more maths grads

INCREASING THE SUPPLY OF MATHEMATICAL SCIENCES GRADUATES

Final Proposal

A bid to the Higher Education Funding Council for England

2006

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OVERVIEW

1 Introduction

The mathematical sciences community proposes a project to be taken forward following publication of the final report of the HEFCE Chief Executive's Advisory Group which considered strategically important and vulnerable subjects. The proposal is submitted to the Strategic Development Fund to align with HEFCE's strategic aim to promote and provide the opportunity of HE to everyone who can benefit from it. Three lead Higher Education Institutions (HEIs) in three regions provide the focus for this project working with the Higher Education Academy (HE Academy) Mathematics, Statistics and Operational Research (MSOR) Network based at the University of Birmingham. The project has been developed following a six-month exploratory investigation funded by HEFCE. This funding has enabled the proposal to be developed based upon a wide consultation among the mathematical sciences community, including industry, through four regional workshops and by utilising the existing wide-reaching communication mechanisms afforded by the lead organisations directly involved in this proposal.

2 Project Summary

This project seeks funding from the Strategic Development Fund in support of HEFCE's strategic aim to promote and provide the opportunity of HE to everyone who can benefit from it.

The overall aims of the project are:

1. To widen participation within the mathematical sciences from groups of learners who have not previously been well represented in Higher Education.

2. To increase the supply of mathematical science graduates in England so that the demands of industry, commerce and education might be better met.

The protection of vulnerable and strategically important subjects will be more robust if action is taken to increase demand for these subjects in HE.

The proposal is to embed, within three designated regions, four aspects of support for school and college students to gain, and then sustain, their interest in the mathematical sciences and to encourage them to study the mathematical sciences in Higher Education. The four strands of activity proposed are as follows:

- **Careers theme:** Promotion of information about the wide-ranging relevance and applicability of mathematics and the breadth of career opportunities open to graduates from the mathematical sciences.

- **Student theme:** Enrichment activities, aimed directly at students to encourage them to raise their aspirations and attainment levels in the mathematical sciences and to consider the study of mathematical sciences in Higher Education.

- **Teaching theme:** Support for mathematics teachers to enable them to raise the aspirations and the attainment level of their students.

- **HE Curriculum theme:** A review of the nature of the Higher Education curriculum in the mathematical sciences to ensure that it is suited to a wide range of students.

Three regions, **West Midlands, Yorkshire and Humberside** and **London**, have been chosen for the proposed first phase project which will run over a period of three years. Within these regions specific areas, one in each region, which meet the criteria for widening participation, have been targeted for this work. Three lead HEIs are involved: **Coventry University, University of Leeds, and Queen Mary, University of London**. In addition, **Sheffield Hallam University** will provide expertise in relation to the HE Curriculum theme and will work on a national scale. At the end of the first phase of activity, it is intended to extend the project more widely to other regions in England. One of the outcomes from the first phase of activity will be a series of recommendations as to how this may be successfully achieved.

The project will work closely with the relevant regional contacts for the Aimhigher network, Action on Access, the National Centre for Excellence in the Teaching of Mathematics (NCETM) and the Science, Engineering, Technology and Mathematics Network (SETNET). Other relevant organisations, both regional and national, such as the Specialist Schools and Academies Trust and the Science, Engineering Manufacturing Technologies Alliance (SEMTA) will be important for the activities undertaken as part of this proposal. Details on the support of these organisations for this project, including how they will contribute to its activities, are contained within the appendices to this proposal.

The project will be based alongside the Higher Education Academy MSOR Network at the **University of Birmingham**. It will be managed at a strategic level by members of the Network based in Birmingham, and the day-to-day running of the project will be overseen by a full-time Project Manager who will also be based in Birmingham.

The funding requested for the project is **£3,300,000** for a period of three years.

3 Lead Participants & Partners

The lead HEIs for the proposed project are as follows:

University of Birmingham;
Coventry University;
University of Leeds;
Queen Mary, University of London;
Sheffield Hallam University.

These HEIs have demonstrated their commitment to this proposal by accepting a reduced figure as a contribution towards Full Economic Costs (fEC). Details can be found within Section 19.

To oversee the preparation of this proposal and to ensure views from across the mathematical sciences community were represented, a Steering Committee was established with the following organisations as members:

Institute of Mathematics and Its Applications (IMA);
London Mathematical Society (LMS)
Royal Statistical Society (RSS);
Heads of Departments of Mathematical Sciences in the UK (HoDOMS);
Higher Education Academy Mathematics, Statistics and Operational Research (MSOR) Network.

These organisations have all agreed to continue their involvement with the project should this proposal be successful, including a financial commitment. Details can be found in Section 19.

In addition, the Steering Committee for the preparation of this proposal also included representatives from:

Advisory Committee on Mathematics Education (ACME);
Further Education (FE) Sector;
Widening Participation Directorate at HEFCE.

The mathematical sciences has a number of different professional bodies covering different aspects of the discipline, and collaborative working has been important for bid preparation. In addition to these bodies, at the delivery stage of the project there are a number of others who will be key to ensuring the success of the initiatives detailed within this proposal. The newly established NCETM and the Specialist Schools and Academies Trust will provide a national network with links to both schools and teachers which we will use in this project. Aimhigher and Action on Access have helped in identifying the areas, and schools within these areas, in which we will work and we will continue to work with them as the project progresses. The regional SETNETs will be important partners in offering appropriately tailored activities and resources, engaging both students and teachers, and ensuring effective dissemination.

In terms of employer input we have, to date, identified four national employers who have agreed to be involved in the activities detailed within this proposal: **Rolls Royce plc**; **Thales UK**; **QinetiQ**, and **Ford UK**. These organisations have agreed to identify, and contribute, appropriate personnel to assist the

activities and initiatives offered to the schools and colleges within the pilot regions in support of the aims of this proposal.

We will also work with SEMTA and, through them, the other Sector Skills Councils as mathematical careers appear in a wide cross-section of the employment sector. Local SETPOINTS and HEIs, via their alumni networks, will offer excellent links to appropriate contacts within industry to ensure that the outputs of the project are relevant to this sector. The local Regional Development Agencies (RDAs) are also to be involved with the project and have been consulted to this effect.

A number of individual HEIs have also expressed a desire to be involved in the activities detailed within this proposal. These include:

- **University of Bath**: Department of Mathematical Sciences
- **University of Bristol**: Department of Engineering Mathematics
- **Brunel University**: School of Information Systems Computing and Mathematics
- **Durham University**: Department of Mathematical Sciences
- **University of Exeter**: School of Engineering, Computer Science & Mathematics
- **University of Greenwich**: Department of Mathematical Sciences
- **University of Hertfordshire**: School of Physics, Astronomy and Mathematics
- **University of Leicester**: Department of Mathematics
- **University of Liverpool**: Department of Mathematical Sciences
- **Loughborough University**: Department of Mathematical Sciences
- **University of Manchester**: School of Mathematics
- **University of Newcastle**: School of Mechanical & Systems Engineering
- **University of Nottingham**: School of Mathematical Sciences
- **University of Oxford**: Mathematical Institute
- **Oxford Brookes University**
- **University of Paisley**: Mathematics & Statistics
- **University of Plymouth**: School of Mathematics & Statistics
- **University of Portsmouth**: Department of Mathematics
- **University of Reading**: Department of Mathematics
- **University of Southampton**: School of Mathematics
- **Staffordshire University**: Faculty of Computing, Engineering and Technology
- **University of Surrey**: Department of Mathematics
- **University of Warwick**: Department of Mathematics
- **University of the West of England**: School of Mathematical Sciences
- **University of Wolverhampton**: School of Computing and Information Technology

Other organisations that have offered support to the project are:

- Engineering Professors' Council
- Institute of Physics

BACKGROUND TO THE PROPOSAL

4 Background

4.1 Role of mathematics

Mathematics is a compulsory part of the National Curriculum for all Key Stages. This is both an advantage and a disadvantage in terms of promoting the value of the mathematical sciences. Mathematics is perceived by many students as being hard, boring, not relevant to their future and not leading to employment [1]. Despite many students finding mathematics hard, there is clear evidence that the current curriculum fails to stretch and inspire the more able student [1].

4.2 Numbers taking mathematics at school

Although many disciplines in Higher Education either require or prefer A-level mathematics as an admission qualification, the number of entries to A-level mathematics has shrunk from nearly 85,000 in 1989 to around 53,000 in 2004. Over the same period, the total number of A-level entries has increased significantly, consequently the percentage of Mathematics entries compared to the total A-level entries has fallen over this time from 12.8% to 6.9%. This is illustrated in Figures 1 and 2.

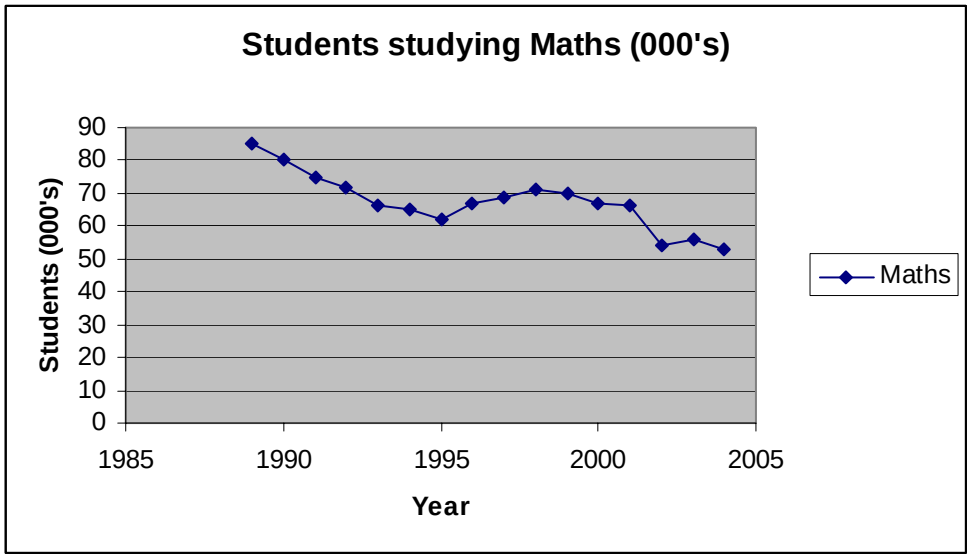

Figure 1: Source QCA Website (1992-2001) JCGQ website (2002-2004)

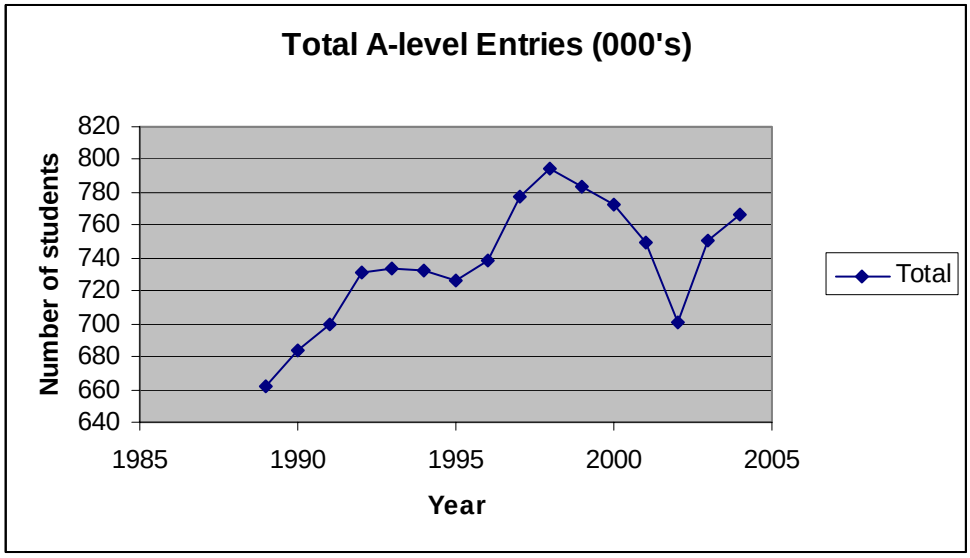

Figure 2: Source QCA Website (1992-2001) JCGQ website (2002-2004)

A recent report by the Qualifications and Curriculum Authority (QCA) [2] on an evaluation of participation in mathematics post-16 comments on this decline. They report that: "there is no doubt that numbers participating in mathematics at A level have declined over recent years. Currently approximately 50% of the GCSE cohort achieve mathematics at grades A*–C, a figure of around 300,000. However, in 2004 only about 63,000 went on to take AS level: of these about 41,500 sat the A level with about 66% of the total taking AS and only about 14% of the GCSE cohort achieving A*–C".

The decline in student numbers studying mathematics also has implications for other subjects in Science and Technology as mathematics underpins many other disciplines such as Chemistry, Physics and Engineering. Those involved in the teaching of Physics and Engineering within HE have spoken of a mathematics problem for some time, particularly at the transition to university study.

4.3 Numbers taking mathematical sciences in HE

Data from the Higher Education Statistics Agency (HESA), given in Appendix 1, shows that the overall number of full-time UK and EU starters studying the mathematical sciences has fallen from 9196 in 1998 to 7985 in 2004, a drop of approximately 13%.

There has been some confusion over the trends in the numbers of undergraduates within the mathematical sciences over the last few years. This uncertainty has arisen primarily as a result of a change in the coding system used by the HESA in 2002-3. A recent study carried out by the LMS on behalf of the community [3] into participation within the mathematical sciences has identified these anomalies and shows that as a percentage of overall students, the number taking mathematics has fallen significantly.

4.4 Strategically important and vulnerable subjects

In June 2005 HEFCE published the report of the Chief Executive's Advisory Group on Strategically Important and Vulnerable Subjects [4]. The report states that *mathematics has seen a fall in activity of 9.3% or 1800 FTEs* measured from 1999-2000 to 2003-04. Mathematics, along with the other STEM subjects (Science, Technology, Engineering and Mathematics) are defined as nationally strategic and important subjects. This project will propose interventions to support mathematics, which in turn will serve to support the other STEM subjects.

4.5 Smith report

In February 2004, 'Making Mathematics Count', the report of the enquiry for the Department for Education and Skills (DfES) into post-14 mathematics education, headed by Professor Adrian Smith [1], was published. The covering letter states that: "it is deeply disturbing that so many important stakeholders believe there to be a crisis in the teaching and learning of mathematics".

The report highlighted three main areas of concern: curriculum and qualifications; a serious shortage of qualified mathematics teachers in schools; and, the lack of an appropriate infrastructure for the continuing professional development of mathematics teachers.

Work is underway across the sector to address the recommendations generated by the Smith report. In particular the Qualifications and Curriculum Authority (QCA) with advice from ACME are looking at the GCSE Mathematics curriculum and at Functional Mathematics. Improvements to the mathematics curriculum will undoubtedly have an impact upon the outcomes of this project. It should be noted, however, that any major changes to the 14-19 mathematics curriculum are unlikely to occur during the lifetime of this project.

