diversity in this study referred to task-related diversity, in which difference is described in terms of educational or professional background, rather than demographic diversity, where differences concern attributes such as gender, age, race, and ethnic differences (Hinnant et al., 2012; Hamdani and Buckley, 2011).

Some researchers (e.g. Østergaard et al. 2011; Stahl et al. 2009; Watson et al. 1993; Cox et al. 1991) argue that innovation can result from diversity; others dispute this (e.g. Jehn et al.,1999; Hamdani and Buckley 2011). Stahl et al. (2009) show how cultural diversity can have both positive and negative implications. While increased team diversity might lead to conflict and decreased social integration there could also be process gains through increased creativity and satisfaction. Team diversity and problems with communication and co-operation were also found by Homan et al., (2007).

Though Østergaard et al. (2011) found no relation between ethnic diversity and the likelihood that firms innovate, they conceded that the level of ethnic diversity in their sample may have been too low to identify an effect. Ethnic diversity is indeed a complex issue, Jones and Elias (2005) demonstrate this when they warn that occupational and ethnic segregation varies greatly (see the earlier discussion in 'Ethnicity in STEMM) and needs to be taken into account in any comparative organisational study. Hence, it is difficult to generalise about ethnic diversity in general rather than in relation to specific ethnicities.

Gratton et al. (2007) provide further evidence (mostly from outside the STEMM sector and centred on the finance sector) to support the suggestion that mixed gender teams can aid innovation and increased feelings of 'psychological security'; they report certain negative 'minority effects' when there is an uneven gender balance.

Whether or not diversity within teams leads to better outcomes, it can be affected by a myriad of factors, including the way diversity is defined and managed, organisational settings and managerial style, as well as the social and institutional forces that drive diversity in a particular organisation (e.g. Hamdani and Buckley, 2011). These more contextual factors have received less attention in previous studies on diversity in teams but warrant closer

scrutiny to facilitate an informed and appropriate judgement on the effectiveness of diverse teams in organisational settings within STEMM.

6.3 Methodological issues with collecting objective data

It is these complexities (and associated methodological difficulties), which have thwarted previous attempts to collect definitive evidence on diversity and teams. Hence, this research project set out to collect data in real organisational settings of whether diversity impacts team performance. Whilst the data collected provide interesting examples, they are insufficient to provide conclusive proof. For example, diverse teams were thought by organisational representatives to include a greater range of perspectives, so enhancing creativity and problem-solving. Some claimed that:

> 'The evidence is overwhelming that diversity out-performs and out-innovates homogenous teams.' (ConsProductCo)

However, scant tangible evidence was put forward to support such claims, despite the anecdotal examples given:

> '…performance outcomes of diverse teams if they are skilled in dealing with diversity and the whole team are equally valued... (there are) some simple things about team development... (recognising) different personalities ... they just need to recognise there are differences ... success is a question of the sophistication of the team...being open...' (Health 2)

Focus group participants also reported on the effects of diverse teams, but again little direct evidence was offered:

> '…diverse teams perform better… and it's because of creativity. There was an MIT study that looked at the diversity of teams and I think their conclusion was that, because the team was diverse, the team was more creative with the ideas they came up with and also in production.' (FG2femANW)

A male medical scientist working in a university considered that, in his experience, there were positive effects from working in a diverse team:

> 'If you put them (scientists) in teams, they can give each other ideas and that can boost output in things like the number of publications. In my university they have small groups in the department. Each group can do similar stuff but people have different preferences. They interact with each other and give each other ideas.' (FG5malAW)

It was notable that there was little actual team-working in some of the STEMM organisations, but rather an emphasis on collaboration, especially on an international basis:

'International collaboration works better than local.' (FG4malCNW)

The international organisation 'Physics' strongly encourages international collaboration because of:

> '…the 'meta-value' of diversity in achieving 'excellence' by fostering collaboration.' (Physics)

Scientists and mathematicians working in universities reported a lack of diversity in teams and observed that in PhD research supervision the ethnicity of the supervisor and student are very often (too often) the same, indicating a lack of diversity inside supervision teams. A biomedical scientist who had worked in a number of countries observed that the UK was different in that:

> 'In Britain, I have often noticed that people tend to group together on the basis of nationality.' (FG3femBNWDD)

Team leadership that was sensitive to diversity was considered important for gaining the potential benefits of team diversity:

> 'I've worked in functional and dysfunctional teams. If you have a dictatorial lead, they can make it dysfunctional for everyone. In a functional team one woman can be a reasonable voice even though everyone is working in their own way.' (FG1femBW)

6.4 Conclusions on teamworking in STEMM and diversity implications

In sum, previous attempts to definitively determine whether teams comprising diverse members do better science, when compared to teams with homogenous team members, have not succeeded in providing convincing evidence. Some empirical studies conducted in laboratory settings suggest that diverse groups may benefit from increased creativity, innovation and problem-solving, whilst potential pitfalls may include conflict, decreased integration and co-operation, and problems with communication. These laboratory studies do not reflect the messy reality of organisational life and existing literature suggested it is necessary to examine contextual variables such as how the diversity is defined and managed, why the organisation strives to increase diversity, the nature of the organisational setting, and the managerial style.

Data collected in this research project provide anecdotal evidence that people believe diversity creates advantages because it brings together a variety of perspectives into a group. However, the data collected also include assertions that appropriate team leadership is important for diversity to be a source of benefits rather than disadvantages. It was

suggested that effective collaboration, rather than teamwork, was often required in the STEMM workplace and that, in the UK, people had a tendency to stay with those of a similar national background.

This aspect of the research echoes earlier work, arguing that organisational settings and leadership play significant roles in determining how diversity is viewed and managed, having in turn an impact on whether diversity acts to deliver potential benefits or not.

7 MEASUREMENT OF DIVERSITY AND PERFORMANCE

7.1 Measuring diversity and progress towards diversity

The measures of diversity used and advocated by practitioners, academics and consultancy-based writers differ. Urwin et al's.(2011) research on the strategic business impact of diversity, commissioned by the London Development Agency, discussed the range of measures that organisations and academics use to establish links between diversity and performance. The indicators and variables used vary and, as CIPD surveys (2007, 2006) show, practice in organisations on the use of diversity metrics is at a relatively early stage of development.

While useful concepts such as the 'diversity scorecard' (Hubbard, 2004) and metrics of diversity density have been developed, metrics that can link diversity with performance need further investigation. Hopkins et al. (2008) define the concept of diversity density as referring not only to the percentage of diverse employees in an organisation's workforce, but also to the extent to which individuals from diverse groups (including diverse professional groupings) are represented at all levels of the organisation. A related concept of 'diversity mindset' refers to the extent to which an organisation's senior executives view diversity as integrated into business strategy rather than simply a human resource management (HRM) issue. Despite such developments, there is little evidence of these concepts being used in the UK within organisations, either in the STEMM sector or more widely. Indeed, the use of diversity measures in organisations is only extensive in those organisations that are 'leading edge' (CIPD 2007, 2006). Monitoring the workforce and job applicants by various demographic criteria is carried out in many organisations, but the extent of full 'diversity auditing', as recommended by Pearn Kandola (e.g 2006), is not known.

There are further academic and practitioner-led developments of relative rather than absolute diversity measures, which are yet to be fully tested. For example, the CIPD (2007) used a questionnaire to develop a 'diversity sophistication score', which can measure the progress an organisation has made in its diversity journey.

Loden (1996:16) developed the 'diversity adoption curve', which seeks to categorise organisations in relation to their progress in relation to diversity:
1. **Traditionalists,** wanting to avoid involvement with any change.
2. **Sceptics,** about new ideas, seeing diversity as potentially harmful and moving too fast.

