National Benchmarking Study 2017

Client: London Mathematics Society

Date: December 2018

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Foreword

The LMS Women in Mathematics Committee and Good Practice Scheme Steering Group are pleased to present the final report from the Benchmarking Survey commissioned from Ortus Economic Research. The goal of the report was to understand the current status of women in UK mathematics departments, as well as to understand the experience that departments have had with the Athena Swan process. The report is based on an analysis of three different types of data: HESA data on proportions of women at various levels in UK HEI mathematics departments, Athena Swan applications contributed by 33 UK mathematics departments and interviews with eight individuals involved with the Athena Swan process in their departments.

The numerical evidence is disappointing. There have been two areas of progress: there has been an increase from 7% to 11% women among UK mathematics professors, and the percent of women among MSc students in mathematics has increased from 37% to 43%, both over the period from 2011/12 to 2016/17. However, percentages of women at other stages of the pipeline have remained roughly constant over this period, and the increase at MSc level is driven by international students and doesn't seem to result in larger per cents at higher levels. This lack of movement is reflected in the struggle that almost all departments report in recruitment of women students and staff. Therefore, there is still considerable work to be done on improving representation of women at all levels of UK mathematics.

The goal of the LMS Good Practice Scheme is in the first instance to improve the practice of departments in areas of relevance to gender and broader diversity. This aligns with the Athena Swan goal of improving the experiences of individuals at all levels in academic departments, and also aligns with the widely held view that a primary goal of Athena Swan and related activities is to bring about culture change. From this perspective, there is substantial evidence of efforts to bring about change in culture and practices, with a wide range of actions proposed and undertaken by the 33 departments whose applications were analysed. While it is encouraging to see this effort broadly undertaken, the evidence base for effectiveness of actions is much less developed, with only 12 evidence-based practices found among the 15 Silver and 1 Gold level applications. This report has been able to provide some evidence through comparing types of actions undertaken with per cents of women staff in departments (Table 25). We can see from this both to the difficulty of individual departments in understanding effectiveness of practices and to the need for national benchmarking and discussion to continue to build a picture of what practices work to improve representation and experiences of women in mathematics.

Finally, although in general, interviewees were positive about the impetus that Athena Swan provided for changes in their departments, many felt the process itself was overly burdensome. This was exacerbated in cases when institutional support for the application process, especially as regards data collection, was insufficient. There were concerns raised as well about the Athena Swan process itself, which was seen by some as constraining, with decision processes that were opaque or inconsistent.

On the whole, we see a picture of a process that has brought important concerns about the participation and experience of women in mathematics to the attention of departments around the UK and given an impetus for change that we would not like to see diminish. However, as the work nationally on gender equality develops, we also see that the Athena Swan mechanism requires some changes, and that it will take continued work at the national level to support change and to understand what actions result in the changes we want to see.

Dr Eugenie Hunsicker, Chair, LMS Women in Mathematics Committee

1. Executive Summary

As part of its Good Practice Scheme, the London Mathematical Society's Women in Mathematics Committee commissioned this research to examine trends in gender diversity in the mathematical sciences in the UK, and to consider the effectiveness of the various practices of university mathematics departments relating to advancing gender diversity. The research aims to:

- provide a national overview of trends in gender diversity in the mathematical sciences in the UK;
- identify strengths and weaknesses in advancing gender diversity in UK universities' mathematical sciences departments;
- enable mathematical sciences departments to assess themselves in relation to the national picture; and
- identify examples of existing effective practice that can be shared among departments.

The research involved a quantitative analysis of data relating to mathematical sciences students and academic staff, a qualitative assessment of the most recent Athena SWAN submissions from 33 participating mathematical sciences departments in UK universities, and in-depth interviews with a number of Heads of Departments and academics with lead responsibility for Athena SWAN in participating departments. Our approach is described in more detail in the Introduction (page 9).

1.1 Approach

The research involved two distinct elements: a quantitative analysis of data relating to mathematical sciences students and academic staff at national level, and a qualitative assessment of Athena SWAN submissions from 33 participating mathematics departments.

The quantitative analysis is based primarily on aggregate data from the Higher Education Statistics Agency (HESA), as well as data from the Joint Council for Qualifications. The report presents a time-series analysis of gender diversity among mathematical sciences students, and among academic staff in the mathematics cost centre[1]. The research also draws on HESA data at institution level alongside data published by Advance HE (previously the Equalities Challenge Unit) on successful Athena SWAN submissions.

The qualitative analysis of applications delivered two outputs:

1. A 'framework' analysis of common elements and links to departments and application characteristics.
2. A depiction of 'effective practice' in addressing gender equality issues.

In addition to the qualitative application analysis, a small number of case study interviews (8) were conducted with Heads of Departments and academics with lead responsibility for Athena SWAN submissions in participating departments.

1.2 Key findings

The findings in this study are set out across four themes. The first examines quantitative HESA data to describe the gender equality landscape in the mathematical sciences higher education across the UK. The second uses qualitative analysis to examine common approaches to data collection and analysis, identifying challenges ('struggles'), identifying responses to struggles ('practices') and defining, measuring

[1] A full description of methodology can be found in Appendix A.

and describing culture. The third is based on a qualitative analysis of Athena SWAN application forms to identify common actions and practices and the evidence of their effectiveness. Finally, the fourth presents findings drawn from a number of case study interviews with Athena SWAN leads in mathematics departments to explore the perception of the processes around, and impact of, Athena SWAN. The findings for each of these four these are presented sequentially below.

1.2.1 Changes in the equality landscape in UK mathematical sciences

The number of women studying mathematics at A Level and in Higher Education has increased in recent years. However, this is not always reflected in an increase in the proportion of students who are female; indeed, this proportion has fallen at some levels:

- Between 2013 and 2017, the proportion of A Level Mathematics students who are female remained at 39%, while the proportion of A Level Further Mathematics students who are female fell from 29% to 27%.
- Between 2011/12 and 2016/17, the proportion of first degree mathematical sciences graduates who are female fell from 43% to 40%.
- The proportion of Master's mathematical sciences graduates who are female rose from 37% to 43% over the same period, driven by increased recruitment of female students from overseas (the proportion of UK-domiciled Master's graduates who are female fell from 34% to 33%).
- The proportion of Doctorate mathematical sciences graduates who are female has fluctuated, rising from 30% to 33% between 2011/12 and 2013/14, but then falling to 26% in 2016/17.

Therefore, many of the trends displayed in the HESA student data analysis are disappointing, from a gender equality point of view. Whilst the total number of women studying maths has increased over recent years, there remains a very mixed picture when measuring the proportion of students that are female.

The number of women in academic positions in the mathematics cost centre in UK universities has also increased in recent years. Again, however, this is not reflected in an increase in the proportion of staff at all levels who are female. The only notable increase is among professors:

- The proportion of lecturers and senior lecturers in the mathematics cost centre who are female has remained constant at 23% since 2011/12.
- 23% of researchers in the mathematics cost centre in 2016/17 are female, up from 21% in 2011/12 but unchanged since 2012/13.
- 11% of professors in the mathematics cost centre are female in 2016/17, compared with 7% in 2011/12.

Trends in gender diversity in the mathematical sciences are examined in more detail in the chapter entitled 'Gender in Mathematics – quantitative analysis' (page 12).

1.2.2 Common data sources, struggles, practices and approaches to culture

The analysis of the four frameworks identified the following key findings:

- **Data sources.** All application forms make extensive use of 'internal information' (e.g. information on the characteristics of specific staff, such as those on the SAT, or descriptive data about the department or institution or other insight drawn from an unspecified source). Staff surveys are more extensively used than student surveys (91% of applications compared to 58% respectively). HESA data is used by almost 9 in 10 applicants (88%)

whilst one fifth (21%) of applicants cite LMS Good Practice scheme data somewhere in their application form.

- **Common struggles.** Every single one of the 33 applications identified the challenge of attracting a greater number of female students, the only struggle unanimously identified across the sample. Seven in ten departments (70%) identified that they have low numbers of female staff. This assessment is often made in comparison with some form of benchmark (e.g. HESA national average). Data gaps are also a common struggle, identified by the majority of departments (61%). Around one in four departments (42%) cite challenges with committee constituency whilst a similar proportion (42%) of departments identify the challenge of a 'leaky pipeline'.

- **Common practices.** There is a very large number and wide variety of practices identified across the applications. Aggregating them together has been a significant challenge. The practice which is most commonly adopted is additional data gathering (94%), which is a far higher proportion than the percentage of departments that identified data gaps as a struggle (61%). Around nine out of ten departments (91%) plan to undertake more targeted and proactive recruitment. The third most prevalent practice is promoting postgraduate opportunities (75%). It is widely accepted that achieving an increase in the number of female postgraduate students is important to ensuring that a greater number of women are in the mathematics career pipeline, so it is encouraging to see three quarters (75%) of departments taking action in this area. Many of the practices identified relate to recruitment and promotion, whilst improving staff career support is also a common area being addressed by departments through Athena SWAN.

- **Culture**. When *defining* culture, the most common terms used are 'social events' (70% of applications), 'commitment to Athena SWAN' (67%), 'internal communication' (41%) and 'physical environment' (30%). The evidence indicates a distinct absence of words and terms that one might associate with a positive culture and environment for equality and diversity, with terms such as 'role models', 'work/life balance' and 'flexible working' appearing in so few applications. When *measuring* culture, the key mechanisms are 'staff surveys' (73%), 'number of social events' (24%) and 'student surveys' (24%). Finally, an assessment of how culture is *described* (which also encapsulated a review of key pages from departmental websites) indicates that the most common words/terms are 'friendly' (70% of departments), 'diverse/diversity' (67%), 'supportive' (64%), 'equal/equality' (64%), and inclusive' (58%).

The detailed analysis of the frameworks can be found in the chapter entitled 'Analysis of Athena SWAN applications', page 2.

1.2.3 Actions and practices in mathematical sciences departments and the evidence for effectiveness

In this report, 'actions' are categorised as the practices and approaches that mathematical sciences departments identify and implement in response to the equality and diversity challenges that they face. The study also recognises that actions to address equality and diversity issues are supported by a range of activities which are not action specific – for example, the support shown by senior leaders in the institution, the approach to constituting and running the self-assessment team, etc.

Very few of the actions and practices identified in the analysis are linked to impact which is evidence-based (i.e. where empirical evidence is presented which substantiates the claim of impact). In this study, these are termed 'evidence-based practices'. Across 33 applications, approximately half of which were at Silver or Gold level, the study identified 12 examples of evidence-based practices.

The following findings key findings have been identified through the analysis of actions and evidenced-based practice:

- The main purpose of the presentation and analysis of data (related to both students and staff) is to evidence the challenges faced by each department.
- Departments often identify actions and practices which have had an impact on student numbers, even if these are not then substantiated through empirical evidence. For example, departments identify changes made to open and post-offer visit days which have been very well received by prospective students.
- Advice provided by the LMS Women in Mathematics Committee has helped departments to rapidly address issues related to low female student numbers.
- Positive and active promotion of Master's programmes to female undergraduates has also been cited as having an impact.
- In terms of addressing issues around staff numbers, evidence-based practice is focused on proactive, strategic recruitment processes which target women, use promotional materials which are carefully worded and might involve actively seeking recommendations from a wide network of senior people in the mathematical sciences community.
- In supporting and advancing women's careers in the mathematical sciences, departments expend a significant amount of time and effort across a very broad range of activities in order to help women sustain and enhance their career. Actions include:

  ➢ the redesign of training courses and combining these with social events,
  ➢ new initiatives to develop postdoctoral career development fellowships which are explicitly designed to offer a specific 'step-up' opportunity whilst also offering greater flexibility and opportunity for career progression, and
  ➢ greater support for grant applications for new staff (including the creation of a Grants Director role to manage and organise support).

- When it comes to supporting female staff returning from maternity leave, evidence-based practice is identified around the use of teaching replacement money to allow members of staff to benefit from protected research time when returning from leave.
- Finally, in terms of organisational culture, the evidence-based practice identified relates to initiatives designed to increase the number of female speakers at seminars and other events. Specifically of note is that the successful initiatives involved both encouraging colleagues to achieve this goal and also to report on progress.

The analysis of evidence-based practice can be found in the chapter entitled 'Practices in mathematical sciences departments and the evidence for effective', page 37. Further details on the 12 cases of evidence-based practice can be found in Appendix F.

1.2.4   The Athena SWAN process

The key findings drawn from the case studies, relating to Athena SWAN impact and process, are as follows:

- Cultural change was regarded as a key outcome of Athena SWAN, though some departments believed change would have been achieved without Athena SWAN (albeit more slowly).
- Applying for an award involved a significant amount of work, especially in relation to data requirements. There is some evidence that departments perceive the significant effort required to apply for the Chart to have the effect of drawing resources away from the process of delivering the changes needed.
- Institutional support for departments preparing an application was mixed. Some departments reported difficulties in accessing the required data, though one outcome of Athena SWAN was that monitoring was reported to have improved. Support from an external mentor was

considered particularly helpful, while the LMS Good Practice Scheme was also considered a useful resource.

- Some departments perceived inconsistencies in the awards process, and there were suggestions that the application process could be streamlined.
- The subject expertise of assessment panel members, and the potential lack of a representative from the mathematical sciences community, was a concern to some departments.
- Departments offered a range of advice to others considering an Athena SWAN application. An enthusiastic self-assessment team whose composition reflected the entire department was considered important. Departments were advised to be self-critical, and to be imaginative in developing action plans which focused on responding to the issues identified within the department.
- Departments often consider themselves 'atypical' which heightens the frustration sometimes felt towards the singular approach to Athena SWAN application.
- There are specific challenges for smaller departments. Low numbers of staff mean that gathering meaningful data can be difficult and that changes involving small numbers staff, or even single staff can suggest significant change when measured quantitatively. An over-focus on quantitative data may therefore present a risk that a false picture is presented, as specific circumstances surrounding such changes (which may not be negative at all) may be ignored.
- Departments value guidance but are wary of prescriptive approaches.

The case study analysis can be found in the chapter entitled 'Case studies', page 56.

1.3 Recommendations

The report makes a number of recommendations for further research.

- There are some areas where additional data analysis may be insightful, where departments may find the centralised collation of other benchmarking data helpful, and where further research may add to a deeper understanding of the factors which impact on women's (and men's) career progression in the mathematical sciences
- The benchmarking data provided by the LMS is seen as valuable by mathematical sciences departments. There is potential to provide greater detail, for example a breakdown by subject area, distinguishing between full-time and part-time students and staff, and/or considering the intersectionality of gender and nationality. There is also the potential to widen the range of benchmarking data available, for example in the areas of committee representation, recruitment, promotion, training and outreach activities.
- Work to streamline the application process and support better assessment of applications is clearly needed. LMS should continue to work with Advance HE to communicate this issue and support the development of appropriate responses to it.
- Statistical analysis of HESA data might explore whether there are other factors such as social status, mix of A Level subjects, etc.) which combine with gender to influence women's career progression in the mathematical sciences, or gender diversity in the mathematical sciences more widely. In other words, such analysis would examine whether there are specific groups of women who are being excluded, compared with men.
- Though helpful, HESA data cover only a relatively small range of indicators applicable to departments in developing equality and diversity initiatives in general, and Athena SWAN applications and action plans in particular. Effectively, unless arrangements are put in place between one department and another (or others) to share information then benchmarking remains a significant challenge across many of the key measures found in an Athena SWAN application.

- While many of the issues are common, the individual circumstances of each department would be better understood if benchmarks for a wider range of indicators were available. Consideration should also be given to the administration burden for departments to provide the data required in a consistent format.
- While it is clear that women remain under-represented in the mathematical sciences, particularly in more senior positions, the factors behind this are not always well understood. Further research could examine how this career path differs for women compared with men, for example by considering the average length of time spent at each stage, and how parental leave (and longer career breaks) impact on progression.
- Given the challenges that this study has faced, consideration should be given to the methodology that should be adopted in any future benchmarking studies. This will also be influenced by what, if any, advances are made around data sharing and benchmarking and how the application process evolves through Advance HE.
- Finally, it is clear that the LMS plays an important role in supporting mathematical sciences departments in relation to Athena SWAN, and gender diversity in general. The LMS should continue to promote the sharing of practice and to facilitate support among the community in identifying and responding to its issues.
- Consideration might also be given to the adoption of a more active advocacy role with Advance HE in relation to perceived issues with the Athena SWAN application and assessment process.

The recommendations can be found in full on page 66.

2. Introduction

The London Mathematical Society strongly supports advancing women's careers in university mathematics departments. The Society's Women in Mathematics Committee promotes a Good Practice Scheme[2] which supports mathematics departments to embed equal opportunities for women within their working practices, to take practical actions to improve the participation of women, and to share examples of effective practice with others.

The Good Practice Scheme provides specific support for departments working towards Athena SWAN Award status. An Athena SWAN Award recognises commitment to advancing gender equality[3] in careers in higher education and research in academic roles and among professional and support staff, and considers representation, the progression of students into academia, progression through career milestones, and the working environment for all staff. To date, more than 40 university mathematics departments in the UK have achieved an Athena SWAN Award at Bronze or Silver level[4].

As part of the Good Practice Scheme, the Women in Mathematics Committee commissioned the current research to examine trends in gender diversity at the national level, and to consider the effectiveness of the various practices of UK mathematics departments relating to advancing gender diversity.

As well as providing an overview of trends at national level, this report aims to identify strengths and weaknesses in advancing gender diversity in mathematics departments across the UK, and to enable departments to assess themselves in relation to the national picture. The research also identifies examples of existing evidence-based practice that can be shared among departments.

Note that in March 2018 and during the course of delivering this study, a merger of the Equality Challenge Unit (ECU – previously responsible for Athena SWAN), the Higher Education Academy and the Leadership Foundation for Higher Education resulted in the creation of a single sector agency for equality and diversity, learning and teaching, and leadership and governance in higher education. This organisation is called Advance HE and it now runs Athena SWAN.

2.1 Approach

The research involved two distinct elements: a quantitative analysis of data relating to mathematical sciences students and academic staff at national level, and a qualitative assessment of Athena SWAN submissions from 33 participating mathematics departments.

The quantitative analysis is based primarily on aggregate data from the Higher Education Statistics Agency (HESA), as well as data from the Joint Council for Qualifications. The report presents a time-series analysis of gender diversity among mathematical sciences students, and among academic staff in the mathematics cost centre[5]. The data which underpin this analysis is presented in a detailed data pack which updates and develops the benchmarking data previously published by the Society, available alongside the report.

At the outset of the research, the intention was to collate data on student and staff numbers from participating departments' Athena SWAN submissions, as the basis for more detailed quantitative analysis. In practice, the variations between submissions in data presentation, time periods covered and

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[2] https://www.lms.ac.uk/women/good-practice-scheme
[3] Including equality of trans staff and students.
[4] http://www.ecu.ac.uk/equality-charters/athena-swan/athena-swan-members/
[5] A full description of methodology can be found in Appendix A.

measures used (headcount versus full-time equivalent, for example) meant this was impossible. Instead, the research also draws on HESA data at institution level, alongside data published by Advance HE (previously the Equalities Challenge Unit) on successful Athena SWAN submissions, allowing us to extend the quantitative analysis to consider all UK institutions.

The qualitative assessment draws on the most recent Athena SWAN submissions from the 33 mathematics departments participating in the research. The submissions provided include a range of successful and unsuccessful applications between November 2014 and November 2017, at Bronze, Silver and Gold levels.

There are three main elements to the qualitative analysis, as follows:

1. **'Framework' analysis of common elements and links to characteristics.** This study is interested in the commonalities between mathematics departments and how the characteristics of departments relate to Athena SWAN outcomes. In order to investigate this, the study has delivered an analysis of the content of application forms against a number of 'frameworks'. The objective is twofold: firstly, to identify common approaches, common challenges and responses to those challenges, and secondly to attempt to identify patterns in the application content of departments sharing common characteristics.

   Our approach has been founded on the idea of thematic 'frameworks', each aligned to aspects of the application process or gender equality issues. Each framework consists of a list of relevant items extracted from the 33 application forms available to this study, gathered through a manual process in order to populate each framework. For example, for the Data framework, the first application was reviewed in order to identify the range of data sources employed against each section of the application form. This began the population of the 'list' of all data sources used across the 33 applications. Then the second application was reviewed, identifying which of those data sources already within the framework have been employed in this second applications, and adding new data sources to the framework if they existed. As such, the frameworks were populated whilst each application was being assessed. The four frameworks are as follows:

   1. Data employed in applications
   2. Common struggles identified in applications
   3. Common practices identified in applications
   4. Definitions and descriptions of culture (in applications and websites)

   Two departmental characteristics have been used in the framework analysis: award success by award level (or application level, in the case of unsuccessful awards) and quartiles based on the proportion of staff within each department that are female.

   An analysis for each framework was then undertaken against the two characteristics (success/level and quartile) in an attempt to, firstly, simply identify the most common data sources, struggles, practices and definitions of culture and then, secondly, to identify patterns and relationships between these aspects and the two characteristics. The analysis below is presented in two sections, corresponding to these lines of enquiry.

2. **Identifying actions and evidence-based practice.** Each Athena SWAN submission was reviewed and compared with the 32 others, examining the content, use of data and range of policies and actions implemented (including any that were deemed 'evidence-based practices'). The Equality Challenge Unit's Athena SWAN guidance and good practice guides provided by the London Mathematical Society have also been considered during the analysis.

3. **Case study interviews.** The qualitative assessment also draws on in-depth interviews with a number of Heads of Departments and academics with lead responsibility for Athena SWAN

submissions in participating departments. These interviews explored the effectiveness of equality and diversity practice in different departmental contexts, as well as experiences of the Athena SWAN process itself.

The approach taken to generating the qualitative evidence presented in this report is fundamentally different to that adopted in the benchmarking exercise undertaken by the Society in 2013, published in the report *Advancing Women in Mathematics*[6]. Then, departments were invited to provide information against a good practice checklist and these responses were analysed to assess equality and diversity practices. Since 2013, many departments have gone on to apply for and in many cases receive Athena SWAN awards. It was therefore considered by the Society to be overly burdensome to request that departments complete such a detailed survey again, given the effort that has already been invested in developing and submitting Athena SWAN applications, and that the applications themselves should provide sufficient evidence of the actions and practices adopted. In taking this approach, the intention is to provide useful feedback regarding the range of approaches to advancing gender diversity adopted by mathematics departments across the UK. Examples of evidence-based practice have also been identified, allowing the report audience to review specific approaches employed by mathematical sciences departments in addressing equality and diversity challenges.

2.1.1   Summary of applications reviewed

The 3 applications made available to this study can be described as follows:

- The submission dates ranged between November 2014 – November 2017
- There were 17 Bronze submissions, of which:
- 4 seeking to renew a Bronze award, 13 first-time submissions
- 14 successful, 3 unsuccessful
- There were 15 Silver submissions
- 5 seeking to renew a Silver award, 10 from departments with a Bronze award
- 6 successful, 9 unsuccessful (Bronze renewed)
- There was 1 Gold submission (which was unsuccessful – the department holds a Silver award)

[6] https://www.lms.ac.uk/sites/lms.ac.uk/files/LMS-BTL-17Report_0.pdf

3. Gender in Mathematics – quantitative analysis

This chapter presents a summary of gender diversity among students studying mathematical sciences in UK Higher Education Institutions (HEIs). It also examines gender diversity among academic staff in mathematics cost centres in UK HEIs. The analysis draws primarily on data from the Higher Education Statistics Agency, as well as data from the Joint Council for Qualifications. A detailed description of methodology can be found in Appendix A.