Recommendations key to this project, as outlined in Professor Smith's report, are as follows:

- **Recommendation 2.7**: The Inquiry recommends that a significant number of places in the Student Associate Scheme be earmarked for undergraduates on degree courses in mathematics or courses involving a substantial component of mathematics;
- **Recommendation 6.3**: The Inquiry recommends that a programme be established to pay selected volunteer undergraduate and postgraduate students in disciplines with high mathematical content to support teachers of mathematics in schools and colleges;
- **Recommendation 6.5/6**: The Inquiry recommends that the national support infrastructure provide appropriate resources to seek ways to promote sustainable closer links between HEI mathematics (and other relevant) departments and mathematics teachers in their local schools and colleges. The Inquiry recommends that in the detailed planning of the national support infrastructure for the teaching and learning of mathematics particular attention should be given to involving the relevant experience and expertise of the Open University;
- **Recommendation 6.7/8**:The Inquiry recommends that overall strategy for and coordination of the networking and other CPD developments relating to the mathematics elements of specialist schools be brought under the auspices of the national support infrastructure for the teaching and learning of mathematics. The Inquiry recommends that the remit of the national infrastructure include responsibility for encouraging and evaluating independent initiatives in the teaching and learning of mathematics and for funding and managing dissemination of successful initiatives more widely across the school and college system;
- **Recommendation 6.9**: The Inquiry recommends that the national infrastructure work with SETNET to improve the provision of mathematics enrichment and careers advice resources provided through SETNET;
- **Recommendation 6.12**: The Inquiry recommends that the national infrastructure for the support of the teaching and learning of mathematics consist of: a National Centre for Excellence in the Teaching of Mathematics (NCETM) to provide expert advice, resources and information in support of the teaching of mathematics, and to oversee the funding for the development and dissemination of mathematics CPD provision at a strategic level and to coordinate its operation nationally; a network of Regional Mathematics Centres (RMCs) to encourage the formation of local communities of teachers of mathematics and relevant stakeholders across all phases and to oversee and coordinate local delivery of CPD.

4.6 Government Adviser on Mathematics

Following the Smith report the DfES have appointed Professor Celia Hoyles as the Chief Adviser on mathematics. The proposed project has been discussed with Professor Hoyles during its planning period, and her support is indicated as part of Appendix 10.

4.7 National Centre for Excellence in Teaching Mathematics

The Smith report made a number of recommendations concerning CPD for mathematics teachers. One result was that the NCETM was established in October 2005. Professor David Burghes was appointed as NCETM Director in January 2006, although its activities commenced in the latter half of 2005 to establish a regional networking structure. The NCETM will be officially launched in June 2006 with an initial three-year period of activity which coincides well with the timescale proposed for this project.

One emphasis of the NCETM will be to provide a comprehensive Web portal collecting together, and developing, resources that teachers will use for their continuing professional development. The proposed activities of this project will link directly with the activities of the NCETM in that it will provide an opportunity for teachers within targeted schools and colleges to engage with the material made available by the NCETM. It will therefore build upon the recommendations from the Smith report to help encourage the formation of local communities of teachers and relevant stakeholders. The proposed project has been discussed with Professor Burghes who is appreciative of the natural links that will be generated with the NCETM within the pilot regions. One of the main activities of the NCETM will be to kite mark CPD whereas initiatives detailed within this proposal will help teachers identify resources for enrichment to make mathematics more appealing to their students. We have also been in discussion with the Training and Development Agency (TDA) who have expressed their satisfaction that we will be collaborating with the NCETM.

4.8 Teaching in mathematics

The annual report of Her Majesty's Chief Inspector of schools for 2004-5 [5] comments that although the standard of teaching of mathematics for 16-19 year-old students has improved since 1997-98 it is still below the average standard for all subjects. The report also records that there is a distinct lack of engagement and motivation for many Key Stage 4 pupils, resulting in limited take-up of the subject post-16 in many schools.

A recent report (2006) by the National Foundation for Education Research for the Department for Education and Skills [6] has demonstrated that around one quarter of students are taught mathematics (up to GCSE level) by non-specialist mathematics teachers. The report also concluded that there is inequality between schools in the qualifications of staff teaching mathematics and science. Mathematics teachers who were not specialists in the subject were most often found in the lowest attaining schools, those serving areas of socio-economic deprivation and those with an 11-16 age range.

The Ofsted report on Secondary education published in 1998 [7] commented that:

“When teachers are thoroughly in command of their subject, they are able to adapt their teaching to the responses of the pupils, to use alternative and more imaginative ways of explaining, and to make connections between aspects of their subject and with pupils' wider experiences, so capturing their attention and interest. The teacher's ability to answer spontaneous questions is an important factor in generating enthusiasm for the subject."

It is therefore vital that this project looks at both motivation of students directly and also encouragement to teachers so that they may help raise students' aspirations and thereby attainment levels.

4.9 Student profile: gender

The recent QCA report on participation in mathematics at A-level [2] comments that: “there is less success in recruiting girls to AS and A level mathematics than boys”. The HESA statistics show that in the mathematical sciences the proportion of females was around 38% in 2003-04 which was similar to the figure in 1999-2000. This can be compared to the overall gender balance whereby the HE student population is 58% female. There are more females in most subject areas apart from the STEM subjects and the architecture and building disciplines. The project will look to redress the gender balance within the pilot regions. As part of the project outputs a number of case studies demonstrating how females have been successful in mathematical science related careers will be produced, and female presenters will contribute to the school, college and HE based events.

4.10 Student profile: ethnicity

There are differences in the participation rate by ethnic origin. The table below shows the percentages of different ethnic groups for full-time UK and EU degree starters in 2004 for all subjects and for the mathematical sciences. The data was provided by HESA.

Ethnicity	Total students	White	Asian (inc. Chinese)	Black	Other	Unknown
Maths	7985	74.8	14.5	3	2.9	4.8
Total	342769	77.0	9.8	4.6	3.2	5.4

Source: HESA

This shows that participation in the mathematical sciences is lower for White and Black groups but higher for Asian groups. However, the higher figure for students of Asian origin is because the mathematical sciences are relatively popular amongst Chinese and Indian students.

Figure 3 below shows that the ethnicity distribution has remained fairly stable over the years 1998 to 2004, although the overall number of full-time UK and EU starters studying the mathematical sciences has fallen by 13%.

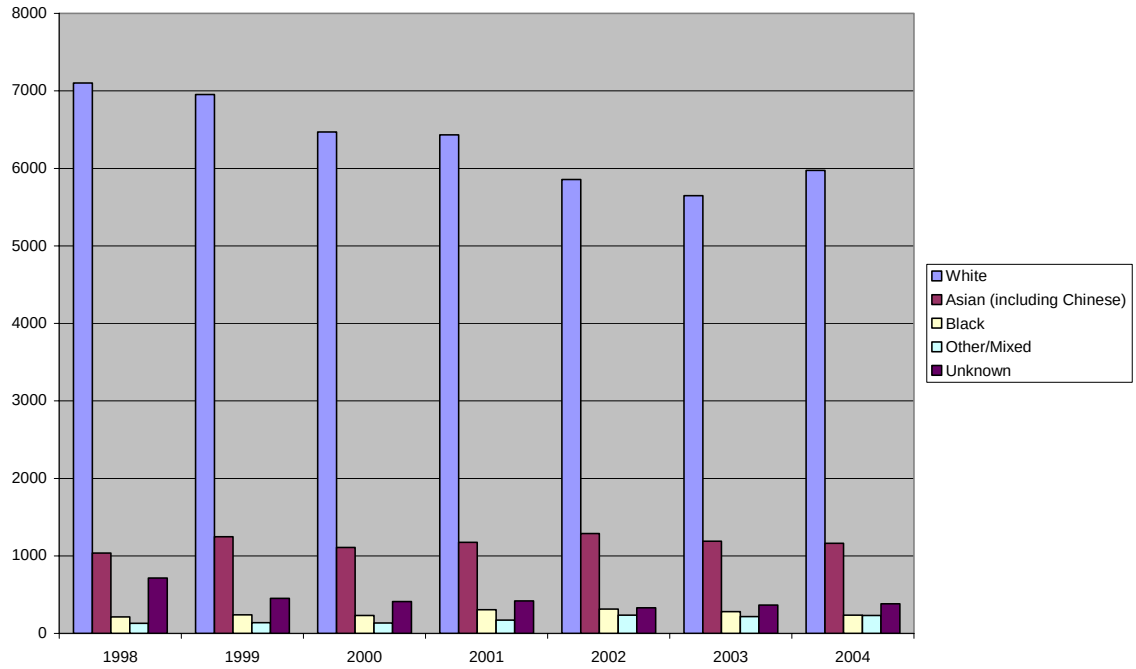

Figure 3: Ethnicity of full time UK and EU starters 1998-2004 (Source HESA)

A recent report published by the Royal Society [7] in April 2005 looked at the attainment of pupils at different stages in mathematics. For example, overall 67% of the 600,398 eligible pupils in 2002 achieved level 5 and above at Key Stage 3 in Mathematics. For the 498,614 students from White ethnic groups 68% achieved level 5 and above, but for students who are from the Black Caribbean (8040), Black African (7003), Pakistani (13,713) and Bangladeshi (5,141) ethnic groups the percentages were 52% or lower. Chinese (1,962) and Indian (13,949) students had higher percentages at 87% and 74% respectively.

There is a need to widen participation in the mathematical sciences at HE level for students from the Black African, Black Caribbean, Pakistani and Bangladeshi groups. In the project we will target schools which have high numbers of students from Black African, Black Caribbean, Pakistani and Bangladeshi backgrounds.

4.11 Student profile: adult returners

HESA data on the numbers of full-time UK and EU starters studying the mathematical sciences and all subjects in 2004 has been analysed by age group. This shows that the students studying the mathematical sciences tend to be younger than the average for students on all subjects. Some students progress through school mathematical examinations at a fast pace and so enter higher education at an earlier age. At the other end of the age range the numbers of older students studying the mathematical sciences are relatively low.

Ages	Total FT students	Under 18/ Unknown	18-21	22-30	31 plus
Maths	7985	4.1	85.7	6.1	4.1
Total	342769	2.6	78.7	12.5	6.2

Source: HESA

Figure 4 shows the position for full-time mathematical science starters from the EU and UK over the period of years 1998-2004 by age group. The situation has remained relatively constant with respect to age groups, with a small decline since 1998 of the proportion aged 22 and over (from 11.4% down to 10.2%).

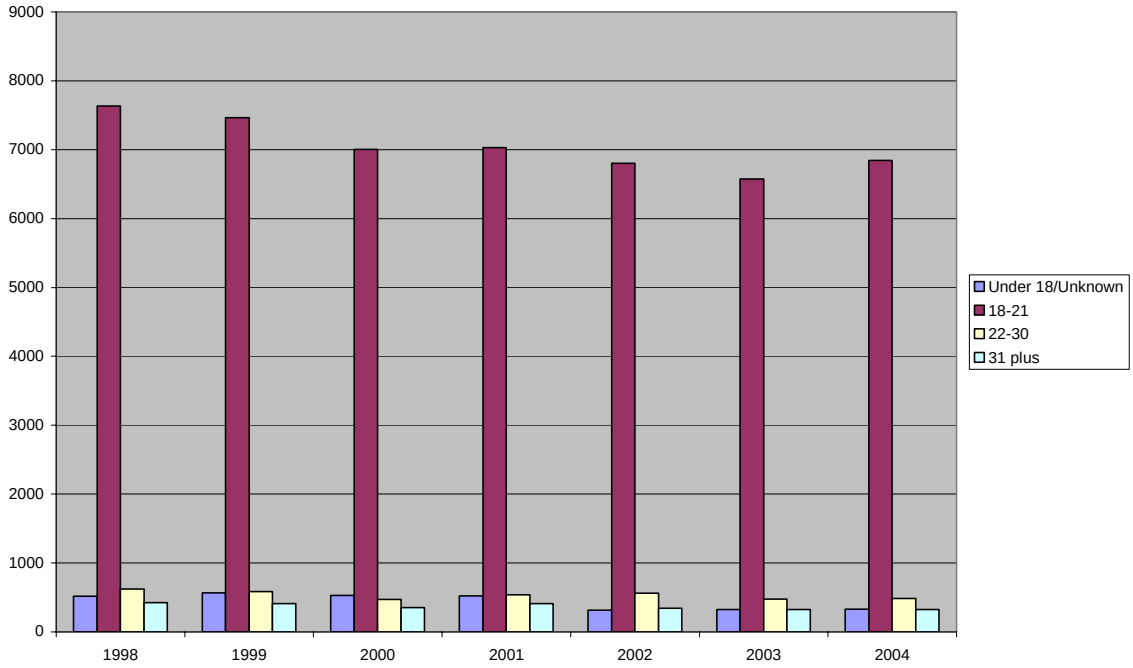

Figure 4: Full-time UK and EU mathematical sciences starters (by age group) 1998-2004
Source: HESA

The table shows that the proportion of students aged over 22 in the mathematical sciences (10.2%) is considerably lower than the average for all disciplines (18.7%) and therefore it is appropriate that this project addresses the issue of provision for this category of learner.

The age distribution amongst part-time students studying the mathematical sciences closely aligns with the age distribution of all part-time students. However, the percentage of part-time students studying the mathematical sciences is significantly lower than the corresponding percentage amongst full-time students. There is therefore a need to increase the total number of part-time students studying the mathematical sciences and since over 90% of such students are aged over 22, this will be most successfully achieved by targeting adult returners.

Ages	Total PT students	Under 18/ Unknown	18-21	22-30	31 plus
Maths	961	1.1	8.3	35.5	55.0
Total	60770	0.5	9.7	33.5	56.3

Source: HESA

Supporting returning adult learners, particularly if they have not studied mathematics for a number of years previously, is one that requires great thought, sensitivity, and consideration of all aspects of the curriculum.

4.12 Student profile: Socio economic classification

HESA have supplied data on full-time UK and EU starters on degrees in the mathematical sciences split by socio-economic classification.

Total	Classification	1	2	3	4	5	6	7	n/a	Unknown
7985	%	22	24	12	6	4	9	3	16	3

Source: HESA

The data in this table shows that the profile of entrants to full-time degrees in the mathematical sciences is heavily weighted towards the higher socio-economic classifications with less than 25% of students in groups 4-7.

The schools that the project will target have been chosen to ensure engagement with pupils from the lower socio-economic classifications.

4.13 Employment opportunities

There is little understanding of the range of careers available in industry and commerce for people with a mathematical sciences degree. This is partly because there are few jobs entitled ‘mathematician’. However, employment prospects for mathematical sciences graduates are very good, particularly for students with wider skills who can communicate mathematical ideas and concepts to non-mathematical people. A mathematician is trained to have good problem formulation and problem solving skills. The mathematician’s approach is often different from approaches developed within other disciplines, thereby making the mathematician uniquely useful to a very wide range of employers. A study at the University of Newcastle, reported in the Times Education Supplement [8], compared the incomes and educational backgrounds of 4,500 people and concluded that having a Mathematics A-level can increase long-term earning power by 7 to 10 per cent.

Several employers have contributed to the development of this project, through their participation in the regional workshops. This employer involvement will be maintained throughout the project, in particular in the careers theme where speakers from local employers will be regularly used in schools. In Section 13 the large employers, who have already committed support to the project, are described. Additional employer participants will be recruited through the professional associations, HEI alumni networks and through working with the relevant SETPOINTs, local RDAs and SEMTA.