3. **Pragmatists,** seeing diversity as desirable after proven productivity improvement.
4. **Change agents,** seeing diversity as 'knowledge-enhancing' and good for people.
5. **Innovators,** seeing diversity as a creative opportunity.

7.2 Diversity metrics and their usage

Benchmarking and the other relative, as distinct from absolute, diversity performance measures may be considered as more practitioner-based than theoretically-driven. Benchmarking techniques emphasise the comparative dimension of organisational diversity performance. However, even if it is possible to design diversity measurement tools, it is less easy to measure diversity across organisations without taking their separate contexts into account. Metrics collected in surveys such as the Black Solicitor's Network Diversity League Tables (2008-2013) give some idea of the level of diversity across legal firms (i.e. the proportion of women or ethnic minorities within the workplace, at different levels of seniority), the implication being that more diverse firms are likely to better represent the customer base and wider society (leading to business benefits). In some studies, where large data sets have been used, a specific attempt has been made to link these measures of diversity to business benefits and firm-level metrics. Riley et al (2013) , for instance, found neither large nor widespread business benefits in the form of relative industry profitability associated with diversity. However, methodological difficulties and lack of organisational data mean that it cannot be concluded that there is no link, just because there is no evidence of one.

Benchmarking diversity monitoring data against other organisations is a technique used in the STEMM sector. 'University', four of whose six Schools are in the STEMM sector, benchmarks its diversity data with other research-intensive Russell Group of universities. The reason for this approach was given as:

> 'Benchmarking is useful because it gives context to diversity data.'
> (University)

Most of the organisations interviewed reported monitoring applicant details though the information collected may be of variable quality since it is:

> '…difficult as candidates are not obliged to give information.' (Oil &Gas)

Voluntary approaches to ethnicity monitoring tend to produce limited data and might contribute to the lack of awareness regarding issues of ethnic diversity in organisations. When organisations do collect data, but do not make use of them, their value is also limited.

Health service organisations interviewed reported the collection and use of a range of diversity data. 'Health 1', for example, makes its data public and seeks to evaluate the extent to which its staffing mirrors the very diverse community served. It is considering whether to use the data for internal benchmarking:

> '….not exactly league tables but encouraging…(internal) competition…. We don't encourage quotas and targets…. There can be significant differences in what is going on in acute medicine in A&E and what is happening in engineering. So in a large place you have to create local balanced scorecards.' (Health 1)

The use of the balanced or diversity scorecard (Hubbard, 2004) ensures a range of factors are used and aids:

> '…transparency in what is going on in different areas.'(Health 1)

Intersectionality (the idea that people may not fit exclusively into one of the 'protected' categories, see section 2.1 'Definition of diversity') complicates how diversity is measured as it should not be assumed that people fit neatly into only one category. Indeed, statistics present a different picture whether from the perspective of social class or in terms of ethnic identity.

In response to questions about ethnic diversity, focus group participants (including those in the ethnicity focus group) and organisations tended to associate this with nationality. Two research organisations ('Research' and 'Physics') spoke of the range of nationalities represented amongst the specialist scientists in their organisations, but not about ethnic diversity:

> '…we have forty odd different nationalities.' (Research)

Such discourses contribute to the weak visibility of ethnicity as an issue per se.

7.3   Measures of performance and innovation

Measurements of performance in STEMM occupations is partial and variable between organisations, and a mixture of absolute and more relative performance measures may be in place (where they are used). Analysis of performance measures in some STEMM sectors (e.g. Diem and Wolter, 2013) indicates that, although there are hard measures of performance in use (such as measures of research outputs and citation counts in academic contexts), these may carry assumptions about gender or ethnicity. In terms of gender, analysis of research performance measured by publication record shows that female

researchers trail behind men in terms of the number of publications and the positive outcomes of research output (Aaltojärvi et al., 2008; Lariviere et al., 2011; De Witte and Rogge, 2010). The picture is more pronounced for certain subject areas (D'Amico et al., 2011); for example, Abramo et al (2009) mention industrial and information engineering. The reasons for such female disadvantage may be weak social capital (collaborators, networks), lower hierarchical positions held, lesser success in attracting funding, having more teaching duties, individual characteristics such as being less competitive than men; as well as care responsibilities leaving women less time than their male colleagues to devote to research and publication (Lariviere et al. 2011; Hunter and Leahey 2010; Sax, 2002). Symonds et al. (2006) show that ranking methods are biased against female scientists, and Leahey's research (2006) indicates that, aswomen are less likely to specialise than men, this may potentially impact negatively on them when they are compared with male colleagues. Research by Kelchtermans and Veugelers (2013) does not however support the thesis of women's disadvantage, revealing that, while women have a significantly lower probability of reaching top performance, as measured through the number of citations of their work, 'they seem to persist in top performance more easily than men do'. Other citation and gender research also shows inconsistent findings: some analyses claim publications are more cited (Borrego et al., 2010), others the reverse (Aksnes et al., 2011).

Research on the link between ethnicity and scientific performance has been particularly prominent in the USA. Hopkins et al. (2012) and Ginther et al. (2011), for example, concluded that black/African-American researchers in the USA are disadvantaged in terms of receiving research funding.

Organisations in this study reported fragmented approaches to informal and formal performance management, with 'billing' and hard measures used in some client-based organisations, and science research and universities using the number of peer-reviewed papers published. In the health service, there is a focus on measures from a service user perspective:

> '…the responses of consumers, patients and members of the public. If the people using the service are from diverse backgrounds, they can say whether or not they are valued, if they are being respect or treated with dignity…' (Health 1)

In the private sector typically financial performance measures are used, such as those in 'Consultancy 1':

> '...fiscal measures. So teams of a certain size are given a profit and loss account to measure classic business metrics such as revenue, profit

> and cash conversion. Also, we measure through client feedback and
> staff engagement or employee engagement index.'

As in the above example, there were combinations of metrics used. 'University' and 'Research' applied a combination of 'hard' measures of performance (peer-reviewed papers) and performance appraisal. In the international 'Physics' organisation annual performance appraisals assessing results and competencies linked to organisational values that underpin these appraisals. This is described in more detail in the box "Strategic values and competency-based diversity plan in 'Physics'"

The use of more subjective annual individual performance appraisal and performance management systems is widespread in STEMM organisations, as is evident from the HR practitioner literature on other sectors (for example, CIPD, 2009). There are, however, questions to be raised regarding the efficacy of performance management practices in relation to overall organisational performance and equality (Bach, 2005). Recent changes in performance systems focus more on employee development than the assessment of performance outcomes (IDS, 2011), as demonstrated by some of the participating organisations.

As organisations assess individual and organisational performance in different ways, the collection and robust evaluation of comparative data has been difficult to achieve, except through the use of qualitative methods of data collection.

No examples were given in this study to link the benchmarking of diversity data with benchmarking of performance data, although in some STEMM organisations this might be possible, based only on 'hard' performance data rather than more subjective performance appraisal data. If this were to be carried out, the potential bias built into such 'hard' measures, as indicated in the literature, would need to be acknowledged.

The second research question, seeking to link diversity to 'good science', has been difficult to answer definitively. The focus group participants discussed both 'good' and 'bad' science but there was little agreement on basic definitions of what each comprises. Some of the factors feeding into 'good' science were said to be linked to the 'free flow of people and ideas' and to taking into account both the 'big picture' and a long-term view. These features were evident in 'Physics' whose diversity initiatives, (see 'Strategic values and competency-based diversity plan in 'Physics') have been designed to promote fruitful science by developing greater international collaboration. In contrast, negative factors or 'bad science' had been observed by focus group participants in the practice in private corporations of 'not

sharing material' and 'sitting on knowledge' thereby 'minimising good science'. The constant pressure in the university sector to publish is also linked to 'bad science' as it potentially leads to mediocre work published too early, rather than to high quality work published in fewer publications..