3.1 The mathematical sciences pipeline: a summary

Figure 1 presents a snapshot of the mathematical sciences pipeline in the UK, from A Level students to researchers and teaching staff in higher education. It shows the proportion of the population who are male and female at each stage of the 'pipeline' in 2016/17[7]. Figure 1 shows that females remain under-represented at all levels of the pipeline, with the largest differentials in the most senior academic roles.

Figure 1: The mathematical sciences pipeline by gender, 2016/17
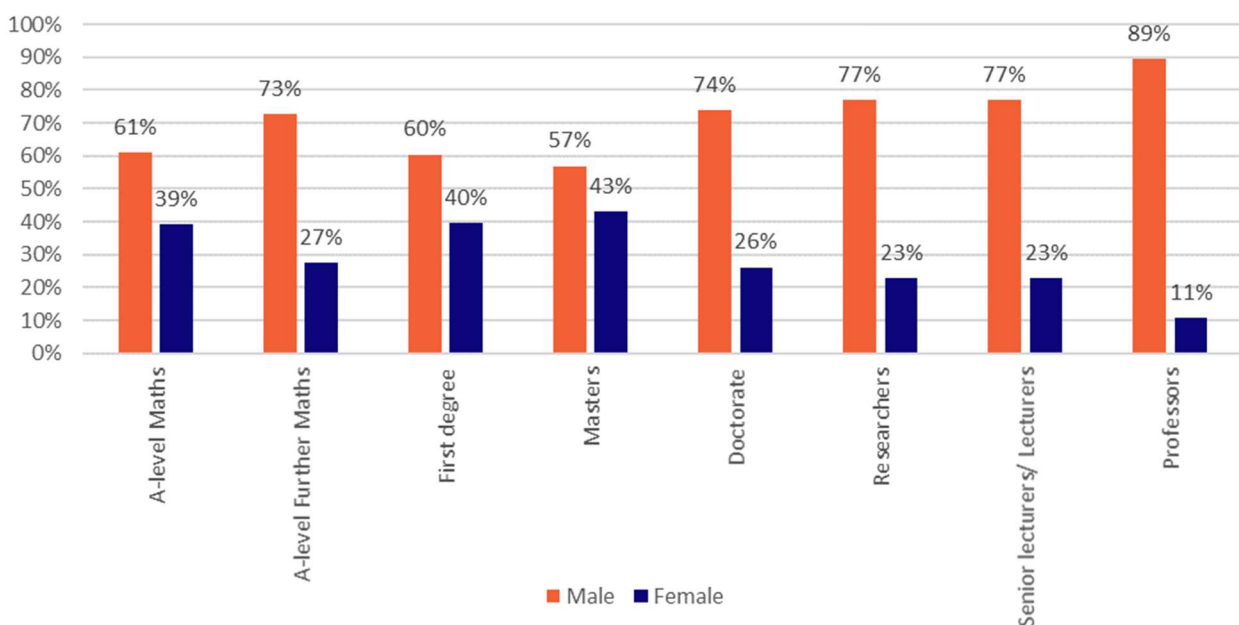
Source: JCQ / HESA Student Record / HESA Staff Record. A Levels data relate to candidates in 2017. First degree, Master's and Doctorate data relate to mathematical sciences graduates in 2016/17. Researchers, senior lecturers/lecturers and Professors data relate to staff in mathematics cost centres in 2016/17.

Figure 1 includes all graduates, regardless of where they are domiciled, and all researchers and teaching staff, regardless of nationality. As shown in Figure 2, a broadly similar picture emerges if we restrict the analysis to UK-domiciled graduates, and academics who are UK nationals[8].

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[7] Note that unlike the Council for the Mathematical Sciences' report *The Mathematical Sciences People Pipeline* (http://www.cms.ac.uk/files/News/article_5630c69e789971.96989222.pdf), the current analysis makes no attempt to track individual progress through the pipeline.

[8] The HESA Student Record distinguishes between the permanent home country of a student or graduate on the point of entry to their course (their domicile), rather than their nationality. The HESA Staff Record distinguishes between the nationality of research and academic staff, rather than their domicile. These two different measures are used to provide the most meaningful indicators in relation to international recruitment of students and staff.

Figure 2: UK-domiciled mathematical sciences graduates, researchers and academics who are UK nationals, by gender, 2016/17
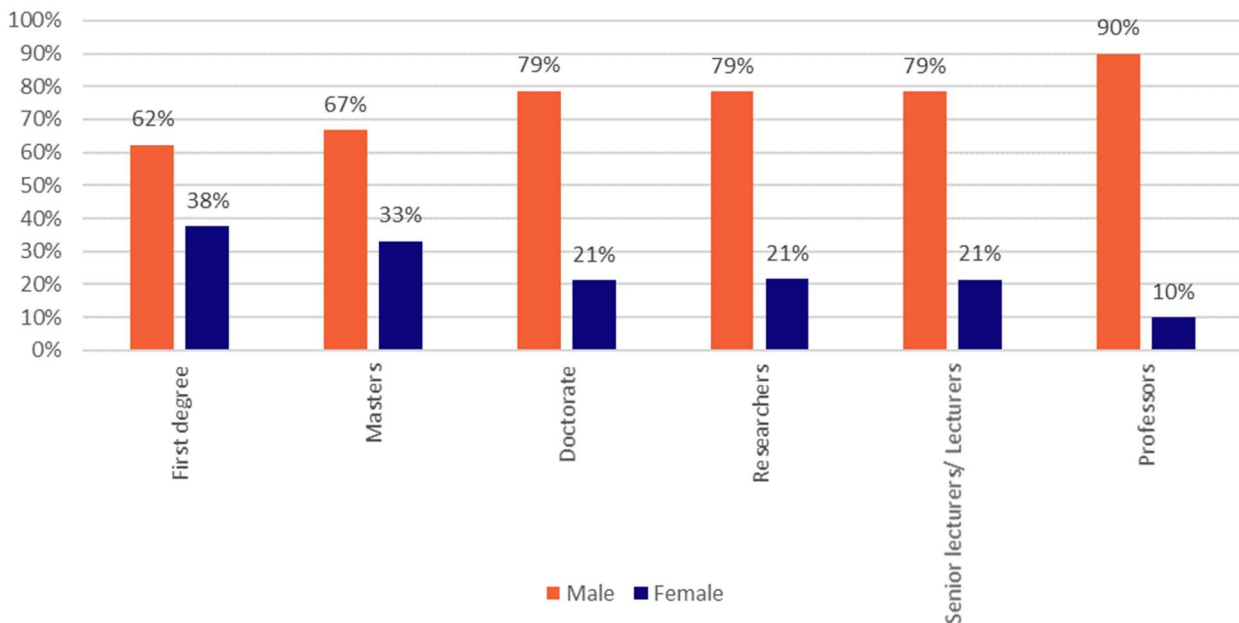
Source: HESA Student Record / HESA Staff Record. First degree, Master's and Doctorate data relate to UK-domiciled mathematical sciences graduates in 2016/17. Researchers, senior lecturers/lecturers and Professors data relate to staff who are UK nationals in the mathematics cost centre in 2016/17.

While the picture is broadly similar, Figure 2 shows that differences in the proportions of men and women at each stage of the pipeline are greater among the UK population (UK-domiciled graduates and academics who are UK nationals) than among the population as a whole. The largest difference is among Master's graduates, and the recruitment of overseas students appears to be particularly important at this level.

It may also be noteworthy that unlike the population as a whole, there is no fall in the proportion of female Doctorate graduates who are UK-domiciled, and the proportions of researchers and senior lecturers/lecturers who are women. Further research is needed to understand how progression from doctorate-level study to research and teaching positions in HE varies by gender and domicile/nationality.

The following sections examine gender diversity in the mathematical sciences pipeline in more detail.

3.2 Mathematical sciences students

Studying the mathematical sciences in higher education requires a suitable academic background, of course, and addressing challenges of gender diversity in higher education mathematics means addressing similar challenges in pre-university education. Figure 3 shows that while the overall number of students entering A Level examinations in Mathematics and Further Mathematics between 2011/12 and 2016/17 has increased (line chart, right axis), the proportion who are female has not improved (column chart, left axis). Figure 3 also shows that women are less likely to take up A Level Further Mathematics than they are to take up A Level Mathematics. Indeed, while the proportion of female A Level Mathematics candidates has remained stable for several years, the proportion of female A Level Further Mathematics candidates has fallen, from 30% in 2011/12 to 27% in 2017/18. In contrast, the proportion of all A Level candidates who are female in 2017/18 was 55%.

Figure 3: A Level Mathematics and Further Mathematics candidates, 2011/12–2067/17
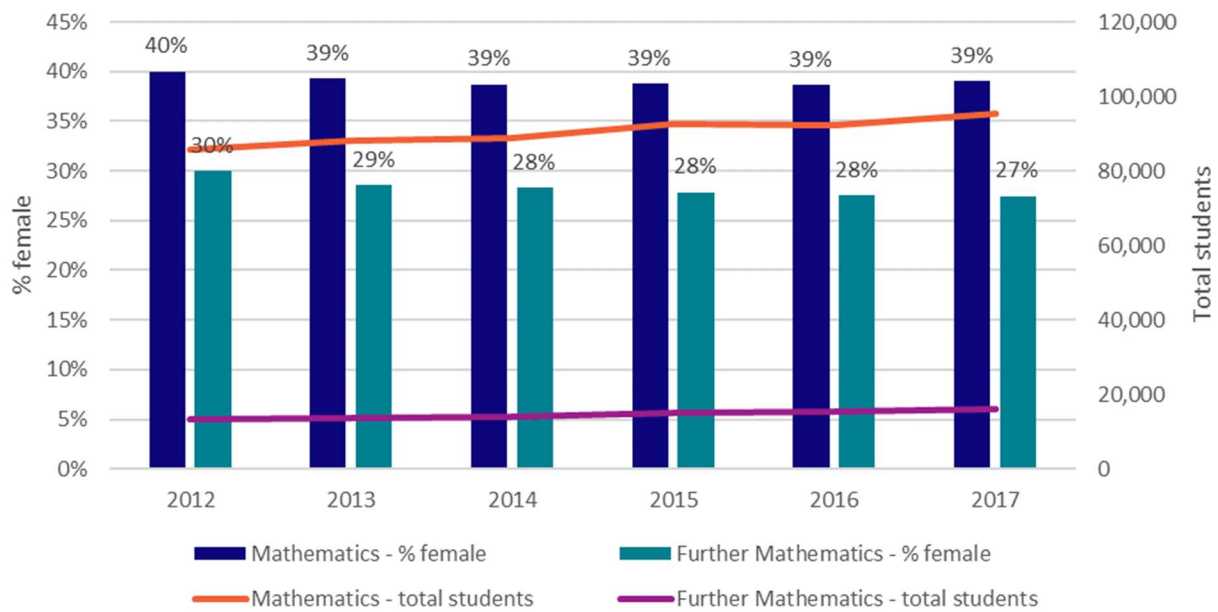
Source: JCQ.

Table 1: A Level Mathematics and Further Mathematics candidates, 2011/12–2016/17

Level	Gender	2012	2013	2014	2015	2016	2017
Mathematics	Female	34,301	34,625	34,374	35,937	35,628	37,212
	Male	51,413	53,435	54,442	56,774	56,535	58,032
Further Mathematics	Female	3,972	3,951	3,975	4,177	4,203	4,441
	Male	9,251	9,870	10,053	10,816	11,054	11,731

Source: JCQ.

Figure 4 shows that between 2011/12 and 2016/17, the total number of graduates from first degree mathematical sciences courses has increased (line chart, right axis), but the proportion who are female has fallen (column chart, left axis) from 43% to 40%. In contrast, the proportion of all first degree graduates (all subjects) who are female in 2016/17 was 57%. The proportion of all first degree science graduates who are female in 2016/17 was 51%[9].

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[9] HESA uses a broad STEMM definition to distinguish science degrees from other degrees. For more details, see: https://www.hesa.ac.uk/data-and-analysis/students/outcomes

Figure 4: First degree mathematical sciences graduates, 2011/12–2016/17
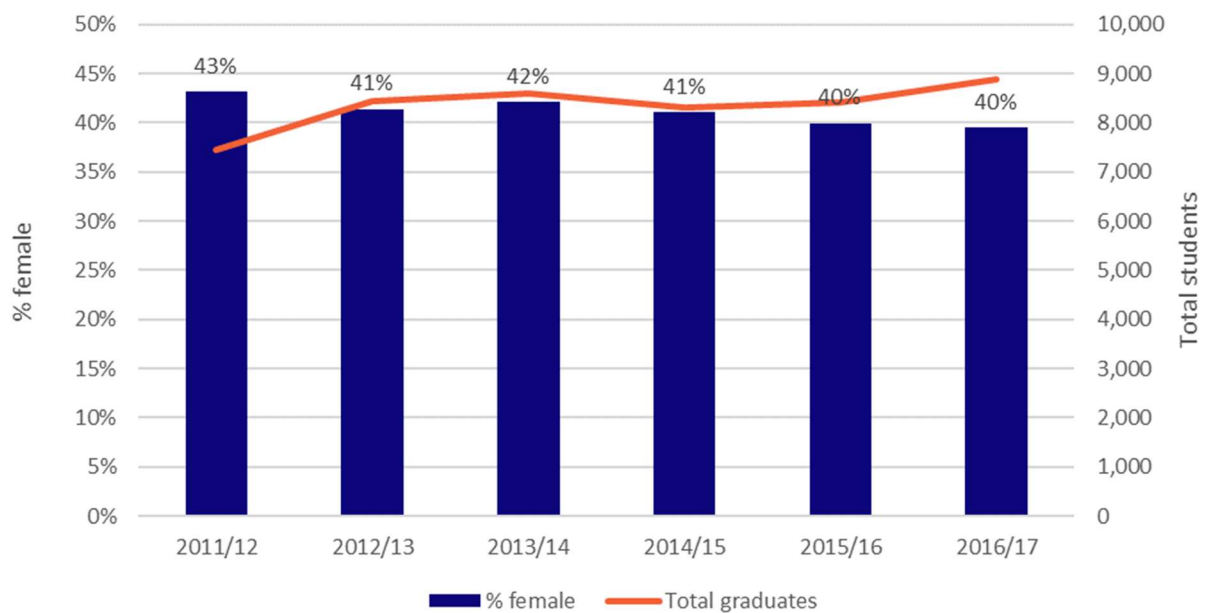
Source: HESA Student Record

Table 2: First degree mathematical sciences graduates, 2011/12–2016/17

Gender	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Female	3,215	3,490	3,630	3,410	3,365	3,510
Male	4,230	4,940	4,975	4,900	5,055	5,365

Source: HESA Student Record

There is no clear pattern among institutions with regards to the proportion of 2016/17 first degree mathematical sciences graduates who are female, in relation to their Athena SWAN status. Departments holding a Bronze award appear more likely to be in the top quartile in terms of the proportion of female graduates than departments which had applied at Bronze level but had been unsuccessful. This was not true of Silver applicants, however[10].

Similarly, departments holding a Bronze award were more likely to have seen improvements in the proportion of graduates who are female than those unsuccessfully applying for a Bronze award. Again, this was not apparent at Silver level.

As shown in Figure 5, the total number of graduates from mathematical sciences courses at Master's level has risen between 2011/12 and 2016/17 (line chart, right axis). The proportion of female graduates has also risen over this period, from 37% to 43%, though this does not represent a constant improvement (column chart, left axis), and remains below the proportion of all postgraduates who are female (58%) and below the proportion of all science postgraduates who are female (52%).

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[10] Data suppression rules mean that many mathematical sciences departments cannot be ranked by quartile, and it is therefore difficult to draw firm conclusions from this analysis. The distribution of departments by Athena SWAN application level and proportion of graduates or staff who are female, by quartile, is shown in Appendix C.

Figure 5: Master's degree mathematical sciences graduates, 2011/12–2016/17
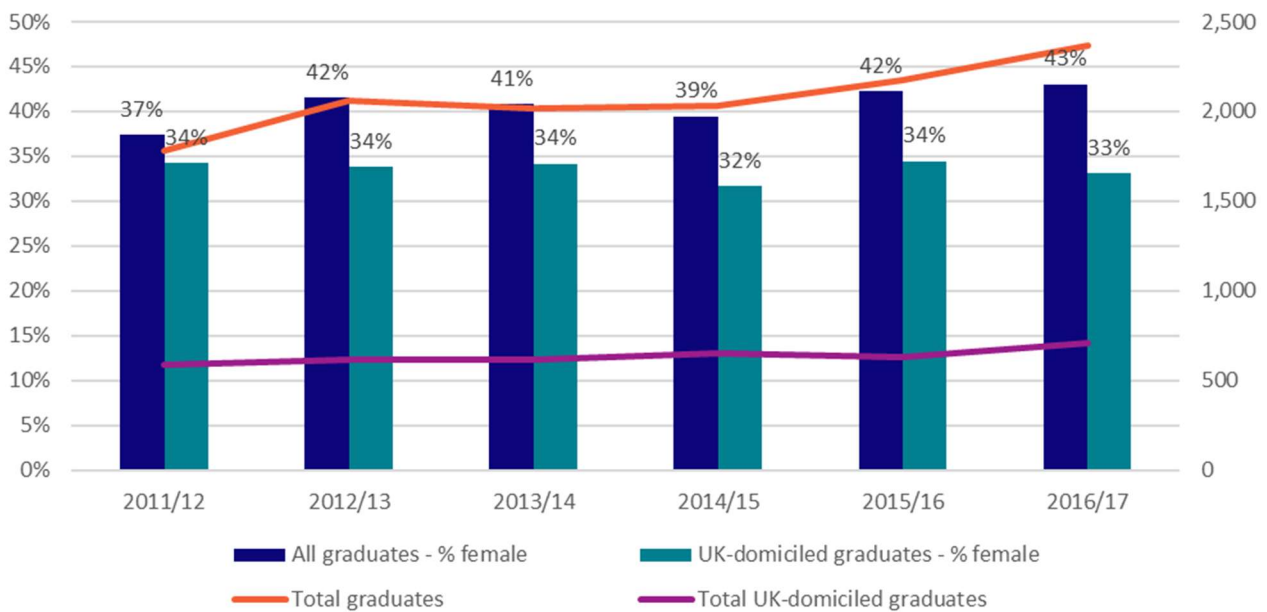
Source: HESA Student Record

Table 3: Master's degree mathematical sciences graduates, 2011/12–2016/17

Domicile	Gender	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
UK	Female	205	210	210	205	220	235
	Male	390	410	410	445	415	475
All	Female	665	855	820	805	920	1,020
	Male	1,115	1,205	1,190	1,230	1,255	1,350

Source: HESA Student Record

The overall increase in mathematical sciences graduates at Master's level is driven by the recruitment of overseas students, who comprise a significant proportion of the student population at this level. While it has risen, the number of UK-domiciled students has not increased at the same pace. The proportion of UK-domiciled Master's graduates from mathematical sciences degrees who are female has not increased, suggesting that the challenges relating to progression of women from first degree to Master's level may be more significant for UK-domiciled women than for women domiciled overseas.

Departments which have applied for an Athena SWAN award appear more likely to be in the top quartile in terms of the proportion of 2016/17 mathematical sciences graduates at Master's level who are female than departments which have not applied. There is no notable difference between departments applying at different levels, or between successful and unsuccessful applications.

At Bronze level, successful departments were more likely to have seen improvements in the proportion of female mathematical sciences graduates at Master's level than departments which applied unsuccessfully. At Silver level, unsuccessful applicants were more likely to have seen a decline in the proportion of female Master's graduates than successful applicants, among whom improvements were less likely than at Bronze level.

Figure 6 shows that the total number of mathematical sciences Doctorates has risen between 2011/12 and 2016/17, despite some volatility early in this period (line chart, right axis). The proportion of Doctorates who are female (column chart, left axis) fell over the same period, despite a peak in

2013/14, when total Doctorate numbers were at their lowest. Even then, only 33% of mathematical sciences Doctorates are female; this proportion fell to 26% in 2016/17, well below both the proportion of all postgraduates who are female (58%) and the proportion of all science postgraduates who are female (52%).

Figure 6: Doctorate mathematical sciences graduates, 2011/12–2016/17
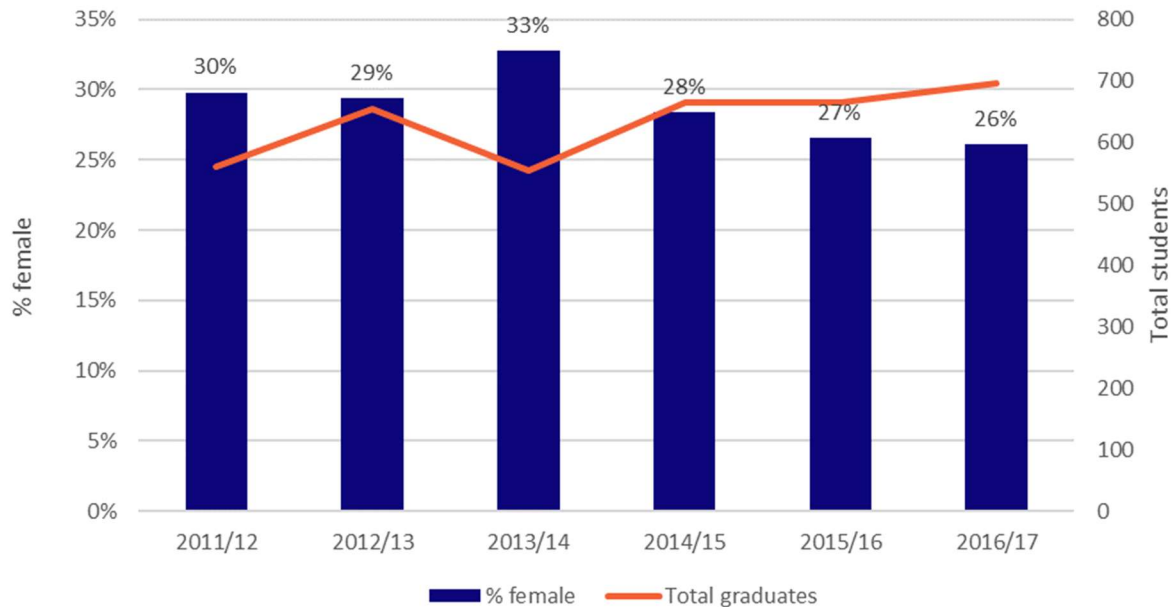
Source: HESA Student Record

Table 4: Doctorate mathematical sciences graduates, 2011/12–2016/17

Gender	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Female	165	195	180	190	175	180
Male	390	460	375	475	490	515

Source: HESA Student Record

Departments holding an award at Bronze or Silver level appear more likely to be in the upper middle or top quartile in terms of the proportion of 2016/17 mathematical sciences Doctorates who are female than departments which had unsuccessfully applied for awards at these levels. Departments which had not applied for an Athena SWAN award tended to have small numbers of Doctorates, and it is difficult to make comparisons between departments engaged with Athena SWAN and those not engaged.

3.3 Mathematics staff

Reflecting rising student numbers, the total number of lecturers and senior lecturers[11] in mathematics cost centres in UK universities increased between 2011/12 and 2016/17, as shown in Figure 7 (line chart, right axis). Over the same period, the proportion of lecturers and senior lecturers who are female remained steady, at 23% (column chart, left axis). By comparison, the proportion of all lecturers and senior lecturers (all cost centres) who are female in 2016/17 was 45%.

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[11] Lecturers and senior lecturers are defined as academic staff (who are not Professors) with a teaching-only or teaching and research employment function.