4.14 Careers information

When students are making their choices with regard to A-levels and university study they are not aware of the types of careers that follow from studying the mathematical sciences. An NICEC report [9] on choosing science at 16 has many messages which are relevant to mathematics as to how best to address this issue. These include:

- Strengthen the links between mathematics departments and careers departments;
- Give priority to events designed to stimulate interest and to inform students about mathematics in Years 7-10;
- Seek local opportunities for students to have contact with holders of some higher-level jobs relating to mathematics, or who have studied mathematics;

The proposed project will undertake to improve the standard of careers advice offered to pupils within schools and colleges with regard to the opportunities that studying mathematics affords by making this area a major theme of activity.

4.15 International picture

The problem with decreasing numbers of mathematical sciences graduates is one shared internationally. A working group, set up under the Lifelong Learning Policy Development work of the European Commission, published a report on issues of increasing recruitment to scientific and technical studies [10]. In the specific area of mathematics, science and technology the joint report points out the 'persistent shortage of women in scientific and technical fields' and calls on Member States to 'encourage the development of a scientific and technical culture among its citizens'. In particular, action was recommended in order to 'motivate young people, especially girls, to undertake science and technical studies and careers'. One of the targets set was to increase the total number of graduates in mathematics, science and technology in the European Union by at least 15% by 2010 while at the same time the level of gender imbalance should decrease. These findings are consistent with the background picture for the proposed project. The recommendations of the report include:

- There should be encouragement for schools to liaise with universities, parents associations and industry on subject development;
- Partnerships should be seen as 'equal opportunities and reciprocal partnerships' – universities should be able to learn from school partners and school partners from universities;
- Alliances should be formed between stakeholders so as to ensure equitable access pathways to training programmes and employment in the field of Manufacturing, Science and Technology.

The following comments were made by Ken Boston, QCA Chief Executive, to the Advisory Committee on Mathematics Education in March 2006:

“It is worth reminding ourselves that the issues we are facing in this country are common across the western world. We are concerned, quite properly, that after eleven years of mathematics in primary and secondary school, there is still a need to teach many young people ‘functional mathematics’, and that many fail to get a grade C or above at GCSE. …..

To a greater or lesser degree, these are recurring concerns in all the advanced economies, even in the highest performing countries in PISA and TIMSS, such as Singapore, Korea and Hong Kong, as well as in countries which perform at about the same level as us, such as Germany, Sweden and the United States. The problem we have is not a uniquely British issue.”[11]

The USA is also experiencing a drop in the number of mathematical sciences graduates. Figure 5 shows the declining number of mathematics and statistics graduates in the USA over the period 1970-2003. This must be contrasted with the steady rise in graduates from 8.8 million in 1970 to 16.6 million in 2002.

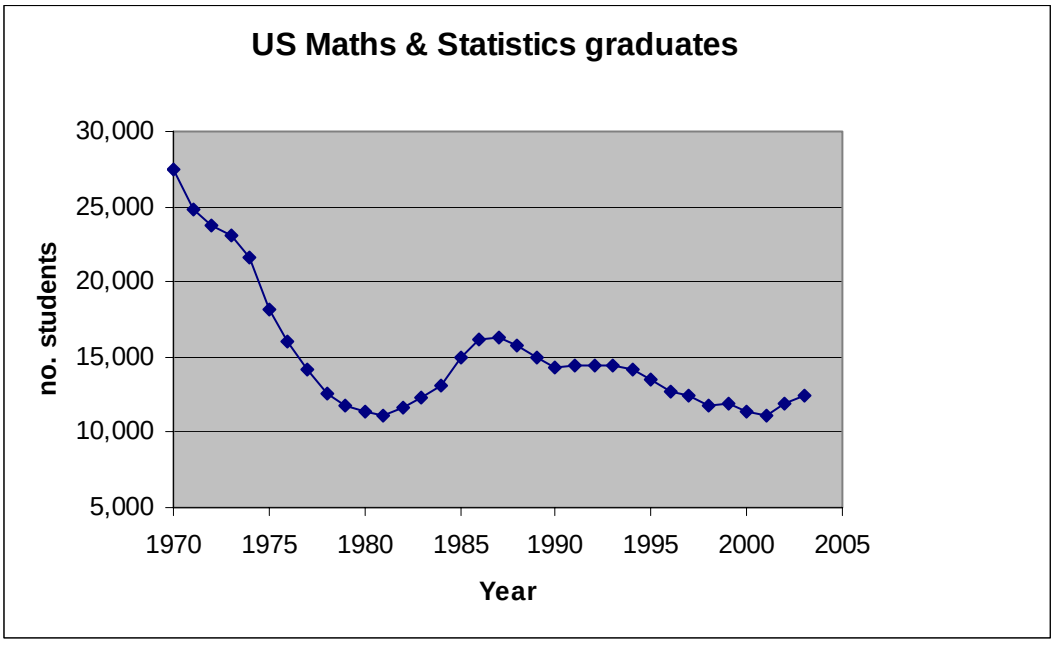

Figure 5: Source: US Government National Center for Education Statistics

4.16 Other partners

Mathematics is one of the STEM subjects and falls under the remit of the SETNET scheme. However, discussions with SETNET personnel have indicated that the remit for Mathematics has been taken up in a rather patchy fashion. It is also important that the wide range of applications for the mathematical sciences is stressed, particularly within the business and finance sectors. These can often be neglected if the mathematics is considered only within the context of science and technology. The project will work closely with SETNET so that the work of this project may complement that of the SETNET teams.

Actions taken through the proposed project will look to address the current issues in conjunction with other key bodies working in this area. The key aims of increasing and widening participation in the mathematical sciences in HE for people who have confidence, attainment potential and aspiration will provide the benefit of increasing numbers on mathematical sciences courses in Higher Education for potential students from all backgrounds.

5 Work of the development phase

5.1 Workshops held autumn 2005

Four workshops were held in the autumn of 2005 in four different regional centres. Attendance overall was around 200 people representing different aspects of the mathematical sciences community. The workshops provided the opportunity for a community-wide consultation not only to identify successful current initiatives upon which the project may build, but also to identify further potential solutions to address the decline in the number of undergraduates within the mathematical sciences. A full list of ideas generated during the workshops is given in Appendix 2 and the attendees at the workshops are listed in Appendix 3. The full list of ideas was evaluated by the Steering Committee as part of the planning process for the project. Good ideas which are not appropriate to be taken forward as part of this proposal will be passed on to more appropriate bodies. However, several ideas were generated or supported by the workshops which will be incorporated into the proposed project.

The ideas to be taken forward may be grouped under four themes of activity:

- Promotion of mathematics through information on the applicability of mathematics and careers;
- Student support to raise aspirations and attainment levels in mathematics;
- Initiatives to help teachers raise student aspirations and attainment levels in mathematics;
- Development of the curriculum in the mathematical sciences in Higher Education to provide opportunities for a wide-range of learners.

One of the key messages to emerge from the workshops is that there is a real need to raise the aspirations of students who, whilst not achieving the highest grades, do perform well (for example, attaining A level mathematics grade C). Such students often believe that they are not capable of undertaking a mathematical sciences degree, when in reality, many HEIs routinely accept such students onto mathematical sciences programmes. Likewise, when choosing A levels, students who have not achieved grade A or A* in GCSE mathematics are often deterred from selecting mathematics. This is echoed in the recent QCA report [2], which cites the problem of targeting only the top set for further study of mathematics.

A crucial element of raising aspirations through interactions with schools is that the activities offered need to be repeated throughout a student's education and with particular emphasis at transition points such as GCSE-AS, AS-A2, and at university application times.

The project will only be able to engage with individual students a few times throughout the academic year and over the three-year period of project activity. One-off activities will only maintain student interest and enthusiasm for a limited period, however, it is important that this enthusiasm is sustained. Teachers have a vital role within this process, since it is the mathematics teacher who has the greatest level of contact with students. Ultimately, it is they who will exert the greatest influence upon their students' perceptions of mathematics. For this reason it is crucial that the project engages directly with teachers in order to enthuse them, so that they may in turn continue to enthuse their students and encourage their further study of mathematics.

5.2 Mathematics resources

As part of the development phase a website www.moremathsgrads.org.uk has been established listing all the initiatives currently underway in the mathematical sciences aimed at promotion, enrichment, enhancement and support for students in the disciplines. This initiative has been widely welcomed and it is proposed that this website should be maintained as part of the project. It is clear that there are a significant number of uncoordinated initiatives underway in various parts of the country and it is important that the good work and practice achieved so far should be built on, as appropriate. Where possible the project will look to build upon existing materials and resources rather than creating new ones entirely from scratch. Delegates at the workshops were asked to ensure that this list was comprehensive and also that the initiatives included were worthwhile. A key principle of this project will be to avoid reinvention of anything that already exists and is fit for purpose.

Ideas and projects that received particularly strong support and which will be built upon in the activities proposed for this project include:

- Student Associate /Undergraduate Ambassador Schemes;
- Millennium Mathematics Project (MMP) and in particular the enrichment materials NRICH and the magazine PLUS which has articles on mathematics and the work that mathematicians undertake;
- Royal Institution Masterclasses. These are offered regionally and teachers select two students each year to participate in these Saturday morning Masterclasses. However, these are aimed at 'high fliers' in mathematics and as part of the wish to widen participation, the project will adapt this successful concept, and will focus upon small group enrichment and enhancement activity for those students in the target schools and colleges who have a reasonable level of mathematical ability but are not necessarily the highest achievers.

- Further Mathematics Network. This is a DfES funded project offering tuition to students in A-level Further Maths who may not otherwise have the opportunity to access such provision.

More details on these, and other projects, is given in Appendix 8.

5.3 Provision for adult returners

As part of the project planning, provision for adult returners in the mathematical sciences was considered. At present, there is limited specialist provision in mathematics available for adult returners wishing to progress to HE in mathematics or other STEM subjects, other than the A level provision in general FE colleges, and even then this is often not accessible due to the scheduling of lessons.

One scheme still in existence is the Polymaths diploma which is accredited by the IMA. This is currently offered by only two centres at the University of Bolton and John Moores University, Liverpool. There are no specific entry requirements for the Polymaths diploma. The course presents mathematics from a modern viewpoint and concentrates on giving an understanding of the structure of mathematics sufficient for entry to a HE mathematical sciences course.

There is only one foundation degree with Mathematics in the title and that is the foundation degree in Computing and Mathematics at London Metropolitan University. This is a two-year course with the third semester spent in industry. The course has been designed to incorporate the skills and knowledge that are increasingly used in industries such as banking and finance, retail management and communications companies. Following completion of the Foundation degree and a bridging course students can progress onto the final year of a mathematics degree course. We have been talking to Foundation Degree Forward and as part of the theme to be pursued on HE Curriculum development will consider further developments in this area.

Mathematics forms part of several access courses allowing entry into the physical sciences, and indeed a small number of students do progress from these onto degrees in the mathematical sciences.

The Open University offers an Openings Programme as part of their commitment to widening participation in HE. This programme aims to recruit students from under-represented groups into Open University study, to enable students to prepare for level 1 entry and to improve the retention of students, particularly from under-represented groups, who then move onto further study with the Open University. Within this programme there are three modules of mathematics study, each of 100 hours and offering 10 credit points. As a next stage, the Open University offers two level-one mathematics courses, each giving 30 credit points, which can be combined to form a Certificate in Mathematics. One module entitled ‘Open Mathematics’ is available to students who have not achieved any recognised level of mathematics in the past whereas the other, ‘Using Mathematics’, is based upon a knowledge of

GCSE. The HESA data on part-time study patterns shows that 81% of part-time HE starters in the mathematical sciences study through Open University programmes. This is compared to 42.5% for all other part-time HE starters.

At present, the provision offered to returning adult learners within the mathematical sciences is not comprehensive and relies almost entirely upon the provision offered by the Open University. The project will work with the Open University as one key source of provision for adult returners studying the mathematical sciences. However, for some adult returners this may not always be attractive as such learners often have low confidence levels and particularly value an even greater amount of face-to-face interaction during their learning than the Open University can offer. One of the areas of activity to be undertaken as part of the HE curriculum theme will look at developing both programmes and mechanisms of support for returning adult learners.

5.4 Careers information

A recent initiative has been the initial development of a careers website, www.mathscareers.org.uk, under the auspices of the Council for Mathematical Sciences (CMS). This website was launched in November 2004 following a small-scale grant from the DfES, but more funding is needed in order to ensure that the site is comprehensive. In particular there is a need to increase the number of career profiles, paying particular attention to issues of gender and ethnicity, highlighting the wide range of careers available after studying for a degree within the mathematical sciences. Despite its limitations, this website has been well received across the community, and in the first eleven months of 2005 received 704,225 hits. Informal feedback indicates that the site appears to be much more use to those looking at careers supported by the mathematical sciences than the Connexions website. As part of the project, we will also work with Connexions, including a sharing of resources and access to the specialist careers contacts, in order to help them develop a further understanding of the careers arising from a study of mathematics.

5.5 Student and teacher views

As part of the planning process, it was felt that in addition to obtaining the views of teachers (primarily via the workshops), it was vital to gain the view of young people on the issues and perceptions surrounding the mathematical sciences. The views of students were obtained by follow-up contact with those teachers who attended the regional workshops, and details of this work are given in Appendix 5. Teachers felt that the reasons why students did not choose to study the mathematical sciences at university, even though they were studying mathematics at A-level included: the subject is hard; they have no natural ability; no passion for maths; they could not see a career for them in mathematics; and, their parents have a negative feeling about studying the subject further. Just under half of the teachers informally surveyed said that they would not know which career to suggest to a student once they had taken a mathematical sciences degree. Around 15% of students said they were considering studying the mathematical sciences at university. However, there were limited ideas as to what career might follow, which clearly

reinforces the need for better careers advice in schools on careers in mathematics. Additional information was gained from students who attended some mathematics Masterclasses in Spring 2006. This emphasised the importance of repeated intervention in helping young people determine their future degree subject.

5.6 Recent meetings

Two meetings held in March 2006 reinforce the ideas contained within this proposal. On 10 March the Royal Society held a conference which investigated mechanisms of increasing the uptake of Science Post-16, including mathematics. The importance of careers knowledge and a good understanding by teachers of mathematics were the key messages to emerge. The role of mathematics in underpinning aspects of the science curriculum was also highlighted.

On 13 March the London Mathematics Centre in conjunction with the Lighthill Institute of Mathematics held a conference exploring the interface between school and HE. Once again, the ideas generated for improving the current situation were similar to those detailed within this proposal. A report of the meeting is given in Appendix 5.

5.7 Other STEM projects

The construction of this bid has been informed through contacts with other STEM projects who are seeking or have obtained funding from HEFCE. Contacts have been made through the HEFCE organised seminars which have provided a forum for a frank exchange of views and ideas. Bid documentation has been shared, providing some new perspectives and pointing to opportunities for co-operation at the delivery stage. To this end, support on the ground notably arising from contacts with the Engineering Professor's Council and the Institute of Physics will be most valuable. Mathematics is a key support subject for the other STEM disciplines, and as one of our intended outcomes is to raise participation in these areas, we will co-operate in the delivery of these projects.