Strategic values and competency-based diversity plan in 'Physics'

A revised Diversity Programme was introduced in 2011 by a new CEO. This extends beyond legal compliance to promote awareness and commitment to diversity. It covers five dimensions:

- nationality / culture;
- gender;
- age / generation;
- profession;
- individual differences (such as ethnic origin, belief, sexual orientation or disability, or opinions provided that they are consistent with the Organisation's values).

Principles underlying the programme:

- **Appreciating differences** – Leveraging the added value that comes from bringing together people of different nationalities, genders, professions, ages, skills, backgrounds, perspective and enabling them all to contribute to their full potential.
- **Fostering equality** – Optimising talent and performance through a leadership culture that focuses on fair treatment and which rules out all forms of discrimination and bias (i.e. creating a level playing field for all).
- **Promoting collaboration** – Creating an inclusive work environment based on mutual respect and exchange where individuals feel encouraged to participate actively without the need for groupings or associations that foster separateness.

Aims of the programme:

- To have an optimally diversified workforce to achieve the goals of a world laboratory.
- To have the creativity and innovation that comes from the 'collision' of diverse ideas, perspectives, and approaches - which is at the heart of the scientific method.
- To create a work environment and behaviour that reflects the Organisation's value of diversity through use of appropriate policies, procedures and practices.

The programme is committed to:

- Promoting a workplace culture that acknowledges the added value of a diverse workforce and enables every member of its personnel to contribute to their full potential regardless of nationality, gender, age, profession, and individual differences such as ethnic origin, belief, sexual orientation or disability, or opinions provided that they are consistent with the Organisation's values.
- Assuring that these diversity principles are integrated into all organisational policies, procedures and practice.

> "As nationalities mingle and visitors come and go, the exchange of ideas and the circulation of people is the life-blood that keeps ….alive."

Implementation:

The diversity principles are embedded in the overall HR strategy and applied across the three main axes of recruitment (including talent sourcing and selection), career development (including leadership development and performance management), and work environment (including awareness and support structures).

7.4 Conclusions on measurement of diversity and performance

The review of existing literature suggests that the term 'diversity' can be defined in a variety of ways, and that practitioners and academics may adopt different definitions in their work. The immediate consequence is that it can be difficult to compare quantitative data collected because the different diversity data sets may be measuring different things. In reality, the CIPD has shown that organisations are relatively unsophisticated in the collection and analysis of diversity data, whilst organisations may capture raw data from job applicants and staff (which may be of questionable quality) they may not do much with the data, and they are certainly unlikely to compare it to measures of organisational performance.

A range of terms and concepts have been developed to articulate the ways in which diversity, and progress towards it, can be tracked; including diversity 'scorecards', measurements of 'diversity density' and 'auditing'. Whether an organisation takes a profound and strategic approach to diversity may be assessed in terms of whether a 'diversity mindset' exists in the organisation; progress towards diversity can be plotted against Loden's 'diversity adoption curve' (1996) which operates from organisations 'dragging their feet' to fully embracing diversity and seeing it as a creative opportunity.

Diversity can be measured in absolute and relative terms, and as has been discussed, practitioners in organisations may not be very sophisticated in their measurement techniques (these comprise the absolute figures) but it is not uncommon for them to conduct benchmarking exercises so they can compare their organisation with others. Unfortunately, these cross organisational comparisons do not account for differing organisational contexts and are therefore useful only to a limited extent. On the other hand, where a benchmarking process triggers an organisation to take deliberate action to become as diverse as comparators it represents a useful catalyst for change, arguably such is the case with cross-profession Black Solicitor's Network Diversity League Tables.

On the basis that meaningful diversity data can be, and is collected, it would then need to be compared with measures of organisational performance in an attempt to demonstrate that a quantitative business case can be made. This leads back to the problem of identifying measures of organisational performance which are meaningful to a range of STEMM employers. In a health setting, one relevant measure of organisational performance was for the staff to be representative of the community served, whilst in academia the number of papers published and citations is considered relevant; in a commercial setting sales made or budgets managed may be more appropriate metrics. These 'hard' quantitative measures

may not be fully representative of what constitutes 'performance', indeed organisations measuring performance at an individual level may often describe performance in 'soft' terms which are more difficult to describe, measure and compare; this will be compounded by the problems inherent in performance appraisal where a manager judges the performance of others.

In sum, defining and measuring diversity is not straight-forward and is prone to producing data that needs to be used with care; measures of performance are clearly context-specific; and measures of individual performance are inherently unreliable for cross-organisational comparisons. Thus the route to demonstrating a business case for diversity, and that diverse teams do 'good' science, is beset by methodological difficulties which have yet to be overcome.

8 EFFECTIVENESS OF THE BUSINESS CASE FOR DIVERSITY IN STEMM

Overall, the findings support a business case for diversity, though one founded more on conviction than organisational evidence, with 'external' and 'internal' benefits that are problematic to measure. Most of the evidence for the business case for diversity gathered was anecdotal and hampered by a lack of past data to compare with:

> 'We're trying to get more data around this but we've seen more diverse project teams being more successful. We've had some early indications, even though not confirmed, that some of our projects with women project directors, on average, deliver more profit on their projects than men but it's a small sample because we don't have that many female directors.' (Consultancy 2)

However, the difficulty of making a business case for diversity with sound evidence was appreciated, for example:

> '…if you have a diverse population in the workforce, which reflects the larger population, there is a view that the said population will make better decisions and do better work. If you have balance, then you will make better decisions. I can't put a business case around that… You've just got to believe that they will make more good decisions than bad ones. There are a lot of cases that you can't build a business case around but you know it to be true and right.' (Consultancy 1)

Where success was referred to, diversity and inclusion were incorporated in the organisation's strategy:

> 'Perhaps that's why we've been more successful because it's become a business strategy. We focus on it and we track it the same way we would do other business measures. Otherwise, it risks becoming something that is just a background programme.' (ConsProductCo)

9　**CONCLUSIONS**

This comprehensive piece of research on diversity in the STEMM sector undertaken for this project drew on multidisciplinary perspectives and mixed methods of inquiry and explored in depth the meaning of diversity in STEMM and possible components of the business case. The study began with two main initial research questions:

1. What evidence is there that establishes the business case for diversity in the scientific workforce?
2. Are diverse teams more likely to do good science?

With respect to the first question, the research findings suggest a conviction among STEMM employees in the business case for diversity, offering both 'external' and 'internal' benefits. However, the metrics and measurement of precise effects of the business case are limited by the paucity of systematic, as opposed to anecdotal, organisational evidence. As indicated in the literature too, there is a poor conceptualisation of both 'diversity' and the business case. Indeed, the study's findings indicate an overlap between the business case and a social or even moral case.

The experimental, technical, scientific problem-solving nature of much work carried out by individuals in STEMM occupations implies that 'internal' business benefits related to the second research question should be to the fore. In fact, the research indicates that it is 'external' benefits related to skills, clients/users and customers that have most relevance in STEMM. While diverse teams and collaborations are valued in positive terms, for the potential creativity and innovation they bring, the dynamics of communication and leadership of teams are either constraints or enablers of positive outcomes. Moreover, the imprecise definitions of 'good science' offered by research participants suggest that more conceptual work on this and on diversity would enable a fuller exposition of the relationship between quality of work and diversity in teams, or among collaborators.