Figure 7: Lecturers and senior lecturers in the Mathematics cost centre, 2011/12–2016/17
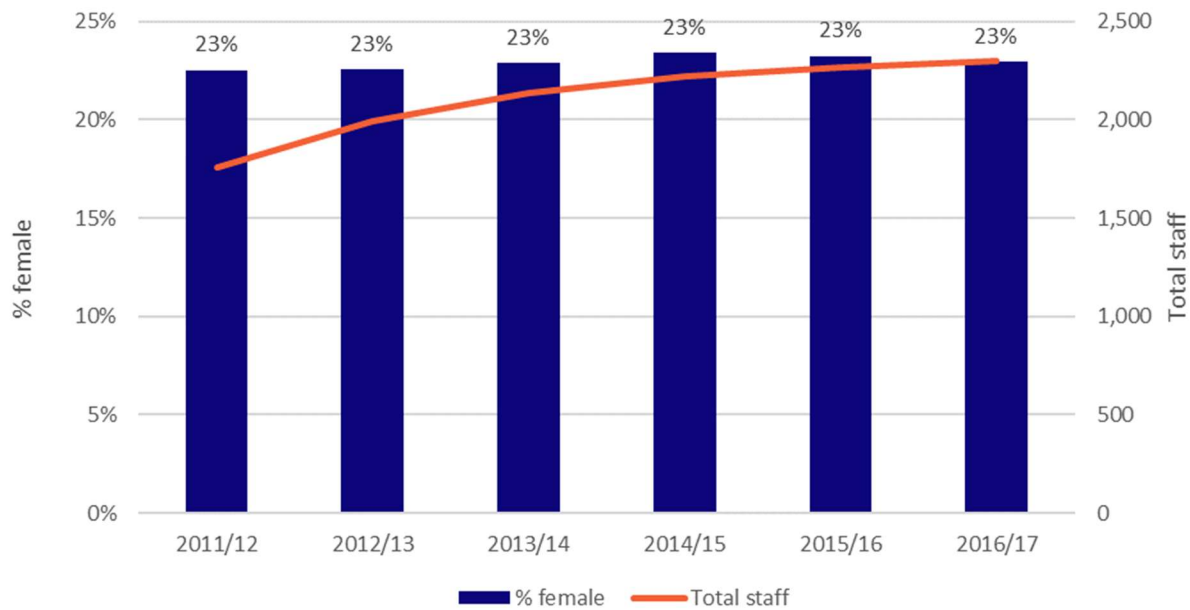
Source: HESA Staff Record

Table 5: Lecturers and senior lecturers in the Mathematics cost centre, 2011/12–2016/17

Gender	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Female	395	450	490	520	525	525
Male	1,365	1,545	1,645	1,700	1,740	1,770

Source: HESA Staff Record

Departments which held a Bronze award were more likely to be in the upper middle and top quartiles in terms of the proportion of lecturers and senior lecturers in the mathematics costs centre in 2016/17 who are female than departments which had applied unsuccessfully for a Bronze award. This pattern was not so clear at Silver level. At Bronze level, successful departments were also more likely to have seen an increase in the proportion of lecturers and senior lecturers who are female than unsuccessful departments, but again, this pattern was not apparent at Silver level.

As Figure 8 shows, the age profile of male and female lecturers and senior lecturers in the mathematics cost centre is broadly similar, though women have a slightly younger age profile than men in these roles. The average age of a female lecturer or senior lecturer in the mathematics cost centre was 41.7 years in 2016/17, compared with 43.3 years for male lecturers and senior lecturers.

Figure 8: Age profile of lecturers and senior lecturers in the Mathematics cost centre by gender, 2016/17
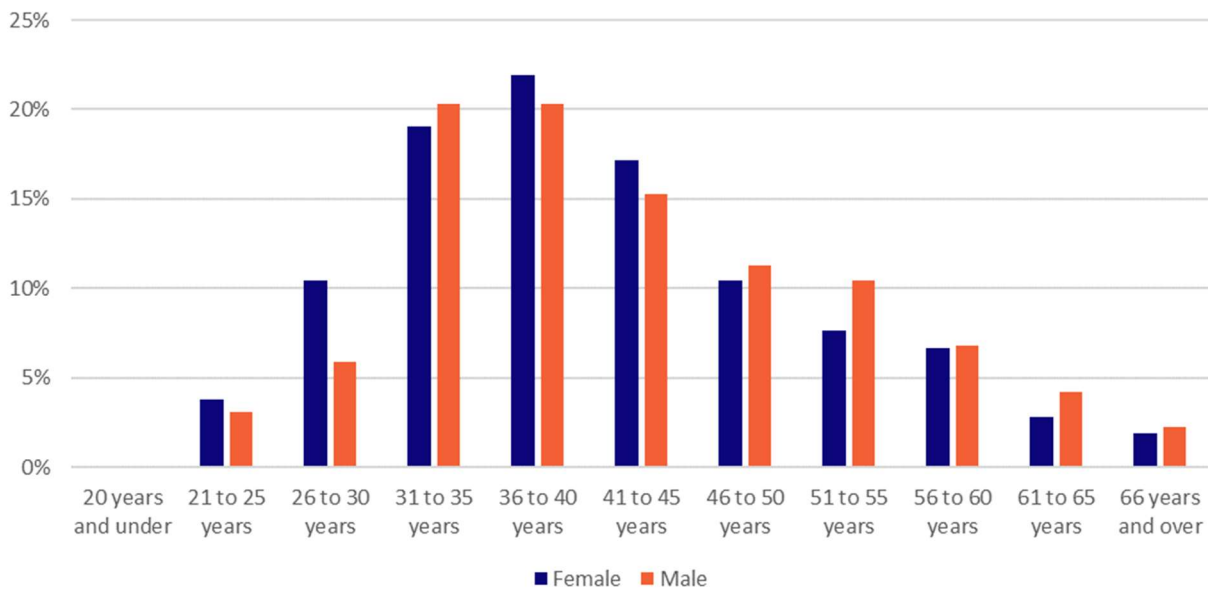
Figure 9 shows that the number of researchers[12] in the mathematics cost centre has also risen between 2011/12 and 2016/17 (line chart, right axis), though not as consistently as the number of lecturers and senior lecturers. Following a rise between 2011/12 and 2012/13, the proportion of researchers who are female has remained relatively steady over this period (column chart, left axis). 23% of researchers in the mathematics cost centre in 2016/17 are female, compared with 47% of all researchers (all cost centres).

Figure 9: Researchers in the Mathematics cost centre, 2011/12–2016/17

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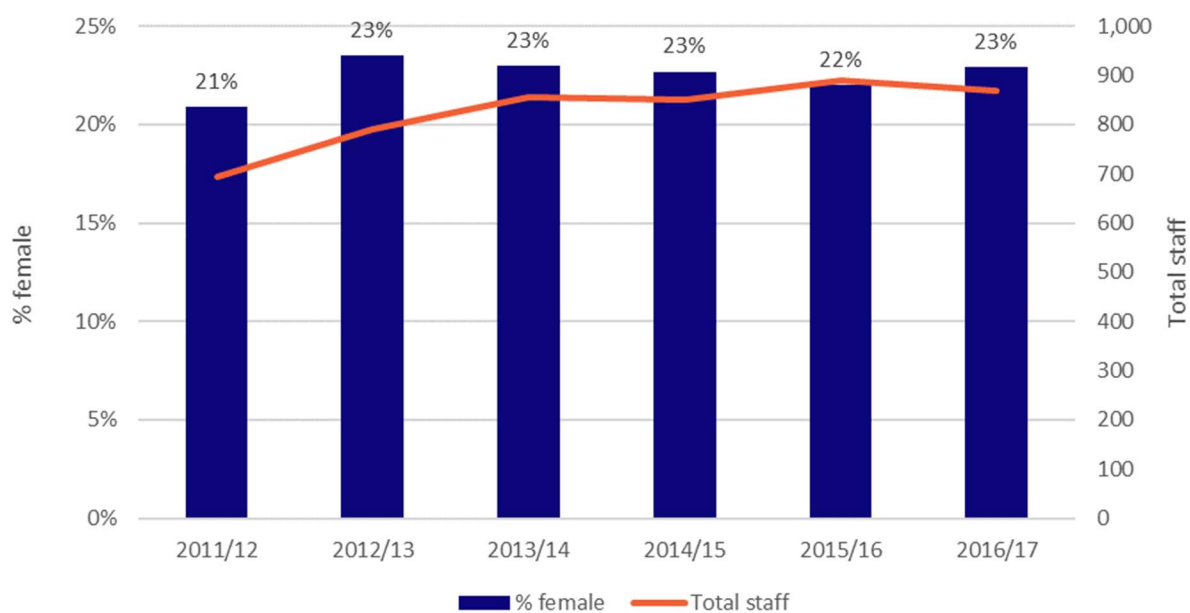
[12] Researchers are defined as academic staff (who are not Professors) with a research-only employment function.

Table 6: Researchers in the Mathematics cost centre, 2011/12–2016/17

Gender	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Female	145	185	195	195	195	200
Male	550	605	660	660	695	670

Source: HESA Staff Record

Figure 10 shows some variation in the age profiles of male and female researchers in the mathematics cost centre. A higher proportion of women in these roles (50%) are aged 21 to 30 years compared with men (46%), while a higher proportion of women in Researcher roles are aged 46 years and over (8%) compared with men (5%). The average age of a female researcher in the mathematics cost centre was 37.0 years in 2016/17, compared with 35.2 years for male researchers.

Figure 10: Age profile of researchers in the Mathematics cost centre by gender, 2016/17
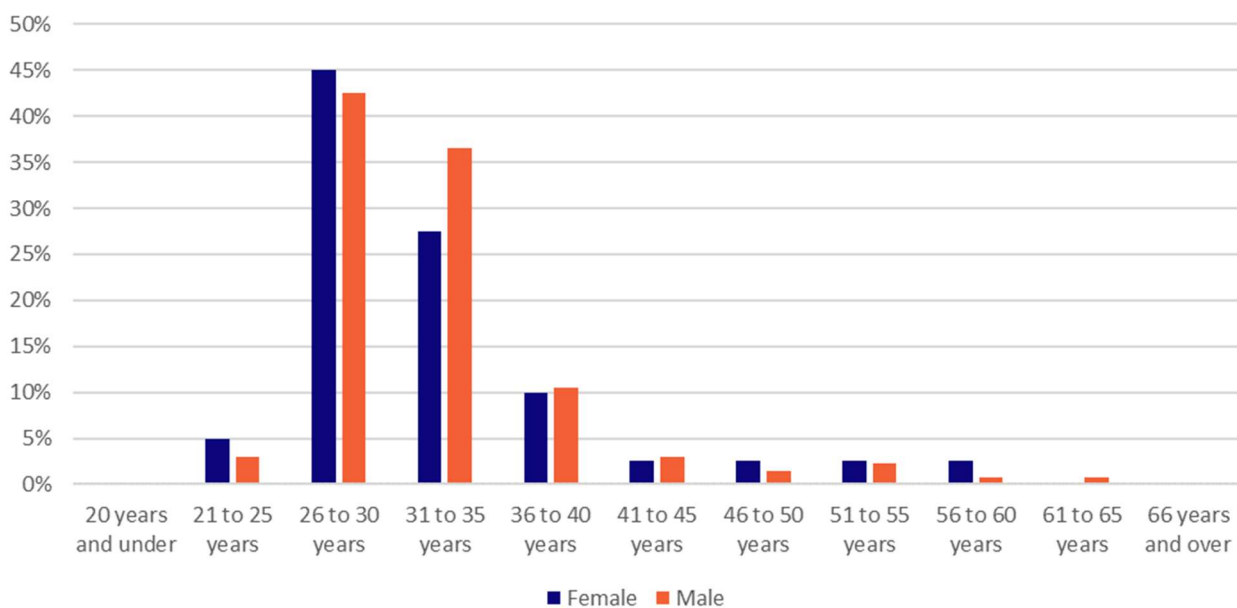
Source: HESA Staff Record

As Figure 11 shows, the number of Professors[13] in the mathematics cost centre has risen slowly since a low in 2012/13 (line chart, right axis). The proportion of Professors who are female has also risen since 2012/13, to 11% in 2016/17 (column chart, left axis). By comparison, 25% of all Professors (all cost centres) in 2016/17 are female.

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[13] From 2012/13, Professors are defined as those with an employment contract which aligns with the Universities and Colleges Employers Association (UCEA) contract level 5A Professor. This level indicates a senior academic appointment (which may carry the title of Professor) but which does not have departmental line management responsibilities.

Figure 11: Professors in the Mathematics cost centre, 2011/12–2016/17
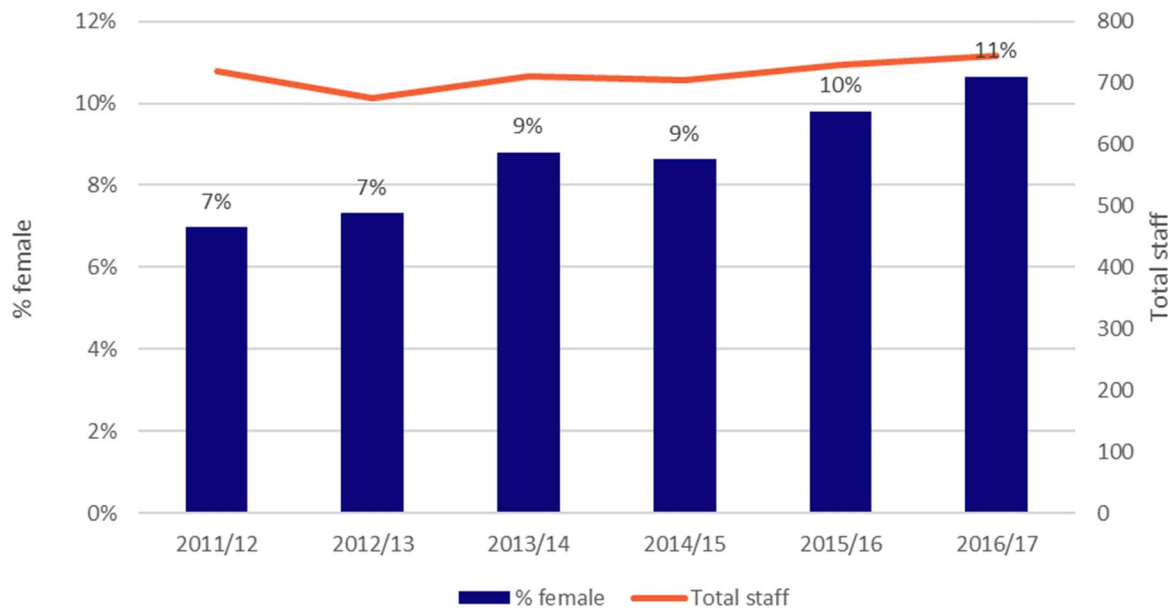
Table 7: Professors in the Mathematics cost centre, 2011/12–2016/17

Gender	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Female	50	50	60	60	70	80
Male	670	625	645	645	660	665

The age profile of female Professors in the mathematics cost centre is lower than among their male counterparts, as shown in Figure 12. The average age of a female Professor in the mathematics cost centre was 50.6 years in 2016/17, compared with 53.4 years for male Professors.

Figure 12: Age profile of Professors in the Mathematics cost centre by gender, 2016/17
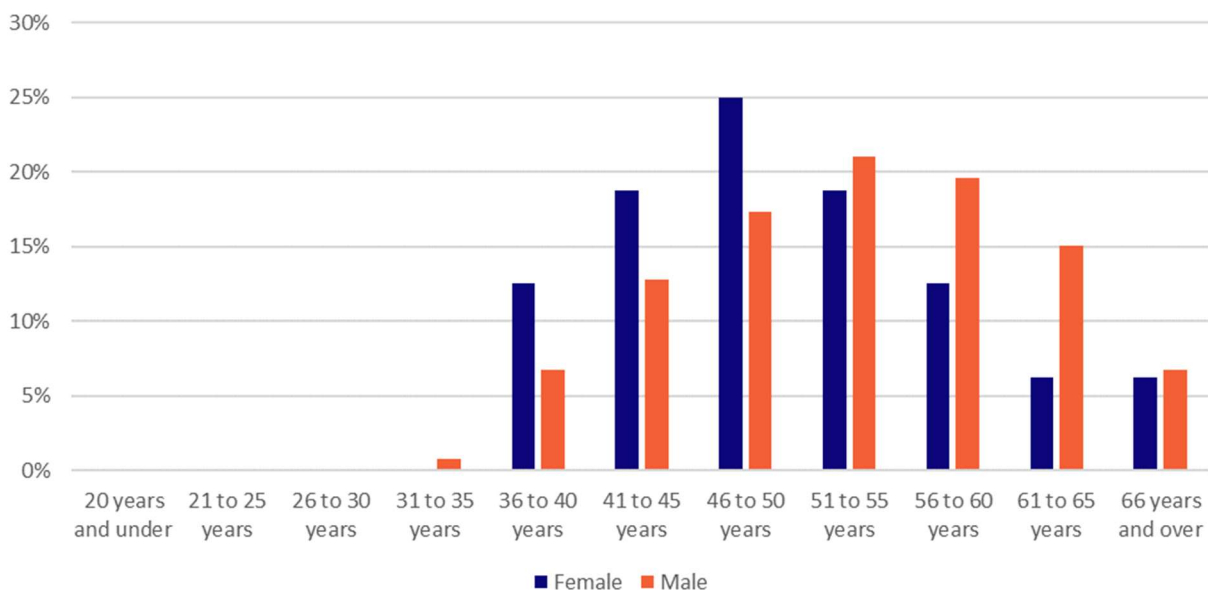
4. Gender in Mathematics – qualitative analysis

This section is divided into three parts, as follows:

- Firstly, an analysis of Athena SWAN application forms has been undertaken to identify patterns in responses across different groups of departments.
- Secondly, examples of actions in response to equality and diversity challenges have been identified both from application forms and the Advance HE Awards Booklets. Within this, examples of 'evidence-based' practice have been identified, where departments have identified impact arising from actions and supported this with evidence.
- Thirdly, evidence gathered through a series of case studies is presented.

4.1 Analysis of Athena SWAN applications

4.1.1 Introduction

This study is interested in the commonalities between mathematics departments and how the characteristics of departments relate to Athena SWAN outcomes. In order to investigate this, the study has delivered an analysis of the content of application forms against a number of frameworks, described in the Approach section (see section 2.1, page 9) and linked to a small number of department characteristics. The objective is twofold: firstly, to identify common approaches, common challenges and responses to those challenges, and secondly to attempt to identify patterns in the application content of departments sharing common characteristics.

4.1.2 Common challenges and approaches

In this section, we present the analysis of common challenges and approaches derived from the framework-based review of 33 application forms.

4.1.2.1 Data sources

Table 8 shows the most commonly utilised data sources across the 33 mathematics departments' application forms. It shows the following:

- All application forms call upon internal information (which could include information on the characteristics of specific staff, such as those on the SAT, or description data about the department or institution or other insight drawn from an unspecified source).
- Internal information is generally a highly important source of insight for application forms.
- A far higher proportion of applications call upon data from a staff survey (91%) than utilise data from student surveys (58%).
- Four in ten applicants (42%) utilise data that describes the outreach activities that they undertake (e.g. the gender make-up of those attending, or those delivering the activities).
- HESA data is used by almost 9 in 10 applicants (88%).
- One fifth (21%) of applicants cite LMS Good Practice scheme data somewhere in their application form.

Table 8: Proportion of applications using common data sources

Data source	Percentage of applications
Internal information (non-specific)	100%
Internal information - staff data	100%
Internal information - student data	100%
Internal information - promotions data	97%
Internal information - recruitment data	97%
Staff survey data	91%
HESA/HEIDI data	88%
Student survey data	58%
Internal information - outreach recipients	42%
LMS Good practice scheme data	21%
REF2014 data	21%
Ofsted A-level data	15%
Russell Group data	15%
LMS Good practice report	12%
Another AS applicants' data	9%
Focus group data	9%
National Student Survey	9%
Complete University Guide	6%
Equality in HE Statistical Report 2016	6%
UCAS data	6%

Source: Ortus Economic Research analysis of Athena SWAN applications. Only struggles which were cited by at least 5% of departments are included in this table.

4.1.2.2   Common struggles

Table 9 shows the most commonly cited struggles and challenges across the 33 mathematics departments' application forms. It evidences the following:

- Every one of the 33 applications identified the challenge of attracting a greater number of female students. This was the only struggle unanimously identified across the sample.
- Seven in ten departments (70%) identified that they have low numbers of female staff. This assessment is often made in comparison with some form of benchmark (e.g. HESA national average).
- A majority of departments (61%) indicate that they struggle with data gaps. This challenge tends to mean that applicants are not able to present the data that they believe would help throw light on the specific issues they face, either because it does not exist, is difficult to acquire (within the departments or across the institution) or sample sizes are insufficiently large to support robust analysis.
- Approximately four in ten departments (42%) cite challenges with committee constituency. This often alludes to the challenge of ensuring that there is a gender balance (or at least some form of female representation) on committees or panels. This struggle is of course related to the general issue of there being low numbers of female staff in mathematics departments, meaning that there is often a significant burden placed on those female staff that are present to take up committee or panel opportunities.
- A similar proportion (42%) of departments identify the challenge of a 'leaky pipeline', a metaphor for the continuous loss of women in STEM as they climb the career ladder.

Table 9: Proportion of applications identifying common struggles

Common struggles	Percentage of applications
Attracting female students	100%
Low numbers of female staff	82%
Data gaps	61%
Committee constituency	42%
Leaky pipeline	42%
Role models	33%
Awareness/perception of promotion system	30%
Workload model	30%
Appointing female staff	21%
Awareness of development and support policies	18%
Female UG confidence	15%
Improve appraisal/progression support	15%
Experience in dealing with gender issues	12%
Funding changes	12%
Physical environment	12%
Training take up	12%

Source: Ortus Economic Research analysis of Athena SWAN applications. Only struggles which were cited by at least 10% of departments are included in this table.

4.1.2.3 Common practices

The final framework examined by this section relates to common practices, i.e. the actions being taken or changes being made by departments in the face of the struggles and challenges they have identified. Of the four frameworks, this one identified the most diverse set of practices. Whilst these have been aggregated together within the framework, there remains a very large number of individual practices. For this reason, Table 10 displays only those which have been adopted by at least 50% of departments. The full list can be found in Appendix D (Table 36, page 74).

Table 10: Proportion of applications identifying common practices

Practice	Proportion of applications
Data gathering	94%
More targeted/proactive recruitment	91%
Promoting postgraduate opportunities	75%
Review/improve promotional material	72%
Review/improve student recruitment activities	72%
Recruitment training	69%
Review/improve promotions processes	69%
Review/improve recruitment materials	69%
Review/improve student support	69%
Review/improve workload allocation	69%
More proactive/targeted approach to career development	66%
Review/improve recruitment processes	66%
Improve staff mentoring	66%
Improve staff career support	63%
Review/improve staff support information	63%
Review/improve staff support processes	63%
Improve access to relevant information (generally)	59%
Raise awareness of equality/diversity activity/issues	53%
Review/improve appraisal processes	53%
Visibility of positive role models	53%
Widen/review SAT membership	53%
Improving academic support for students	50%

Source: Ortus Economic Research analysis of Athena SWAN applications. Only practices which were cited by at least 50% of departments are included in this table. The full table is available in the Appendix.