HEFCE has currently funded a number of other similar projects for Engineering, Chemistry, Physics, and proposals are currently being developed for Computer Science and Foreign Languages. It is therefore likely that there will be a level of overlap between the activities of the different projects within a number of regions. In order to minimise the burden upon schools and colleges, one of the first activities to be undertaken by the Project Manager appointed as part of this proposal will be to meet with those leading the other HEFCE funded projects and determine the regions in which their activities will take place. If common schools and colleges are identified between proposals, a strategy will then be developed to ensure co-ordination in the delivery of each project’s activities and initiatives.

THE PROJECT

6 Aims and objectives

The overall aims for this project are:

1. To widen participation within mathematical sciences from groups of learners who have not previously been well represented in Higher Education.

2. To increase the supply of mathematical science graduates in England so that the demands of industry, commerce and education might be better met.

The key objectives to achieve these aims are to:

1. Improve understanding of the wide-ranging applicability of mathematics and the breadth of career opportunities open to graduates from the mathematical sciences.

2. Help school and college students to understand the purpose of mathematical study, to enjoy mathematics, to be confident about meeting challenges in the subject, to raise their aspirations and to realise their potential in mathematics.

3. Contribute to the development of teacher's enjoyment, confidence and knowledge of mathematics and its applications so that they can help stimulate interest in further study of mathematics in their students.

4. Increase the scope of the mathematics curriculum for HE nationally in order to allow real choices for a wide range of students.

If there is success in widening participation in the mathematical sciences in Higher Education, then it follows that there will also be success in increasing the number of mathematical sciences graduates. The two aims of this project, therefore, are intrinsically linked.

In addition to increasing the number of mathematical sciences graduates, there will also be success in other important areas that will be of real benefit for society, such as:

- Increasing the number of students taking mathematics at A-level (or other level 3 qualification), particularly amongst students who have not achieved the highest grades at GCSE;
- Increasing the number of students who progress to the mathematical sciences in HE particularly those with grades other than the highest at A-level;
- Increasing the mathematical achievement of students who may decide to study other STEM related programmes within HE;

- Increasing the number of specialist mathematics teachers in schools by increasing the number of undergraduate students who wish to train as teachers.

7. Location

It is proposed that the project is piloted in three regions. The regions and areas proposed are:

- West Midlands (Coventry and Warwickshire);
- Yorkshire and Humberside (West Yorkshire);
- London (London East);

The lead HE institutions within each of these regions will be:

- Coventry University, Department of Mathematical Sciences;
- University of Leeds, School of Mathematics;
- Queen Mary, University of London, School of Mathematical Sciences;

The Project Manager will be based at the University of Birmingham where they will work closely with the MSOR Network. The MSOR Network has a key central role in promoting good practice across HEIs and is well-established as the primary channel for dissemination throughout the community. This will be beneficial in both the development of the project and the dissemination of its findings.

In London East, we will involve the London Mathematics Centre at the Institute of Education University of London, as this centre is currently undertaking activity directly related to the objectives of this project in, amongst other things, developing a body of mathematics teachers with a high level of confidence in and enthusiasm for their subject.

The HE Curriculum development post will be based at Sheffield Hallam University, but the person appointed will have responsibility for working with the three partner HEIs and with other HEIs throughout England as the project progresses.

There are a number of proposed areas of activity to be taken forward, and this will be more effective if undertaken in a small area in a concentrated way rather than taking one idea forward on a national scale. The generic reasons for this choice of regions are:

- To ensure that widening participation is a relevant feature;
- It is important that a different labour market predominates in each of the three regions chosen;
- There should be HE provision in the mathematical sciences within the region;

- There is already a different profile within each region on the scope and number of previous initiatives offered. This will enable a comprehensive evaluation of measures of success to be undertaken taking into account previous levels of intervention.

The specific features in each area are as follows:

Coventry and Warwickshire:

- There are two Local Education Authorities (LEAs), Coventry and Warwickshire, and schools and colleges with widening participation needs are being targeted with the help of the LEA advisors;
- Coventry University has a Centre for Excellence in Teaching and Learning (CETL) in HE mathematics and statistics support so natural links may be easily established between the work of the CETL and this proposal;
- There has been limited activity in mathematics enrichment in this area so a project of this nature will be breaking new ground;
- Employment opportunities in this area have been changing over recent years.

West Yorkshire:

- West Yorkshire has five LEAs and it is proposed that a school/college in each of these is targeted: Bradford, Calderdale, Kirklees, Leeds and Wakefield. All are areas with parts with low socio-economic indicators;
- The project will link with the SETNET project funded by the GE Foundation on Functional Mathematics in this area (see Section 13);
- Leeds is seen by SETNET as an area where there has been some good mathematics activity already, so schools and colleges are already interested in mathematics thereby providing a good platform on which this proposal can build;
- Employment opportunities in this area have been changing over recent years;

London East:

- London East has six boroughs/LEAs but the project will concentrate on the four boroughs with low socio-economic indicators i.e. Barking and Dagenham, Tower Hamlets, Hackney and Newham;
- The project will link with the London Mathematics Centre at the Institute of Education which has built strong networks for Mathematics teacher education in London and hence has good knowledge of the area;
- The area is within easy reach of many financial institutions which is a key employment factor;
- The project will link with the SETNET project funded by the GE Foundation on Functional mathematics in this area (see section 13).

It is proposed that the activity within each region will start with a phased approach. Activity will commence initially within only one area of the chosen region so as to provide a ‘test bed’ for the validity of the approach adopted. This will allow the approach to be refined if the project evaluation indicates it is

not having the desired impact. Once initial success has been determined, activities will spread to other areas within the region over the three-year period of the project, so that activities are underway in all areas no later than year 3. This will allow sufficient time for all activities to be fully evaluated within each region.

Within all regions, contact has been made with the relevant RDA. This will enable communication links across the region, particularly with local industry and other employers. This is important to the careers theme and the HE curriculum development theme in order to ensure that the requirements of employers are considered.

The proposed project has already been discussed with the Aimhigher regional coordinators and in particular, the relevant area coordinator for each of the regions chosen. Encouragement has been given that we are correct in basing activity within these regions based upon the objectives the project proposes to achieve. The SETNET regional directors for these regions have encouraged us to work within these particular areas, and have offered their support once the activities of the project commence. The SETPOINTs will provide access to a number of presenters for project's activities. This involvement will be helpful for all the themes in this proposal and will help to reinforce the role of mathematics in underpinning the other STEM subjects. In addition, the SETPOINTs, may be commissioned to deliver enrichment and enhancement activities within the themes of this proposal.

The project is targeting seven secondary schools/FE colleges within each region with a typical mix of five schools and two colleges. However, in areas where the school provision is 11-16 and then sixth form or general FE college, *e.g*. Wakefield, slightly more separate institutions will be targeted. In choosing the targeted schools and colleges we have looked at socio-economic class, gender and ethnic diversity issues. The Aimhigher personnel within each of the regions have provided advice with regard to target schools and colleges that meet widening participation criteria.

In addition, one school in the West Midlands will be chosen on the basis that it is an 11-18 school, has traditionally good participation within HE, no widening participation issues and has a strong level of mathematics provision with a large number of students. The purpose of this is to investigate the impact of the project activities upon students who will almost certainly go on to study in HE, but may not necessarily consider studying the mathematical sciences. This will be an essential activity for assisting with the project evaluation, as it will help to 'tailor' the focus of activities offered to the needs of different schools and different groups of learners.

We have also incorporated within the proposal provision for a local contact who will offer advice and guidance on local issues in order to ensure good coordination with other initiatives in the region.

Further descriptions of these areas, including the names of schools and colleges that we are approaching, are given in Appendix 6.

Even though the activities of this project are focussed within three regions, its outcomes will extend far beyond these boundaries even during the first three years of activity. The proposal is to have a number of key individuals working within each region, yet the outcomes from the project will be disseminated nationally with the dominant vehicle for this being the website that has already been established. The project will produce a number of leaflets, guides and publications, and these will be made available electronically for pupils, teachers, careers advisors and parents to use nationally. This will be an important aspect in preparation for a second stage of the proposal where a roll-out to other regions is considered.

8 Target outputs

In this section the target outputs and their relationship to the aims and objectives of the project are considered.

The key aims are to widen participation and increase the number of students studying the mathematical sciences in HE, and therefore activities must be chosen to achieve these aims. The activities undertaken by this project integrate within the four project themes detailed within section 5.1

Within each region we will employ a total of three staff, equating to a total of 2.5 Full-Time Equivalents (FTEs), and a Regional Director. The three staff may be described as follows: Careers Coordinator (1FTE); Subject Coordinator (1FTE), and an Administrator (0.5FTE). A HE Curriculum Developer (1FTE) will be appointed at Sheffield-Hallam University to work, in the first instance, across the three pilot regions, and then on a national scale as the project progresses.

A detailed discussion of these roles, and other key people employed by the project follows in Section 9.

8.1 Careers theme

The careers theme addresses the objective to:

“Improve understanding of the wide-ranging applicability of mathematics and the breadth of career opportunities open to graduates from the mathematical sciences.”

This strand of activity will be the primary responsibility of the Careers Coordinators, and the activities to be undertaken as part of it are:

- **Careers materials**: The Careers Coordinators will develop high quality careers materials such as posters, brochures, leaflets, guides etc. for increasing awareness of the usefulness of mathematics and for helping students understand the range of career opportunities for graduates of the mathematical sciences. This material will be suitable for use within

schools, colleges and universities and will be linked to the national careers website. Local employers, as well as large national (and international) corporations will have direct input into the creation of these materials.

- **Careers Website**: Extensive development of the website www.mathscareers.org.uk will be undertaken to convert it from a static information source into a dynamic and regularly updated site. More careers profiles will be developed with care taken to ensure a good range of role models, in particular taking account of gender, ethnicity and age. By the end of the first year, we will aim to have at least 50 profiles hosted on this site. This website will also be linked to the new science careers website which will reinforce the role of mathematics within other science subjects. However, as mathematics underpins careers in areas such as economics and finance which are not necessarily seen as science based careers these areas will also be covered alongside the more scientific based careers.

- **Connexions**: The Careers Coordinators will work with Connexions both locally and nationally to improve their understanding of careers supported by a study of mathematical sciences. The Connexions websites need more information on mathematics and careers, and in addition Connexions careers advisors need to be made aware of the range of careers available with a study of mathematical sciences.

- **Careers awareness for teachers and advisors**: We will commission the Careers Research Advisory Centre (CRAC) to run a careers event in the first year for careers advisors and mathematical sciences teachers within each region at one of the targeted schools. Connexions careers advisors will be invited to attend. In subsequent years, this event will be repeated by the Careers Coordinators. In this way, the careers work undertaken as part of this project is linked to national careers initiatives and good practice on ways of developing lifelong careers thinking. This activity will be offered first to the targeted schools but may also be made available to staff from other schools in the region. We will also make sure that other national careers organisations such as National Association for Careers and Guidance Teachers (NACGT) and the Institute for Career Guidance (ICG) are kept informed, and are invited to attend. It is likely that each event will be run for 15 staff members, and so in total, it is anticipated around **135** staff will attend**.**

- **Students' careers awareness**: We will offer each year one large careers fair per region hosted by the local HEI. This will be open to pupils at targeted and other schools in the area, and will consist of talks and exhibits by appropriate employers. We plan that each event will attract about **1,000** students from the area on the assumption that around 20 schools and colleges will be invited to send participants. This means that around **3,000** students will be involved in this activity annually.

- **Employer activity**: We will provide talks twice yearly in each targeted school/college by employers about careers and the usefulness of mathematics. These will be to two groups in each of our 7 targeted schools/colleges within each of the 3 regions. This will be aimed at students taking GCSE Mathematics or A/AS level Mathematics. The Science and Engineering Ambassadors Scheme will be a useful additional link for ideas for possible speakers. This will involve about 120 students per school per visit so overall around **5,040** students per year will be involved. This event will be different in nature to the large careers fair detailed above as it will provide employers with a greater opportunity to engage with individual students and enable them to discuss careers paths and opportunities within their area of employment.

- **Knowledge transfer**: We will promote activities from existing mathematics resources such as the PLUS magazine Website within schools. The project will contribute material to this publication based upon resources generated by the project. This is another activity that will ensure national dissemination of the project resources.

8.2 Student theme

The student theme addresses the objective to:

"Help school and college students to understand the purpose of mathematical study, to enjoy mathematics, to be confident about meeting challenges in the subject, to raise their aspirations and to realise their potential in mathematics." This theme links closely to the third theme on teaching support and will primarily be the responsibility of the Subject Coordinators. The activities proposed as part of this theme are:

- **Ambassador Schemes**: We will use a student ambassador type scheme, whereby undergraduates from the local HEI assist teachers within local schools, in around 15 secondary schools and colleges per region. We will thus be able to offer this to more schools in each region in addition to our target schools, and this will be a good means of evaluating the effectiveness of this single initiative. We will have **30** ambassadors each year per region from HEIs primarily targeting Year 9 although some schools may prefer the input in another year. Several HEIs in the area may be involved in the provision of student ambassadors. Assuming each ambassador works with 2 sets of 30 students then we will reach **5,400** students each year and **16,200** students overall.

- **Small events in schools**: We will hold small events in the six targeted schools in each of the three regions. These events, which will be aimed at enrichment and enhancement, will be targeted at a range of students in each of Years 7, 8, 9 and 10 and will be held twice yearly. These events will be arranged by the subject coordinator, and will be

presented by the subject coordinator with input from HEIs and other organisations such as the SETPOINTs. We will also encourage the teachers themselves, with the support of the subject coordinator, to offer some of the events. The events will be offered in conjunction with the teachers in each school so that they might be encouraged to take ideas further. This will provide 16 events in each school each year but can be delivered with two on the same day. This will give **96** small events per region and **288** small events overall each year. The number of students reached through this activity will be about **8,640** students.

- **Small events in colleges**: We will hold small events in each of the targeted colleges with similar aims, and will run two events per college per region per year. Assuming an audience of 40 students per event, these activities will reach around **240** college students per year.

- **Visits to HEIs**: A visit to an HE institution will be arranged for students from our targeted institutions in each of Years 11 and 12 in each region. We expect about **400** students per region to attend giving a total exposure to **1,200** students.

- **Further Mathematics Network**: We will ensure there are links to the Further Mathematics Network within each region for those who want to study more mathematics at A-level. This will enable some students in our targeted areas to study Further Mathematics at A level.

- **Adult Learners**: We will work with the Specialist Schools, holding an evening session per region per year as part of their community involvement activity, to promote opportunities, such as the Open University Mathematics modules, to ensure that adult learners are aware of the opportunities available to enable them to study the mathematical sciences in higher education.

8.3 Teaching theme

The Teaching theme addresses the objective to:

"Contribute to the development of teacher's enjoyment, confidence and knowledge of mathematics and its applications so that they can help stimulate interest in further study of mathematics in their students."

This theme links closely with the student theme and will primarily be the responsibility of the Subject Coordinators.

Whilst the student theme directly addresses current students, in order to achieve long term embedding and sustainability of key elements of the project it is necessary to engage teachers fully with these elements. This will enable teachers to be more effective in promoting the mathematical sciences to their students without the intensive support that is to be provided by this project. For this reason, the project will work closely with the NCETM to ensure the successful delivery of this theme.

