Review of Mathematics Access Grid: Instruction & Collaboration

Final Report by DTZ

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Executive Summary

Taught Course Training in MAGIC Universities

The 2010 International Review of Mathematics pointed out that although TCCs were a step in the right direction in improving the knowledge and breadth of Maths PhD students in the UK, a lot remained to be done to improve their competitiveness in the academic jobs market. If MAGIC members are serious about the goal of broadening mathematical knowledge, then we believe the following principles will be important for the future:

- To make taught course provision mandatory.
- To require a minimum threshold of training to achieve broadening. Under the current PhD funding model this would be 80 – 100 hours. If a more generous funding environment was possible, then 120 hours would be the ideal target.
- This would require a minimum of 5 MAGIC courses or equivalent.
- The practice of providing alternative options to MAGIC we believe is appropriate, but they should not be seen as a 'soft option' and should be equivalent in scope and rigour to MAGIC provision.
- For appropriate students the expectation is that MAGIC courses would comprise at least 75% of subject-specific taught course provision (we appreciate there may need to be some flexibility for special cases).

It is likely that EPSRC will require universities to move in this direction in any case for DTA students in the future.

There is considerable variation in the way in which universities assess MAGIC courses. On the whole, assessment is informal and 'light touch'. It is either delegated to the judgement of supervisors or it is incorporated into other assessment procedures for the progression of PhD students. In general, universities are comfortable with this approach and do not want to move to a more formal assessment system which involves marking and grading students.

However, the International Review Panel was unhappy about the lack of formal course assessment across some TCCs. It believes there is an urgent need to increase the rigour of taught course training in PhDs to improve the competitiveness of UK PhD students in the academic jobs market. In response to the International Review, it is likely that EPSRC will require universities to move in this direction for DTA students There are two ways in which this could be done.

Option 1: A 'light touch formal' assessment at the university level. Specific recommendations include:

- Delivery of course write-up and/or assignments by students
- Oral examination – short presentation to academics additional to the supervisor; and this must include formal Q&A on the taught course syllabus.
- The formal recording of student performance relating to taught course provision (pass/fail) which is reported to the department's postgraduate committee as at Newcastle University.

Option 2: The MAGIC lecturer sets and grades (pass/fail) an assessment. Again, there would be formal recording and reporting of student performance within the department.

The advantage of Option 2 is the assessment is being undertaken by the most knowledgeable person about the course. It would add to the workload on MAGIC lecturers but some said it would not be too much additional work to simply issue pass / fail grades. The advantage of Option 1 is that it is less burdensome on MAGIC lecturers but there may not be people within the department who have enough specialist knowledge to undertake a rigorous assessment.

Operation of the MAGIC Network

Course Syllabus – the development of the new set of core courses has been highly successful. It is therefore recommended that the Programme Committee conducts a similar review for the specialist courses, to be ready for the 2011/12 academic session.

Course Delivery – the following actions should be considered to enhance course delivery:

- *Recording lectures* – the current initiative to record MAGIC lectures should be maintained to provide 100% coverage of taught course provision. A policy should then be developed for the provision of recordings internally to students and staff; and externally to other customers.
- *Training of lecturers* – a training programme for lecturers across the MAGIC network should be introduced. This should focus on:
    - Communication skills with students – verbal and written
    - How to exploit the multi-media environment most effectively
    - Learning how to operate the AG technology effectively.
- *Conferences* – these are very valuable forums for student communication and should be supported on an ongoing basis. This will require appropriate budgeting.

Network Structure – the current 19 member network should be retained. The scope for inclusion of additional university members, should there be the demand now or in the future, should be reviewed, so that MAGIC has a clear policy on this issue.

Governance & Management – DTZ recommends a significant restructuring of the current model, the key elements of which are:

- **SAC** – this should be disbanded

- **ASC** – this should be retained, to meet via AG nodes annually. Its role will be to review and sign-off the management plan prepared by the Management Team. To provide the required external governance element, it is proposed that one or two external members be invited to join the ASC. It will be chaired by the Director of MAGIC.