Table 10 identifies the following headlines in relation to common gender equality practices:

- The practice which is most commonly adopted is additional data gathering (94%), which is a far higher proportion than the percentage of departments that identified data gaps as a struggle (61% – see Table 9). This suggests that additional data is being sought in departments that have not acknowledged the lack of data as a challenge. This itself may indicate that departments are generating greater insight through additional data analysis.
- Around nine out of ten departments (91%) plan to undertake more targeted and proactive recruitment.
- The third most prevalent practice is promoting postgraduate opportunities (75%). It is widely accepted that achieving an increase in the number of female postgraduate students is important to ensuring that a greater number of women are in the mathematics career pipeline, so it is encouraging to see three quarters (75%) of departments taking action in this area.
- Many of the practices identified relate to recruitment and promotion, whether that be improving promotion materials (72%), improving student recruitment activities (72%), recruitment training (69%), improving promotions processes (69%) or improving staff recruitment materials (69%), improving career development approaches (66%) or improving recruitment processes (66%).

- Improving staff career support is also a common area being addressed by departments through Athena SWAN.

4.1.2.4   Culture

Moving on to examine culture, Table 11 shows the most commonly cited terms or words used to *define* culture in applications. Note that we look at how culture is *measured* and *described* in the analysis below. The framework has been populated based on the identification of key words and terms within the 'Culture' section of Athena SWAN applications.

Table 11 evidences the following findings:

- Seven in ten departments (70%) identify social events as being important to the culture of their department, whilst a marginally smaller proportion (67%) highlight their commitment to Athena SWAN within the Culture section of their application.
- Just over four in ten departments (41%) comment a focus on internal communication within the departmental culture.
- Almost one third (30%) of departments comment on the physical environment in the context of culture.
- Around one quarter of departments (24%) use the terms 'social space' and 'atmosphere' in defining their culture.

Perhaps what is most striking about Table 11 is the absence of words and terms that one might associate with a positive culture and environment for equality and diversity, with terms such as 'role models', 'work/life balance' and 'flexible working' appearing in so few applications.

Table 11: Words/Terms used to Define Departmental Culture

Term/word used in Defining Culture	Proportion of applications
Social events	70%
Athena SWAN commitment	67%
Internal communication	42%
Physical environment	30%
Social space	24%
Atmosphere	24%
Open door policy	21%
Diversity training/awareness	18%
Diverse website	15%
Visible role models	15%
Childcare support	12%
Flexible working	9%
Work/life balance	9%
Hierarchy	6%
Females in leadership roles	6%
Networking opportunities	6%
Diverse range of speakers	3%
Decision making processes	3%
Mentoring	3%

Source: Ortus Economic Research analysis of Athena SWAN applications

Table 12 below examines the mechanisms used by departments to measure culture. The analysis highlights the following findings:

- Staff surveys are the most prevalent source of data on culture, highlighted by 73% of departments. However, this proportion is lower than the percentage that gather data through this source (91% – see Table 8). This suggests either that the use of this source in informing an assessment of culture is not cited in all cases where it provides data, or that the staff survey is not used as a mechanism for assessing culture. This means there is either an opportunity to identify better how such data is used in an assessment of culture, or an opportunity to exploit more effectively the staff survey approach.
- Other ways of measuring culture are much less common than the staff survey. The second most common is a count of social events (24%) along with student survey data (24%), followed by data on the proportion of female speakers at events (21%).
- Given the importance of staff survey data as a tool for measuring culture, it is quite surprising to see that just under one in four departments (24%) use student survey data in the same way.

Table 12: Mechanisms for Measuring Culture

Mechanism for measuring culture	Proportion of applications
Staff survey responses	73%
Number of social events	24%
Student survey responses	24%
Percentage of female speakers	21%
Attendance at events	15%
Diversity training rates	15%
Gender balance of department	12%
Student awards	12%
Staff awards	9%
Number of staff working flexibly	6%
Informal staff feedback	6%
Engagement with Athena SWAN	3%
Number of female role models on website	3%
Webpage views	3%
£s in Professional Development Accounts	3%
Workload points for ED&I	3%
Number of children using childcare provision	3%
REF data	3%
Percentage of staff with caring responsibilities	3%

Source: Ortus Economic Research analysis of AS applications

Finally, the approach examined the words and terms used to **describe** departmental culture. Evidence was drawn from two sources for this framework; the 'Culture' section of Athena SWAN application forms and departmental websites. The website search was limited to a small number of pages, typically the department home page, 'About Us' and other similar pages. Departmental websites are often rich sources of information, but as one would expect they are non-standardised. The search of web pages was limited by the resource available to the study but also the need to focus on the most obvious locations for comments regarding culture. As a result, it was not possible to rely on a consistent source

of evidence from web pages, unlike application forms which are all structured similarly and follow common guidance (albeit that some adopt the pre-2015 format).

Table 13 identifies the words and terms commonly used to describe departmental culture, and this provides the following headline findings:

- The most common descriptive term is 'friendly' (70%), closely followed by 'diverse/diversity' (67%).
- The next three most prevalent words are all highly relevant to the equality and diversity agenda, being 'supportive' (64%), 'equal/equality' (64%), and inclusive' (58%).
- One third of departments (33%) describe their culture as one where 'excellence' is delivered or sought, whilst almost one quarter of departments (24%) use the word 'welcoming'.

Table 13: Words/terms used to describe departmental Culture

Term/word used in describing culture	Proportion of applications
friendly	70%
diverse/diversity	67%
supportive	64%
equal/equality	64%
inclusive	58%
excellence	33%
welcoming	24%
respectful	15%
positive	15%
open	12%
fairness	12%
dynamic	12%
safe	9%
flexible	9%
informal	9%
happy	9%
stimulating	9%
proud	6%
outstanding	6%
inspiring	6%
caring	3%
approachable	3%
help	3%
dignity	3%
productive	3%
competitive	3%

Source: Ortus Economic Research analysis of AS applications

The table above focuses only on positive words in relation to culture. In executing the data capture, the research team also searched for negative words (e.g. unsupportive, inequality) and these were indeed present in description of culture. However, whilst the positive words which became the focus of this exercise were universally used to typify the culture that was in place or was aspired to, it was

concluded that the negative words were used in a specific context. For example, a department might highlight results from a survey where one question asked respondents to associate their feelings about departmental culture with specific words or phrases. If any respondents associated with words such as 'unequal' or 'unfair', then these words would be present within the application text. It was decided that the context in which the negative words/phrases were placed was crucial to understanding the reason for their presence, and therefore to include these descriptors in the same way as those cited in Table 13 would create a misleading impression of departmental culture and how it is described.

4.1.3   Relationships between challenges/approaches and departmental characteristics

The objective in this section is to attempt to identify patterns in the application content of departments sharing common characteristics. Two departmental characteristics have been used in the analysis presented below: award success by award level (or application level, in the case of unsuccessful awards) and quartiles based on the proportion of staff within each department that are female.

An analysis for each framework has been undertaken against the two characteristics (success/level and quartile) and this is presented below. In each table, notable differences have been shaded in order to highlight them.

4.1.3.1   Data sources

Table 14 examines the proportion of applications which cite each data source within the 'A picture of the department: student data' section, categorised by level/success. The table cells are shaded according to the proportion of applications citing each data source, as follows:

75% or more
Between 50% and 74.9%
Between 25% and 49.9%
Up to 25%

Strong and meaningful patterns are difficult to determine, though one noticeable difference that does stand out is the proportion of unsuccessful applications at Silver level utilise HESA data (64% compared to 100% of successful Silver applications and 85% of applications overall). Another noticeable difference is that Silver applications generally are much more likely to utilise student survey data than Bronze applications.

Table 14: Data sources by level/success – student data

Data source	Bronze – Unsuccessful	Bronze – Successful	Silver – Unsuccessful	Silver – Successful	All
Internal information – student data	100%	100%	100%	100%	100%
HESA data	100%	92%	64%	100%	85%
Student survey data	25%	8%	55%	50%	30%
LMS Good practice report	0%	8%	18%	25%	12%
Russell Group data	0%	8%	18%	0%	9%
Ofsted A level data	25%	0%	0%	50%	9%
Outreach recipient data	0%	0%	9%	25%	6%
Another AS applicants' data	25%	0%	0%	0%	6%
Equality in HE Statistical Report 2016	25%	0%	9%	0%	6%
UCAS data	0%	0%	18%	0%	6%

Table 15 shows a similar analysis, where departments have been split into quartiles based on the proportion of female staff. The notable differences between quartiles are highlighted and show that departments in the middle top quartile and top quartile are more likely to use student survey data and more likely to call on data from the LMS Good Practice report.

Table 15: Data sources by female staff quartiles – student data

Data source	Bottom Quartile	Middle Bottom	Middle Top	Top Quartile	All
Internal information - student data	100%	100%	100%	100%	100%
HESA data	92%	100%	100%	64%	85%
Student survey data	8%	25%	50%	55%	30%
LMS Good Practice report	8%	0%	25%	18%	12%
Russell Group data	8%	0%	0%	18%	9%
Ofsted A level data	0%	25%	50%	0%	9%
Outreach recipients data	0%	0%	25%	9%	6%
Another AS applicants' data	0%	25%	0%	0%	6%
Equality in HE Statistical Report 2016	0%	25%	0%	9%	6%
UCAS data	0%	0%	0%	18%	6%

Table 16 examines the proportion of applications which cite each data source within the 'A picture of the department: staff data' section, categorised by level/success.

As above, distinctive and meaningful patterns are difficult to identify, but results that do stand out are that Silver applications (both successful and unsuccessful) make greater use of staff turnover data generated from internal sources than Bronze applications, and a higher proportion of successful Silver applications make use of HESA data than applications in any other category.

Table 16: Data sources by level/success – staff data

Data source	Bronze – Unsuccessful	Bronze – Successful	Silver – Unsuccessful	Silver – Successful	All
Internal information – staff data	100%	100%	100%	100%	100%
Internal information – staff turnover	75%	77%	100%	100%	88%
HESA data	50%	54%	45%	75%	52%
LMS Good practice scheme data	25%	8%	36%	25%	21%
Internal information - recruitment data	0%	31%	9%	0%	15%
Staff survey data	0%	15%	18%	0%	12%
Russell Group data	25%	8%	9%	0%	9%
Another AS applicants' data	0%	0%	0%	25%	6%

Table 17 presents a similar analysis looking at departments by female staff quartile. It shows that departments in the middle top quartile and top quartile are more likely to have utilised internal data relating to staff turnover than departments in the bottom and middle bottom quartiles. There also

seems to be an increase in the use of LMS Good Practice Scheme data as the proportion of female staff increases across the quartiles.

Table 17: Data sources by female staff quartiles – staff data

Data source	Bottom Quartile	Middle Bottom	Middle Top	Top Quartile	All
Internal information – staff data	100%	100%	100%	100%	100%
Internal information – staff turnover	77%	75%	100%	100%	88%
HESA data	54%	50%	75%	45%	52%
LMS Good practice scheme data	8%	25%	25%	36%	21%
Internal information recruitment data	31%	0%	0%	9%	15%
Staff survey data	15%	0%	0%	18%	12%
Russell Group data	8%	25%	0%	9%	9%
Another AS applicants' data	0%	0%	25%	0%	6%

Source: Ortus Economic Research analysis of Athena SWAN applications. Only data sources which were cited by at least 5% of departments are included in this table.

Table 18 focuses on the number of data sources utilised in the most data-rich sections of the Athena SWAN application form (namely, 'A picture of the department: student data' and 'A picture of the department: staff data'). The analysis demonstrates that in these sections of the application forms, whilst there are no clear patterns connecting success and the prevalence of data, there is a noticeable difference between bronze applications and silver applications. The data demonstrates that silver applications call on a larger number of data sources within the student data section of the form. A similar difference can be seen in the staff data, though unsuccessful applications at both the bronze and silver level call upon the same number of sources on average (3.3).

Table 18: Average number of data sources utilised by level/success

Theme	Bronze – Unsuccessful	Bronze – Successful	Silver – Unsuccessful	Silver – Successful
A picture of the department – student data	3.5	2.2	3.6	3.8
A picture of the department – staff data	3.3	3.0	3.3	3.8

Source: Ortus Economic Research analysis of Athena SWAN applications

When a similar analysis is performed by female staff quartile, as shown in Table 19, the data does not identify any discernible patterns.

Table 19: Average number of data sources utilised by female staff quartiles

Theme	Bottom Quartile	Middle Bottom	Middle Top	Top Quartile
A picture of the department – student data	2.8	3.3	2.8	3.6
A picture of the department – staff data	3.0	3.5	2.9	3.6

Source: Ortus Economic Research analysis of Athena SWAN applications

4.1.3.2 Common struggles

Table 20 presents the findings of our analysis of common struggles by level/success. There are a number of differences evidenced in these data, all relating to unsuccessful Bronze applications. The analysis shows that these are more likely than applications from any other category to identify struggles around low numbers of female staff (100% of unsuccessful bronze applications), data gaps (75%), committee constituency (75%) and role models (75%).

Table 20: Common struggles by level/success

Struggle	Bronze – Unsuccessful	Bronze – Successful	Silver – Unsuccessful	Silver – Successful	All
Attracting female students	100%	100%	100%	100%	100%
Low numbers of female staff	100%	69%	64%	50%	70%
Data gaps	75%	62%	55%	50%	61%
Committee constituency	75%	38%	45%	25%	42%
Leaky pipeline	50%	62%	0%	75%	42%
Role models	75%	23%	27%	25%	33%
Awareness/perception of promotion system	25%	46%	9%	25%	30%
Workload model	0%	46%	18%	25%	30%
Appointing female staff	25%	0%	36%	25%	21%
Awareness of development/support policies	25%	8%	27%	25%	18%
Female undergraduate confidence	25%	8%	9%	50%	15%
Improve appraisal/progression support	0%	8%	36%	0%	15%

Source: Ortus Economic Research analysis of Athena SWAN applications. Only struggles which were cited by at least 15% of departments are included in this table.

When common struggles are examined by female staff quartile, as set out in Table 21, we find it very difficult to identify meaningful differences and patterns. A minor difference is that departments in the middle top quartile and top quartile are more likely to identify data gaps as a challenge.

Table 21: Common struggles by female staff quartile

Struggle	Bottom Quartile	Middle Bottom	Middle Top	Top Quartile	All
Attracting female students	100%	100%	100%	100%	100%
Low numbers of female staff	83%	64%	73%	60%	70%
Data gaps	33%	55%	73%	80%	61%
Committee constituency	50%	36%	45%	40%	42%
Leaky pipeline	33%	45%	36%	60%	42%
Role models	33%	45%	27%	20%	33%
Awareness/perception of promotion system	17%	36%	36%	20%	30%
Workload model	33%	36%	18%	40%	30%
Appointing female staff	33%	18%	18%	20%	21%
Awareness of development/support policies	33%	18%	0%	40%	18%
Female undergraduate confidence	17%	18%	9%	20%	15%
Improve appraisal/progression support	17%	27%	9%	0%	15%

Source: Ortus Economic Research analysis of Athena SWAN applications. Only struggles which were cited by at least 15% of departments are included in this table.

Table 22 examines the average number of struggles identified across a number of key themes within application forms, by level/success. Note that only themes with a sufficient number of struggles identified to underpin a meaningful analysis have been included. This analysis identifies one notable difference, which is that successful silver applications identified 4.8 struggles on average within the 'a picture of the department – student data' theme, which is at least 1.5 higher than the next highest category (unsuccessful bronze).

Table 22: Average number of struggles identified by level/success

Theme	Bronze – Unsuccessful	Bronze – Successful	Silver – Unsuccessful	Silver – Successful
A picture of the department – student data	3.3	2.6	2.3	4.8
A picture of the department – staff data	1.3	1.4	1.1	1.5
Advancing women's careers – recruitment	1.5	1.5	1.5	1.3
Advancing women's careers – promotion	0.5	0.5	0.3	0.3
Organisation and culture – culture	0.3	0.4	0.6	0.0
Organisation and culture – representation of men and women on committees	0.8	0.5	0.6	0.5

Source: Ortus Economic Research analysis of Athena SWAN applications

Table 23 presents an analysis of the average number of struggles identified across a number of key themes within application forms, by female staff quartile. It shows two notable differences, both within the 'a picture of the department – student data' theme. Applications in the middle bottom quartile and top quartile identify a higher number of struggles, on average, than departments in the other quartiles.

Table 23: Average number of struggles identified by female staff quartile

Theme	Bottom Quartile	Middle Bottom	Middle Top	Top Quartile
A picture of the department – student data	1.3	3.4	2.5	4.2
A picture of the department – staff data	1.3	1	1.4	1.4
Advancing women's careers – recruitment	1.8	1.5	1.4	1.4
Advancing women's careers – promotion	0.5	0.5	0.4	0.4
Organisation and culture – culture	0.5	0.2	0.7	0.0
Organisation and culture – representation of men and women on committees	0.7	0.5	0.4	0.8

Source: Ortus Economic Research analysis of Athena SWAN applications.

4.1.3.3   Common practices

In this section we examine differences between applications by level/success and quartile in relation to the common practices (or responses to struggles) which are evidence in the application forms.

Table 24: Proportion of applications identifying common practices by level/success

Practice	Bronze – Unsuccessful	Bronze – Successful	Silver – Unsuccessful	Silver – Successful	All
Data gathering	100%	85%	100%	75%	94%
More targeted/proactive recruitment	100%	100%	82%	50%	91%
Promoting postgraduate opportunities	75%	85%	64%	75%	75%
Review/improve promotional material	100%	69%	73%	25%	72%
Review/improve student recruitment activities	75%	69%	64%	75%	72%
Recruitment training	75%	62%	73%	75%	69%
Review/improve promotions processes	75%	77%	64%	50%	69%
Review/improve recruitment materials	100%	62%	73%	50%	69%
Review/improve student support	75%	62%	73%	50%	69%
Review/improve workload allocation	50%	69%	64%	75%	69%
More proactive/targeted approach to career development	75%	77%	45%	50%	66%
Review/improve recruitment processes	50%	77%	64%	25%	66%
Improve staff mentoring	25%	69%	73%	50%	66%
Improve staff career support	50%	77%	55%	50%	63%
Review/improve staff support information	50%	62%	82%	0%	63%
Review/improve staff support processes	75%	54%	73%	50%	63%
Improve access to relevant information (generally)	75%	62%	45%	50%	59%
Raise awareness of equality/diversity activity/issues	50%	46%	55%	50%	53%
Review/improve appraisal processes	50%	46%	64%	50%	53%
Visibility of positive role models	25%	62%	45%	50%	53%
Widen/review SAT membership	50%	62%	45%	50%	53%
Improving academic support for students	75%	54%	36%	50%	50%

Source: Ortus Economic Research analysis of Athena SWAN applications. Only practices which were cited by at least 50% of departments are included in this table. The full table is available in the Appendix.

Table 24 highlights a number of key differences by level/success. All unsuccessful bronze applications identified the need to review/improve promotional materials, which is higher than any other category. Bronze applications – whether successful or not – were more likely to identify the need to review and improve promotions processes. Finally, all unsuccessful bronze applications identified the need to review/improve recruitment materials, whilst applications from other groups were less likely to do this.

Table 25 examines differences in applications by quartile and identifies a number of notable differences between applications by quartile. Applications in the middle top quartile and top quartile unanimously identified data gathering as a practice to be improved, whilst only four in five applications in the bottom and middle bottom quartiles did so. Applications in the middle top and top quartiles were also more likely than those in the bottom and middle bottom quartiles to state that they intend to review/improve promotions processes. Finally, all applications in the top quartile included the intention to improve staff career support practices, compared to a maximum of 64% in other quartiles.

Table 25: Proportion of applications identifying common practices by female staff quartile

Practice	Bottom Quartile	Middle Bottom	Middle Top	Top Quartile	All
Data gathering	83%	82%	100%	100%	94%
More targeted/proactive recruitment	100%	82%	91%	80%	91%
Promoting postgraduate opportunities	83%	73%	64%	80%	75%
Review/improve promotional material	50%	73%	64%	100%	72%
Review/improve student recruitment activities	33%	64%	91%	80%	72%
Recruitment training	67%	73%	64%	60%	69%
Review/improve promotions processes	50%	55%	82%	80%	69%
Review/improve recruitment materials	50%	55%	82%	80%	69%
Review/improve student support	83%	64%	73%	40%	69%
Review/improve workload allocation	67%	64%	73%	60%	69%
More proactive/targeted approach to career development	83%	55%	73%	40%	66%
Review/improve recruitment processes	83%	64%	55%	60%	66%
Improve staff mentoring	50%	73%	55%	80%	66%
Improve staff career support	50%	45%	64%	100%	63%
Review/improve staff support information	50%	64%	55%	80%	63%
Review/improve staff support processes	67%	73%	36%	80%	63%
Improve access to relevant information (generally)	33%	64%	55%	80%	59%
Raise awareness of Equality/diversity activity/ issues	50%	64%	45%	40%	53%
Review/improve appraisal processes	33%	55%	55%	60%	53%
Visibility of positive role models	33%	45%	55%	80%	53%
Widen/review SAT membership	33%	45%	64%	60%	53%
Improving academic support for students	50%	45%	64%	40%	50%

Source: Ortus Economic Research analysis of Athena SWAN applications. Only practices which were cited by at least 50% of departments are included in this table. The full table is available in the Appendix.

In Table 26 below, the analysis shows that bronze applications identified a higher number of practices in both the 'a picture of the department – student data' and 'advancing women's careers – promotion' themes when compared to silver applications.

Table 26: Average number of practices identified by level/success

Theme	Bronze – Unsuccessful	Bronze – Successful	Silver – Unsuccessful	Silver – Successful
A picture of the department – student data	5.8	5.8	5.2	4.7
A picture of the department – staff data	2.8	2.7	2.8	2.0
Advancing women's careers – recruitment	4.0	3.7	3.5	3.3
Advancing women's careers – promotion	1.8	2.5	1.7	2.0
Organisation and culture – culture	1.8	2.3	1.5	0.3
Organisation and culture – representation of men and women on committees	0.5	1.2	1.5	1.0

Source: Ortus Economic Research analysis of Athena SWAN applications.

Table 27 shows an interesting trend in the 'a picture of the department – student data' theme, where the average number of practices identified rises steadily across the quartiles. It also shows that applications in the top quartile identify a higher number of practices on average than applications in other quartiles in the 'a picture of the department – staff data' theme.

Table 27: Average number of practices identified by female staff quartile

Theme	Bottom Quartile	Middle Bottom	Middle Top	Top Quartile
A picture of the department – student data	4.5	5.0	5.3	7.0
A picture of the department – staff data	2.8	2.7	1.7	3.8
Advancing women's careers – recruitment	3.5	3.4	3.5	3.8
Advancing women's careers – promotion	1.8	1.5	2.4	2.6
Organisation and culture – culture	1.2	2.4	1.5	1.6
Organisation and culture – representation of men and women on committees	2.2	1.8	1.3	2.8

Source: Ortus Economic Research analysis of Athena SWAN applications

4.1.3.4 Culture

The tables presenting an analysis of how departments define, measure and describe culture are located in Appendix D. An examination of the analysis revealed no discernible patterns or difference by level/success or female staff quartile.

4.2 Practices in mathematical sciences departments and the evidence for effectiveness

4.2.1 Introduction

The approach taken to generating the evidence presented in this report is fundamentally different to that adopted in the benchmarking exercise published in 2013. Then, departments were invited to provide information against a good practice checklist and these submissions were analysed to assess equality and diversity practices. Since 2013, many departments have gone on to apply for and in many cases receive Athena SWAN awards and it was therefore considered by the LMS to be overly burdensome to request that departments complete such a checklist again, given the effort that has already been invested in developing and submitting applications. It was therefore decided that the applications themselves would be used as the sole piece of evidence of practice.

Approximately half of applications reviewed are at the Bronze level (17 out of 33, 52%). There is no requirement to demonstrate effectiveness (i.e. impact) in these applications and therefore the contribution they make to an assessment of effective practices is minimal.