The activities proposed are:

- **Enrichment for teachers**: An annual meeting will be held each year at an HEI in each region for all the mathematics teachers within the 7 targeted schools/colleges. The emphasis will be on how mathematics is developed in Higher Education and there will also be an opportunity to review the support and enrichment ideas in this project to ease the transition for students entering HE. A larger annual meeting will be held in the lead HEI in each region to which all mathematics teachers at schools within the pilot area will be invited. The emphasis here will be mainly on the links between HEIs and schools/colleges. The use and applicability of mathematics in HE will be a key issue. Both events will engage about **200** teachers from across the 3 regions

- **CPD awareness**: The Subject Coordinators will promote the importance of Continuing Professional Development (CPD) both in the subject and in subject pedagogy for all teachers of mathematics. The NCETM will be leading in this area as this is their key objective but the project gives an opportunity to supplement and reinforce the work of the NCETM by the use of appropriate HE staff.

- **Teaching Resources**: The Subject Coordinators will catalogue and evaluate existing resources for enrichment in mathematics. The particular emphasis will be on how these resources can be used to promote mathematics and also to ease the transition to HE. Information on this will be made available on the *moremathsgrads* website and will also be disseminated through the NCETM website to ensure national availability. In addition we will promote the range of these resources available to the HE community through the Subject Network of the Higher Education Academy.

- **Support**: In order to ascertain that the project is addressing the specific needs of the students, the Subject Coordinators will provide a brokering role between schools and HEIs. The purpose of this is to improve the support provided by HEIs to assist mathematics teachers in encouraging and supporting students who could study mathematics at higher levels.

While not included within the request for funding from HEFCE, the project will seek to identify sources of additional funding to run an annual **Summer School** for teachers. The Summer School will be offered to 30 teachers primarily from the 21 targeted schools/colleges. Any spare places will be offered to other schools within the targeted areas. It is likely that the annual summer school will be held once in each of the three regions throughout the duration of the project, and will be planned by the Subject Coordinators, drawing on staff from HEIs to deliver sessions exposing teachers to the latest applications of mathematics.

8.4 HE Curriculum development theme

This theme addresses the objective to:

“Increase the scope of the mathematics curriculum for HE nationally in order to allow real choices for a wide range of students”.

This theme will primarily be the responsibility of the HE Curriculum Developer.

Work in this theme will take place in two phases: a development phase and an implementation phase.

The activities to be undertaken during the development phase are:

- **Learning and teaching methods**: Review of learning and teaching methods used on the courses in the lead HEIs to determine if changes might be made particularly in the first year to ease transition into HE mathematical sciences courses.

- **Assessment methods**: Review of assessment methods used on the courses in the lead HEIs to determine whether the methods used are appropriate in the light of the employment patterns and the wide range of student intake.

- **Additional Support**: Develop the provision of additional support for first year students to ease the transition into study of the mathematical sciences within HE.

- **Careers**: Consider how best to integrate the careers materials developed through this project into the courses in the lead HEIs.

- **Adult returners**: Consider the supply of appropriate pre-degree provision in order to ease the transition into HE for adult returners. This will incorporate current Open University provision and Polymath type access course. This will involve links with the local FE colleges.

- **Regional Provision**: Discuss with other HEIs in the region the scope of mathematical sciences provision and its attractiveness and accessibility to a wide range of learners.

- **Foundation degrees:** Consider the development of a Foundation degree based on mathematical sciences.

The activities to be undertaken during the implementation phase are:

- **Dissemination Workshops**: A series of three workshops focusing on the student mathematical experience, careers education and employability within mathematical sciences degrees, accessibility and attractiveness of HE mathematical sciences courses. We anticipate that staff from at least **30** different HEIs would participate in at least one

of these workshops, so taking as a conservative estimate an average of 50 first-year students at each of these institutions these events will impact upon **1500** first year undergraduates.

- **Good Practice Guide**: The HE curriculum developer will work together to produce a good practice guide focusing upon the wider experience of mathematical sciences students. This guide will incorporate a range of case studies as illustrations of different approaches which have successfully enhanced aspects of the broader curriculum and/or increased the attractiveness or accessibility of mathematical sciences provision. Using the dissemination capabilities of the MSOR Network copies of this guide will be made available to every HE mathematical sciences department.

- **Consultancy Service**: In the final year of the project and following implementation of the outcomes of the design phase in their own institutions, the HE curriculum developer will offer a consultancy service to other HEIs wishing to implement change in line with the aims of this proposal.

8.5 Resource development

An important part of the project and hence the work of all coordinators is that resources to aid the promotion and enrichment of mathematics, along with careers awareness, should be developed to the point where they can be used nationally and delivered within the designated areas.

It is assumed that key resources and projects as listed in Appendix 8 and including particularly successful initiatives such as the DfES Standards Unit material, the MMP, the RI Masterclass series and the Further Mathematics Network will continue to exist. The project is offering support for these initiatives in terms of raising greater awareness. The planning process has shown that there is a substantial supply of resources already in existence which could be developed into a more coordinated whole. Any gaps will be identified and a sum of money set aside for tailoring of the materials rather than development of new ones. However, on the careers side there is a need to develop a considerable range of new resources, as few exist at present.

8.6 Relative importance of themes

The project will employ 7 FTE (Full Time Equivalent) staff to undertake the activities detailed within this proposal. The Careers Coordinators (3 FTE) will deliver the careers theme. The Subject Coordinators (3 FTE) will deliver the student and teaching themes, and make a contribution towards the HE curriculum development theme within their HEI (this will be split in the anticipated ratio 80:10:10 respectively). The HE Curriculum Coordinator (1 FTE) will deliver the HE curriculum development theme across all three HEIs in the first instance, and later on a national scale. The allocation of staff time between the themes is thus:

Careers theme: 42.8%
Student theme: 34.3%
Teaching theme: 4.3%
HE Curriculum development theme: 18.6%.

The costs of activities related to each of the particular themes (as detailed within 19.1) can be directly attributed to them, and all other costs can be allocated on the basis of direct staff costs. Although based upon a number of assumptions, this does give an indication of the relative importance of each theme in terms of total funding required:

Careers theme: 39.9%
Student theme: 41.7%
Teaching theme: 3.5%
HE Curriculum development theme: 14.9%.

The total funding requested for each of these themes may therefore be summarised as:

Careers theme: £1,316,700
Student theme: £1,376,100
Teaching theme: £115,500
HE Curriculum development theme: £491,700

However, the four project themes are intrinsically linked, and so the above information is only an indication of their relative weightings within the context of the overall project.

8.7 Outcomes

The activities and outputs described in Sections 8.1 – 8.5 have been designed to produce the following key outcomes:

- A positive change in the perception of mathematics amongst school students and in the way in which schools engage with HE and the mathematical sciences;
- An improved understanding of the pathways available for students who wish to study the mathematical sciences in HE;
- A greater awareness and understanding of the applications and opportunities offered by a study of the mathematical sciences;

Leading to:

- More HE students within the mathematical sciences;
- More HE students within the mathematical sciences who are young women, students from the lower socio-economic groups, minority ethnic students and adult learners;
- More students who are young women, students from the lower socio-economic groups, minority ethnic students and adult learners enrolled

upon HE courses with a significant mathematical component, for example, Economics, Physics and Engineering;

Providing:

- Evidence that a coordinated and structured approach as detailed in this proposal leads to an increased flow of students into the mathematical sciences and other courses with a strong mathematical component;

The project will impact at three levels: the targeted schools and colleges; the pilot regions; and, nationally. The majority of effort is being directed to the targeted schools since they will present the greatest challenge to widening and increasing participation in the mathematical sciences. Some activity is regionally based and will have direct impact beyond the targeted schools. Some significant aspects of the project, for example, the careers website, HE curriculum development, and teaching resources, can reasonably be expected to have an impact nationally. Our aims for increased applications to mathematically rich HE courses are based upon these three groups. In targeted schools we are aiming for 100 additional applications per year by the end of the first full academic year of project activity. It is anticipated that regionally we could achieve twice as many additional applications (200). The effects on a national scale are harder to estimate, but taking into account potential synergies with projects in other disciplines, it is not unreasonable to expect an additional 300 applications per year.

The pilot phase of this project will leave a lasting imprint through the infrastructure developed by the work done with pupils in pre-GCSE year groups and also through the impact on teachers. As a consequence, additional applications from the targeted schools and nationally to mathematically rich courses in HE may be expected to continue for some years after the pilot phase is complete.

Furthermore, a number of the initiatives, activities and resources developed as part of this pilot project will contribute to further roll-out phases which will deliver the aims of the project nationally.

9 People

There will be a **Project Manager** who will be responsible for the national day-to-day management of the project, and for ensuring good coordination across the three regions. The Project Manager will be based at the University of Birmingham to enable close liaison with the HE Academy MSOR Network. Strategic advice and support to the project will be provided by the HE Academy MSOR Network, who will also oversee financial monitoring and reporting. The Manager of the MSOR Network will act as direct line manager for the Project Manager. In addition, the HE Academy MSOR Network will provide a focal point for the national dissemination of the project's outcomes.

A **Project Evaluator** will be appointed at the start of the project to allow an ongoing evaluation. The Project Evaluator will work closely with the Project Manager and the HE Academy MSOR Network to evaluate the impact of the project's activities. One of the outcomes of the project is to change the perception of the mathematical sciences within the three pilot regions amongst students, and it is therefore important that the Project Evaluator is involved with the project from the beginning.

An **Administrator** (0.5FTE) will be appointed to support the Project Manager at the University of Birmingham. This post will provide day-to-day administrative support, and will be the first contact for all national queries relating to the project.

Technical Support is also required on a national scale to further develop and maintain the CMS Careers website and the *moremathsgrads* website.

Within each of three regions a **Careers Coordinator** and a **Subject Coordinator** will be appointed. The Coordinators will implement the ideas chosen from those generated at the workshops to be taken forward as part of the project activity, and outlined in Section 8. The Coordinators will work in conjunction with the regional arms of the NCETM, SETNET, Aimhigher and with national bodies such as the five sponsoring organisations and national careers advisor associations. The Coordinators could be seconded academic staff from HE or experienced teachers.

A **HE Curriculum Developer** will be appointed to work across the three pilot regions for the duration of the project. This is likely to be someone on secondment from Sheffield Hallam University. The HE Curriculum Developer will undertake a review of the HE Curriculum to ensure that it is accessible to a wide range of learners and that it facilitates widening participation.

There will be a 0.5FTE **Administrator** in each region, to support the other staff and to provide a link for all institutions within the pilot area. Additional funding has also been budgeted across the three regions to provide support for event organisation where necessary.

Within each region a **Regional Consultant** will be employed to ensure that existing links are effectively utilised and to provide advice on local decisions.

Thus, within each region there will be 2 Coordinators, an Administrator, and a Regional Consultant. Line management responsibility in terms of staff development, and reward and recognition will rest with the lead HE institutions with input from the Project Manager, However, the Project Manager will be responsible for all decisions made as part of the project within each area. This model is similar to ones used effectively on multi-site research projects.

The day-to-day activities undertaken by those appointed to work on the project will develop and change as the project progresses. For instance, the initial phase will be further determination of what is already available within each area, and becoming acquainted with the relevant schools and colleges.

Later phases of the proposed project, however, will involve work in other parts of the regions beyond the areas initially identified.

The activities for the different project personnel are as set out below:

Project Manager: The Project Manager will:

1. Be responsible for the overall day-to-day management of the project;
2. Monitor the financial position of the project;
3. Ensure appropriate links to other national projects;
4. Receive regular reports from the six coordinators and the HE Curriculum Developer;
5. Develop the plans for the future roll out of the project;
6. Develop ideas for the long term sustainability of the project;
7. Consider other fund raising possibilities particularly from industry and commerce;
8. Liaise with lead institutions on human resources issues;
9. Prepare reports for the Project Design Group;
10. Liaise with the Impact Assessment Group;
11. Ensure good dissemination of the ideas arising from the project;
12. Work with the overall Steering Committee.

(See Section 10 for a description of the Project Committees)

Careers Coordinators: The Careers coordinators will work primarily on the Careers Theme. Jointly they will:

1. Visit secondary schools, sixth form and general FE colleges and HE institutions within the region and support both the careers and the mathematics staff within each institution to become more aware of the range of careers material available in mathematics, the range of careers available to graduates from the mathematical sciences, and more generally, the usefulness of mathematics;
2. Arrange events in the local schools to help students in Years 9, 10, 11, 12 and 13 understand the range of careers available following the study of mathematical sciences and the usefulness of studying mathematics at all levels;
3. Arrange events in FE colleges to help learners of all ages understand the range of careers in mathematics and the usefulness of studying mathematics at all levels;
4. Work with the local specialist mathematics and computing schools to promote dissemination of careers materials;
5. Organise an annual regional mathematics careers fair;
6. Work with the regional coordinators for Aimhigher, SETNET and the NCETM to ensure the activities of the project are complementary to the overall activities within the region;
7. Catalogue and prepare resources on careers following from a study of the mathematical sciences;
8. Establish links with, and visit employers both locally and nationally;
9. Develop content for the CMS Careers website;

10. Produce suitable careers resources demonstrating the application of mathematical sciences in a wide range of careers;
11. Work with national careers organisations to improve understanding of the range of careers available nationally following study of the mathematical sciences and of the usefulness of mathematics;
12. Contribute to the evaluation of the project including measurement of success;
13. Prepare updates and materials for the Project websites, ensuring they are up-to-date and reflect the current activities of the project.

Subject Coordinators: The Subject Coordinators will work primarily on the Students and Teaching themes. Jointly they will:

1. Visit secondary schools, sixth form colleges, FE colleges and HEIs within the region, to be a link between the mathematics staff in the institutions, and promote the usefulness and applications of mathematics;
2. Arrange enrichment and enhancement activities in the targeted schools/colleges to make students, and teachers aware of the applications and usefulness of mathematics;
3. Work with the regional coordinators for Aimhigher, SETNET and the NCETM to ensure the activities of the project are complementary to the overall activities within the region;
4. Arrange regular annual visits to HEIs in the region for learners and teachers from schools and colleges;
5. Encourage and arrange visits to schools and colleges by appropriate individuals from HEIs and employers (in conjunction with the Careers Coordinator);
6. Provide support for student ambassador schemes within the targeted schools;
7. Work with, and promote the activities of, the Further Mathematics Network within the region;
8. Coordinate details of enrichment material available for learners of all ages in conjunction with the NCETM;
9. Prepare updates and materials for the project website, ensuring it is up-to-date and reflects the current activities of the project;
10. Promote, in conjunction with NCETM, existing support and enrichment materials, suitable for students at the transition to HE;
11. Contribute to the evaluation of the project including measurements of success;
12. Work with local FE colleges to establish links for adult learners interested in the further study of the mathematical sciences;
13. Work with the Open University and other providers to promote opportunities for adult learners in the mathematical sciences;
14. Work with the HE Curriculum Developer and other course teams within the University to implement any changes to the curriculum, particularly with a view to helping the wider range of students who could be studying the mathematical sciences as a result of the other initiatives as part of this project.