- **Management Team** – this will be an executive body comprising c. 5 – 8 representatives from across the 19 member network. These should be volunteers with the interest and skills to contribute to the management of the MAGIC network. Detailed proposals include:

- Its remit will include policy and operational management issues associated with membership, web site, recording of lectures, etc.
- It will have the latitude to create task-oriented committees, such as the Programme Committee
- The Team should meet face-to-face – initially quarterly, moving to six monthly once the recommendations from the review have been implemented.
- Rotation – there should be a process for members to retire and the recruitment of new members on a rolling three year basis
- The preparation of an Annual Management Plan for submission to the annual meeting of the ASC. This would review progress during the year, plans for the forthcoming year, financial reporting, etc.

- **Programme Committee** – this should remain, with the same modus operandi as at present

- **Director of MAGIC** – there should be one overall Director of MAGIC, eliminating the current dual PI structure. This post should have funding to cover the management time involved in the delivery of this post. There should also be a rotation policy of around three to four years. To assist with this, another member of the Management Team should be appointed as Deputy Director to form part of a succession plan and to provide cover for the Director. This is good risk management practice.

- **Supporting Staff** – additional administrative and IT support should be provided to support the Director in the day-to-day delivery of the MAGIC service, operation of the web site, communication across the university network through field visits, provision of IT training, etc.

Sustainability of the MAGIC Network

The sustainability of the MAGIC Network depends on having sufficient funds to cover the direct financial costs of operating the Network after EPSRC core funding ceases in Autumn 2011.

DTZ has prepared three future financial scenarios for the MAGIC Network and the annual costs of each are shown below:

	Annual Cost (£)
Basic – coverage of only essential costs	57,000
Enhanced – essential costs plus contribution for future replacement of equipment	128,000
Hybrid – essential costs plus just a 50% contribution for future replacement of equipment	95,000

Once EPSRC funding ceases, there are three main ways in which revenue can be generated to cover these costs:

- University Subscriptions – each university would pay a subscription to be part of the MAGIC Network and to benefit from the service it provides

- Student Charges – there would be a charge for each student registration
- Commercial income – there may be opportunities to generate revenue through company sponsorship or through charging universities outside the Network to access courses / recordings.

The current PI (Prof. Jitesh Gajjar) is exploring opportunities to generate commercial income and there are encouraging prospects in the pipeline. However, in the short-term revenue generation depends on either introducing university subscriptions or student charges. Overwhelmingly, consultees preferred the former to the latter. It was felt that student charges would be too complex and bureaucratic to administer and could deter participation.

EPSRC has indicated that it will provide transitional funding to TCCs to support the transition to full self-funding in the future. It would not be unreasonable for the MAGIC Network to bid to EPSRC to cover 50% of the essential basic costs of running the Network in the future. This would be £28,500 per annum. If this funding was received, the level of annual subscriptions payable by member universities would be as follows:

	Annual University Subscription with EPSRC Transitional Funding*
Basic Costs Scenario	£1,500
Hybrid Scenario	£3,500
Enhanced Costs Scenario	£5,250
* The cost of an equipment maintenance contract would need to be added to this after the current contract runs out in three years.	

If subscription fees are linked to the broad size of departments in terms of the proportion of PhD students recruited annually for whom MAGIC is expected to be the primary provider of taught courses, the annual subscription fees would be:

	Basic	**Hybrid**	**Enhanced**
Small – 10 or less PhD students recruited annually (for whom MAGIC is expected to be the primary provider of taught courses)	875	2000	2,950
Large – 11+ PhD students recruited annually (for whom MAGIC is expected to be the primary provider of taught courses)	2,625	6,100	9,200
Total Revenue Generated	£28,875	£66,700	£99,800
EPSRC Grant	£28,500	£28,500	£28,500
Total	£57,150	£95,280	£128,445
Target	£57,000	£95,000	£128,000

	Basic	Hybrid	Enhanced
Average cost per registered student p.a.* assuming EPSRC grant of £28,500 pa	£100	£233	£348
Note: * The average number of students registered with MAGIC for the last three years (287) has been used to calculate the annual average cost per student.			