However, the applicants for Silver (15, 45%) and Gold awards (1, 3%) are required to provide evidence of impact as part of their application.

The sections below provides some anonymised examples of evidence-based practice which are evidenced in the Silver and Gold applications, as well as the nature of the evidence provided to demonstrate their effectiveness (i.e. impact). The examples are presented by the Equality and Diversity (E&D) theme.   Further detail on these examples of evidence-based practice can be found in Appendix F.

4.2.2 Leadership and engagement

As would be expected, the letters from Heads of Departments (HoD's) which preface the applications show that there is significant support from senior leaders within mathematical sciences departments. Our review highlights a number of common themes and some differences, as follows:

- The letters often comment on the need for continual review of working practices to embed cultural change.
- It is common practice for HoD's to comment on a small number of actions and interventions which they perceive as being effective (e.g. outreach activities), though in the brief summary provided by the letters it is understandable that no evidence is provided of the link between action and impact.
- It is also common for HoD's to comment on issues which are being addressed as well as outstanding challenges which have yet to be resolved by E&D actions/interventions.
- The letters tend to identify the 'marquee' changes and impacts which evidence how their approach to increasing diversity is paying dividends.
- In most cases the letters state a commitment to ensuring action plans are implemented and to monitor outcomes. Monitoring and oversight arrangements are often alluded to (e.g. the constituency of the Self-Assessment Team (SAT) and its lines of reporting, or the convergence between the SAT and a wider E&D committee, which is quite common practice).
- Occasionally, the letters comment on an immediate perceived impact arising from the Athena SWAN (AS) application process, where efforts and activities are galvanized behind a set of diversity goals and where motivation is enhanced through the possibility of external recognition. There is talk of how an initial application for an award has led to an

increased awareness of both the benefits of increased diversity but also the nature and scale of the challenge, which is seen as a positive benefit of the process.

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4.2.2.1   Action reported by departments

- Department-wide regular networking events focused on career development and progression.
- Celebrating success via a monthly newsletter reinforcing community spirit.
- Increasing the visibility of female staff members through active selection onto University Committees.
- Complete rethink of entry requirements of undergraduates to address low female student numbers.
- Ensuring adequate resourcing in order to deliver the action plan.
- AS used as a tool to demonstrate commitment but also to ensure equality is embedded in departmental practices.

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4.2.3   The self-assessment process and self-assessment team (SAT)

Our review of the available application forms leads us to make the following comments regarding the self-assessment process and SAT:

- SATs have a schedule of regular meetings, often several times each term.
- Recruitment to the SAT is usually fulfilled by requests for volunteers but specific individuals are often approached to ensure a diverse and balanced team.
- Diverse membership of the SATs includes students, junior and senior staff and includes a diverse range of personal circumstances (for example with and without parenting and caring responsibilities).
- Membership of the SAT is usually credited in the department/institution workload model but this is not universally the case.
- Some departments provide an annual budget for AS activities whilst others do not comment on this aspect at all.
- Often progress relating to AS is monitored via dedicated equality webpages.
- A large proportion of SATs are part of, or work very closely with, wider equality and diversity committees either in the department or the University.
- Many departments arrange regular and informal lunchtime meetings with presentations and discussions on relevant topics such as equality, diversity and unconscious bias.
- The use of surveys for data collection is very common. In some cases, the application forms comment on the use of focus groups to gain further insight but not as widely.
- SATs often report having discussions with other mathematical sciences departments in other institutions as well as other AS representatives in other departments within their own university, either to share best practice, generate additional benchmarks or simply to share ideas and experiences with others in the mathematical sciences/AS community.
- In some departments, SAT meetings are timetabled at family friendly times to avoid clashes and ensure maximum attendance.
- In some cases, AS is a standing item on the agenda for all departmental meetings and this is done to raise the profile and importance of AS and to ensure that both AS and the wider issue of broadening diversity is embedded in departmental culture,

- Feedback is often sought on draft AS applications from beyond the SAT team, and could include external consultants, HR departments and other successful AS applicants in other departments within the applicant's institution. Where this is done it is recognised as both a useful mechanism to acquire feedback and also to identify effective practice, introduce alternative thinking and generate ideas.
- It is common for departments to mention that AS representatives attend Good Practice Scheme events run by the London Mathematical Society.
- Some applicants have made a formal appointment to the role of 'AS Champion', as a mechanism for embedding equality and diversity into department activities and to raise the profile of AS.

4.2.3.1 Actions reported by departments

- Student survey responders were given the opportunity to enter a prize draw to encourage uptake.
- The AS Action Plan was published on the School E&D webpages and colour coded using a 'traffic light' scheme to enable the whole community to track progress.
- Several departments celebrate International Women's Day with outreach activities and public lectures.
- Regular coffee mornings attended by students and staff to exchange ideas on how to help younger women consider a career in mathematics and support female colleagues at key points during their careers. Departments report that these have been very productive in providing constructive ideas for actions, e.g. Maths Young Parents' Network, women's lunchtime meetings, a summer family event, part-time positions both new and after career breaks, and suggestions for speakers.
- Contribution and discussions carried out by email to ensure contribution from those who are not on campus full-time.
- Evidence-based practice: Improved promotion applications and success rates by women and men since AS bronze award.
- Evidence-based practice: One SAT proposed and secured a policy on financial support for childcare during conference attendance and has received and approved three successful applications for support.

4.2.3.2 Actions reported in Advance HE Awards Booklets

Exeter - Development of an 'Athena SWAN-Wiki tool' to record data and progress on the action plan.

4.2.4 Student data

Our review of applications generates the following summary comments:

4.2.4.1 Foundation courses

The majority of respondents do not run foundation courses. Some contribute to foundation courses run by other departments. Often, the numbers on foundation courses are so small that it is not possible to gain meaningful insight from any data relating to these courses.

4.2.4.2   Undergraduate (UG)

- Monitoring of UG data is a fundamental part of applications and all departments used these data to ensure any trends or significant changes in female participation are highlighted and investigated.
- Departments articulate their concern if the level of female participation is below the national average or if it is falling and, in these circumstances, are keen to discover the reasons behind such trends.
- The requirement to have Further Mathematics A Level is cited by a number of departments as a potential factor in lower levels of female applicants.
- Most departments do not offer part time UG courses but many will consider part time applications on a case by case basis.
- Some departments report that the proportion of female UGs is higher for international students than UK/EU students.

4.2.4.3   Postgraduate Taught (PGT)

- Many departments report that a large number of applicants for the PGT courses are from overseas.

4.2.4.4   Postgraduate Research (PGR)

- Some departments report that more female than male UG students lacked confidence in their academic abilities and were less likely to apply for a PhD.
- In some cases where offers have been made later than usual (often due to various administrative factors) it has been reported that this has led to a lower number of acceptances from females. Respondents suggest that this is because more female applicants had accepted other offers, preferring to have the next stage of their career organised as soon as possible.

4.2.4.5   Actions reported by departments

4.2.4.6   Foundation

- All promotional material for a foundation course, including the student prospectus and course webpage, feature interviews with female students.

4.2.4.7   Undergraduate

- Increasing visibility of female staff and students at open days.
- Creating a 'buddy system' pairing undergraduates with A-Level students to act as mentors.
- Providing revision days for school students and annual motivational talks to teachers on the value of Further Mathematics from a University perspective.
- Running Summer and Easter schools for years 10-12 pupils from non-privileged backgrounds.
- A web page on 'Girls 'n Maths' was created to counter the traditional view that maths is just for boys with portraits of successful female students, staff and alumnae.
- Planning to update the alumni pages of websites to give a better balance of profiles both in terms of gender and careers.
- Introduction of a new online STEP Support Programme which provides weekly assignments from the summer of Year 12 onwards designed to provide a graduated introduction to advanced problem-solving and support for STEP preparation. This has been developed partly to address the issue of lower achievement/engagement in the STEP programme by female applicants.

- Evidence-based practice: At the post-offer Visit Days where, additionally, UG applicants attend a talk by two current students (but never by two male students). Surveys show this is the most popular and influential element of the day, with 93% of attendees showing a positive experience.
- Evidence-based practice: Strong evidence that encouraging more female undergraduates to study the 4‑year Master's programmes is working, with female Masters graduates rising from 24% to 43% over three years.
- Evidence-based practice: Changes were made to the format of open days after a survey indicated that female UGs were less impressed than male UGs by their first visit to the campus. Changes included increasing visibility of female staff and students and explicitly referencing the commitment to AS. Subsequent surveys indicate that these changes have been a success, with a much higher level of satisfaction reported.

4.2.4.8 Postgraduate Taught

- None

4.2.4.9 Postgraduate Research

- To encourage more female participation information sessions have been included where former and current female PGR students gave presentations about their life and career. The session also included round table activities about role models, careers guidance and a networking social.
- Higher visibility of female staff and students on the department's webpages including a number of case studies.
- Informal social events such as lunches and afternoon teas to encourage female UGs to meet with staff and discuss PGR opportunities.

4.2.4.10 Progression

- Some departments have introduced female-only PhD studentships in order to address gender imbalances.
- It is often reported that most of PGT/PGR students aren't recruited from the department's UG students.

4.2.4.11 Offer/Acceptance

- Some departments have noted a lower offer acceptance rate from female applicants and are investigating what factors are behind this trend. For those departments with a higher female conversion rate they report that this is due in part to efforts made via outreach activities and open days to make their departments an attractive choice for female applicants.
- Evidence-based practice: In its first year of operating, 100% of the student intake for a new course was male. Following this, the department consulted with the London Mathematical Society (LMS) Women in Mathematics Committee to improve gender balance in recruitment materials, webpages, and interviews with female staff, corresponding with measures taken for UG recruitment. 50% of the next cohort was female and has remained high.

4.2.4.12 Attainment

- Nothing of note

4.2.4.13 Actions reported in ECU Awards Booklets

- Cambridge - 'Maths cafe' for undergraduates encourages peer support and gives them the opportunity to ask PhD students about further study and research.
- Durham - Module in third year for undergraduates to consider the public perception of mathematics, including gender stereotypes and undertake a school-based research project of their own design.
- Exeter - The study by a PhD student, jointly funded by the college of engineering, mathematics and physical sciences and psychology, to attain better qualitative data concerning the undergraduate student population.

Open - Interactive online diagnostic quizzes which enable students to make informed decisions on which module to study, give constructive criticism and alert tutors to areas in which individual students may require additional support.

4.2.5 Staff data

- In some cases, it is reported that there is a general lack of awareness of career progression mechanisms.

4.2.5.1 Actions reported by departments

- Increasing numbers of female applicants by targeted advertising and offering part time roles.
- All jobs are advertised via women in mathematical sciences networks.
- Long term mentoring to enable Staff Tutors to take advantage of new opportunities for promotion to professor.
- Evidence-based practice: A department had developed a proactive recruitment strategy to encourage women to apply. For example, using carefully worded advertising materials and by encouraging all staff to approach research leaders worldwide asking for suggestions of possible candidates. This approach is now reaping success.

4.2.5.2 Actions reported in ECU Awards Booklets

- Cambridge - Corfield Lectureship established to develop the role of women in mathematics.
  St Andrews - Inclusion of staff through a range of consultation methods including surveys, discussions and panels.

4.2.6 Supporting and advancing women's careers: Key career transition points: academic staff – recruitment

A review of the available applications generates the following summary findings:

- Many departments identify a key issue as being a small proportion of women (compared to men) applying for the jobs.
- In most cases, it is university (or department) policy that all interview panels should contain both women and men.
- To avoid overloading female staff when ensuring fair gender representation during the recruitment process on selection and interview panels, many departments often bring in female staff from other departments.
- It is common practice to include text in all job adverts such as "We particularly welcome female applicants as they are under-represented in our department".

4.2.6.1   Actions reported by departments

- Unconscious bias training for those involved in short-listing for interview.
- Mandatory training for all panel members including awareness of diversity, equality and unconscious bias.
- The University's AS award and commitment to gender equality are prominently displayed on all job advertisements.
- Positive action to increase the numbers of female applicants by encouraging staff to specifically invite candidates to apply.
- All academic positions being listed as suitable on a part-time and job-share basis.
- Provide candidates with the option to interview via Skype should they not be able to attend due to caring commitments.
- Encouraging staff to talent-spot when attending conferences.

4.2.7   Supporting and advancing women's careers: Key career transition points: academic staff – induction

A review of the available applications generates the following summary findings:

- New staff are commonly assigned a mentor.
- Departments consistently provide a handbook to support induction, outlining relevant policies including equality and diversity, flexible working arrangements, childcare, health and safety etc.
- Equality and diversity training is often a mandatory part of the induction process.
- Reduced workloads in the first year are common.

4.2.7.1   Actions reported by departments

- Induction checklists which include reference to AS.
- New staff are surveyed about induction training by HR six months following appointment to review its effectiveness.
- New female staff are invited to write a short paragraph about themselves for the Women in Mathematics webpage.
- In one department research group, staff eat lunch together on most days - particularly during term-time - and ensure that new staff are included. This provides an excellent opportunity for new staff to find out about departmental procedures and practices in an informal setting.

4.2.8   Supporting and advancing women's careers: Key career transition points: academic staff – promotion

A review of the available applications generates the following summary findings:

- Promotion criteria and guidelines are available on the University webpages.
- Some departments select candidates who are ready or eligible for promotion and some require candidates to apply for promotion. In some departments, promotion occurs by progression and development rather than a formal application process.

> ### 4.2.8.1 Actions reported by departments
>
> - Annual appraisal meetings for staff members should include a discussion regarding promotion.
> - Holding a biennial 'Making Professor' workshop about academic promotion, career development and removing barriers to progression to which all academic staff are invited.
> - Running targeted 'Pathways to Promotions' workshops.

4.2.9 Supporting and advancing women's careers: Key career transition points: academic staff – departmental submissions to the Research Excellence Framework (REF)

Our review of AS application forms indicates that a number of departments are keen to improve the transparency of the REF submission process.

> ### 4.2.9.1 Actions reported by departments
>
> - Proactively approached staff who had not taken a sabbatical in recent years and encouraging them to do so.

4.2.9.2 Actions reported in ECU Awards Booklets

- Kent - A school promotion panel has been established, chaired by the Head of School to identify future promotion candidates, provide objective evaluation of each case and offer support to staff preparing for promotion.
- Oxford - A weekly seminar series for early career researchers, combining skills training and career development sessions with interdisciplinary mathematics colloquia.
- Sheffield - All staff considered in every promotion round, with gender monitoring of those who chose to opt out.
- Southampton - A policy to extend shortlists in order to improve gender balance in the institute.
- UCL - A promotions committee, with three of the five being self-assessment team members, meets to review all eligible staff.
- UEA - All staff and research students are able to apply for funding to attend conferences, with it being explicitly stated that this may be used to cover childcare costs.
  Warwick - A female tutor for women is available to discuss personal or course related issues.

4.2.10 Supporting and advancing women's careers: Career development: academic staff – training

Some departments are looking at ways to raise awareness of the training opportunities available whilst others are trying to understand how to make training more attractive and relevant to staff.

4.2.10.1 Actions reported by departments

- Actively working to promote training opportunities to women where there is low uptake.
- Identifying personal development and training needs as well as recording the number and nature of training courses attended is a core component of the annual appraisal meeting.
- Female staff are actively encouraged to apply for the Aurora programme.
- Evidence-based practice: Changing the format and content of training courses following on from a history of low attendance from graduate students in particular. The weekly seminar series preceded or followed by a social event resulted in a much higher uptake.

4.2.10.2 Actions reported in ECU Awards Booklets

- Queen Mary - Induction buddies and mentors as part of a large suite of support for staff.
- Reading - Gender awareness training for all.
  UCL - Chair of academic appointment panels rolled out unconscious bias awareness training to all academic staff involved in recruitment and selection.

4.2.11 Supporting and advancing women's careers: Career development: academic staff – appraisal/development review

Appraisal development meetings are usually held annually and in some cases are voluntary. The meetings are often used to discuss promotion opportunities and career planning. In many cases appraisers have to undergo appraisal training.

4.2.11.1 Actions reported by departments

- The appraisee has a choice of appraiser, and a female appraiser is available. As this could overload senior female colleagues there is the possibility of appraisers from other disciplines.
- Taking a pro-active approach in encouraging staff engagement with the appraisal scheme. The appraisal cycle is announced to all staff via the e-bulletin and via email notification at departmental level to all appraisers.
- The department has strategically timed performance reviews in relation to the University's promotion deadlines and require reviewers to discuss career development.
- Where possible a member of staff will have the same reviewer each year, to ensure continuity of mentoring.

4.2.11.2 Actions reported in ECU Awards Booklets

- Sussex - All departmental appraisals now include a promotions checklist, which ensures that career progression is the main focus of the appraisal.

4.2.12 Supporting and advancing women's careers: Career development: academic staff – Support given to academic staff for career progression

Career development is often supported through annual appraisals.

4.2.12.1 Actions reported by departments

- Annual Women in Mathematics Day provides an opportunity for mathematicians to network and socialise.
- Career development is provided for all staff through mentoring.
- Staff, especially females, have been encouraged to take study leave to undertake sizeable projects (e.g. research foundations for major grant applications) to enhance career progression.
- Career development is now an integral part of the annual CV review, appraisal and workload planning round.
- Providing travel and subsistence support for conference participation, at a rate of approximately one international conference per year.
- All staff can apply for one-to-one personal development support from the Coaching Academy, with 40 qualified internal coaches.

4.2.12.2 Actions reported in ECU Awards Booklets

- Nottingham - Athena SWAN champion sits on recruitment panels and overall pro-active approach to recruiting women.
- Bath - Action for the promotions committee to identify, encourage and support potential candidates to apply.
- Leeds - Analysis of the number of years spent at a previous grade prior to promotion.
  Reading - Esteem panel established that will oversee research awards, prizes and fellowships and promote applications and nominations.

4.2.13 Supporting and advancing women's careers: Career development: academic staff – Support given to students (at any level) for academic career progression

The review of departmental AS applications indicates that students at all levels benefit from the general careers support and advice at university level. Undergraduates are usually supported by an academic tutor whose role includes assisting with a student's career planning and providing references.

4.2.13.1 Actions reported by departments

- Running a pilot scheme offering doctoral students and postdocs the opportunity to apply and be interviewed for fictional jobs, both within and beyond academia. There were training sessions on applying for jobs and being on an interview panel, and early career researchers were included on the panels.
- Holding weekly maths-focused career workshops.
- MathSoc run careers events and staff contribute to sessions concerning academic careers.
- Annual event for UG and PGT students who may be considering doing a PhD that includes practical advice around how to apply, available support and discipline-specific information.
- An online community for current students and recent graduates to connect with alumni and find a mentor to advise them in their professional development.
- Introducing a new 'Personal Development Planning' initiative which helps to support tutors in engaging in careers discussions with their students.
- Having a dedicated part-time careers consultant, and internships coordinator who provides one-to-one support and advice to our undergraduate and postgraduate taught students.
- Developing a bespoke PGR Training and Mentorship Programme which involves teaching training (tutorial strategies, classroom observations, teaching statements) and development of an academic portfolio (grants, funding, outreach in teaching, research statements).
- Running biannual progress reviews and yearly one-to-one meetings with the Doctoral Programme Director in which the career development of each PhD student is an important item.
- Postgraduates are encouraged to gain teaching experience, for example, by applying to become Associate Lecturers, teaching in local schools and working with organisations such as the UK Mathematics Trust and the Brilliant Club. They are also encouraged to take part in outreach events.
- Developed diversity awareness sessions for all students as a novel employability skill.
- External advice and guidance is often provided by alumni which helps to establish role models that students can aspire to.
- Evidence-based practice: One department set up a new initiative to offer eight postdoctoral 'career development fellowships' which were designed to offer greater opportunities for career progression: the researcher would not be tied to a particular research project and would be free to conduct their own research programme. The positions were thus seen as a very attractive 'step up', allowing greater opportunity for progression to a permanent academic role. The eight positions drew a very strong field of applicants and two of the new appointments were women. Both of these post-holders have now secured highly prestigious positions.

4.2.14 Supporting and advancing women's careers: Career development: academic staff – Support offered to those applying for research grants

Support and feedback are often available to those whose applications for research grants are unsuccessful.

4.2.14.1 Actions reported by departments

- Applicants are encouraged to contact the university's Research Division, which has extensive experience and knowledge regarding application procedures.
- All substantial applications undergo internal peer review.
- When appropriate, a mock interview is conducted for an applicant.
- A new promotion scheme also rewards efforts to obtain funding.
- 'Meet the Researchers' event including talks by academic members of staff aimed at post-docs.
- Requiring staff to fill out a research plan for the following year. The Research Director is then able to allocate resource appropriately and provide mentors for those hoping to bid for funding.
- Specific mentoring provided to support fellowship/grant applications.
- Having a department level portfolio of research grants with significant levels of travel funds. These are used to ensure Research Assistants have the opportunity to present their work at international conferences.
- Where relevant specific interview training with an external coach is provided to those applying for funding.
- Evidence-based practice: One department has a Grants Director who provides support to all new staff writing their first grants, including both a grants workshop and detailed individual feedback on drafts. This has helped increase the grant capture of the department considerably over the last few years.

4.2.15 Supporting and advancing women's careers: Flexible working and managing career breaks – cover and support for maternity and adoption leave (before, during and on return)

4.2.15.1 Before maternity/adoption leave

Applications commonly report that the process of departing on maternity or other leave is commonly preceded by a meeting with HoDs before going on leave to discuss cover and any necessary arrangements to be made whilst on leave and workloads rearranged during pregnancy for example to account for medical appointments.

Risk assessments are common to assess whether all duties required of the role can be safely performed. Where necessary, adjustments to duties are made to suit the individual's needs.

4.2.15.2 During maternity/adoption leave

- Staff can take up to 10 paid keeping-in-touch (KIT) days throughout maternity/adoption leave.
- Most universities offer enhanced maternity/adoption leave packages over and above the statutory requirement.
- In some case for professional and support staff, a maternity cover administrator is recruited for the duration of the maternity leave funded by the university. For academic staff the department often funds maternity cover posts rather than asking other academics to cover extra teaching and administration. In other cases the absence is covered by other staff in a similar way to covering sabbaticals.

4.2.15.3 After maternity/adoption leave

- Staff meeting with their HoD/line manager to discuss their return to work and have the option to request part time hours. Workloads are often reduced for returners for a transition period.
- Returning mothers are provided with private and comfortable facilities for breastfeeding and to express breastmilk when required.

4.2.15.4 Actions reported by departments – Before maternity/adoption leave

- Creating a mathematical sciences-specific parental leave factsheet and maternity staff network.
- Informal mathematical sciences mentoring puts staff applying for leave in contact with staff with previous parental leave experience.
- Guidance documents available which give step-by-step guidance (with checklists) on supporting staff before, during and after maternity leave as well as step-by-step guidance for staff planning to take maternity leave, covering the time before, during and after leave.
- One department has produced a series of parental leave case studies and a checklist for the use of staff and their line managers, which covers actions over the whole period from notifying the department of the intention to take leave to returning to work.
- In some case, working from home was an available option to relevant staff later on in pregnancy.
- One department has awarded maternity pay to two graduate students who, not being university employees, had no standard entitlement to this.

4.2.15.5 Actions reported in ECU Awards Booklets

- York - Good policies in place for maternity leave, including reducing teaching load for the first year after return from maternity leave.

4.2.15.6 Actions reported by departments – During maternity/adoption leave

- Department keeps in touch with staff on maternity leave through the email lists used for internal communication, so they stay updated on developments during their absence. Staff can select whether or not to be contacted in this way.