HE Curriculum Developer: The HE Curriculum Developer will work primarily on the fourth theme of Curriculum Development, and will receive support from the Subject Coordinator within each HEI. They will:

1. Review current teaching, learning and assessment methods, especially in the first year of undergraduate programmes;
2. Develop appropriate support provision for first year undergraduates to ease the transition into HE study of the mathematical sciences;
3. Improve alignment of HE mathematical sciences courses with regional or national economic needs;
4. Work with course teams to implement any required changes, particularly with a view to helping the wider range of students who could be studying the mathematical sciences as a result of the other initiatives as part of this project;
5. Work with FE colleges within each region to establish links for adult learners interested in the further study of the mathematical sciences;
6. Work with course teams and HE careers advisors to develop the use of appropriate careers materials with HE courses;
7. Work with the Open University and other providers to promote opportunities for adult learners in the mathematical sciences.
8. Work with the HE Academy MSOR Network to ensure that all activities undertaken as part of the Curriculum Development theme are appropriately structured and coordinated, and that the appropriate outcomes are disseminated nationally. The emphasis in dissemination will be on the process of change.

Technical support: The two Websites: www.mathscareers.org.uk (CMS Careers) and www.moremathsgrads.org.uk will require ongoing technical support throughout the lifetime of the project. This will be at the annual average level of 18 hours per week in the first two years and 15 hours per week in year 3. Technical support will be provided by the learned societies who are currently the lead bodies on these websites, for which a fee will be paid.

Regional Consultants: A Regional Consultant will be employed for each region to assist the coordinators in making local decisions. They will have knowledge of existing initiatives and activities within their region, and will facilitate the building of links between projects. Close contact with the regional structure of the NCETM, the Aimhigher regional and area coordinators and the SETNET regional coordinator will be essential for the project, and thus, the Regional Coordinators will minimise the risk of overlap with existing initiatives, and will enable advantage to be taken of the synergy that could arise if complementary projects are happening within the same region. The involvement of each Regional Consultant will be 0.1FTE on average.

Project Evaluator: The Project Evaluator will be engaged as a consultant to the project and will be responsible for:

- Data collection from national data sources;
- Data collection from the institutions involved in the project;

- Design, administration and analysis of questionnaires;
- Visits to activities for direct observation in all regions;
- Evaluation of dissemination work;
- Development of case studies.

Two monitoring reports will be produced each year. The evaluator is likely to be home based but will work closely with the Project Manager in Birmingham.

Administrators: There will be one Administrator per region, and one based at the University of Birmingham. The Administrator based in Birmingham will support the Project Manager and provide a national first point of contact for the entire project. It is likely that the Regional Coordinators will be away from an office base for a significant period of time and the role of the Administrator will be to provide a fixed contact point, particularly for the local education institutions with which the coordinators are working. All administrators will be involved in the organisation and support of project meetings, and will assist with the regional events.

Specifications for each of these roles are given in Appendix 7. The organisational structure of the project is illustrated within Figure 6:

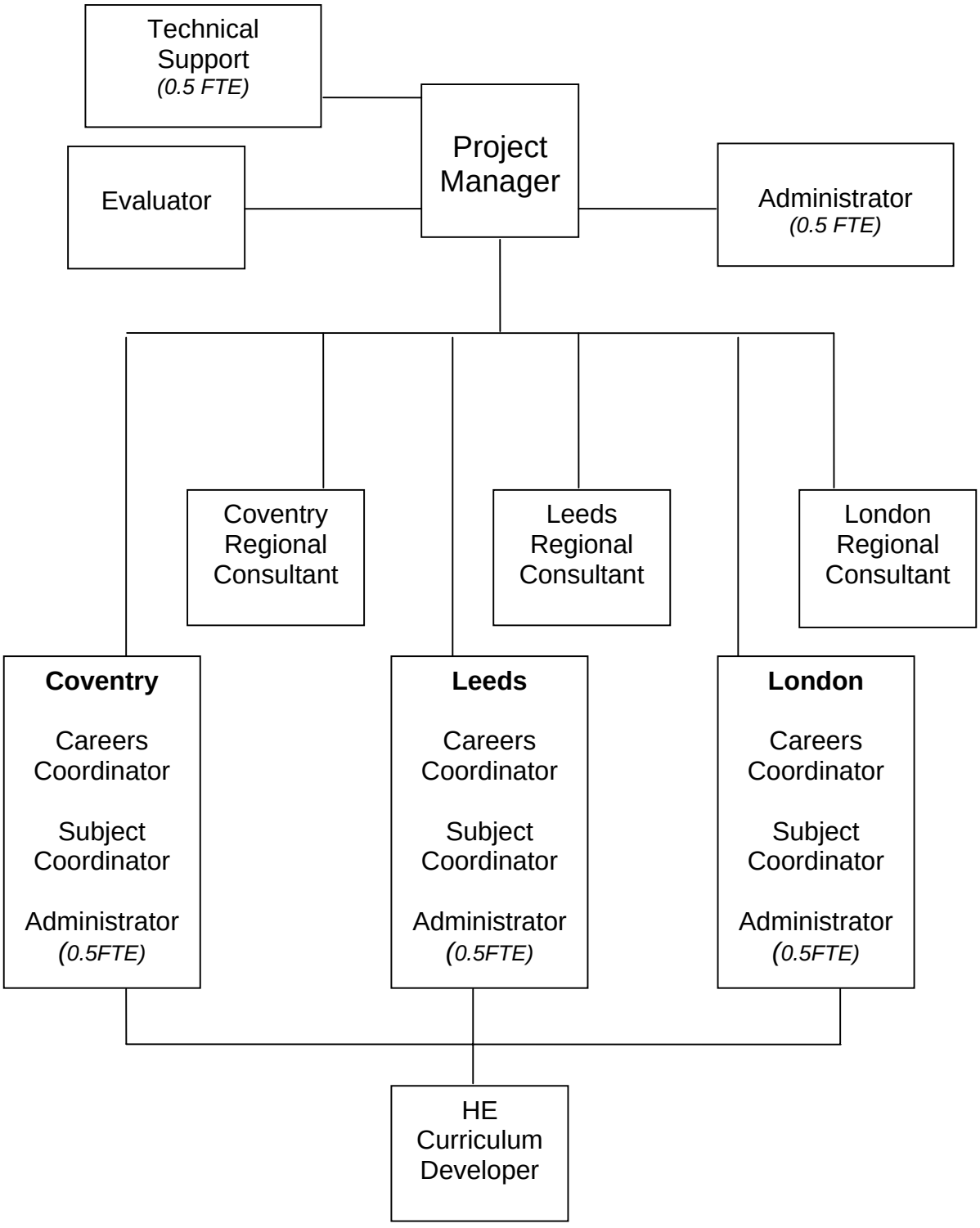

Figure 6: Project Organisation Chart

OPERATIONAL ASPECTS

10 Management

The project will be managed on a day-to-day basis by the Project Manager, with strategic advice and support provided by the HE Academy MSOR Network. The HE Academy MSOR Network will also oversee financial monitoring and reporting.

There will be a Committee structure, see Figure 7, to assist the overall development of the project. Details of the terms of reference and the likely membership of the various project groups are given in Appendix 9.

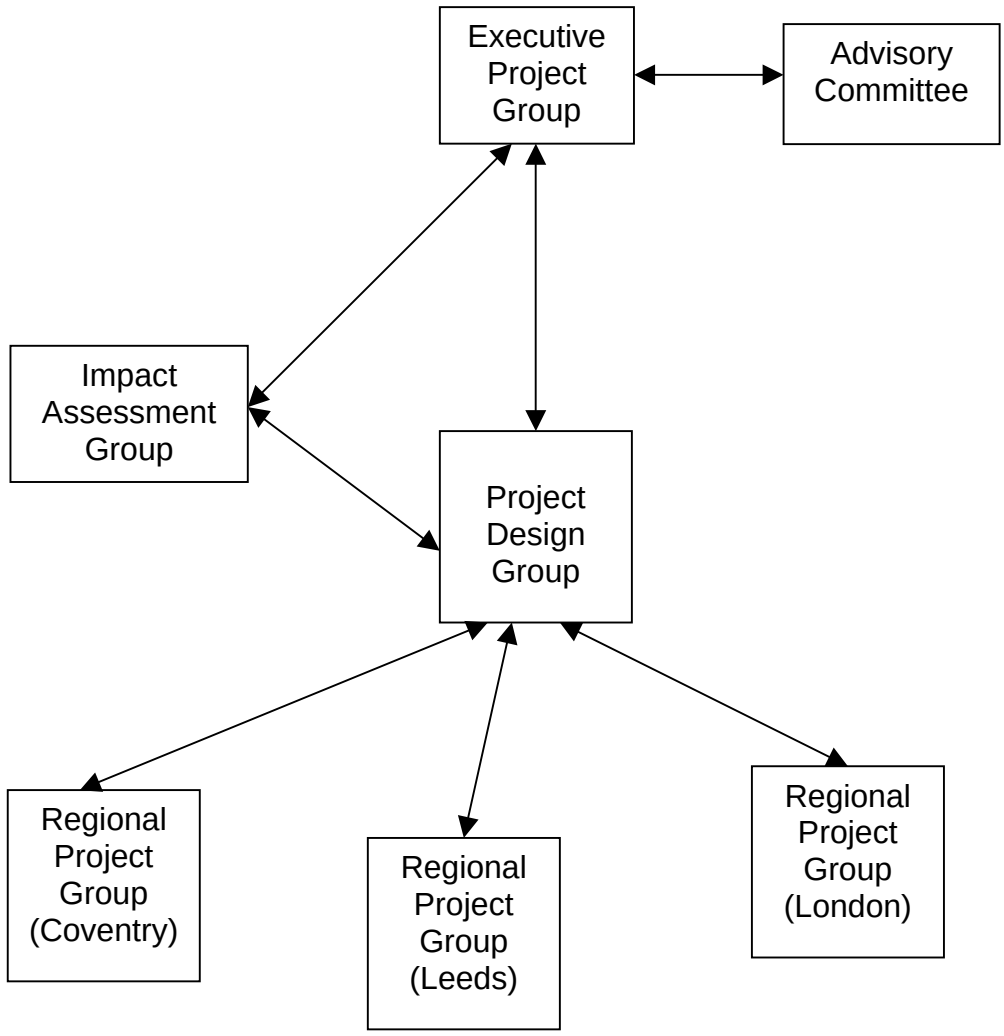

Figure 7: Overall Project Committee Structure

Within each region there will be a **Regional Project Group**. The purpose of this group is to ensure consultation with a wide range of stakeholders and other interested and relevant organisations. The group will review the regional initiatives undertaken and schedule future activities based upon guidance from the Project Manager and the Project Design Group.

Membership will include both Coordinators, and representatives from other initiatives that are taking place in the region with direct relevance to the mathematical sciences. These groups are likely to meet every two months.

Representatives from each regional pilot project will be members of the overall **Project Design Group**. The Project Design Group will meet between two and four times each year to review the work undertaken by the project, evaluate priorities and mechanisms for delivery, and to ensure that there is coordination across all three regions.

There will be an **Impact Assessment Group** which will look across the whole project and at its achievements in relation to the objectives defined within this proposal. Membership of the Impact Assessment Group will be small and will include the Project Evaluator, Project Manager and a representative from HEFCE. It is likely to meet twice each year.

An overall **Advisory Committee**, with representation from the original five organisations and other interested bodies, including HEFCE, will meet twice a year to evaluate the overall achievements of the project and provide a community-wide vision for its strategic direction. This is likely to be similar in composition to the Committee which has overseen the development of this proposal. The Project Manager and Project Evaluator will be ex-officio members of the Steering Committee.

An **Executive Project Group** will be established which will have overall responsibility for providing strategic advice and guidance to the project. The Executive Project Group will meet monthly, and will consist of the Project Manager, a representative from the MSOR Network, a representative from the University of Birmingham and an additional representative from one of the organisations involved in the development of this proposal. The purpose of this group will be to review the day-to-day activities of the project and provide strategic advice, guidance and support as necessary to ensure that the activities undertaken by the project continue to meet its overall aims and objectives.

The Careers Coordinators should meet quarterly with the Project Manager, as should the Subject Coordinators and the Curriculum Developer. In addition, the Project Manager will maintain regular contact with the HE Academy MSOR Network to discuss strategic issues. The Curriculum Developer will also maintain regular contact with the HE Academy MSOR Network to discuss issues relating to aspects of curriculum development activity.

11 Accommodation and other resources

There is a need for an office suitable for three people within each of the regions. Each lead HEI will provide this. All personnel within each region will require a PC with Internet access.

Accommodation and office equipment for the Project Manager and the Administrator will be provided in a joint office at the University of Birmingham. It is assumed that the Evaluator will work from a home base, but will attend regular meetings with the Project Manager in Birmingham.

12 Timescale

It is proposed that the project is funded for three years with a view to roll out to further regions afterwards. During the three-year period it is intended that there will be roll out to more areas within the original regions. The project will commence with work on the coordination of resources and initial contacts before any of the key activities are launched within the institutions. Roll out to further regions would take another three years.

It is proposed that the project will start from **1st August 2006** and continue until **31st July 2009**. The Project Manager will be in post by 1st November 2006 and the coordinators in post by 1st January 2007.

Visits to schools will start from 1st January 2007 with events from 1st March 2007.

The large careers-focused events will be in July 2007 and again in July 2008 and July 2009.

The dissemination meetings will be in June/July 2007, 2008, and 2009.

Internal project monitoring reports will be available at six monthly intervals and so based upon the above timescale, these will be presented on:

31 January 2007	**31 July 2007**
31 January 2008	**31 July 2008**
31 January 2009	**31 July 2009**

The reporting process to HEFCE has not been officially agreed to date, and therefore, some of the above reporting timescales may be used for this purpose. In all cases, however, internal project reports will also be made available to HEFCE.

An important output from the project will be plans for broadening the project nationally in future years, and for sustaining the enthusiasm for mathematics in the original areas once this project comes to an end. The project will produce a series of recommendations for both of these aspects that will be ready by **31st January 2009.**

13 Industrial Links

The project is supported by a number of national employers. These are:

- Rolls-Royce PLC
- Thales
- Qinetiq
- Ford UK

These organisations have expressed their support to this proposal, particularly in relation to the careers theme. Further details on these organisations can be found in Appendix 10.

The project will also work alongside the SETNET project funded by the GE Foundation. This project promotes the use of mathematics within schools, based upon how mathematics is used in the GE Foundation's diverse range of businesses. The GE Foundation project started in January 2006 and two of the three areas it targets, London and Leeds, are the same as the regions chosen for this proposed project. It is intended to include some schools common to both projects.

This project will work alongside the SETPOINTs in each region to provide local industrial links. The Science and Engineering Ambassadors Scheme has already recruited a number of mathematicians to assist with activities.

SEMTA has offered support based upon its extensive contact network to identify appropriate industrial representatives to participate in the activities of the project. Through SEMTA, it is intended to contact the other relevant Sector Skills Councils and hence other employers as mathematics has a key role across many industry sectors. Employers suggested by HEIs based upon their research and alumni networks, will also be engaged as part of this project. The local RDAs will also be helpful in identifying suitable employer contacts. Access to further industrial contacts will also be made via the lead professional bodies involved with this proposal.