Whilst the study revealed a range of initiatives to improve diversity, there is some evidence that the STEMM sector (outside of the Health Service) is taking fewer actions to improve diversity, via diversity polices and processes, than organisations outside STEMM. Some poor employment practices are indicated, for example, in relation to fixed-term contracts and tardiness in improving practices that enable women returners to continue careers.

Although integration of diversity issues with the organisation's business strategy is seen as important to success, it is not the only success factor. Whilst previous research indicates

that business cases may be business context specific, they may also depend on specific organisational factors, leadership behaviours and managerial practices. This study shows that some training interventions are beneficial but that embedded cultural factors and assumptions that underpin managerial systems may also impede the success of these. To increase diversity in organisations would require: fundamentally different leadership mindsets to be adopted; the breaking away from traditional patterns of thinking and behaving; changing to adopt new expectations; and modelling inclusive thinking and behaviour to create and recreate different norms and values, which are then embodied in organisational cultures. This is extremely challenging (as the Athena SWAN experience shows) and needs the active participation of men. As this study found, men (who are also mostly white and able-bodied), in positions of power in organisations, who were asked to take part in a study on diversity were reluctant to do so in spite of active encouragement. This clearly indicates that the change process which needs them to adopt a different mindset is being inhibited.

At a strategic level, when organisations plan for more diversity, there are differences between broad, comprehensive approaches, and simple, more focused measures. Where these approaches are proving effective, they tend to be focused on gender equality and there is a general lack of visibility of ethnicity. Ethnicity is seen in global, nationality terms rather than in UK-based minority ethnic terms. Disability issues also have little visibility or action in the sector, outside of the health service. These visibility issues are illustrated in Figure 2 on p.75.

The initiatives taken by organisations to remedy this biased focus can be fragmented because the different STEMM professions have different perspectives. Presently, STEMM employers, with the exception of the health sector, appear to be lagging behind current trends in the pursuit of increased diversity. Even when initiatives are taken, there are questions about how much success they achieve in increasing diversity. When more radical changes are made, requiring more fundamental changes in organisations, they have been more effective, but the strength of existing organisational cultures can hamper progress. The question of why there is so little change brought about by diversity initiatives would usefully be the subject of future research.

Figure 2: Aspects of diversity policy and practice in STEMM – the 'Visible', 'Emerging' and 'Still Hidden'

	MEANING OF DIVERSITY IN STEMM ORGANISATIONS	DIVERSITY POLICIES COVER:	DIVERSITY IN PRACTICE COVERS:	DIVERSITY INITIATIVES
ABOVE SURFACE VISIBLE	Diversity of ideas Inclusion (Inter)nationality of workforce	Gender Disability Ethnicity	Gender	Encouraging recruitment of women Mirroring in workforce diversity: • Clients • Talent (recruits) • Services/products Legal compliance Limited diversity monitoring Flexible working
BELOW SURFACE EMERGING	Citizenship Migration	Age	Disability Ethnicity Age	Awareness raising Diversity training Mentoring Networking Use of diversity monitoring data Diversity as 'good practice' Branding – 'employer of choice'
STILL HIDDEN NOT VISIBLE	Equal treatment	Social class	Social class	Sponsoring for career progression Monitoring and evaluating diversity Diversity performance data/indicators collected and evaluated Positive action Transparency of career progression process

10   RECOMMENDATIONS

The research suggests that the piecemeal and fragmented basis on which the range of actions is being taken is because different STEMM professions have different perspectives. More strategic central co-ordination of both initiatives and information would be beneficial. Government, the Royal Society, professional bodies and employers need to act in a co-ordinated way to set standards and perhaps establish a centre of excellence to support employers wishing to increase the diversity of their workforce. Accountabilities for action should be allocated in order to ensure effective coordination.

To further these aims the Athena SWAN award experience can be built upon to aid organisations to become diversity 'employers of choice'. Specific work related to this could include:

1. Development Of Benchmarking Frameworks
    A consistent and comparative framework needs to be developed so that valid benchmarking between organisations can take place. Given the difficulties for the STEMM sector as a whole to evidence the diversity of its workforce, it might be more practical to do this sector by sector (for example, for universities, the NHS, different industry sectors) because potential external benefits will show sectoral differences.

2. Creating A Benchmarking League Table
    The value of benchmarking diversity and performance is evidenced by the Black Solicitors' Network. Introducing a similar scheme in the STEMM sector offers the dual benefits of collecting data about diversity and providing an element of 'competition' between organisations to improve their diversity performance. By including ethnicity and disability, as well as gender, the visibility of all three could be improved.

3. Increased Monitoring of Information on Employment Practices and Career Progression
    Monitoring the application of employment activities and initiatives, such as the use of fixed-term contracts, flexible-working arrangements and requests, and progression of different groups through the organisation would enable employers to keep track of decisions being made by line managers and to intervene with new decision-making criteria for the line managers to use to promote increased diversity.

4. Encouragement of Networking, Sponsorship and Mentoring
    Creation or encouragement of social networks accessible to people working or aspiring to work in STEMM careers, the establishment of buddying and mentoring schemes and matching mentees to mentors at varying stages in their careers could

all encourage entry and progression in STEMM careers. Similarly, outreach activities in the community are being taken in a range of STEMM environments, but the effectiveness of these is not proven and might be more fully evaluated centrally.

5. Reduce Emphasis on Class of Institution

    Focus group participants wanted action to reduce the distinctions between the perceived 'class' of educational institutions. Encouragement should be given to foster (or make visible) employment opportunities to potential recruits who are studying at universities that are not routinely targeted by employers.

6. Test the Effectiveness of Diversity Training and Develop Effective Programmes

    Some organisations are actively training staff on issues associated with diversity, but the effectiveness of these programmes is not fully verified. Moreover, such training is likely to be expensive to provide and may be out of the reach of many organisations, particularly Small-to-Medium-Sized Enterprises (SMEs). When training interventions are proven effective, some centralised organisation of cost-effective training would be beneficial.

7. Creation of a STEMM Employers' Good Practice Forum

    Increased co-operation and coherence of diversity initiatives between professional bodies operating in STEMM professions should increase communication and awareness of diversity issues, encourage isomorphic behaviour and lead to increased diversity in organisations with respect to women, minority ethnic and disabled people.

11 LIMITATIONS

The research was principally qualitative and gave a depth of insight into diversity in the STEMM sector, though some aspects need further, perhaps broader research. One of the findings was also a limitation. Strategic change to achieve greater diversity is shown to need the active commitment of (predominately white) men. The researchers found it very difficult to encourage white men to take part in the focus groups and also in the interviews. The majority of men, whose experiences are analysed in this research, are not white. This 'silence' of (white) men on diversity issues and apparent lack of interest in discussing the topic is a limitation of the research, but a finding in itself.

Ethnicity issues were also lacking in visibility and the underlying reasons for this need further exploration. The emphasis on gender is understandable but the lack of attention to disability is also a drawback. It was also notable that some BME women chose to attend the gender focus group, rather than the group focusing on ethnicity, indicating they wished primarily to discuss gender issues.

A further limitation entailed difficulties associated with uncovering the basis for the business case(s) for diversity in the STEMM sector. While there were positive perceptions that a business case could be made, the evidential base for this was lacking in the organisations. The researchers therefore were not able to analyse this aspect in depth, as the organisations taking part simply did not have relevant data, nor were they planning to collect them. The conceptual problems of both diversity and of defining what are 'good' or 'bad' science were also constraints in this research.

Finally, the definition of which occupations or roles are in STEMM, and which are not, needs clarification so that a clear set of occupations can be consistently used for both measuring and monitoring diversity in the future and enable accurate comparisons to be made going forward.