4.2.15.7 Actions reported by departments – After maternity/adoption leave

- Availability of a 'Parenting Leave Fund' open to academic or research-only staff who have returned to work after a period of maternity/adoption leave, additional paternity leave, or caring responsibilities. Eligible staff can apply for up to £10,000 to be used to support them in their return to work.
- Mentors appointed to advise on the crucial process of restarting research.
- Evidence-based practice: one maternity returner was awarded teaching replacement money, to allow protected research time upon return, and found this very beneficial to her career development.
- Sabbatical credit is now earned during maternity leave.
- Requests for timetabling teaching hours in the core hours (10:00 - 16:00) are respected and treated favourably. Committee meetings are always scheduled during core hours.
- Upon returning to work following maternity, paternity or adoption leave for a period of 18 weeks or more in total, academic staff are entitled to four months of research leave to help re-establish their research trajectory.
- Sponsoring four waiting list places at university nurseries to help staff secure a nursery place promptly.

4.2.15.8 Actions reported in ECU Awards Booklets

- Manchester - Developing a policy where returners have access to more money for research.

4.2.16 Supporting and advancing women's careers: Flexible working and managing career breaks – maternity return rate and paternity/shared parental/adoption/parental leave uptake

Our review of applications has derived the following summary observations:

- In some cases, there had been no relevant leave in the time period being reported on. Where there have been instances of leave being taken it is often in quite small numbers.
- Some departments report 100% maternity leave return rate. Of those that have had staff not return this can be for numerous reasons for example securing alternative employment nearer to home.
- Most departments report a 100% take up of paternity leave. There are a very few examples of shared parental leave being taken but this option is well publicised by most departments.

4.2.16.1 Actions reported by departments

- In one case a colleague was promoted to Professor whilst on maternity leave.
- Some departments offer enhanced paternity leave of two weeks on full pay.

4.2.17 Supporting and advancing women's careers: Flexible working and managing career breaks – flexible working

Our review of applications has derived the following summary observations:

- Whilst some departments have formal flexible working arrangements, others state that flexible working can often be arranged on an informal basis or by submitting a formal request to change working hours, for example. If it is arranged on an informal basis there may not be any data to analyse on take up and patterns in flexible working.
- Flexible working arrangements can include reduced working hours, working from home, compressed hours and fitting teaching around family commitments.

4.2.17.1 Actions reported by departments

- Arrangement whereby those with childcare commitments in school half term can ask to arrange for one-week lecture cover from a colleague, or they may move their teaching to a different week.
- Staff can request times/dates during the working week when they would prefer not to be scheduled for teaching to accommodate parent and carer responsibilities.
- All line managers are trained in managing flexible working patterns.
- The development of a 'flexible working Toolkit' for staff and managers with extensive information and guidance on the implementation and support of flexible working for staff.

4.2.17.2 Actions reported in ECU Awards Booklets

- Warwick - Staff often work from home during school holidays, and children are welcomed to departmental social occasions.

  Open - Flexible working policies are in place and staff are encouraged to make use of them, with the success of this benchmarked.

4.2.18 Supporting and advancing women's careers: Flexible working and managing career breaks – transition between part-time to full-time

Our review of applications has derived the following summary observations:

- Some departments do not have a formal policy for the transition from part time to full time and most departments have no experience of such transitions.
- In some departments those wanting to increase their hours must present a written business case to be considered.

- Guaranteeing a return to their previous working pattern (full time for most) after a period of working part-time for those who want to.

4.2.19 Organisation and culture – culture

The review of available AS applications has derived the following summary observations:

- Social gatherings and events are wide-ranging, from informal gatherings in the coffee room to cycle rides and Christmas parties.
- Open door policy is common.
- Celebrating success in newsletters, emails, webpages and posters.
- Common room available to staff and students.
- Surveys and focus groups inform departments of any issues or areas for concern.
- Student mathematics societies are well supported by departments, both financially and with staff.

4.2.19.1 Actions reported by departments

- Plans for an explicit departmental policy stating that nobody is expected to answer emails outside working hours.
- Creating two new annual awards for a lecturer who has inspired female students and to recognise staff or students who have worked to promote gender equality.
- An externally accessible departmental AS webpage gives practical examples of the positive departmental culture to potential students and job applicants.
- The introduction of free childcare provision at the onsite nursery for children of staff and students working at recruitment Open Days on Saturday.
- Women's networking events with tea and cakes. This provides an informal opportunity to welcome new colleagues, and for PhD students and staff to get to know each other, to share advice and concerns, and celebrate successes.

4.2.19.2 Actions reported in ECU Awards Booklets

- Birmingham - The midweek morning coffee break for all staff, attended by the Head of School
- Bristol - 'Women in Maths' lunches across the faculty.
- Strathclyde - Consideration of the cultural effect of the physical environment, such as automatic-close office doors.
- UWE Bristol - Senior staff are discouraged by the Head of Department from sending emails in the evenings and at weekends.
  Warwick - Monthly staff lunch, with opportunity for brief presentations on matters of common concern.

4.2.20 Organisation and culture – HR policies

There is usually a designated contact within the department who is the first contact for any HR issues as well as the university-wide HR department. HR information and policies are usually available to all staff online and also communicated through emails, newsletters, staff meetings and staff training.

4.2.20.1 Actions reported by departments

- Staff can report any incidents of harassment and bullying using an anonymous online tool.
- Where there is a significant change in policy, such as the implementation of shared parental leave, drop-in sessions or workshops are arranged giving staff the opportunity to talk through the changes and ask questions.
- Plans to work with HR to introduce an annual "policy and practice" refresher course in the department or school for staff with management responsibilities.

4.2.21 Organisation and culture – representation of men and women on committees

The review of available AS applications has derived the following summary observations:

- The issue of "committee overload" is recognized as being a particular problem for female members of staff.
- Expand and formalise policy to co-opt academic women onto all committees in an 'attend and contribute, but no work' capacity.
- Representation on committees is often attributed to a lack of senior female staff in the department so measures to increase the number of senior female staff should eventually have an impact on this.

4.2.21.1 Actions reported by departments

- In order to provide a better gender balance some female administrative staff with responsibilities relevant to specific committees were invited to participate alongside the few female academics.
- Mentors are asked to encourage women to consider nomination for/election to university committees.

4.2.21.2 Actions reported in ECU Awards Booklets

- York - Post-docs serve on departmental committees.

4.2.22 Organisation and culture – participation on influential external committees

In some cases, involvement with external committees, not just internal committees, is accredited on the workload model.

4.2.22.1 Actions reported by departments

- Academic staff are expected to and supported in developing their profile and influence by participating in external committees and establishing links with other academic related organisations. Evidence of external activities are included in applications for promotion and in staff appraisal objectives.
- Heads of Division have been very pro-active in encouraging female staff to apply to key external committees, acknowledging that representation on such committees can support individuals' career advancement.

4.2.23 Organisation and culture – workload model

The review of available AS applications has derived the following summary observations:

- There are various formal and informal models used for allocating workload taking into account various teaching, research and administrative tasks.
- Some departments have used the same workload model for many years whilst others have implemented a new model very recently or plan to do so shortly.
- Agreement that measures designed to increase diversity should not actually overburden female staff.
- Transparent processes for allocating workload are valued.
- A lot of departments recognise that female staff members are more likely to be called to internal and external committees, and this is taken into account in the workload allocation.
- Workload of all staff is often circulated internally within the department.
- Some departments do not currently monitor workload by gender.

4.2.23.1 Actions reported by departments

- A new workload model is in the process of being introduced and the AS Champions have been consulted to determine appropriate activities for inclusion.

4.2.23.2 Actions reported in ECU Awards Booklets

- Loughborough - SAT membership included in workload model.

4.2.24 Organisation and culture – timing of departmental meetings and social gatherings

Our review of available AS applications has derived the following summary observations:

- Most departments have core hours and try to schedule departmental meetings, seminars and other key events within these hours.
- Importance is given to providing as much notice as possible to events such as away days to enable participants to make any necessary arrangements.
- A number of departments have highlighted that including part time staff in meetings and events can sometimes be problematic.
- Many social events are family friendly and students and staff are encouraged to bring along their partners and children.

4.2.24.1 Actions reported by departments

- Social events moved from evenings to lunchtimes to enable greater participation.
- Staff are discouraged from sending emails in the evenings and at weekends to ensure no-one feels under undue pressure to respond; staff choosing to work at such times are encouraged to use the delay-send email facility.
- Staff are able to access some meetings remotely via Skype.

4.2.24.2 Actions reported in ECU Awards Booklets

- Manchester - 'Who's Who' document, listing all committee members.

4.2.25 Organisation and culture – visibility of role models

Wide use of female case studies and images in promotional material, on department webpages etc.

4.2.25.1 Actions reported by departments

- Providing additional funds in support of female speakers from outside the UK
- Evidence-based practice: By periodically reminding seminar organisers about the target to increase the number of female speakers and requiring them to report progress, there has been success in increasing the female representation for academic seminar speakers.
- Two rooms used by undergraduates were recently officially named after female mathematicians.
- Female staff have a prominent role in Open Days, Applicant Visit Days (AVDs), promotional videos and posters. Visitors will therefore always understand that people who work in a maths department may be of either gender.

4.2.26 Organisation and culture – outreach activities

A review of available applications leads to the following observations:

- Outreach activities often involve students as well as staff.
- Activities can be on campus (open days, public lectures) and off campus (visits to local schools involving children of all ages).
- Outreach activities are often recognised in the workload model.
- Some schools have a dedicated outreach officer.

4.2.26.1 Actions reported by departments

- Outreach activities are part of the portfolio candidates must offer as evidence for promotion.
- All marketing materials for outreach events feature photos and/or quotes from female students or staff.
- One Faculty currently employs two female PhD students as 'Education Outreach Fellows'.
- Plans to send students as 'Ambassadors' to their former schools to promote the study of mathematical sciences at university.
- Securing £15k in charitable funding, for the purposes of developing a Year 11 summer school series.
- Running an 'Undergraduate Ambassador Scheme' gives students the chance to work in local classrooms as classroom assistants and gets great reviews from prospective students and parents. Since the majority of its participants are female, this provides valuable mathematical role models for girls
- Plans to put outreach videos online so that a larger number of applicants get a chance to view them.

4.2.26.2 Actions reported in ECU Awards Booklets

- Lancaster - The annual 'Florence Nightingale Day' which targets female pupils in years 11 and above, encouraging the students to consider careers in the mathematical sciences.

4.3 Case studies

4.3.1 Identifying and sharing effective practice

Interviewees described a number of ways in which they identify effective practice which can be adopted in their departments. Often, this was through informal channels. Several interviewees mentioned networking with colleagues in other departments, and in other institutions. Some interviewees had found examples of effective practice using social media, including information shared by the Equality Challenge Unit in relation to Athena SWAN. One interviewee maintains an email list for women in mathematics, using it to share relevant information.

Several interviewees had identified examples of effective practice in other departments' Athena SWAN submissions. These tended to be shared informally, though some respondents described actively seeking examples of others' submissions early in their own Athena SWAN work. One interviewee had sat on a number of Athena SWAN panels, and had seen a large number of Athena SWAN submissions in this role.

Some institutions had equality and diversity committees or other networks through which effective practice could be shared internally. Other institutions did not have such formal mechanisms in place, but departments still tended to share effective practice in less formal ways. These tended to be institutions with less STEM provision, which did not perceive issues around gender diversity across the institution as a whole. One interviewee reported working closely with the mathematics department in another university to support each other's Athena SWAN applications. A second interviewee reported sharing effective practice through their university alliance's Athena SWAN network.

Perhaps unsurprisingly, interviewees identified the LMS Good Practice Scheme as a particularly useful source of information on effective practice. Two interviewees were members of the Women in Maths Committee, but most others also cited LMS newsletters and workshops as useful sources. Some interviewees also referred to guidance from the Institute of Mathematics and its Applications and the Royal Society. Smaller departments, however, reported that they sometimes found it difficult to send representatives to external workshops due to lack of capacity.

4.3.2 Impact of Athena SWAN

Some interviewees found it difficult to identify changes in their department that were driven specifically by Athena SWAN, suggesting that "all the things we've done, we would have done anyway", although they also acknowledged that Athena SWAN had provided some impetus, or had provided a framework through which departments could formalise effective practice where their approaches had previously been more informal. Most interviewees, though, pointed to cultural change as the key impact of Athena SWAN. Usually such cultural change encompassed both a wider awareness of issues relating to equality and diversity and an increased desire to address them.

Many interviewees identified specific changes in their department's policies and practices which had come about because of their work on Athena SWAN. In some cases, the application process had required departments to look at data they had not previously considered (for example, gender differences in attainment), and they had identified issues they were not previously aware of. In other cases, self-assessment surveys among students and staff had highlighted issues. Sometimes, issues had been identified but interviewees commented that they were not yet fully understood (because data related to small numbers of people, for example, or because an issue was apparent in some years but not others and no consistent trend was yet apparent), and noted that their departments were continuing to monitor and investigate; this ongoing monitoring was identified as a change introduced through Athena SWAN, with the underlying issue to be addressed in a future action plan. One

department, for example, had funded a PhD student to examine student confidence in STEMM (Science, Technology, Engineering, Mathematics and Medicine) subjects as part of their Athena SWAN self-assessment, and had identified that female third-year students tended to be less confident than their male peers, independent of attainment. The department was undertaking further research to determine whether this was a consistent issue that they needed to address.

Commonly, recruitment and promotion were areas where changes had been implemented. One department, for example, had introduced a checklist for recruiters to follow to help them attract strong female candidates, and had seen an upturn in the number of applications from women which had led to more women being appointed. Another department had introduced procedures to try to address unconscious bias in shortlisting, changing the way they approached the metrics of candidates' publications histories to take account of periods of maternity leave, as well as recognising that women are generally less likely to publish than men. Often, departments had changed their approach to managing promotions. Several interviewees noted that surveys had identified a lack of understanding of career development and promotions processes among staff. In response, departments had introduced more effective mentoring support for staff, and had formalised promotions committees to provide clearer guidance and support to staff around career development. One interviewee noted that their self-assessment survey had identified a lack of mentoring support for staff in part-time positions, which the department had recognised as an equality issue (although it was not related specifically to gender) and had addressed this. Another department now ensures that progression to PhD is discussed with all female fourth-year MMath students.

Interviewees also identified attitudes and approaches to parental responsibilities as an area where changes had been brought about through Athena SWAN. One noted that their work on Athena SWAN had raised awareness of rights relating to maternity leave for women on short-term contracts. Some interviewees described changes to their department's support for women returning from maternity leave; one noted that while the number of women involved is small, this was one area where their department had instigated "real change". Several interviewees said that Athena SWAN had encouraged their department to move meetings to core hours, and to try to ensure that seminars are held in core hours. One department's maternity leave policy, developed alongside Bronze and Silver departmental Athena SWAN awards, had been adopted as institution policy.

Sometimes, interviewees described some of the changes in their department as "little things" or "simple things", while other interviewees described "quick wins" or "easy wins", which were easy to implement but which had a notable positive impact on departmental culture. Changes described in this manner included shifting meetings to core hours, but also included the provision of baby changing facilities and facilities for breast feeding, evening the gender balance in the pictures displayed around the department, and introducing targets for gender equality among seminar speakers.

Several interviewees suggested that it was difficult to evidence the changes in their department. Sometimes this was due to the relatively small size of their departments, which meant that benchmarking analysis could be skewed due to the small numbers (e.g. of teaching positions filled) involved. More often, it was because cultural change was felt to be the most significant. Some departments which had applied for renewal of their Bronze award, or which were moving from Bronze to Silver, were able to demonstrate cultural change through repeated self-assessment surveys. Other departments, which were earlier in their Athena SWAN journey, had not yet undertaken second self-assessment exercises.

4.3.3 Culture change driven by Athena SWAN

Interviewees tended to agree that Athena SWAN had helped raise awareness of equality issues, and to embed effective practice. Several gave consideration of the gender representation of seminar speakers as an example, commenting that "people don't have to be reminded to think about it now". Several interviewees commented that this awareness of equality issues went wider than gender equality, and also encompassed greater sensitivity to parental responsibilities, religion, and attitudes to alcohol, for example. Some interviewees commented that Athena SWAN had helped enhance communication within their department, had made it more open and inclusive, and that "people feel valued and respected". One interviewee noted that in their large department, Athena SWAN had helped change the attitudes of some staff who "were perhaps more circumspect" in their attitudes towards women's careers in mathematics because of their own cultural background.

It was difficult for interviewees to describe differences between the culture of their own department and others, however, whether these were other departments in the same university, or mathematical sciences departments in other institutions; interviewees noted that they were not familiar enough with the culture of other departments to comment. Many interviewees recognised that gender representation was worse in other STEMM subjects, but it was also noted that there are large differences between subjects, and that even within mathematical sciences some subjects attract more women than others. One interviewee suggested, "That's not a problem… It's not about quotas – it's about removing the barriers which prevent some people doing what they want to do".

Interviewees differed somewhat in their opinions on whether the changes that had been effected in their departments could have been achieved without Athena SWAN. Some suggested that similar outcomes would have been achieved, but not as quickly. For them, Athena SWAN had provided "a focus" which had "concentrated our minds", and helped accelerate change within their departments. Other interviewees thought that it was "difficult to see what might drive such change in the absence of Athena SWAN", and that "it would have taken considerable effort by influential people to make those changes happen". One interviewee suggested that "the key difference is about having a focus, a timeframe and a purpose to do it – without that, things would probably drift".

Some respondents noted that Athena SWAN had also provided a focus for their institution to raise awareness of effective practice in equality and diversity, and that their institution was pushing all departments to achieve an award (it was also noted that Athena SWAN accreditation is increasingly important for funding purposes). One department was using its Silver status as leverage to push for change at institution level.

4.3.4 The Athena SWAN process

While it was recognised that Athena SWAN helps empower change, interviewees also noted that this was "at some price". Financial costs, the time required, and the workload involved in delivering an application were all cited by interviewees. Several interviewees described the application process as "too bureaucratic". Two interviewees said that in discussions among their Athena SWAN teams about the changes they wanted to make happen, and ways they might achieve this, the team was "full of ideas and energy", and developing an action plan was "exciting and stimulating", but that the report-writing process was "onerous" and "energy-sapping"; these, and others who noted a tension between "the time needed to develop an action plan, and the time available to implement it" suggested that the process of applying for an Athena SWAN award meant that "momentum was lost". One interviewee noted that because their institution does not use Microsoft Office, it was difficult for their Athena SWAN team to complete the application form in MS Word format.

Some interviewees reported that they had received dedicated support from their institution when preparing their department's Athena SWAN application, but others reported little support. This tended to vary depending on how long the department had been involved in Athena SWAN, and when the institution itself had engaged with it. Some departments had applied for an Athena SWAN award before their institution. Departments which had received awards earlier, and departments in institutions which had engaged earlier, tended to report more formal institutional support mechanisms (such as an institution-wide Athena SWAN committee, to which departmental committees reported). Those later to engage tended to report less support. In one case, the institution had discouraged a department's application because the institution did not believe it would be successful, contrary to advice the department received from an external mentor arranged through the LMS Good Practice Scheme – the department submitted anyway, and successfully achieved its award.

Support from an external mentor from another mathematical sciences department was considered especially helpful by departments developing their Athena SWAN applications, Most often, mentoring had been arranged through the LMS. A number of interviewees referred positively to the support they had received from the LMS, including not only guidance provided and effective practice shared, but also the benchmarking data published on student and staff numbers nationally, and workshops organised. Some interviewees, however, commented that their departments sometimes found it difficult to send a representative to workshops because of timings or the distance and costs involved.

Most often, interviewees' complaints about a lack of institutional support related to data. Several interviewees commented that it was difficult to access the data required to complete an Athena SWAN application. Historic data in particular was difficult to obtain in many cases, and though it was often noted that better monitoring was one positive outcome of Athena SWAN, smaller departments in particular commented that the resource required for ongoing monitoring could also be significant.

The data analysis required in an Athena SWAN application was considered by some interviewees to be "burdensome", though one interviewee suggested that this meant that action plans needed to address the issues that make it difficult to collate the data required. Another interviewee reported that their institution had recruited a data analyst specifically to provide additional resource to the central team in support of Athena SWAN. Some interviewees commented that ECU feedback on their applications included "petty" comments on "the minutiae of data presentation" such as chart styles, which did not reflect the purpose of Athena SWAN. One interviewee noted a "disconnect" between the advice their department had received from Advance HE during the preparation of their Athena SWAN application, and feedback post-submission: they had been advised to present data relating to small numbers of staff, but feedback from the assessment panel was that this shouldn't have been included. Another interviewee commented that the panel assessment can focus too much on marginal changes in the data, even when sample sizes are very small, and that negative trends are sometimes identified in panel assessments "without consideration for the underlying data or statistical noise".

Departments participating in this research provided Athena SWAN applications at Bronze, Silver and Gold level from across the period November 2014 to November 2017 (a new format of application form was introduced by Advance HE in May 2015, though some November 2015 applications still used the old format). Several interviewees reported that they found the application forms constraining, though those who had not prepared an application using the new form acknowledged their experiences of it may be different. Those who complained about the application being "very tightly prescribed", "inflexible" and "frustrating" tended to be interviewees from smaller departments, and those who suggested their departmental structure was "unusual" or "atypical". One said that the application required their department to "explain things that are irrelevant [to us], and miss out things that we

consider relevant". Another suggested that "word limits can be constraining when you're trying to explain why things are different".

Applications were presented in a range of different styles, partly due to the change in application forms. While all applications presented data analysis as required by Advance HE, the level of detail varied with larger departments tending to present the most detailed breakdowns. Some applications presented data tables while others used charts. While most applications reported students and staff numbers in terms of headcount, others reported numbers of full-time equivalents. Some offered little commentary on the data analysis while others provided detailed comments.

The different styles of application meant that it was difficult to reach objective conclusions about the quality of an application in relation to its success. Stronger applications linked evidence to action and then to outcome (i.e. the problem was *x*, the solution we identified was *y* and this led to *z*). While this is more relevant to Silver and Gold awards, even within these there was some variance in how clearly these links are made.

Some applications were much clearer than others around the specific action points which flow from evidence. Some applications only referenced an action by number, for example, in the main body of the application. This then required the reader to look that up in another part of the document. The better applications state what the action is as well as the number, which removes the need for such cross-referencing. This may have been driven by the need to conform to a word limit in each section of the application form. Several applications, however, appeared to disregard word limits; it is not clear why this was the case, or whether it counted in their assessment.

Several interviewees criticised what they perceived as inconsistencies in the award process, though not all interviewees considered inconsistency to be an issue. Some interviewees had shared the feedback they'd received from Advance HE with other mathematical sciences departments, and suggested it was difficult to understand "why some things are identified as negatives in some cases but not others". Interviewees who had sat on Athena SWAN panels suggested that the way they work can be very different, and that "it really matters who's sat on the panel". A key concern was the subject expertise of panel members, with interviewees tending to believe a panel was more effective if it included "a maths person". It was also pointed out, however, that panel members should not be familiar with the department whose application they're assessing, which meant it can be difficult to have this subject representation on all panels. Some interviewees commented that there were also inconsistencies in the way that applications are developed in different institutions, with some institutions providing more centralised support than others.

Some interviewees cited a lack of transparency in the assessment process, rather than a lack of consistency. It was noted that feedback on an application is written entirely by Advance HE, with no direct involvement from the panel. One interviewee suggested that if panel chairs reviewed feedback before it was provided to the submitting department, this would help improve consistency and help improve confidence in the assessment process. Another interviewee commented that there have been some instances where more than one panel has assessed an application, either as an ECU trial or because an ECU moderator had queried one panel's response and referred the application to another. Such a process was also felt to be one way in which issues of consistency might be addressed, though it was recognised that Advance HE's time and resource pressures would make this difficult.