EVALUATION AND DISSEMINATION

14 Measures

As outlined in Section 9, an evaluator will be employed for the duration of the project. This will allow data collection from the onset of the project and to adapt the data collection process as the project progresses.

The project will further investigate HESA data so that a better understanding of the numbers of students on different types of degree programme may be developed. This will enable a comprehensive position with regard to current student numbers in the mathematical sciences to be determined, and will allow a baseline for measuring the overall success of this project against its aims in subsequent years. The DFES and NFER (National Foundation for Educational Research) are currently investigating the reasons behind student choices, looking particularly at GCSE grades. This project will review the relevance of this work and possibly extend it to include post-16 performance.

The proposed model for the evaluation of the project is based upon the following principle: the project will carry out a range of activities; these activities result in direct engagement with a variety of individuals and groups; these engagements (both direct and indirect) have effects upon students, teachers, careers advisors, and institutional policies and perceptions; and finally, will result in changes to the number of students studying mathematics (and the other STEM subjects) post-16.

The following table proposes an evaluation framework for the project:

Type of indicator	Description	Suggested Indicators	Example collection methods	Extent
Activity: Quantity	Indicators of range and quantity of activity	• No. of events; • No. of visits; • No resources produced;	Monitoring of activity, record keeping & databases	Comprehensive; annual
Activity: Quality	Feedback on the experience of the intervention	• timing, relevance & utility • quality of preparation, materials, presenters, location etc	feedback forms	Comprehensive; ongoing
Engagement	Indicators of how well the project engages those within chosen areas	• no. of participants at events • no. of web users/month • awareness of activities by local schools/FE staff	Databases and monitoring; Surveys.	comprehensive; annual
Effects on individuals and institutions	Extent and quality of changes in perceptions by staff/students; changes in practice	• Staff/student changes in enjoyment levels of mathematics; • Change in staff/student attitude towards mathematics; • increased staff/student awareness of applications of mathematics; • increased staff/student awareness of mathematics career opportunities. • Development of alternative access provision & curricula.	Activity evaluations; follow-up surveys; trajectory studies of specific activity; case studies	Selective; rolling programmes
Effects on study patterns	Changes to number of students studying mathematics & the mathematical sciences at all levels; changes to student numbers studying STEM based subjects; changes to student numbers studying courses with a significant component of mathematics.	• Numbers studying mathematics post-16; • Number of applications to HE mathematical science courses from targeted schools, and from individuals from traditionally under-represented groups; • Applications to study HE STEM subjects;	HESA & UCAS data; case studies	comprehensive; annual

15 Links between activities outcomes and measures

The overall aims of the project are both to widen participation in the mathematical sciences from groups who have not previously been well represented in Higher Education and to increase the supply of mathematical science graduates in England. The tables below show how each of the key objectives will be measured.

Objective 1: Improve understanding of the wide-ranging applicability of mathematics and the breadth of career opportunities open to graduates from the mathematical sciences.

Activities	Outcomes	Measures
Develop careers materials.	A range of materials for use in schools, colleges and HE (*e.g*. posters, case studies, guides).	Number of resources developed by the project.
Extensive development of careers website.	A comprehensive site with content appropriate for students of all ages, and containing information on a wide range of mathematically related careers.	Number of new resources added to website; Number of new profiles; Increase in number of website users; Number of resources downloaded from site.
Disseminate expertise concerning mathematically-related careers to Connexions.	Connexions Careers Advisors are better informed (and hence able to communicate this information to students) of the range of applications of mathematics & of the broad range of careers open to graduates from the mathematical sciences.	Number of resources shared with Connexions; Number of Connexions Advisors attending events; Number of meetings with Connexions Advisors.
Careers awareness courses for teachers and careers advisors.	A course run by CRAC, to train those who will be involved in promoting to students the opportunities afforded by a study of the mathematical sciences. 8 further regional courses, based upon the format of the CRAC events, to be run by the Careers Coordinators for more careers advisors and teachers to increase awareness.	Number of participants at events; Post event and further follow-up questionnaires. Number of participants at events; Post event and further follow-up questionnaires.
Localised events to enhance student careers awareness.	Increased awareness of usefulness of mathematics More contact with employers and schools	Measured through questionnaires at different periods of time. Evaluated through case studies
Regional careers fair.	Increased awareness of the usefulness of mathematics for more students.	Number of students attending fair.

		Post-event and further questionnaires.
Disseminate information on careers opportunities directly to students, *e.g.* MMP Plus Magazine.	Increased student awareness on the applications of mathematics along with the range of opportunities available to them that its further study offers.	Number of resources disseminated directly to students; Number of students who receive resources; Targeted questionnaires & surveys; Production of case studies.
Overall (Note: The 3-year timescale of this project may be too short to accurately detect all of these overall measures during the lifetime of this project)		Number of students from the targeted regions studying mathematics post-16; Number of students from the targeted regions applying to study the mathematical sciences & mathematics related courses compared to previous years; Increased number of students engaged in further study of mathematics from traditionally underrepresented groups; Number of students from targeted schools, from the targeted regions commencing mathematical sciences courses within HE.

Objective 2: Help school and college students to understand the purpose of mathematical study, to enjoy mathematics, to be confident about meeting challenges in the subject, to raise their aspirations and to realise their potential in mathematics.

Activities	Outcomes	Measures
Student ambassador scheme.	Enhanced links between local schools, colleges and HEIs; 15 schools/colleges per region with student ambassadors; Increased student enthusiasm towards mathematics.	30 university students from each region working within local schools & colleges; Questionnaires at different points in time on student attitudes and perception of mathematics.
School-based events to enrich and enhance the student experience.	Increased and enhanced links between local schools, colleges and HEIs.	Number of HE staff participating in local schools; Questionnaires targeted at different times to determine changes in student attitudes and perceptions of mathematics.
Industrial, professional and academic speakers to promote applications of mathematics.	Increased and enhanced links between local schools, colleges, HEIs and industry; Increased student awareness of practical applications of mathematics and career	Number and range of speakers from different employers; Increased student & teacher knowledge of applications of mathematics (questionnaire); increased

	opportunities.	knowledge of range of careers available (questionnaire).
Regional mathematics workshops hosted by HEIs.	Enhanced links between schools, colleges and HEIs; Greater enjoyment of mathematics by students; greater awareness by students of applications of mathematics and the opportunities its further study affords.	Number of students visiting HEIs each year in each region; changes in attitudes to (student & teacher) and perceptions of mathematics (questionnaire).
Links to Further Mathematics networks.	All students have the opportunity to study Further Mathematics.	Number of students from targeted schools and colleges studying Further Mathematics at A-level.
Overall (Note: The 3-year timescale of this project may be too short to accurately detect all of these overall measures during the lifetime of this project)		Number of students from the targeted regions studying mathematics post-16; Number of students from the targeted regions applying to study the mathematical sciences & mathematics related courses compared to previous years; Increased number of students engaged in further study of mathematics from traditionally underrepresented groups; Number of students from targeted schools, from the targeted regions commencing mathematical sciences courses within HE.

Objective 3: Contribute to the development of teachers' enjoyment, confidence and knowledge of mathematics and its applications so that they can help stimulate interest in further study of mathematics in their students.

Activities	Outcomes	Measures
Evaluation of resources to aid the transition to HE.	Increased awareness (in schools, colleges and HE) of the range of resources available; Use of resources amongst students and teachers within targeted schools, colleges and HEIs; increased range of support material available for students of all ages; increased student/teacher confidence in mathematics.	Number of hits to resource section of project website; Questionnaires (targeted at different times) to students and teachers.
Collaboration with the NCETM as subject professionals.	Teachers feel more confident with use of project resources and materials; Students of all	Questionnaires over time to staff and students.

	abilities feel able to achieve their potential in mathematics.	
Enrichment opportunities for teachers.	Teachers develop confidence in their mathematical ability; increased teacher awareness of mathematical applications & approaches.	Numbers attending from targeted schools and from across regions; teacher targeted questionnaires.
Overall (Note: The 3-year timescale of this project may be too short to accurately detect all of these overall measures during the lifetime of this project)		Number of students from the targeted regions studying mathematics post-16; Number of students from the targeted regions applying to study the mathematical sciences & mathematics related courses compared to previous years; Increased number of students engaged in further study of mathematics from traditionally underrepresented groups; Number of students from targeted schools, from the targeted regions commencing mathematical sciences courses within HE.

Objective 4: Increase the scope of the mathematics curriculum for HE nationally in order to allow real choices for a wide range of students.

Activities	Outputs	Measures
Improve alignment of HE courses with regional or national economic needs.	Review of current provision offered to undergraduates in the mathematical sciences within target HEIs relative to regional & national needs; (if appropriate) recommendations to align provision to national and regional needs; (if appropriate) implementation of recommendations with target HEIs.	Production of good practice guide; national discussion on issues arising; development (if appropriate) of additional provision; dissemination workshops.
Review teaching and learning and assessment methods, especially in the first year.	Changes, where appropriate, especially in the first year of HE courses.	Questionnaire amongst students before and after first year on an HE course; good practice guide; dissemination workshops.
Review support methods.	Changes, where appropriate, especially in the first year of the HE course.	Questionnaire amongst students before and after first year on the HE course; assessment of number of students progressing to subsequent years; changes in overall student abilities; good practice guide; dissemination

		workshops.
Determine appropriate access provision.	Review of provision necessary for returning adult learners; development of appropriately identified access provision.	Dedicated programmes available (if appropriate) for returning adult learners; accessible provision available for all learners.
Overall (Note: The 3-year timescale of this project may be too short to accurately detect all of these overall measures during the lifetime of this project)		Number of students from the targeted regions studying mathematics post-16; Number of students from the targeted regions applying to study the mathematical sciences & mathematics related courses compared to previous years; Increased number of students engaged in further study of mathematics from traditionally underrepresented groups; Number of students from targeted schools, from the targeted regions commencing mathematical sciences courses within HE; increased number of adult learners studying the mathematical sciences at HE level.

16 Dissemination strategy

Although the project will concentrate activities within three regions, the resources produced by the project will be available for use nationally. The dissemination mechanism used for this will be the careers website (www.mathscareers.org.uk) and the project website (www.moremathsgrads.org.uk). To promote these websites and the resources they contain, the existing communication mechanisms of all organisations involved in developing this proposal will be utilised. Such mechanisms have already proved effective in encouraging the mathematical community to become involved in the development of this proposal.

In addition, three national workshops will be held, one after each completed year of the project. The aim of these workshops will be not only to disseminate the project outcomes, but also to learn from the activities and approaches adopted, gather the views of the mathematics community on the activities to date which will aid with project evaluation, and to develop approaches for a national rollout of the project's activities.

The MSOR Network has expertise in the national dissemination of practice in the teaching, learning and assessment of Mathematics, Statistics and Operational Research, and so will be heavily involved in disseminating the outcomes of the project. In addition, opportunities will also be taken to promote the project and its

activities at major national mathematics events, and events run by the organisations involved in the development of this proposal.

It is intended that the Project Manager will develop, with guidance from the Project Executive Group and in close liaison with HEFCE's Communication Officer, a comprehensive 'Communication and Dissemination Strategy' to be implemented across the project. Not only will this ensure effective dissemination of the outcomes from the project within the Mathematical Sciences community and with the other HEFCE funded projects but it will also allow a national and international dissemination mechanism. It will also ensure any promotional materials, for example press releases, are shared with HEFCE prior to release.

17 Sustainability

At the end of the three-year period, it is intended that the project will be extended more widely to other regions within England. One of the outcomes from this project will be a series of recommendations, as to how this may be successfully achieved. In addition, mechanisms will be developed to sustain activity and support within the 3 pilot regions once the initial period of funding is complete.

Plans for the rollout of the project to further regions will be based upon the experience and expertise gained as the project progresses. At this stage it is intended that the rollout should be extended to the other six regions, although there will almost certainly be differences in the support and activities provided within each region. Decisions will be made based upon an evaluation of the activities undertaken by this project, and upon regional needs, which will be identified as part of the 3 year phase of activity.

The project will produce many new resources to promote the careers and opportunities arising from a study of the mathematical sciences, the applications of mathematics, and enrichment materials. These will be available for use in the rollout to further regions, and while a small degree of updating may be necessary, production of new resources will not be required. In addition, the two project websites will already be established, and so will only require maintenance and updating throughout the next phase of activity.

One key aspect of this proposal is to promote the applications of mathematics and the career opportunities its further study affords, which will ultimately lead to an increase in awareness of the usefulness of the subject amongst students and teachers. One possible mechanism that could be adopted for the rollout process, and this will be investigated during the project, will be to use those teachers involved in this phase of activity to provide advice and guidance to those within the further regions.

A key consideration during the project activity will be the identification of funding opportunities for the further rollout stage. This will primarily be the responsibility of the Project Manager.

18 Risk assessment and risk management

The possible risks associated with this project have been considered and it is believed that these can all be successfully managed.

The Project Manager will have responsibility for the overall management of day-to-day risks associated with the project, although advice and guidance will be provided by the Maths, Stats & OR Network which has significant expertise in managing national projects. The Project Design Group and the Executive Project Group will be a regular forum in which an overview of all associated risks (as they may arise) will be considered. Should a major risk occur that could threaten the project, the Steering Committee, which includes representation from HEFCE, will be immediately convened and tasked with overall responsibility of managing the risk.