DTZ considers this level of subscription fee is within a range that would be acceptable to most universities. **The average cost per registered MAGIC student would be only £100 under the basic funding model. Even under the enhanced funding model the cost is only £350.** This represents good value for money compared to the cost of alternative teaching models. For example, last year non EPSRC PhD students paid a £120 registration fee plus travel and accommodation costs to attend just one APTS training week.

Since the analysis for this report was undertaken, EPSRC have announced a call for follow-on funding which specifies that up to £150,000 per TCC is available over a period of five years (£30,000 per annum) to ease the transition to self-sustainability.

The financial projections above assume EPSRC transitional funding of £28,500 per annum. However, no allowance has been made for the cost of setting up a legal structure that can hold subscription income from universities to fund the MAGIC Network. This is essential and it would be reasonable for MAGIC to bid for the full £30,000 per annum on the basis that funding will be required to set up an appropriate legal structure (contingency funding could also be used for this purpose).

In the future, it will be important to look at ways of minimising costs so subscription charges do not rise too steeply after EPSRC transitional funding ends. Recommendations are:

- Building on current work to explore further opportunities for commercial income generation.
- Incorporating more modules that are already being delivered at member universities into the MAGIC programme, subject to timetabling issues.
- Linking into the Oxford-Led TCC which also uses AG technology.

The sustainability of the Network also depends on universities continuing to make their crucial in-kind contributions. All universities said they were, in principle, prepared to continue current in-kind contributions. However, DTZ has suggested that the MAGIC sustainability plan should formalise these commitments. We believe the following principles are important:

- There needs to be a formal commitment by each university to make staff time available for supporting the MAGIC Network (including delivery of lectures) and that this needs to be recognised as a legitimate activity within the department ie. offset against other teaching commitments. Expectations of the amount of teaching time universities are expected to contribute could be included as a guide (see DTZ suggestions for different sizes of department).

- An expected contribution of management time should be formalised when the sustainability plan for the MAGIC Network is prepared and DTZ would suggest this should be around 3-5% of a senior academic.
- An expected contribution of technical support time should be formalised when the sustainability plan for the MAGIC Network is prepared. DTZ would suggest 5-10% of a technician or the equivalent.

1. Introduction

DTZ was commissioned by the Mathematics Access Grid: Instruction and Collaboration (MAGIC) Network of 19 universities to undertake a review of their Taught Course Centre. The work was managed by a Steering Group comprising five member universities as follows:

Professor Jon Forster – Chair of MAGIC SAC, University of Southampton
Professor Jitesh Gajjar – MAGIC Principal Investigator, University of Manchester
Professor Neil Strickland – MAGIC Principal Investigator, University of Sheffield
Professor Peter Ashwin – University of Exeter
Professor Mary Rees – University of Liverpool.

The work was undertaken between January to March 2011. As the principal public sector funder of the MAGIC network for its first five years EPSRC was supportive of, and engaged in, the review process.

1.1 Reasons for Review

An international review of UK Mathematical Sciences in 2004 said that while the UK PhD standard remained high, new PhDs from the UK usually have less breadth and experience than their peers from other countries. The review recommended that in order to keep UK PhDs competitive in the jobs market (particularly for academic positions where the jobs market is highly international), students needed to be given the opportunity to develop a greater breadth of knowledge as part of their PhD.

EPSRC's response to the international review was to issue a call to establish Mathematical Sciences Taught Course Centres (TCCs) for PhD students. The rationale behind TCCs is that it is not practical or economically viable for most universities to provide their own taught course programme for PhD students. It makes sense for universities to 'pool' their subject expertise and to work together in delivering a taught course programme. EPSRC agreed to provide £2.9 million funding over five years to 'pump-prime' the establishment of TCCs. Thereafter (from Autumn 2011 onwards) they were expected to be sustained by universities. In total six TCCs were established:

- The Academy for PhD Training in Statistics (APTS)
- The National Taught Course Centre in Operational Research (NATCOR)
- The London Taught Course Centre (LTCC)
- The Oxford-Led Taught Course Centre (Oxford-Led)
- The Scottish Mathematical Sciences Training Centre (SMSTC)
- Mathematics Access Grid Instruction and Collaboration (MAGIC)

In April 2010, DTZ was commissioned by EPSRC to undertake a review of TCCs. TCCs were in their fourth year at this time, so EPSRC wished to review how successful the initiative had been in relation to its original aims and the steps that were being taken by universities to ensure the sustainability of the initiative after EPSRC core funding came to an end in autumn 2011.