Several interviewees suggested that the application and assessment process could be streamlined. Some interviewees thought that an online application process would make it easier. Some interviewees believed that Advance HE could provide clearer guidance, especially in relation to identifying suitable responses to issues identified in their action plans. While it was acknowledged that this could be

difficult, "because example actions can just be parroted back", and interviewees were aware of ECU guidance around effective practice in Silver and Gold applications, there was a perceived lack of similar guidance at Bronze level, "for people starting out".

Some interviewees suggested that the process should not be treated less as "a box-ticking exercise", that Advance HE shouldn't "let the process get in the way of what we are trying to achieve", and that assessments should focus more on culture change and less on data analysis. Some interviewees also suggested that applications should allow greater flexibility to reflect the differences between departments, whether in terms of their particular organisational structure, the demographics of their students (and, to a lesser extent, staff) or the subjects they taught (such as actuarial science). One interviewee suggested that Advance HE might consider inspecting departments, and that they could "make it more like Ofsted, because it's too easy to hide things in a carefully worded application, but they can't be hidden when you see them".

Based on their experience, interviewees offered a range of advice to departments considering starting the process of gaining an Athena SWAN award. Most suggested that the work involved should not be underestimated and that departments should "start early", with one interviewee suggesting they "start at least one year in advance" of their planned submission date. The self-assessment team "need[s] to be enthusiastic", and "need[s] to represent the full spectrum of people in the department, from students to senior staff" in order to ensure that the issues and perceptions of all parts of the department could be recognised. Several interviewees suggested that a senior member of staff, ideally the Head of Department, should chair the self-assessment team in order to "push the agenda within and outside the department to build buy-in".

Interviewees commented that it was important to "take the self-assessment process seriously", and that departments should "be self-critical" and "not afraid of recognising weak points". It was suggested that "it's likely that most departments are already aware of their issues, and are informally already doing many of the things they need to". Departments were advised to "be imaginative" in developing an action plan. Actions "must be focused on the issues identified", and should not be "generic 'nice-to-haves'". Some interviewees suggested that actions should focus on "things we can control locally, within the department" because it can be difficult to influence the institution's policies and procedures. One interviewee suggested a "focus on recruitment, retention, progression – if you focus on these three areas, everything else will fall into place… These three things are crucial".

5. Conclusions and recommendations

In this section, the study presents the key findings and conclusions, followed by a set of recommendations for future action.

5.1.1   Changes in the equality landscape in UK mathematical sciences

A key point is that the intended approach, which was to aggregate data presented in individual applications, was deemed impossible once the application forms were reviewed. This is because of the wide variety of data sources used, the presentational techniques employed and the fact that many statistics were presented as percentages, which of course is perfectly acceptable and sensible but does not allow aggregation. The quantitative analysis presented in this study is therefore entirely based on HESA data, which was supplied based on a bespoke data request.

The data analysis shows that while the number of women studying mathematics at A Level and in Higher Education has increased in recent years, this is not always reflected in an increase in the proportion of students who are female:

- The proportion of A Level Mathematics students who are female has remained at 39% since 2013.
- The proportion of A Level Further Mathematics students who are female has fallen from 29% to 27% over the same period.
- Between 2011/12 and 2016/17, the proportion of first degree mathematical sciences graduates who are female fell from 43% to 40%.
- The proportion of Master's degree mathematical sciences graduates who are female rose from 37% to 43% between 2011/12 and 2016/17. This rise was driven by increased recruitment of female students from overseas. The proportion of UK-domiciled master's degree graduates who are female fell from 34% to 33% over the same period.
- The proportion of Doctorate mathematical sciences graduates who are female has fluctuated, rising from 30% to 33% between 2011/12 and 2013/14, but then falling to 26% in 2016/17.

Therefore, many of the trends displayed in the HESA student data analysis are disappointing, from a gender equality point of view. Whilst the total number of women studying maths has increased over recent years, there remains a very mixed picture when measuring the proportion of students that are female. There will inevitably be some concern that the proportion of females taking A level Maths and taking up a first degree in Maths have both declined.

The number of women in academic positions in the mathematics cost centre in UK universities has also increased in recent years. Again, however, this is not reflected in an increase in the proportion of staff at all levels who are female:

- The proportion of lecturers and senior lecturers in the mathematics cost centre who are female has remained constant at 23% since 2011/12.
- The proportion of researchers in the mathematics cost centre who are female was 23%, up from 21% in 2011/12 but unchanged since 2012/13.
- 11% of professors in the mathematics cost centre are female in 2016/17, compared with 7% in 2011/12.

Contrary to the student data, the analysis indicates some positive trends in the proportion of female staff in maths departments across the UK, though there is still much work to do to overcome the challenges faced and to have a major impact on the proportion of academic staff at all levels that are female.

5.1.2 Common data sources, struggles, practices and approaches to culture

This study has developed a novel and experimental approach to gathering data in support of a qualitative analysis of Athena SWAN application forms. This is based on the creation of four 'frameworks', as follows:

1. Data employed in applications
2. Common struggles identified in applications
3. Common practices identified in applications
4. Definitions and descriptions of culture (in applications and websites)

Each framework consists of a list of relevant items extracted from the 33 application forms available to this study, gathered through a manual process in order to populate each framework.

This analysis has identified the most common approaches expressed within the application forms and has generated the following key findings:

- **Data sources.** All application forms call upon internal information (which could include information on the characteristics of specific staff, such as those on the SAT, or descriptive data about the department or institution or other insight drawn from an unspecified source) as a key source of data. A far higher proportion of applications call upon data from a staff survey (91%) than utilise data from student surveys (58%). HESA data is used by almost 9 in 10 applicants (88%) whilst one fifth (21%) of applicants cite LMS Good Practice scheme data somewhere in their application form.

- **Common struggles.** Every one of the 33 applications identified the challenge of attracting a greater number of female students. This was the only struggle unanimously identified across the sample. Seven in ten departments (70%) identified that they have low numbers of female staff. This assessment is often made in comparison with some form of benchmark (e.g. HESA national average). Data gaps are also a common struggle, identified by the majority of departments (61%). This challenge tends to mean that applicants are not able to present the data that they believe would help throw light on the specific issues they face, either because it does not exist, is difficult to acquire (within the departments or across the institution) or sample sizes are insufficiently large to support robust analysis. Approximately four in ten departments (42%) cite challenges with committee constituency whilst a similar proportion (42%) of departments identify the challenge of a 'leaky pipeline'.

- **Common practices.** There is an almost bewildering number and variety of practices identified across the applications. Aggregating them together has been a significant challenge. However, once this was completed, the framework data highlighted some interesting findings in relation to common practices. The practice which is most commonly adopted is additional data gathering (94%), which is a far higher proportion than the percentage of departments that identified data gaps as a struggle (61%). This suggests that additional data is being sought in departments that have not acknowledged the lack of data as a challenge. Around nine out of ten departments (91%) plan to undertake more targeted and proactive recruitment. The third most prevalent practice is promoting postgraduate opportunities (75%). It is widely accepted that achieving an increase in the number of female postgraduate students is important to ensuring that a greater number of women are in the mathematics career pipeline, so it is encouraging to see three quarters (75%) of departments taking action in this area. Many of the practices identified relate to recruitment and promotion, whether that be around improving promotion materials (72%), improving student recruitment activities (72%), recruitment training (69%), improving promotions processes (69%) or improving staff recruitment

materials (69%), improving career development approaches (66%) or improving recruitment processes (66%). Improving staff career support is also a common area being addressed by departments through Athena SWAN.

- **Culture**. When *defining* culture, the most common terms used are 'social events' (70% of applications), 'commitment to Athena SWAN' (67%), 'internal communication' (41%) and 'physical environment' (30%). The evidence indicates a distinct absence of words and terms that one might associate with a positive culture and environment for equality and diversity, with terms such as 'role models', 'work/life balance' and 'flexible working' appearing in so few applications. When *measuring* culture, the key mechanisms are 'staff surveys' (73%), 'number of social events' (24%) and 'student surveys' (24%). Finally, an assessment of how culture is *described* (which also encapsulated a review of key pages from departmental websites) indicates that the most common words/terms are 'friendly' (70% of departments), 'diverse/diversity' (67%), 'supportive' (64%), 'equal/equality' (64%), and inclusive' (58%).

5.1.3 Practices in mathematical sciences departments and the evidence for effectiveness

Effective practice within departments can be difficult to define. Our approach has been to examine the actions that departments put in place to address equality and diversity challenges, coupled with the identification of examples of impact arising from such actions that is backed by evidence (i.e. 'evidence-based practices).

It is worth noting that the overall impact of actions to address equality and diversity issues is supported by a range of activities which are not action specific – for example, the support shown by senior leaders in the institution, the approach to constituting and running the self-assessment team, the methodologies used to capture and analyse data and how departments benchmark themselves, both quantitatively and qualitatively. It is much more difficult to assess what is effective practice or otherwise in these (and other similarly non-action specific) activities and approaches.

The number of examples of evidence-based practice that have been identified in this study is quite modest: across 33 applications, approximately half of which were at Silver or Gold level, the study identified 12 examples of evidence-based practice. Looking at evidence-based practice when defined as those approaches which are evidenced as being effective, the following conclusions can be drawn:

- The main purpose of the presentation and analysis of data (related to both students and staff) is to evidence the challenges faced by each department. However, departments often identify actions and practices which have had an impact on student numbers. For example, departments identify changes made to open and post-offer visit days which have been very well received by prospective students. These changes have included the introduction of content delivered by existing female students and generally increasing the visibility of female staff and students, as well as effort being applied to explicitly identifying the commitment to Athena SWAN and equality and diversity generally. Advice provided by the LMS Women in Mathematics Committee has helped departments to rapidly address issues related to low female student numbers. Positive and active promotion of Master's programmes to female undergraduates has also been cited as achieving desirable impacts. In terms of addressing issues around staff numbers, evidence-based practice is focused on proactive, strategic recruitment processes which target women, use promotional materials which are carefully worded and included actively seeking recommendations from a wide network of senior people in the mathematical sciences community.
- In supporting and advancing women's careers in the mathematical sciences, departments expend a significant amount of time and effort across a very broad range of activities in order to help women sustain and enhance their career in the mathematical sciences.

Practices which are evidenced as having had a positive impact include those around the redesign of training courses and combining these with social events, new initiatives to develop postdoctoral career development fellowships which are explicitly designed to offer a specific 'step-up' opportunity whilst also offering greater flexibility and opportunity for career progression, and greater support for grant applications for new staff (including the creation of a Grants Director role to manage and organise support).

- When it comes to supporting female staff returning from maternity leave, evidence-based practice is identified around the use of teaching replacement money to allow members of staff to benefit from protected research time when returning from leave.
- Finally, in terms of organisational culture, the evidence-based practice identified relates to initiatives designed to increase the number of female speakers at seminars and other events. Specifically of note is that the successful initiatives involved both encouraging colleagues to achieve this goal and also to report on progress.

It should be noted that alongside these 12 examples of evidence-based practice, the review of applications identified a significantly larger number of statements of the impact that actions to address equality and diversity challenges have delivered. However, the vast majority of these statements were either not made in direct reference to a specific action (or set of actions) or was not backed by evidence (or both). Further details regarding the 12 examples can be found in

5.1.4 The Athena SWAN process

Cultural change was regarded as a key outcome of Athena SWAN, though some departments believed change would have been achieved without Athena SWAN (albeit more slowly). Some evidence has been gathered which suggests that not all departments believe that Athena SWAN is especially effective in driving meaningful change, though it is very useful in focusing the attention of departments and institutions on the importance and presence of gender equality issues.

Applying for an award involves a significant amount of work, especially in relation to data requirements. Some case study respondents even went as far as to suggest that the effort required is detrimental to instrumenting change, as it drains time and resource away from actually addressing issues and effecting change.

Institutional support for departments preparing an application was mixed. Some departments reported difficulties in accessing the required data, though one outcome of Athena SWAN was that monitoring was reported to have improved. Support from an external mentor was considered particularly helpful, while the LMS Good Practice Scheme was also considered a useful resource.

Some departments perceived inconsistencies in the awards process, and there were suggestions that the application process could be streamlined. The subject expertise of assessment panel members, and the potential lack of a representative from the mathematical sciences community, was a concern to some departments. Some departments suggested that the application felt like "a box-ticking exercise" which focused too much on requirements for data analysis and not enough on cultural change, and which didn't reflect their specific characteristics. The process is often seen as unnecessarily bureaucratic and it is perceived that there can be a disconnect between the principles of the Charter and the pedantic nature of some of the award process feedback.

Departments offered a range of advice to others considering an Athena SWAN application. An enthusiastic self-assessment team whose composition reflected the entire department was considered important. Departments were advised to be self-critical, and to be imaginative in developing action plans which focused on responding to the issues identified within the department.

5.1.5   Study challenges

This study has encountered numerous challenges in the course of its execution. These include:

- The variety and variation between application forms – both the need to review applications in two different formats (pre- and post-2015) and the heterogeneity of data contained within them.
- The inability to aggregate application form quantitative data as originally intended
- The experimental nature of the data capture and analysis
- The scarcity of evidence provided in application forms in relation to the impact of gender equality initiatives.
- A relatively small sample of application forms made available to the study (33)

These challenges have had a number of implications, including:

- the effort and resource required to deliver the study has been considerably larger than originally estimated and the the original study timetable has consequently had to be extended.
- the need to rely on HESA data alone to support the quantitative analysis, which whilst providing a valuable and robust picture across Mathematics in the UK, is limited in its scope and relatively inflexible.
- The degree of variance in content, style and nature of the assessment contained within the application has limited the scope of analysis possible.
- The ability to cut the data and examine specific groups of departments (e.g. by level/success and female staff quartiles, as well as other characteristics) has been very limited and the results achieved when this has been done can be considered as indicative only (i.e. their statistical significance has not been tested).

5.2   Recommendations

The quantitative and qualitative analysis in this research has supported an extensive review of gender diversity in the mathematical sciences in UK Higher Education, of university departments' work in relation to gender diversity and of their experiences of applying for Athena SWAN awards as a means of accrediting this. Nevertheless, there are some areas where additional data analysis may be insightful, where departments may find the centralised collation of other benchmarking data helpful, and where further research may add to a deeper understanding of the factors which impact on women's (and men's) career progression in the mathematical sciences:

- The benchmarking data provided by the LMS is seen as valuable by mathematical sciences departments. There is potential to provide greater detail, for example a breakdown by subject area, distinguishing between full-time and part-time students and staff, and/or considering the intersectionality of gender and nationality. There is also the potential to widen the range of benchmarking data available, for example in the areas of committee representation, recruitment, promotion, training and outreach activities. This would require departments to submit their data to a central data store which could be managed by LMS, managed confidentially and used to publish aggregated benchmarks on a regular basis.
- Work to streamline the application process and support better assessment of applications is clearly needed. LMS should continue to work with Advance HE to communicate this issue and support the development of appropriate responses to it. For example, to explore whether a centralised, digital application process which provided not only the

structure for an online submission but also templates for data gathering and analysis would be welcomed and effective.

- Statistical analysis of HESA data might explore whether there are other factors such as social status, mix of A Level subjects, etc., which combine with gender to influence women's career progression in the mathematical sciences, or gender diversity in the mathematical sciences more widely. In other words, such analysis would examine whether there are specific groups of women who are being excluded, compared with men.

- Though helpful, HESA data cover only a relatively small range of indicators applicable to departments in developing equality and diversity initiatives in general, and Athena SWAN applications and action plans in particular. Effectively, unless arrangements are put in place between one department and another (or others) to share information then benchmarking remains a significant challenge across many of the key measures found in an Athena SWAN application. While many of the issues are common, the individual circumstances of each department would be better understood if benchmarks for a wider range of indicators were available. There may be a role for the LMS in facilitating the collation of benchmarking data in areas such as the gender representation of seminar speakers, staff promotions and parental leave/return to work. Of course, issues of individual confidentiality would need to be considered. Consideration would also need to be given to the representativeness of benchmarking data which could be collated centrally by an organisation such as the LMS, in terms of their engagement with mathematical sciences departments in all institutions across the UK (it may be preferable to lobby HESA, university alliances or even Advance HE to take on such a role). Consideration should also be given to the administration burden for departments to provide the data required in a consistent format.

- While it is clear that women remain under-represented in the mathematical sciences, particularly in more senior positions, the factors behind this are not always well understood. Of course, under-representation of women is due to smaller numbers of women entering mathematics compared to men, and proportionately more women than men leaving at each stage in the career path. While there is much evidence relating to subject choices among young people, and differences by gender, ethnicity and social background (though it is beyond the scope of this research to review it), there appears to be less evidence of the factors impacting on women's career progression of in the mathematical sciences. The Athena SWAN applications reviewed suggest a broadly defined academic career path. Further research might examine how this career path differs for women compared with men, for example by considering the average length of time spent at each stage, and how parental leave (and longer career breaks) impact on progression.

- Given the challenges that this study has faced, consideration should be given to the methodology that should be adopted in any future benchmarking studies. This will also be influenced by what, if any, advances are made around data sharing and benchmarking and how the application process evolves through Advance HE.

Finally, it is clear that the LMS plays an important role in supporting mathematical sciences departments in relation to Athena SWAN, and gender diversity in general. Our interviews suggest there is great enthusiasm for gender equality across the UK mathematics community. This should, of course, be encouraged, and the LMS should continue to promote the sharing of good and effective practice and to facilitate support among the community in identifying and responding to its issues. Consideration might also be given to the adoption of a more active advocacy role with Advance HE in relation to perceived issues with the Athena SWAN application and assessment process.

6. Appendix A: Quantitative analysis method

Quantitative analysis is based on the following data sources:

- Joint Council for Qualifications A Level Results Tables (https://www.jcq.org.uk/examination-results/a-levels)
- Higher Education Statistics Agency Student Record (https://www.hesa.ac.uk/collection/c16051)
- Higher Education Statistics Agency Staff Record (https://www.hesa.ac.uk/collection/c17025)

6.1 A Level students

Data count individual candidates sitting A Level examinations in each year.

6.2 HE graduates

Data count individual graduates in each year from the mathematical sciences subject area, by level of study.

6.3 HE staff

Data count the full time equivalent (FTE) number of academic staff in the mathematics cost centre, by contract level and academic employment function.

HESA requires Higher Education Institutions (HEIs) to map their constituent departments to cost centres as a way of distinguishing between different activities. Departments can be apportioned across a number of cost centres, which can lead to anomalies: in some cases, HEIs report mathematical sciences staff even though there is no recognised mathematical sciences department; in other cases staff numbers may not match those in a specific mathematical sciences department as staff from other departments may be counted as belonging to the mathematics cost centre, and/or staff working in a mathematical sciences department may be assigned to another cost centre.

Staff full-time equivalent numbers are defined by contract(s) of employment and are apportioned to each activity's cost centre. FTE indicates the proportion of a full-time year being undertaken over the course of the reporting period 1 August to 31 July. The FTE is therefore counted using a population of staff who were active during the reporting period, not just on a given snapshot date.

Contract level and academic employment function combine to identify the different types of staff described in this report. From 2012/13, staff with the contract level of 'F1 Professor' constitute the 'Professors' category in the analysis; prior to 2011/12, a separate Professor marker was available. The two are not directly comparable. Other staff (i.e. those not identified as Professors) with an academic employment function of either 'teaching' or 'teaching and research' are counted as 'senior lecturers/lecturers', while those with an academic employment function of 'research only' are counted as 'researchers'.

7. Appendix B: Benchmarking data – women in mathematics by quartile

The following tables show quartiles for the proportion of females at various stages of the mathematical sciences pipeline, by institution. Data are provided to facilitate departmental benchmarking. Further benchmarking data is published separately by the London Mathematical Society, alongside this report.

Table 28: Proportion of first degree Mathematical Sciences graduates who are female, by quartile

Quartile	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Minimum	20.3%	19.4%	19.5%	18.3%	17.6%	16.7%	14.6%	13.8%	15.0%
1st quartile	37.9%	38.5%	38.4%	38.6%	37.3%	36.0%	35.7%	34.8%	33.7%
Median	40.9%	42.6%	42.1%	41.8%	40.9%	40.8%	39.1%	38.3%	39.4%
3rd quartile	45.7%	46.8%	46.6%	45.0%	44.8%	43.6%	44.6%	42.8%	43.0%
Maximum	90.6%	90.0%	89.6%	81.7%	83.5%	82.5%	76.4%	76.4%	78.0%

Source: HESA Student Record

Table 29: Proportion of Masters' degree Mathematical Sciences graduates who are female, by quartile

Quartile	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Minimum	12.9%	18.4%	12.5%	14.7%	17.4%	17.4%	18.9%	13.1%	15.6%
1st quartile	29.4%	29.7%	30.8%	33.4%	29.1%	29.4%	33.9%	33.0%	37.2%
Median	36.9%	39.4%	40.7%	38.5%	37.4%	36.3%	44.0%	40.8%	43.3%
3rd quartile	45.8%	45.0%	45.5%	47.1%	42.8%	41.8%	48.5%	46.8%	47.2%
Maximum	52.6%	51.5%	71.3%	76.8%	70.8%	62.6%	58.5%	60.0%	59.1%

Source: HESA Student Record

Table 30: Proportion of Doctorate Mathematical Sciences graduates who are female, by quartile

Quartile	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Minimum	16.2%	16.1%	15.3%	17.4%	13.8%	15.9%	16.7%	11.5%	14.6%
1st quartile	24.7%	25.8%	26.7%	26.4%	23.0%	22.2%	22.6%	22.9%	21.8%
Median	31.1%	33.2%	33.3%	29.3%	27.4%	27.8%	26.1%	28.8%	30.7%
3rd quartile	35.6%	38.0%	38.6%	37.1%	33.1%	34.0%	34.8%	34.8%	34.5%
Maximum	56.2%	54.7%	46.9%	46.5%	41.4%	46.2%	48.0%	43.9%	47.7%

Source: HESA Student Record

Due to relatively small student numbers in many institutions, the proportion of females among other postgraduates and other undergraduates is not shown.

Table 31: Proportion of lecturers/senior lecturers in the Mathematics cost centre who are female, by quartile

Quartile	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Minimum	5.4%	4.3%	0%	3.6%	2.8%	3.2%	4.7%	4.9%	7.1%
1st quartile	9.5%	9.9%	9.9%	11.0%	10.2%	11.0%	11.7%	13.7%	14.0%
Median	14.7%	16.2%	18.4%	16.0%	17.6%	19.4%	17.9%	18.2%	18.8%
3rd quartile	20.7%	23.5%	24.3%	23.2%	26.0%	24.5%	22.8%	24.0%	24.3%
Maximum	39.0%	39.0%	39.5%	43.9%	45.6%	43.7%	40.6%	47.5%	48.4%

Source: HESA Staff Record

Due to relatively small staff numbers in many institutions, the proportion of females among professors and research-only staff is not shown.

8. Appendix C: Benchmarking data – UK HEIs by quartile

The following tables show the distribution of UK Higher Education institutions by level of their mathematical sciences departments' Athena SWAN application and the proportion of females at various stages of the mathematical sciences pipeline in 2016/17, by quartile. Because of the small number of mathematics departments applying for an award at Gold level, only Bronze and Silver applications are shown, along with institutions with mathematical sciences graduates and/or staff in the mathematics cost centre which have never submitted an Athena SWAN application.

Data suppression rules (designed to protect the confidentiality of individual data subjects) mean that due to small numbers of students and staff at some stages of the mathematical sciences pipeline, many institutions cannot be ranked in this manner. These are counted in the 'Not ranked' column.