As outlined within the table that follows, risks of all kinds: operational, intellectual, financial and human have been considered, along with activities and approaches designed to ensure they are minimised:

Risk Assessment

Identified Risk	Implications	Actions to Minimise Risk	Likelihood	Impact
The shortage of mathematicians will resolve itself thereby rendering the project not very useful.	This is most unlikely to happen given the current national situation in mathematics. In addition, the project aims to widen participation from traditionally underrepresented groups.	The project forms part of a widening participation initiative. Regions have been chosen where there is a need to widen participation in the mathematical sciences.	Low	Low
Failure to recruit suitable personnel for the project.	The project does not achieve what is required.	Preliminary discussions indicate that there are suitable candidates with the ability and interest for the job as part of career development. The structure allows both mathematicians and non-mathematicians to be used for some aspects of the project. Mathematicians for the HE curriculum development theme are necessary, and the lead HEIs have all agreed to support this.	Low	High
Key project personnel leave mid-way through the project.	Activities within each region reduce or are less effective; personnel take key knowledge with them; Overall direction of project suffers.	Strategic advice and guidance will be provided by the MSOR Network, who will assist in finding personnel on a short term basis to continue project activities until replacements can be found. The Network will have knowledge of the whole project thereby reducing the emphasis of all knowledge being retained by one individual.	Medium	Medium

Failure to recruit sufficient numbers of student ambassadors from HEIs.	Fewer students will be available to participate in activities within local schools, which may result in reduced links between HEIs and local schools.	Funding will be offered to HEIs agreeing to implement a student teaching scheme. Hourly funding will also be provided to undergraduates participating in the scheme for the time they spend in local schools and colleges.	Low	Medium
Project activities are separate from other possible regional (and linked) activities.	Unnecessary duplication of effort.	The project will work with bodies such as Aimhigher, SETNET and NCETM and there will be continued dialogue throughout the project. The Regional Consultants are employed to work on this aspect.	Low	Medium
Each region works separately and hence there is overall duplication of project activities.	Unnecessary duplication of effort	The proposed committee structure and Project Manager will work to avoid this.	Low	Medium
Failure to recruit HEIs and members of university staff to engage in activities with local schools and colleges.	Lack of subject and promotional expertise at events. Some school based and HEI visits may not run. Student ambassador schemes may not be implemented within HEIs.	Many HE staff already participate in this type of activity on a voluntary basis. Payments will be made to members of HE staff (or their institution) as a contribution towards their participation.	Low	High

Failure to find accommodation and other support resources for project team.	Coordination and regular project team contact would become difficult.	Regional HEIs have agreed to provide these facilities.	Low	Low
Failure to recruit appropriate local schools and colleges to engage with project activities.	Project ideas would not be developed in practice.	A number of schools and colleges within each region have been identified with the support of Aimhigher. The number of schools in each region involved is small compared to the total number of schools.	Low	High
Excessive time is taken to develop project resources.	Some time available for all planned activities would be lost.	Experts from other areas, where appropriate, will be used to ensure that materials are developed in an efficient and effective way. The Project Manager will have responsibility for overall project management.	Low	High
Existing materials prove not to be suitable for use in the project.	More time would be spent on developing materials and hence other activities may suffer.	Regional workshops have confirmed that appropriate materials are available in all areas other than careers. In careers there are good models from other disciplines which could be utilised as a starting point.	Low	High

Evaluation is neglected.	The achievements of the project would not be clearly defined at the end of the 3 year period of activity. Ideas will not be adapted as project progresses.	An Evaluator will be employed from the start of the project to ensure that evaluation is well embedded.	Low	High
There is no dissemination of results and good practice.	The achievements of the project will not be disseminated, and hence useful, to a wide audience.	Dissemination is planned from the start, and the Project Manager will engage with this. The MSOR Network will also provide national expertise for dissemination activities.	Low	High
Financial mismanagement	The project ceases.	The project is based within the financial structures and procedures of the University of Birmingham. The MSOR Network will provide support and guidance with financial management and reporting.	Low	High
Failure to find suitable additional funding for the rollout phase	The direct contact activities of the project cease within the three regions, and no further activity takes place nationally. No further resources are added to the project websites.	The Project Manager will work to identify suitable further opportunities for funding throughout the project, preparing bids for funding where appropriate.	Medium	High

Failure to determine an appropriate roll-out mechanism for further national activity.	Project cannot be rolled-out in an effective manner nationally, or the approach adopted is uncoordinated and unstructured.	The Project Manager and Project Evaluator will work to identify successful initiatives, and where necessary conduct small scale pilots based upon the proposed roll-out mechanism.	Low	High
Failure to recruit HEIs/schools within other regions.	The activities of the project cannot be undertaken within other regions.	Many HEIs have expressed support for the project and a willingness to be involved. Links with further schools will be developed naturally as the project progresses.	Low	High

FINANCE

19 Finance

The total amount requested for the first three years of the project is **£3,300,00**. The attached table shows the allocation of the total amount of finance required for these initial three years of the project. As the activities detailed within this proposal will not commence immediately in Year 1 (primarily due to the need to recruit project staff), the figures quoted for Year 1 relative to Years 2 and 3 are significantly lower.

The total required for roll out to 6 other regions over another 3 year period will be at least double this as some activities will not need to be redone but others will start sooner than in the project scheme. Firm ideas will emerge during the three years of the first stage but at this stage it is envisaged that the sum required would be in the region of £10 million.

The figures shown in the attached table are all at current prices. Incremental salary increases equivalent to 3% per annum have been included and an inflation rate of 4% assumed. All figures quoted include VAT where appropriate.

In addition the project will benefit from contributions from those employers who have agreed to support the project and from the professional bodies leading the proposal.

The Institute of Mathematics and its Applications has provided time and meeting facilities to the sum of £16000 in the preparation of this proposal. For the next three years the input from the IMA is budgeted at £10,000 equating to £30,000 over the three years of the project. In addition to a significant contribution towards the development of this proposal, The Royal Statistical Society will contribute £21,000 in kind over three years and the London Mathematical Society £15000 over three years.

The HE Academy MSOR Network has already contributed a significant proportion of staff time to the development of this proposal, and will continue to do so by providing the strategic advice and direction required by the project. The MSOR Network will also oversee financial monitoring and reporting, and dissemination of the project's outcomes, particularly in relation to the HE Curriculum theme.

All lead HEIs involved in the project have agreed to receive only a contribution towards full economic costs rather than the full amount. In this way these institutions are making a substantial contribution to the project. The contribution from each HEI (assuming an annual inflation rate of 4%) is shown in the table below:

HEI	Year 1 (£)	Year 2 (£)	Year 3 (£)	Total (£)
University of Birmingham	22,257	22,469	22,157	**66,883**
Coventry University	71,067	70,649	69,983	**211,699**
University of Leeds	31,939	33,217	34,545	**99,701**
Queen Mary, University of London				**148,300**
Sheffield Hallam University				**23,384**
				£549,967

19.1 Budget

Activities	Year 1	Year 2	Year 3	Total
Staffing: National				
Project Manager (100%)	40,537	57,897	62,020	**160,454**
Admin support (50%)	9,113	13,015	13,942	**36,069**
HE Curriculum Developer (100%)	24,806	45,553	48,796	**119,155**
Staffing: West Midlands				
Careers Coordinator (100%)	24,806	45,553	48,796	**119,155**
Subject Coordinator (100%)	24,806	45,553	48,796	**119,155**
Administrator (50%)	7,088	13,015	13,942	**34,044**
Staffing: Yorkshire & Humberside				
Careers Coordinator (100%)	24,806	45,553	48,796	**119,155**
Subject Coordinator (100%)	24,806	45,553	48,796	**119,155**
Administrator (50%)	7,088	13,015	13,942	**34,044**
Staffing: London				
Careers Coordinator (100%)	26,933	49,457	52,979	**129,368**
Subject Coordinator (100%)	26,933	49,457	52,979	**129,368**
Administrator (50%)	8,151	14,967	16,033	**39,151**
Total HEI Staffing Costs	**249,871**	**438,588**	**469,816**	**1,158,275**
Full Economic Costs	**199,897**	**350,871**	**375,853**	**926,620**
Consultancy & Technical Support				
Technical & Website Support (50% in Year 1 & 2, 40% in Year 3)	19,500	27,040	28,122	**74,662**
Regional Consultant (West Midlands)	3,750	5,200	5,408	**14,358**
Regional Consultant (Yorkshire & Humberside)	3,750	5,200	5,408	**14,358**
Regional Consultant (London)	4,125	5,720	5,949	**15,794**
Project Coordination by Maths, Stats & OR Network	20,000	20,800	21,632	**62,432**
Project Evaluator	10,000	15,600	16,224	**41,824**
Other Staffing Costs				
Advertising for Staff	28,000	6,000	6,000	**40,000**
Staff Development	5,000	5,200	5,408	**15,608**
Other Staffing Costs	**94,125**	**90,760**	**94,150**	**279,035**
Commissioned Work/Activities				
Initial Data Gathering Exercise	25,000			**25,000**
Student Ambassadors (including recruitment)	25,263	52,546	54,648	**132,456**
Buyout of HE Staff for Activities/Events	22,031	30,550	31,772	**84,353**
Production/Development of Careers Resources	35,250	17,625	5,875	**58,750**

Production/Development of Maths Enrichment Materials	23,500	8,813	2,938	**35,250**
Careers training	21,150	5,499	5,719	**32,368**
Careers Website migration to an improved platform	5,523	4,521	4,702	**14,746**
(N.B. All figures in this section include VAT @ 17.5%)				
Total Commissioned Work	157,716	119,554	105,654	**382,924**
Communication/Marketing/Dissemination				
School Based Events	21,000	21,840	22,714	**65,554**
HE Based Events	22,500	23,400	24,336	**70,236**
Dissemination Workshops	5,000	5,200	5,408	**15,608**
Student travel to events	15,000	15,600	16,224	**46,824**
Advertising & Promotion (Events)	5,000	5,200	5,408	**15,608**
Promotion of adult learning opportunities	2,000	2,080	2,163	**6,243**
Event Coordination/Organisation	6,000	6,240	6,490	**18,730**
Total Communication & Marketing	76,500	79,560	82,742	**238,802**
Travel & Subsistence				
Travel	35,000	62,400	66,637	**162,296**
Accommodation	4,083	7,280	7,571	**18,935**
Subsistence	2,042	3,640	3,786	**9,467**
Total Travel & Subsistence	41,125	73,320	77,994	**190,698**
Office Running Costs & Overheads				
Equipment & Furniture	17,400	1,600	1,741	**20,741**
Telephone	2,917	5,200	5,408	**13,525**
Postage	1,750	3,120	3,245	**8,115**
Printing	3,000	3,120	3,245	**9,365**
Stationery	2,042	3,640	3,786	**9,467**
Contingency	20,000	20,800	21,632	**62,432**
Total Office Running Costs & Overheads	47,108	37,480	37,315	**123,645**
Total Forecast	**866,343**	**1,190,133**	**1,243,524**	**3,300,000**

19.2 Financial Assumptions

The financial assumptions used to construct each budget element detailed within Section 19.1 are as follows:

Staffing Costs:

- The salaries proposed for all staff to be employed as part of this proposal have been costed at the appropriate level based upon the new national HE pay spine. In London, a weighting of 10% has been applied to all salaries.
- All salary costs include National Insurance and pension contributions (where appropriate).
- Technical and website support will be provided by the learned societies involved in the development of this proposal for which a fee will be paid.
- Recruitment costs are high in the first year as there is a need to recruit the equivalent of 10FTE staff. An additional allowance has been made in subsequent years should the need to replace project staff arise.
- The contributions to Full Economic costs have been calculated at the rate of 80% of total salary costs. This figure includes office space, IT support and associated university services for all staff employed by the project.

Commissioned Work/Activities

- There is a need to better understand the current national situation with regard to the mathematical sciences in terms of current student numbers, study patterns, etc. This will establish a baseline by which project success can be measured. £25k has been budgeted for further data analysis and data collection.
- The costs for Student Ambassador Schemes include recruitment, development and incidental costs. Payments will be made to departments establishing such scheme, along with payments to the HE students involved. It is planned to have 90 ambassadors each year offering 3 hours for 20 weeks to Year 9 pupils in 15 schools in each region.
- HE expertise will be essential for many of the activities detailed within this proposal, and so a figure of £84,353 has been included to make a ‘goodwill’ payment for the buyout of staff time across the three years of the pilot.
- CRAC will provide an initial training course for teachers from the regions and project staff. This will subsequently be delivered by the Careers Coordinators and will be offered in Years 1, 2 and 3.
- The mathscareers website needs to be migrated to a new platform in order to be able to host the additional resources developed by the

project, and cope with the enhanced website traffic that will follow. £14,746 has been budgeted for this purpose.

Communication and Marketing

- £21,000 per annum has been allowed for the costs of the 288 small events and 42 careers events each year. This figure includes the purchase of all materials and resources required for the events, including the hiring/transport of any specialist equipment.
- £22,500 per annum has been allowed for the HE based events. This includes catering costs, payments to HE staff and students and the purchase of any resources/materials required for the event.
- It is important that free travel is offered to students attending events away from their own schools and colleges in order to encourage participation within the project. £15,000 per annum has been allowed for this purpose.

Travel and Subsistence

- The Subject and Careers Coordinators will spend a large proportion of their time travelling to, and then working with, local schools. The Project Manager will regularly visit each pilot region, and the HE Curriculum developer will need to meet regularly with other members of the project team. In addition, the travel expenses of all speakers at the events will need to be met. There will be a significant amount of travel involved by those associated with the project and so £60,000 per (full) year has been budgeted for this purpose.

Office Running Costs and Overheads

- While office space will be provided as part of the FEC costs, equipment and furniture will not. £20,741 has been budgeted for the purchase of IT equipment and furniture.
- A contingency of £20,000 has been allowed per annum. In part, this has been allowed in case there are significant changes to HE staff salaries as is currently a possibility.

20 Assessment of affordability

Whilst lead HEIs and sponsoring organisations are making substantial contributions towards the delivery of this project it will only be affordable if funding is secured from HEFCE.

The project is based on human capital and our discussions with various interested people have led us to believe that we should be able to recruit good

people at the salary levels proposed. We believe that it is right to start with three regions as each will present a different base for measuring progress but each represents an interesting challenge in terms of widening participation in Higher Education. Employment of an evaluator from the start enables us to be sure that we are embedding evaluation.

The grant requested is tied firmly to particular activities for which costs have been obtained.

REFERENCES

21 References

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(5) The Annual Report of Her Majesty’s Chief Inspector of Schools 2004/5 Ofsted Oct 2005.

(6) ‘Mathematics and science in secondary schools: the deployment of teachers and support staff to deliver the curriculum’ NFER report for DFES Helen Moor, Megan Jones, Fiona Johnson, Kerry Martin, Elizabeth Cowell (NFER) and Chris Bojke (PharMerit), January 2006.

(7) ‘Science, Engineering and Technology and the UK's Ethnic Minority Population’ Report for Royal Society, April 2005.

(8) ‘A level Maths equals money’ Report in TES Feb 19 1999 on research by Anna Vignoles and Peter Dolton at University of Newcastle.

(9) ‘Choosing science at 16’ NICEC Project Report Munro M. and Elsom D, 2000.

(10) ‘Increasing recruitment to scientific and technical studies’ European Commission Lifelong Learning Policy Development Mathematics Science and Technology, December 2004.

(11) Ken Boston QCA http://www.qca.org.uk/251_16054.html

22 Acronyms

ACME	Advisory Committee on Mathematics Education
CETL	Centres for Excellence in Teaching and Learning
CMS	Council for Mathematical Sciences
CRAC	Careers Research Advisory Centre
DfES	Department for Education and Skills
FE	Further Education
fEC	Full Economic Costs
FTE	Full Time Equivalent
HE	Higher Education
HEI	Higher Education Institution
HESA	Higher Education Statistics Agency
HoDOMS	Heads of Departments of Mathematical Sciences in the UK
ICG	Institute for Careers Guidance
IMA	Institute of Mathematics and Its Applications
JMC	Joint Mathematical Council
LEA	Local Education Authority
LMS	London Mathematical Society
MEI	Mathematics in Education and Industry
MMP	Millennium Maths Project
MSOR	Higher Education Academy Mathematics, Statistics and Operational Research Network
NACGT	National association for Careers and Guidance Teachers
NANAMIC	National Association for Numeracy and Mathematics in Colleges (FE)
NCETM	National Centre for Excellence in the Teaching of Mathematics
NFER	National Foundation for Educational Research
NICEC	National Institute for Careers Education and Counselling
QCA	Qualifications and Curriculum Authority
RDA	Regional Development Agency
RI	Royal Institution
RSS	Royal Statistical Society
SETNET	Science, Engineering, Technology and Mathematics Network
SEMTA	Science, Engineering Manufacturing Technologies Alliance
STEM	Science, Technology, Engineering & Mathematics
TDA	Training and Development Agency