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APPENDICES

APPENDIX 1: DEFINITIONS OF STEMM OCCUPATIONS

For the purposes of this research on diversity within STEMM, the STEMM workforce has been defined by drawing on the Royal Society's own definition, as applied in its project "Leading the way: Increasing diversity in the scientific workforce". Thus STEMM occupations included in this research project and report fall into categories that fit the following description:

> '… the 'scientific workforce' is taken to comprise all those for whom their scientific knowledge, training, and skills are necessary for the work that they do. This includes scientists, technologists, engineers and medical practitioners...' (The Royal Society, http://royalsociety.org/policy/projects/leading-way-diversity/).

Some of the occupations included in the Royal Society's full definition of the scientific workforce are included in the quantitative analysis where they appear defined as STEMM+; this is to distinguish them from the occupations which might be considered the core of the scientific workforce (termed STEMM in this report). Thus STEMM+ comprises STEMM and:

> '…school teachers, nurses, surveyors, actuaries, economists, programmers, statisticians, technical sales staff, pilots, divers, scientific administrators, journalists.'

For the purposes of this research, the University of Westminster team has used SOC codes provided by the Royal Society to determine those included in the STEMM and STEMM+ workforce, these are set out overleaf.

The Royal Society classification of STEMM occupations by SOC code

SOC2000	Standard Occupation	SOC2000 minor code
11210	Production, works and maintenance managers	112
11220	Managers in construction	112
11230	Managers in mining and energy	112
11231	Mining, quarrying and drilling managers	112
11232	Gas, water and electricity supply managers	112
11354	Operational research, organisation and methods managers	113
11360	Information and communication technology managers	113
11361	Information managers	113
11362	Computer operations managers	113
11363	Telecommunications managers	113
11370	Research and development managers	113
11410	Quality assurance managers	114
11810	Hospital and health service managers	118
11820	Pharmacy managers	118
11830	Healthcare practice managers	118
12110	Farm managers	121
12120	Natural environment, conservation and heritage managers	121
12190	Managers in animal husbandry, forestry and fishing nec	121
21110	Chemists	211
21111	Research/development chemists	211
21112	Analytical chemists	211
21120	Biological scientists and biochemists	211
21121	Biochemists, medical scientists	211
21122	Biologists	211
21123	Bacteriologists, microbiologists etc.	211
21124	Botanists	211
21125	Pathologists	211
21126	Agricultural scientists	211
21127	Physiologists	211
21130	Physicists, geologists and meteorologists	211
21131	Physicists	211
21132	Geophysicists	211
21133	Geologists, mineralogists etc.	211
21134	Meteorologists	211
21135	Astronomers	211
21136	Mathematicians	211
21210	Civil engineers	212
21211	Water, sanitation, drainage and public health engineers	212

21212	Mining, quarrying and drilling engineers	212
21213	Construction engineers	212
21220	Mechanical engineers	212
21221	Aeronautical engineers	212
21222	Automobile engineers	212
21223	Marine engineers	212
21224	Plant and maintenance engineers	212
21230	Electrical engineers	212
21231	Electricity generation and supply engineers	212
21232	Telecommunications engineers	212
21240	Electronic engineers	212
21241	Broadcasting engineers	212
21242	Avionics, radar and communications engineers	212
21250	Chemical engineers	212
21260	Design and development engineers	212
21270	Production and process engineers	212
21280	Planning and quality control engineers	212
21281	Planning engineers	212
21282	Quality control engineers	212
21290	Engineering professionals nec	212
21291	Metallurgists and material scientists	212
21292	Patents examiners, agents and officers	212
21293	Heating and ventilating engineers	212
21294	Food and drink technologists (including brewers)	212
21295	Acoustic engineers	212
21310	It strategy and planning professionals	213
21311	It consultants and planners	213
21312	Telecommunications consultants and planners	213
21320	Software professionals	213
21321	Software designers and engineers	213
21322	Computer analysts and programmers	213
21323	Network/systems designers and engineers	213
21324	Web developers and producers	213
22110	Medical practitioners	221
22111	Pre-registration house officers	221
22112	Senior house officers	221
22113	Specialist registrars, consultants and general practitioners	221
22120	Psychologists	221
22121	Education psychologists	221
22122	Clinical psychologists	221
22123	Occupational psychologists	221
22130	Pharmacists/pharmacologists	221
22131	Pharmacists	221
22132	Pharmacologists	221
22140	Ophthalmic opticians	221
22150	Dental practitioners	221

22151	General practice dentists	221
22152	Hospital dentists, house officers (dental)	221
22160	Veterinarians	221
23210	Scientific researchers	232
23220	Social science researchers	232
23290	Researchers nec	232
24210	Chartered and certified accountants	242
24211	Chartered accountants	242
24212	Certified accountants	242
24213	Public finance accountants	242
24220	Management accountants	242
24230	Management consultants, actuaries, economists and statisticians	242
24234	Statisticians	242
24235	Actuaries	242
24330	Quantity surveyors	243
24340	Chartered surveyors (not quantity surveyors)	243
24341	General practice surveyors	243
24342	Land surveyors	243
24343	Building surveyors	243
24344	Hydrographic surveyors	243
31110	Laboratory technicians	311
31111	Laboratory technicians (non medical)	311
31112	Medical laboratory technicians	311
31120	Electrical/electronic technicians	311
31130	Engineering technicians	311
31140	Building and civil engineering technicians	311
31150	Quality assurance technicians	311
31190	Science and engineering technicians nec	311
31210	Architectural and town planning technicians	312
31211	Town planning assistants, technicians	312
31212	Architectural technicians, assistants	312
31220	Draughtspersons	312
31221	Design draughtsperson	312
31222	Mechanical engineering draughtsperson	312
31223	Cartographical draughtsperson	312
31224	Drawing office assistants, tracers	312
31230	Building inspectors	312
31310	It operations technicians (network support)	313
31320	It user support technicians (help desk support)	313
32110	Nurses	321
32111	Hospital matrons and nurse administrators	321
32112	Staff nurses (adult)	321
32113	Staff nurses (children)	321
32114	Staff nurses (mental health)	321
32115	Non hospital nurses (e.g. general practice, community, clinics etc)	321
32120	Midwives	321

32130	Paramedics	321
32140	Medical radiographers	321
32150	Chiropodists	321
32160	Dispensing opticians	321
32170	Pharmaceutical dispensers	321
32180	Medical and dental technicians	321
32181	Medical technicians	321
32182	Audiologists	321
32183	Dental technicians	321
32210	Physiotherapists	322
32220	Occupational therapists	322
32230	Speech and language therapists	322
32292	Dieticians	322
32293	Osteopaths, hydrotherapists, massage therapists, chiropractors	322
32294	Psychotherapists	322
34122	Technical authors	341
34220	Product, clothing and related designers	342
34221	Interior decoration designers	342
34222	Set designers (stage, etc)	342
34223	Industrial designers	342
34224	Textile designers	342
34225	Clothing designers	342
34226	Clothing advisers, consultants	342
35510	Conservation, heritage and environmental protection officers	355
35680	Environmental health officers	356
52110	Smiths and forge workers	521
52120	Moulders, core makers, die casters	521
52130	Sheet metal workers	521
52140	Metal plate workers, shipwrights, riveters	521
52150	Welding trades	521
52160	Pipe fitters	521
52210	Metal machining setters and setter-operators	522
52220	Tool makers, tool fitters and markers-out	522
52230	Metal working production and maintenance fitters	522
52240	Precision instrument makers and repairers	522
52310	Motor mechanics	523
52320	Vehicle body builders and repairers	523
52330	Auto electricians	523
52340	Vehicle spray painters	523
52410	Electricians, electrical fitters	524
52411	Production fitters (electrical/electronic)	524
52412	Electricians, electrical maintenance fitters	524
52413	Electrical engineers (not professional)	524
52420	Telecommunications engineers	524
52430	Lines repairers and cable jointers	524
52440	Tv, video and audio engineers	524