Table 32: Number of UK Mathematical Sciences departments by Athena SWAN application level and proportion of 2016/17 first degree Mathematical Sciences graduates who are female, by quartile

Level of application	Quartile					Total
	Bottom	**Lower middle**	**Top middle**	**Top**	**Not ranked**	
Bronze, successful	7	4	6	3		20
Bronze, unsuccessful	2	2	4			8
Bronze total	*9*	*6*	*10*	*3*		*28*
Silver, successful	2		2	1		5
Silver, unsuccessful	4	3	2	3		12
Silver total	*6*	*3*	*4*	*4*		*17*
No application	5	10	6	14	24	59
Grand total	*20*	*19*	*20*	*21*	*24*	*104*

Source: Ortus Economic Research analysis of Athena SWAN applications and HESA Student Record

Table 33: Number of UK Mathematical Sciences departments by Athena SWAN application level and proportion of 2016/17 Masters' degree Mathematical Sciences graduates who are female, by quartile

Level of application	Quartile					Total
	Bottom	**Lower middle**	**Top middle**	**Top**	**Not ranked**	
Bronze, successful	3	5	2	4	5	19
Bronze, unsuccessful	1			2	4	7
Bronze total	*4*	*5*	*2*	*6*	*9*	*26*
Silver, successful	1		2	1	1	5
Silver, unsuccessful	2	2	3	2	3	12
Silver total	*3*	*2*	*5*	*3*	*4*	*17*
No application	2	1	1		33	37
Grand total	*9*	*8*	*8*	*9*	*46*	*80*

Source: Ortus Economic Research analysis of Athena SWAN applications and HESA Student Record

Table 34: Number of UK Mathematical Sciences departments by Athena SWAN application level and proportion of 2016/17 Doctorate Mathematical Sciences graduates who are female, by quartile

Level of application	Quartile					Total
	Bottom	**Lower middle**	**Top middle**	**Top**	**Not ranked**	
Bronze, successful	5	3	3	3	5	19
Bronze, unsuccessful			1			7	8
Bronze total	5	4	3	3	12	27
Silver, successful	*1*	*2*	*1*	*1*		*5*
Silver, unsuccessful	3	2	4	1	2	12
Silver total	4	4	5	2	2	17
No application				3	32	35
Grand total	*9*	*8*	*8*	*8*	*46*	*79*

Source: Ortus Economic Research analysis of Athena SWAN applications and HESA Student Record

Due to small student numbers in many institutions, the distribution of mathematical sciences departments according to the proportion of females among other postgraduates and other undergraduates is not shown.

Table 35: Number of UK Mathematical Sciences departments by Athena SWAN application level and proportion of 2016/17 lecturers/senior lecturers in the Mathematics cost centre who are female, by quartile

Level of application	Quartile					Total
	Bottom	**Lower middle**	**Top middle**	**Top**	**Not ranked**	
Bronze, successful	6	2	6	3	3	20
Bronze, unsuccessful	1		1	1	5	8
Bronze total	7	2	7	4	8	28
Silver, successful		2	2	1		5
Silver, unsuccessful	3	5		4		12
Silver total	*3*	*7*	*2*	*5*		*17*
No application	1	2	1	3	33	40
Grand total	*11*	*11*	*10*	*12*	*41*	*85*

Source: Ortus Economic Research analysis of Athena SWAN applications and HESA Student Record

Due to small staff numbers in many institutions, the distribution of mathematical sciences departments according to the proportion of females among professors and research-only staff is not shown.

9. Appendix D: Additional Qualitative Analysis Tables

Table 36: Full List of Common Practices

Practice	Proportion of applications
Data gathering	94%
More targeted/proactive recruitment	91%
Promoting postgraduate opportunities	75%
Review/improve promotional material	72%
Review/improve student recruitment activities	72%
Recruitment training	69%
Review/improve promotions processes	69%
Review/improve recruitment materials	69%
Review/improve student support	69%
Review/improve workload allocation	69%
More proactive/targeted approach to career development	66%
Review/improve recruitment processes	66%
Staff mentoring	66%
Improve staff career support	63%
Review/improve staff support information	63%
Review/improve staff support processes	63%
Improve access to relevant information	59%
Improving gender balance	53%
Raise awareness of equality/diversity activity/issues	53%
Review/improve appraisal processes	53%
Review/improve promotions information	53%
Visibility of positive role models	53%
Widen/review SAT membership	53%
Improving academic support for students	50%
Better gender balance of seminar speakers	47%
Improve staff support	47%
Review/improve induction processes	47%
Review/improve training processes	47%
Introduction of core hours	41%
Student funding	41%
Student mentoring	41%
Diversity training	38%
More proactive/targeted approach to promotions	38%
Review/improve outreach	38%
Improve visibility in promoting department	34%
Review/improve flexible working processes	34%
Improving promotions processes	31%
Review/improve information about workload	31%
Outreach activities for females	28%
Raise awareness of Athena SWAN activities	28%

Practice	Proportion of applications
Review/improve committee membership recruitment	28%
Informal networking	25%
Physical surroundings	25%
Staff funding for career development	25%
Gender monitoring of workload	22%
Review/improve career development information	22%
HR training	19%
Improve gender balance in outreach	19%
Improve visibility to current students/staff	19%
Improving careers support for students	19%
Managing Athena SWAN action plan	19%
Outreach in workload allocation	19%
Review/improve research processes	19%
Social events	19%
Student funding for career development	19%
Widen access to meetings/availability of information from meetings	19%
More proactive/targeted approach to training	16%
Outreach activities promoting maths	16%
Promote part time working	16%
Review/improve information for students	16%
Review/improve outreach activities	16%
Raise awareness of achievements	13%
Review/improve appraisal information	13%
Review/improve induction material	13%
Review/improve outreach materials	13%
Workload allocation	13%
Family friendly social events	9%
Improve research support for staff	9%
Improved opportunities for staff feedback	9%
Include Athena SWAN in workload	9%
Knowledge sharing	9%
Review/improve scheduling information	9%
Support/budget for Athena SWAN	9%
Address exit issues	6%
Dedicated outreach roles	6%
Improve staff development opportunities	6%
More proactive/targeted approach to flexible working	6%
More support for outreach activities	6%
Promoting part-time study	6%
Promotions training	6%
Raise awareness of Athena SWAN activities	6%
Recruiting overseas students	6%
Widening staff participation	6%

Practice	Proportion of applications
Workload model	6%
Childcare support	3%
Core hours	3%
Development opportunities for students	3%
Improve administration of meetings	3%
Improved appraisal process	3%
Improving appraisal/review processes	3%
Monitoring gender balance	3%
More proactive/targeted approach to promotion	3%
Outreach activities encouraging further maths	3%
Providing funding for research	3%
Review workload	3%
Review/improve maternity support	3%
Review/improve promotion information	3%
Timetabling flexibility for staff	3%
Timings of social events	3%
Unconscious bias	3%
Workload accreditation	3%

Source: Ortus Economic Research analysis of Athena SWAN applications

Table 37: Words/Terms used to Define Departmental Culture by level/success

Word/term	Bronze – Successful	Bronze – Unsuccessful	Silver – Successful	Silver – Unsuccessful	All
Social events	69%	50%	75%	73%	70%
Athena SWAN commitment	46%	75%	75%	82%	67%
Internal communication	54%	25%	50%	27%	42%
Physical environment	31%	25%	50%	18%	30%
Social space	31%	0%	25%	18%	24%
Atmosphere	31%	0%	0%	36%	24%
Open door policy	15%	50%	50%	9%	21%
Diversity training/awareness	23%	0%	25%	18%	18%
Diverse website	15%	0%	25%	18%	15%
Visible role models	15%	0%	25%	18%	15%
Childcare support	8%	25%	0%	18%	12%
Flexible working	15%	0%	0%	9%	9%
Work/life balance	8%	0%	0%	18%	9%
Hierarchy	8%	0%	0%	9%	6%
Females in leadership roles	0%	25%	25%	0%	6%
Networking opportunities	8%	0%	0%	9%	6%
Diverse range of speakers	0%	0%	0%	9%	3%
Decision making processes	0%	25%	0%	0%	3%
Mentoring	0%	0%	0%	9%	3%

Source: Ortus Economic Research analysis of Athena SWAN applications

Table 38: Words/Terms used to Define Departmental Culture by female staff quartile

Word/term	Bottom quartile	Lower middle quartile	Upper middle quartile	Top quartile	All
Social events	67%	73%	82%	40%	70%
Athena SWAN commitment	83%	64%	55%	80%	67%
Internal communication	50%	64%	27%	20%	42%
Physical environment	33%	45%	27%	0%	30%
Social space	17%	45%	18%	0%	24%
Atmosphere	17%	45%	9%	20%	24%
Open door policy	0%	18%	45%	0%	21%
Diversity training/awareness	17%	9%	36%	0%	18%
Diverse website	0%	0%	45%	0%	15%
Visible role models	67%	0%	9%	0%	15%
Childcare support	17%	9%	18%	0%	12%
Flexible working	17%	9%	9%	0%	9%
Work/life balance	0%	9%	18%	0%	9%
Hierarchy	0%	9%	9%	0%	6%
Females in leadership roles	0%	18%	0%	0%	6%
Networking opportunities	0%	9%	0%	20%	6%
Diverse range of speakers	0%	0%	9%	0%	3%
Decision making processes	0%	0%	9%	0%	3%
Mentoring	0%	9%	0%	0%	3%

Source: Ortus Economic Research analysis of Athena SWAN applications

Table 39: Mechanisms for Measuring Culture by level/success

Word/term	Bronze – Successful	Bronze – Unsuccessful	Silver – Successful	Silver – Unsuccessful	All
Staff survey responses	69%	100%	75%	64%	73%
Number of social events	31%	25%	0%	18%	24%
Student survey responses	23%	25%	25%	18%	24%
Percentage of female speakers	15%	0%	50%	27%	21%
Attendance at events	23%	0%	25%	9%	15%
Diversity training rates	8%	25%	0%	18%	15%
Gender balance of department	8%	50%	0%	9%	12%
Student awards	15%	0%	0%	18%	12%
Staff awards	0%	0%	25%	18%	9%
Number of staff working flexibly	8%	0%	0%	9%	6%
Informal staff feedback	0%	0%	25%	9%	6%
Engagement with Athena SWAN	0%	0%	25%	0%	3%
Number of female role models on website	0%	0%	25%	0%	3%
Webpage views	0%	0%	25%	0%	3%
£s in Professional Development Accounts	0%	0%	25%	0%	3%
Workload points for ED&I	8%	0%	0%	0%	3%
Number of children using childcare provision	0%	0%	0%	9%	3%
REF data	0%	0%	0%	9%	3%
Percentage of staff with caring responsibilities	0%	25%	0%	0%	3%

Source: Ortus Economic Research analysis of Athena SWAN applications

Table 40: Mechanisms for Measuring Culture by female staff quartile

Word/term	Bottom quartile	Lower middle quartile	Upper middle quartile	Top quartile	All
Staff survey responses	67%	64%	82%	80%	73%
Number of social events	17%	45%	9%	20%	24%
Student survey responses	17%	18%	36%	20%	24%
Percentage of female speakers	50%	27%	9%	0%	21%
Attendance at events	17%	9%	9%	40%	15%
Diversity training rates	0%	18%	27%	0%	15%
Gender balance of department	0%	9%	18%	20%	12%
Student awards	33%	18%	0%	0%	12%
Staff awards	17%	9%	0%	20%	9%
Number of staff working flexibly	17%	9%	0%	0%	6%
Informal staff feedback	0%	9%	0%	20%	6%
Engagement with Athena SWAN	0%	0%	0%	20%	3%
Number of female role models on website	0%	9%	0%	0%	3%
Webpage views	0%	9%	0%	0%	3%
£s in Professional Development Accounts	0%	9%	0%	0%	3%
Workload points for ED&I	0%	0%	9%	0%	3%
Number of children using childcare provision	17%	0%	0%	0%	3%
REF data	17%	0%	0%	0%	3%
Percentage of staff with caring responsibilities	0%	0%	9%	0%	3%

Source: Ortus Economic Research analysis of Athena SWAN applications

Table 41: Words/terms used to describe departmental Culture by level/success

Word/term	Bronze - Successful	Bronze - Unsuccessful	Silver - Successful	Silver - Unsuccessful	All
friendly	69%	75%	50%	73%	70%
diverse/diversity	62%	75%	75%	64%	67%
supportive	46%	50%	50%	91%	64%
equal/equality	69%	75%	50%	55%	64%
inclusive	69%	75%	50%	36%	58%
excellence	31%	50%	25%	27%	33%
welcoming	46%	0%	25%	0%	24%
respectful	15%	25%	25%	9%	15%
positive	23%	0%	0%	18%	15%
open	8%	25%	25%	9%	12%
fairness	8%	25%	0%	18%	12%
dynamic	15%	25%	0%	9%	12%
safe	15%	0%	25%	0%	9%
flexible	0%	0%	0%	27%	9%
informal	15%	0%	0%	9%	9%
happy	8%	0%	0%	9%	9%
stimulating	15%	25%	0%	0%	9%
proud	8%	0%	0%	9%	6%
outstanding	0%	0%	25%	9%	6%
inspiring	0%	25%	0%	9%	6%
caring	0%	0%	25%	0%	3%
approachable	0%	0%	0%	9%	3%
help	0%	0%	0%	9%	3%
dignity	0%	0%	25%	0%	3%
productive	8%	0%	0%	0%	3%
competitive	0%	0%	0%	0%	3%

Source: Ortus Economic Research analysis of Athena SWAN applications

Table 42: Words/terms used to describe departmental Culture by female staff quartile

Word/term	Bottom quartile	Lower middle quartile	Upper middle quartile	Top quartile	All
friendly	50%	73%	73%	80%	70%
diverse/diversity	83%	73%	64%	40%	67%
supportive	67%	64%	45%	100%	64%
equal/equality	67%	45%	91%	40%	64%
inclusive	67%	64%	55%	40%	58%
excellence	50%	36%	36%	0%	33%
welcoming	50%	9%	27%	20%	24%
respectful	17%	18%	18%	0%	15%
positive	17%	9%	27%	0%	15%
open	17%	9%	18%	0%	12%
fairness	17%	9%	9%	20%	12%
dynamic	17%	9%	18%	0%	12%
safe	17%	9%	9%	0%	9%
flexible	0%	9%	9%	20%	9%
informal	0%	9%	18%	0%	9%
happy	17%	9%	0%	20%	9%
stimulating	17%	0%	9%	20%	9%
proud	17%	0%	9%	0%	6%
outstanding	17%	9%	0%	0%	6%
inspiring	0%	9%	9%	0%	6%
caring	0%	9%	0%	0%	3%
approachable	0%	0%	0%	20%	3%
help	0%	0%	0%	20%	3%
dignity	0%	9%	0%	0%	3%
productive	17%	0%	0%	0%	3%
competitive	0%	9%	0%	0%	3%

Source: Ortus Economic Research analysis of Athena SWAN applications

Table 43: Average number of terms defining culture by level/success

Theme	Bronze – Successful	Bronze – Unsuccessful	Silver – Successful	Silver – Unsuccessful
Defining culture	3.8	3.0	4.3	4.0
Measuring culture	2.1	2.5	3.3	2.4
Describing culture	5.3	5.5	4.8	5.0

Source: Ortus Economic Research analysis of Athena SWAN applications

Table 44: Average number of terms defining culture by female staff quartile

Theme	Bottom quartile	Lower middle quartile	Upper middle quartile	Top quartile
Defining culture	3.8	4.4	4.3	1.8
Measuring culture	2.7	2.5	2.1	2.4
Describing culture	6.2	4.6	5.5	4.4

Source: Ortus Economic Research analysis of Athena SWAN applications

10. Appendix E: Participating departments

33 departments participated in the research:

- Department of Mathematical Sciences, University of Bath
- Department of Economics, Mathematics and Statistics, Birkbeck, University of London
- School of Mathematics, University of Birmingham
- Department of Mathematics, University of Bristol
- Faculty of Mathematics, University of Cambridge
- School of Mathematics, Cardiff University
- Department of Mathematical Sciences, Durham University
- School of Mathematics, University of East Anglia
- Department of Mathematics and Computer Science, University of Exeter
- Department of Mathematics, Statistics and Actuarial Science, University of Kent
- Department of Mathematics, King's College London
- Department of Mathematics and Statistics, Lancaster University
- Faculty of Maths and Physical Sciences, University of Leeds
- Department of Mathematics, University of Leicester
- Mathematical Sciences Department / Mathematics Education Centre, Loughborough University
- Department of Mathematics, London School of Economics
- Department of Mathematics, University of Manchester
- Department of Mathematical Sciences, University of Nottingham
- Department of Mathematics and Statistics, Open University
- Mathematical Institute, University of Oxford
- Department of Mathematical Sciences, Queen Mary University of London
- School of Mathematical, Physical, and Computational Science, University of Reading
- Department of Mathematics, Royal Holloway, University of London
- School of Mathematics and Statistics, University of Sheffield
- School of Mathematics, University of Southampton
- School of Mathematics and Statistics, University of St Andrews
- Department of Computing Science and Mathematics, University of Stirling
- Department of Mathematics and Statistics, University of Strathclyde
- Department of Mathematics, University of Sussex
- Department of Mathematics, University College London
- Department of Engineering, Design and Mathematics, University of the West of England, Bristol
- Mathematics Institute, University of Warwick
- Department of Mathematics, University of York

11. Appendix F: Evidence-based practices

Evidence-based example	Challenge	Action	Output/outcome	Evidence	Theme
Evidence-based: Improved promotion applications and success rates by women and men since AS bronze award.	Increase the number of female staff across all staff grades	A range of actions designed to ensure that all staff are aware of the University promotion process , for example regular communications regarding procedures and deadlines, and how to obtain support and mentoring.	Improved promotion applications and success rates by women and men: 4 out of 7 women (57%), 11 out of 16 men (68%), indicating no gender bias	Staff survey	Improve numbers
Evidence-based: One SAT proposed and secured a policy on financial support for childcare during conference attendance and has received and approved three successful applications for support	Encourage more women to attend conferences as part of their career development	The creation of a childcare conference grant to cover childcare costs for conference attendance.	The initiative has already supported a number of staff who might otherwise have had difficulty attending conferences	Internal information	Improve numbers
Evidence-based: At the post-offer Visit Days where, additionally, UG applicants attend a talk by two current students (but never by two male students). Surveys show this is the most popular and influential element of the day, with 93% of attendees showing a positive experience.	Attracting/retaining greater numbers of female students	Improve the visibility of female role models at open days and post-offer visit days (e.g. ensure a lecture is given my at least one female staff member, display picture so male and female staff, highlight Athena SWAN and success of female students, enhance diversity messages on admission materials and web pages)	The proportion of offers accepted by female students greatly increased	Internal information	Improve numbers

Evidence-based example	Challenge	Action	Output/outcome	Evidence	Theme
Evidence-based: Strong evidence that encouraging more female undergraduates to study the 4-year Masters programmes is working, with female Masters graduates rising from 24% to 43% over three years.	Improving the number of women going on to further study (i.e. staying in the pipeline)	Personal tutors to encourage undergraduates to consider MSci and postgraduate studies	The number of female students progressing to the 4-year MSci programmes is increasing, with female MSci graduates rising from 6 (24%) to 20 (43%) over three years	Internal information	Improve numbers
Evidence-based: Changes were made to the format of open days after a survey indicated that female UGs were less impressed than male UGs by their first visit to the campus. Changes included increasing visibility of female staff and students and explicitly referencing the commitment to AS. Subsequent surveys indicate that these changes have been a success, with a much higher level of satisfaction reported.	Attracting/retaining greater numbers of female students	Improved the experience of potential female applicants at Open Days. Female staff and student volunteers are well represented and the department's commitment to gender equality is outlined in presentations and leaflets.	Proportion of students who had attended Open Days and reported being impressed has increased	Student survey	Improve numbers
Evidence-based: In its first year of operating, 100% of the student intake for a new course was male. Following this, the department consulted with the London Mathematical Society (LMS) Women in Mathematics Committee to improve gender balance in recruitment materials, webpages, and interviews with female staff, corresponding with measures taken for UG recruitment. 50% of the next cohort was female and has remained high.	Attracting/retaining greater numbers of female students	Consulted with the London Mathematical Society (LMS) Women in Mathematics committee to improve gender balance in recruitment materials, CDT webpages, and interviews with female staff, corresponding with measures taken for UG recruitment	Improve proportion of female undergraduate students from 0% to 50%	Internal information	Improve numbers

Evidence-based example	Challenge	Action	Output/outcome	Evidence	Theme
Evidence-based: A department had developed a proactive recruitment strategy to encourage women to apply. For example, using carefully worded advertising materials and by encouraging all staff to approach research leaders worldwide asking for suggestions of possible candidates. This approach is now reaping success.	Increase the number of female staff across all staff grades	The development of a proactive recruitment strategy which targets women, including carefully wording advertising materials and encouraging all staff to approach research leaders worldwide asking for suggestions of possible candidates	50% of new appointments were women	Internal information	Improve numbers
Evidence-based: Changing the format and content of training courses following on from a history of low attendance from graduate students in particular. The weekly seminar series preceded or followed by a social event resulted in a much higher uptake.	Improving career development for staff in order to improve retention	A fundamental overhaul of the format and timing of training sessions (including induction)	The proportion of research staff and research students attending training sessions has increased	Internal information	Improve numbers/experience/ culture
Evidence-based: One department set up a new initiative to offer eight postdoctoral 'career development fellowships' which were designed to offer greater opportunities for career progression: the researcher would not be tied to a particular research project and would be free to conduct their own research programme. The positions were thus seen as a very attractive 'step up', allowing greater opportunity for progression to a permanent academic role. The eight positions drew a very strong field of applicants and two of the new appointments were women. Both of these postholders have now secured highly prestigious positions.	Increase the number of female staff across all staff grades	A new initiative to offer eight postdoctoral 'career development fellowships' which were designed to offer greater opportunities for career progression	The 8 positions drew a very strong field of applicants and 2 of the new appointments were women (both of which have now secured highly prestigious positions).	Internal information	Improve numbers/experience

Evidence-based example	Challenge	Action	Output/outcome	Evidence	Theme
Evidence-based: One department has a Grants Director who provides support to all new staff writing their first grants, including both a grants workshop and detailed individual feedback on drafts. This has helped increase the grant capture of the department considerably over the last few years.	Increase the number of female staff across all staff grades	The department has established a Grants Director who provides support to all new staff writing their first grants, including both a grants workshop, held for groups of staff from time to time as needed, and detailed individual feedback on drafts.	Considerable increase in the grant capture of the school over recent years	Internal information	Improve numbers/experience
Evidence-based: one maternity returner was awarded teaching replacement money, to allow protected research time upon return, and found this very beneficial to her career development.	Ensure that those returning from maternity/parental leave are fully supported	A 'Returning Carers' has been established which allows staff to apply for up to £10k to support their return to research.	A maternity returner was awarded teaching replacement money, to allow protected research time upon return, and found this very beneficial to her career development.	Internal information	Improve numbers/experience/culture
Evidence-based: By periodically reminding seminar organisers about the target to increase the number of female speakers and requiring them to report progress, there has been success in increasing the female representation for academic seminar speakers.	Attracting/retaining greater numbers of female students	Periodically reminding seminar organisers about the target to ensure that 20% of speakers at seminars/workshops are women and requiring them to report progress	Increase in the female representation for academic seminar speakers (from 14% to 22% over three years), with similar increases for workshops	Internal information	Improve numbers/culture