DTZ's report highlighted the fact that MAGIC is considerably the largest and most complex of all the TCCs funded by EPSRC. It has a more challenging operating environment than the other TCCs and various issues were raised in the report relating to:

- Network size
- Management structure
- Succession planning
- Sustainability planning
- Administration
- Course provision and assessment
- Technology resilience.

Since the publication of DTZ's report, EPSRC has indicated that it aims to provide all TCCs with transitional funding from Autumn 2011, to help universities take full financial responsibility for TCCs in due course. EPSRC and the MAGIC Network were keen that issues identified in the earlier study should be examined and addressed before the call for proposals was issued. Thus, in December 2010 DTZ was commissioned by the MAGIC Network to undertake a more detailed management review of the TCC which examined the issues above.

1.2 International Review of Mathematics 2010

Since the study was commissioned, a draft report from an International Review of Mathematical Sciences in the UK has been published. It refers to TCCs and is supportive of them saying '*TCCs seem to be fulfilling the purpose of increasing students' knowledge of mathematical sciences areas outside their PhD topics*'. However, the International Panel was unhappy about variation across universities in TCC requirements and the lack of formal course assessment. Similar concerns were raised by DTZ in its report.

The International Panel also pointed out that although TCCs were a step in the right direction in improving the knowledge and breadth of Maths PhD students in the UK, a lot remained to be done to improve their competitiveness in the academic jobs market:

"*Strikingly few of the postdocs and junior faculty whom the panel met had received their PhDs in the UK....Based on comments during the site visits from departments and researchers who had recently hired postdocs or junior faculty, the panel attributes this problem almost entirely to the more mathematically rich preparation of PhD students from other countries*".

It is likely that EPSRC will respond to the above by issuing guidance to Heads of Department on minimum taught course requirements for EPSRC funded PhD students that will need to be formally assessed. Looking to the future, the MAGIC Network will need to ensure it has the capacity and capability to meet these requirements.

1.3 Methodology

The work programme comprised the following tasks:

- An inception workshop with the Steering Group
- Pilot fieldwork at Birmingham University to test the questionnaires and checklists developed for the review

- Fieldwork visits to five universities (Exeter, Leeds, Loughborough, Nottingham and York). These were selected by DTZ to provide a good mix of universities participating in the MAGIC Network). At each university interviews were held with the lead node contact and other senior staff in the department, including the head of department in most cases. Focus groups were also held with academic staff who had delivered MAGIC courses and supervised PhD students who had participated in MAGIC courses. Focus groups were also organised with PhD students who had undertaken MAGIC courses over the last few years.
- Telephone interviews with lead node contacts at all the remaining universities in the MAGIC Network.

In total DTZ consulted:

- 19 lead node contacts at member universities
- 29 other academic staff at member universities (a mix of senior management staff, MAGIC lecturers past and present and PhD supervisors).
- 25 PhD students who had undertaken a range of MAGIC courses over the last 3-4 years.

A list of consultees is provided in Appendix A.

1.4 Report structure

The remainder of the report is structured as follows:

- **Section 2** – provides contextual information on the MAGIC network
- **Section 3** – sets out the level and nature of participation in the MAGIC Network to date using data from the monitoring database.
- **Section 4** – considers the operation of the MAGIC Network
- **Section 5** – provides a critique of the MAGIC Network based on feedback from the consultation programme.
- **Section 6** – assesses the level of costs incurred by universities in being part of the MAGIC Network.
- **Section 7** – considers what needs to be done to ensure the future sustainability of the MAGIC Network
- **Section 8** – sets out recommendations from this review.