52450	Computer engineers, installation and maintenance	524
52490	Electrical/electronics engineers nec	524
53110	Steel erectors	531
53120	Bricklayers, masons	531
53130	Roofers, roof tilers and slaters	531
53140	Plumbers, heating and ventilating engineers	531
53150	Carpenters and joiners	531
53160	Glaziers, window fabricators and fitters	531
53190	Construction trades nec	531
54930	Pattern makers (moulds)	549
61112	Surgery, theatre and sterile services assistants	611
61113	Occupational therapy and physiotherapy assistants	611
61120	Ambulance staff (excluding paramedics)	611
61130	Dental nurses	611
61310	Veterinary nurses and assistants	613
81110	Food, drink and tobacco process operatives	811
81120	Glass and ceramics process operatives	811
81130	Textile process operatives	811
81140	Chemical and related process operatives	811
81150	Rubber process operatives	811
81160	Plastics process operatives	811
81170	Metal making and treating process operatives	811
81180	Electroplaters	811
81190	Process operatives nec	811
81210	Paper and wood machine operatives	812
81220	Coal mine operatives	812
81230	Quarry workers and related operatives	812
81240	Energy plant operatives	812
81250	Metal working machine operatives	812
81260	Water and sewerage plant operatives	812
81290	Plant and machine operatives nec	812
81310	Assemblers (electrical products)	813
81320	Assemblers (vehicles and metal goods)	813
81330	Routine inspectors and testers	813
81340	Weighers, graders, sorters	813
81350	Tyre, exhaust and windscreen fitters	813
81380	Routine laboratory testers	813
81390	Assemblers and routine operatives nec	813
81410	Scaffolders, stagers, riggers	814
81420	Road construction operatives	814
81430	Rail construction and maintenance operatives	814
81490	Construction operatives nec	814

The Royal Society classification of 'possibly STEMM' (STEMM+) by SOC code

SOC2000	Standard Occupation	SOC2000 minor code
11120	Directors and chief executives of major organisations	111
11130	Senior officials in local government	111
11142	Senior officials of employers, trades and professional associations	111
11320	Marketing and sales managers	113
11321	Marketing managers	113
11322	Sales managers	113
11323	Market research managers	113
11324	Export and import managers	113
11330	Purchasing managers	113
11710	Officers in armed forces	117
11711	Army officers	117
11712	Navy officers	117
11713	Air force officers	117
11730	Senior officers in fire, ambulance, prison and related services	117
12191	Animal establishment (not livestock) managers	121
12192	Forestry and tree felling managers	121
12320	Garage managers and proprietors	123
23110	Higher education teaching professionals	231
23111	University and higher education professors	231
23112	University and higher education lecturers	231
23113	Teacher training establishment lecturers	231
23114	University tutorial and teaching assistants	231
23120	Further education teaching professionals	231
23140	Secondary education teaching professionals	231
23141	Secondary head teachers	231
23142	Secondary teachers	231
23152	Primary teachers	231
23190	Teaching professionals nec	231
23194	Examiners and moderators	231
24110	Solicitors and lawyers, judges and coroners	241
24111	Barristers and advocates	241
24112	Solicitors	241
24113	Judges, magistrates, coroners and sheriffs	241
24233	Economists	242
24310	Architects	243
32290	Therapists nec	322
32291	Acupuncturists, reflexologists	322
33110	Armed forces: ncos and other ranks	331
33120	Police officers (sergeant and below)	331

33130	Fire service officers (leading fire officer and below)	331
33191	Customs, excise and duty officers	331
34120	Authors, writers	341
34121	Authors	341
34310	Journalists, newspaper and periodical editors	343
34311	Editors	343
34312	Journalists	343
34345	Sound recordists, technicians, assistants	343
35110	Air traffic controllers	351
35120	Aircraft pilots and flight engineers	351
35121	Aircraft pilots and instructors	351
35122	Aircraft flight engineers, navigators	351
35130	Ship and hovercraft officers	351
35203	Adjudicators, tribunal and panel members	352
35310	Estimators, valuers and assessors	353
35311	Insurance surveyors, inspectors	353
35312	Insurance claims officials, adjusters	353
35313	Estimators	353
35321	Stockbrokers	353
35330	Insurance underwriters	353
35340	Finance and investment analysts/advisers	353
35341	Investment advisers	353
35342	Pension advisers	353
35345	Financial analysts	353
35370	Financial and accounting technicians	353
35410	Buyers and purchasing officers	354
35411	Buyers and purchasing officers	354
35412	Contract officers (purchasing)	354
35420	Sales representatives	354
35422	Technical sales representatives	354
35520	Countryside and park rangers	355
35650	Inspectors of factories, utilities and trading standards	356
35660	Other statutory inspectors	356
35670	Occupational hygienists and safety officers (health and safety)	356
35671	Health and safety officers	356
51110	Farmers	511
61150	Care assistants and home carers (elderly and infirm)	611
82170	Seafarers (merchant navy); barge, lighter and boat operatives	821
82180	Air transport operatives	821

APPENDIX 2: METHODOLOGY

The research design for this study consisted of three phases; these principally comprised qualitative work supplemented by analysis of quantitative national datasets.

Phase one

Phase one (August-September 2013) was designed to summarise the existing evidence on the diversity business case and consisted of a literature review and interviews with key stakeholders. These aimed to identify appropriate measures of diversity/functional diversity, and the output of scientists within an academic context; an industrial setting; and within the voluntary sector context.

These issues were explored in largely semi-structured interviews, with use of a broad topic guide. Data collected in these initial interviews were also used to feed into the next phases, and issues identified as important were explored by these stakeholders in more depth in phases two and three.

Phase one sample

The four interviewees were known by the research team prior to this research and were drawn from their own professional networks. These interviewees were chosen as representatives of diversity and science managers in organisation with significant STEMM workforces, covering different parts of the STEMM sectors.

A first interim report submitted to the Royal Society in October 2013 reported on the results of this stage and feedback on this report was received.

Phase two

Phase two (October- middle November 2013) consisted of qualitative primary data collection through focus groups and interviews. This primary data collection intended to gather multi-level data from people working (including PhD students) in STEMM fields through the use of a set of focus groups, and individual in-depth interviews.

Phase two focus groups

Invitations were sent by email to the relevant STEMM network of the Royal Society, and additional STEMM networks of the research group. The invitation was sent out via these networks; recipients were asked to send it on to other colleagues whom they thought would be interested and suitable for focus group participation.

Five focus groups of STEMM scientists were conducted in October-November 2013 at The University of Westminster premises:

- Two focussed on gender issues experienced by women and discussed in a group of female participants.
- One focussed on disability, as experienced by participants with disabilities.
- One focussed on ethnicity, as experienced by participants from a range of ethnic backgrounds.
- One comprising male participants focussed on diversity in relation to gender and other diversity strands.

The topic of social class was discussed in each focus group. The focus groups lasted 2-2.5 hours each.

All focus group participants filled in a demographic questionnaire - an overview of their demographic details is provided in Table 1 (overleaf). All participants signed a consent form agreeing that the data could be recorded and could be used for this research on an anonymous basis (see Appendix 3).

A total of 18 participants took part in the five focus groups and each participant has been given a unique tag to enable the reader to relate back a specific comment made to the person making the comment, whilst maintaining anonymity for our focus group participants. The method for determining tags is as follows:

- focus groups numbered from 1 to 5;
- 'fem' or 'male' for gender;
- letter A to E indicating a specific individual;
- W (white) or NW (non-white) for a broad ethnicity indicator;
- DD – if a disability was declared by the focus group participant.

The data from the focus group transcripts was analysed using key themes identified in the literature review and the pilot organisational interviews, and then used to form the topic guides for the organisational interviews.

These main themes arising comprised:

- the meaning of diversity for individuals;
- perceived barriers to diversity including discrimination;
- early career choices and opportunities;

- career transitions and progression;
- the importance of networks and networking;
- social class;
- enabling the achievement of greater diversity;
- organisational context and diversity policy;
- good practice examples;
- teamwork and collaboration;
- views on good and bad science;
- views on the business case and performance measurement.

Table 1   Focus group participants

TAG	JOB TITLE	SECTOR	GENDER	DISABLED	HIGHEST QUALIFICATION	ETHNICITY	CARE RESPONSIB-ILITY	PARENTAL BREAD WINNER	OCCUPATION OF MAIN BREADWINNER
FG2femDNW	PhD researcher	Academic	Female	No	MSc, MS	Indian	99	Father	Astrophysicist
FG2femCW	PhD student	Academic	Female	No	MSc Physics	White British	No	Mother	Teacher
FG2femANW	Deputy Head - Careers	Charitable Foundation (biomedical)	Female	No	PhD	British Bangladeshi	No	Father	Restaurant Mgr/Worker
FG2femBW	VP Tech Insp Serv	Industrial/ commercial	Female	No	PhD	White British	No	Father	Engineer
FG2femEW	Project Manager	Voluntary/ Not-for-profit	Female	No	MA	British	No	Mother= Father	Nurse/ Nurse
FG4malBNW	PhD student	Academic	Male	No	Masters	Black African	No	Mother	Trader
FG4malANW	Senior Lecturer	Academic	Male	No	PhD	South Asian	Yes	Mother= Father	Researchers
FG4malCNW	PhD researcher	Academic	Male	No	MSc Pharm Science	Black African	No	Father	Pharmacist
FG4femANW	Part-time VL	Academic	Female	No	MSc transferring to MPhil/PhD	Indian (Asian)	Yes (Child aged 9)	Father	Government Employee
FG3femAWDD	Senior Lecturer	Academic	Female	Mild physical disability	PhD	White	No	Father= Mother	Lecturer
FG3femBNWDD	Senior biomedical scientist	Academic	Female	Yes, physical	PhD	99	No	Father	Doctor - GP
FG1femBW	Software Developer	Industrial/ commercial	Female	No	BSc Maths	White British	Yes (Children aged 3 & 5)	Father	Pharm Consultant

TAG	JOB TITLE	SECTOR	GENDER	DISABLED	HIGHEST QUALIFICATION	ETHNICITY	CARE RESPONSIB-ILITY	PARENTAL BREAD WINNER	OCCUPATION OF MAIN BREADWINNER
FG1femAW	Reader (Physics)	Academic	Female	No	PhD in Physics	99	No	Father	Army Officer
FG1femW	Professor	Academic	Female	No	PhD	White	No (2 daughters at Univ)	Father	Owned Corner Shop
FG5malANW	Teaching Fellow	Academic	Male	No	PhD	White	No	Father	Judge
FG5malBW	PhD student	Academic	Male	No	MSc	White British	No	Father	Caretaker
FG5malDW	Doctoral student	Academic	Male	No	MSc	European	No	Father	Pilot
FG5malCW	Principal Lecturer	Academic	Male	No	MSc	Irish	Yes	Father	Lorry Driver

99 indicates that no answer was given by the focus group participant

Phase two in-depth interviews

The organisations and interviewees to be included in this research were sourced and negotiated via the Royal Society and the research group's STEMM networks. In total ten organisations took part. Interviews were conducted with both HR managers who had a diversity role, and/or science line managers, with one to two interviewees per organisation. Organisations targeted were chosen as they would provide views that represented the broad variety of the STEMM sector: academia; industry; voluntary organisations; public and private organisations, health and non-health sectors.

Table 2 (overleaf) provides an overview of the interviews in phases 1, 2 and 3; it identifies the organisational roles of the interviewees (as specifically as possible but still maintaining confidentiality) and the nature of their organisation. The majority of interviews were recorded and transcribed and took on average between 60 and 90 minutes. Three interviews were conducted by telephone and for two of these only notes were available for analysis. Interviews were conducted in November and December 2013.

Table 2   Organisational interviews

	Organisations	Interviewees		
		Science Manager	**HR/Diversity Manager**	**Strategic level interview**
1	'Oil and Gas' company		√	√
2	Electrical contractors 'Contractors'	√		
3	'Consultancy 1'	√	√	
4	Large multinational science project – 'Physics'		√	
5	London hospital – 'Health 1'		√	
6	'Surveyors'	√	√	
7	Large multinational consumer product company – 'ConsProductCo'	√	√	√
8	Multinational design and engineering company – 'Consultancy 2'	√	√	
9	'University'		√	
10	'Research'	√		
11	'Health 2'			√
13	Chief Medical Officer 'CMO'			√
14	Athena SWAN Steering Committee Member			√
15	London Hospital 'Health 3'		√	

The data captured in each interview was based on a set topic list and while the topics were uniform, the interviews were largely open-ended as our concern was, according to the qualitative tradition, to discover how interviewees "filled in" these issues. Therefore it was important to introduce the topics to interviewees only in a broad way, so that respondents would then themselves define the focus. The broad topics explored in the interviews were:

- the organisation's workforce;
- meaning of diversity;
- company diversity strategy, policies and practices, diversity measures;
- performance and diversity;
- diversity awareness;
- diversity monitoring;
- recruitment to STEMM roles;
- diversity initiatives;
- diversity support;
- business case for diversity;
- barriers to diversity.

The majority of interviews were conducted by two interviewers. To keep the interview experience consistent, all interviews in a particular company/organisation were conducted by the same two interviewers. All interviewers in the research team also read the interview transcripts from those interviews that they did not attend in order to maintain consistency.

Verbatim interview transcripts were analysed by the research team. Manual coding was preferred to the use of software because of time constraints and the relatively small number of transcripts. Through an iterative process of coding, mostly inductive, a thematic analysis was developed on the following themes:

1. the meaning of diversity;
2. diversity policies;
3. diversity strategies
   a. training;
   b. recruitment;
   c. leadership;
   d. external links;
4. processes and practices
   a. measurement & monitoring;
   b. teams;

5. initiatives – successes and failures;
6. business case;
7. performance measurement.

Phase three

Phase three included five strategic level interviews (see Table 2 for details) and some primary analysis of national data sets. The aim of the strategic level interviews was to gain some insights on diversity in the sector from strategic decision-makers; most of these interviews were conducted once initial results of Phase Two were known. In all, five such interviews were conducted, two in organisations that had also taken part in the organisational level interviews.

Quantitative data analysis - data and methodology

The phase three qualitative empirical analysis was supplemented by a quantitative analysis of diversity related issues in the STEMM sectors from the Quarterly Labour Force Survey, January-March, 2013 and the Workplace Employment Relations Survey, 2011. The aim of this was to give an up-to-date picture of the levels of diversity amongst those working within STEMM sectors and across STEMM occupations in the UK. The analysis is descriptive in nature, and does not claim to represent causal relationships. Its function is to give a context to the qualitative data.

Labour Force Survey, Q2 2013

The Labour Force Survey (LFS) is a high-quality, government survey of households living at private addresses in the UK. It is used to provide official measures of employment and unemployment and also contains information on a wide range of topics such as occupation, training, hours of work and personal characteristics. The sample currently consists of around 41,000 responding (or imputed) households in Great Britain every quarter, representing about 0.16% of the population of Great Britain. Data from approximately 1,600 households in Northern Ireland are added to this, representing about 0.23% of the NI population, allowing analysis of data relating to the United Kingdom. The LFS uses a rotational sampling design, whereby a household, once initially selected for interview, is retained in the sample for a total of five consecutive quarters. The final sample used in the analysis includes only adults aged 16 and over and people who were employed for at least one hour a week. The LFS contains questions on the worker's occupation, and these are codified using the Standard Occupation Classification (SOC 2010) system. SOC codes are internationally recognised standardised codes used to classify workers into occupational categories. These codes provide us with the means to classify workers into STEMM and Non-STEMM groups. All SOC codes

appearing in the dataset were classed as either 'STEMM', 'Non-STEMM' or 'possibly STEMM'; 'possibly STEMM' includes, for example, teachers in secondary, further and higher education. The three groups used in the final analysis are 1) STEMM, 2) Non-STEMM and 3) STEMM plus, which combines STEMM and possibly STEMM.

Other key variables used in the analysis include gender (male or female) and ethnicity; where "Black" includes Black / African / Caribbean; "Asian" includes Indian, Pakistani, Bangladeshi, Chinese and 'Any other Asian Background'; and "Other" includes Mixed / Multiple ethnicities and 'Other ethnic group'. Disability is based on a question reporting current disability and includes 'Work-limiting disabled only', 'DDA disabled' and 'DDA disabled and work-limiting disabled'. The industrial grouping 'Industry section main job' is used to determine whether or not the person works in the health sector.

Workplace Employment Relations Survey, 2011

The Workplace Employment Relations Survey (WERS) provides large-scale, statistically reliable evidence on a broad range of employment practices across sectors of the economy. WERS collects information from managers with responsibility for employment relations or personnel matters, employee representatives and employees. Our analysis makes use of the most recent 2011 version of WERS, with data from a sample of 2680 establishments.

Our classification of organisations into STEMM and Non-STEMM is based on the main tasks and activities of the largest non-managerial group of employees within the workplace. Although the data also contains SIC 2010 codes (Standard Industrial Classification), this is only available at a very broad level (sector level). As such, this was used to divide organisations into health and non-health, whilst the SOC codes of the largest non-managerial group of employees were used to classify the organisations as STEMM or non-STEMM. In this case, it was not possible to include a group of 'possibly STEMM' organisations. In the WERS dataset, all questions relating to gender, ethnicity and disability used the responses of the organisations interviewed and did not require further classification on our part.

The research team

The research was overseen by a steering group of three – Professor Linda Clarke, Professor of European Industrial Relations at Westminster Business School and co-Director of the Centre for the Study of the Production of the Built Environment (ProBE); Professor Peter Urwin, Director of the Centre for Employment Research (CER); and Dr Miriam Dwek, Reader in Life Sciences. The research team principally comprised (Co-ordinator) Dr Angela Wright,

Elisabeth Michielsens and Dr Sylvia Snijders. They were supported by Dr Leena Kumarappan, Michele Williamson and Olivia Birchall.

The researching team met regularly; they also met the internal steering group members to discuss and agree on key issues, including broad interview themes, selection/negotiation of interviewees, data analysis and results, and the focus and verbatim quotes to be used in the research report. The research project coordinator was in regular contact with the Royal Society.

APPENDIX 3: FOCUS GROUP PARTICIPANT DETAILS & CONSENT FORM TEMPLATE

ROYAL SOCIETY RESEARCH ON DIVERSITY
FOCUS GROUP PARTICIPANT DETAILS

Please provide us with some details about yourself and confirm your willingness to participate in the research.

Information about you will facilitate analysis of the focus group sample; we reiterate that your details will only be used for this research, all information collected will be held confidentially, stored securely and will not be passed to anyone else.

Please return this form to:

Michele Williamson   Email:
m.williamson@westminster.ac.uk
Westminster Business School
University of Westminster
35 Marylebone Road
London NW1 5LS

1. Your contact details

    Name:

    Email:

2. Your current job title (or most recent one if not currently in employment)

    ………………………………………………………………………………………………

    Please indicate in which sector your employer is situated. Please tick one:

Academic	
Industrial/commercial	
Voluntary/Not-for-profit	
Other, please specify……………………………………	

3. What is your gender? Please tick one:

Male	
Female	

Other	
Prefer not to say	

Do you consider yourself as disabled[4]? Please tick the categories in the table below that apply to you.

No disability	
Yes - Physical disability	
Yes - Mental disability	
Yes - Learning Difficulty	

4. Please state your highest educational qualification:

   …………………………………………………………………………………............
   ....

5. Please state with which ethnic group you identify most:

   ………………………………………………………………………………………
   ……

6. Please indicate if you *currently* have caring responsibilities? Please tick.

Yes, I currently have caring responsibilities	
No, currently I don't have caring responsibilities	
Comment………..………	

---

[4] Under the Equality Act 2010, a person is disabled 'if they have a physical or mental impairment, and the impairment has a substantial and long-term adverse effect on his or her ability to carry out normal day-to-day activities'. 'Substantial' is defined by the Act as 'more than minor or trivial'. An impairment is considered to have a long-term effect if: (a) it has lasted for at least 12 months; (b) it is likely to last for at least 12 months; or (c) it is likely to last for the rest of the life of the person. Impairments include:
o   A specific learning difficulty such as dyslexia, dyspraxia or AD(H)D
o   General learning disability (such as Down's syndrome)
o   A social/communication impairment such as Asperger's syndrome/other autistic spectrum disorder
o   A long standing illness or health condition such as cancer, HIV, diabetes, chronic heart disease, or epilepsy
o   A mental health condition, such as depression, schizophrenia or anxiety disorder
o   A physical impairment or mobility issues, such as difficulty using arms or using a wheelchair or crutches
o   Deaf or serious hearing impairment
o   Blind or a serious visual impairment uncorrected by glasses
o   A disability, impairment or medical condition that is not listed above

7. Referring back to the family in which you grew up, what were the main occupations of the family breadwinners?

   a. The main breadwinner was (please select the appropriate option): father / mother / other, please specify………………………….…………………….…

   b. Their occupation was (please specify an occupation or job title): ……………………………………………………………………………………………… …………….

   c. Second breadwinner (please select the appropriate option): father / mother / other, please specify……………………………………………………….

   d. Their occupation was (please specify an occupation or job title): ………………………………………………………………………………………..... ....

   e. Other breadwinners were (please specify who): ..……………………………………………….

   f. Their occupation was (please specify an occupation or job title): ………………………………………………………………………………………..... ....

ROYAL SOCIETY RESEARCH ON DIVERSITY
FOCUS GROUP PARTICIPANT CONSENT

Thank you for providing these details. Please now confirm your willingness to participate in the research and awareness that the focus groups will be recorded.

I have read the information on the aims of this focus group, and I am willing to act as a participant and consent to the focus group being audio taped.

Name: ………………………………………….   Signature: ……………………………………………..

Date: …………………………………………

This consent form will be stored separately from any data you provide so that your participation remains anonymous. In respect of the audio tapes made, every effort will be made to ensure confidentiality and anonymity of all those involved. The tapes and description of these tapes will be used for the purpose of this research only.

Please return this form to:

Michele Williamson   Email:
m.williamson@westminster.ac.uk