Acknowledgements

DTZ would like to thank the following for their support in the execution of this research:

- The Steering Group for overseeing the study
- Jitesh Gajjar, who acted as Study Director and supported DTZ in the day-to-day management of the assignment
- The 19 lead node contacts who gave of their time in the consultation programme and accessed relevant information for us
- The lecturers, supervisors and students who participated in our field visit workshops
- EPSRC for reviewing the draft report.

2. MAGIC Network: the Context

2.1 Evolution of the MAGIC Network

In response to EPSRC's invitation to bid for TCC funding in 2005/06, a group of universities started to discuss how they could respond to this initiative. Sheffield was interested in delivering a pure mathematical programme and Manchester was in discussions with other universities about a more applied mathematical programme. Eventually, a joint bid was submitted by the two lead universities (Manchester and Sheffield) to deliver a programme of postgraduate courses in pure and applied mathematics using Access Grid technology for scalable video conferencing.

The size of the Network (14 universities at this time) meant that PhD students would have access to a broad range of academic expertise. The use of video conferencing technology eliminated all travelling time for students and lecturers, and provided a cost effective way of delivering postgraduate courses across the universities.

The bid was successful and a grant of £853,839 was approved for the two Principal Investigators (Professor Neil Strickland at Sheffield University and Professor Jitesh Gajjar at Manchester University). The main categories of expenditure associated with the grant are shown in Table 2.1 below.

Table 2.1: MAGIC Budget	**£**
Installation of Access Grid Technology (40k per node x 14)	560,000
Maintenance costs (6.6k x 14)	92,400
Course development (2.5k per course x 85)	212,500
Web / software development	10,000
Administration (8k per annum)	40,000
Conferences / meetings	60,000
Other	18,939
Total	**993,839**
Less university contribution (10k x14)	140,000
EPSRC Grant	**853,839**

Key points about the MAGIC budget are as follows:

- The bulk of the funding was allocated to technology set-up costs and to a lesser extent course development work.
- There was a minimal budget for management and administration and for technology support and maintenance which are essential to the smooth operation of a Network of this kind.

Since its launch the MAGIC Network has expanded to include five other universities (Exeter, East Anglia, Cardiff, Surrey and Reading). Most of these universities also approached the Oxford-Led TCC but while happy to provide access to courses, it would not allow the universities involvement in the management of the TCC. They would have been 'sleeping partners'. The reason for joining the MAGIC Network is that it was prepared to accept them as equal partners. Surrey University also considered the LTCC as it is relatively easy for students

to travel to London. However, the advantage of the MAGIC Network was the wide variety of courses on offer and the ability to access these without travelling.

All the universities, with the exception of Cardiff, were already using Access Grid technology. It was therefore relatively straightforward to make some modifications and link into the MAGIC Network. However, this means that the rooms used for MAGIC lectures are not necessarily in the maths departments of these universities. For example, the University of Reading had two rooms equipped with Access Grid technology. There is a large room in the University's Centre for Distance Learning which is used for staff delivering a MAGIC lecture. There is also a smaller room in the School of System Engineering which is closer to the maths department which is used by students attending MAGIC lectures. It is expected that this will move into the maths department in due course.

Cardiff University did not have Access Grid technology but was able to cover the installation costs through a special grant from EPSRC and its own departmental funding.

2.2 Member Universities

Figure 2.1 and Table 2.2 show the average annual number of PhD students recruited by maths departments across the MAGIC Network and specifically:

- The number for whom the MAGIC Network is expected to be the primary provider of taught courses.
- The number for whom the MAGIC Network is not expected to be the primary provider of taught courses ie. because the students are statisticians, mathematical physicists etc and use other establishments for taught course training.

Overall, the universities that comprise the MAGIC Network recruit approximately 270 PhD students per annum. **The MAGIC Network is expected to be the primary provider of taught courses for approximately 190 of these students**.

The information is useful since it is an indication of the potential level of usage of the MAGIC Network by individual universities. Some universities have a much larger potential 'customer' base than others and could be expected to make correspondingly larger contributions in terms of staff resources etc for the MAGIC Network.

Figure 2.1: Number of Maths PhD Students Recruited Annually by MAGIC Universities

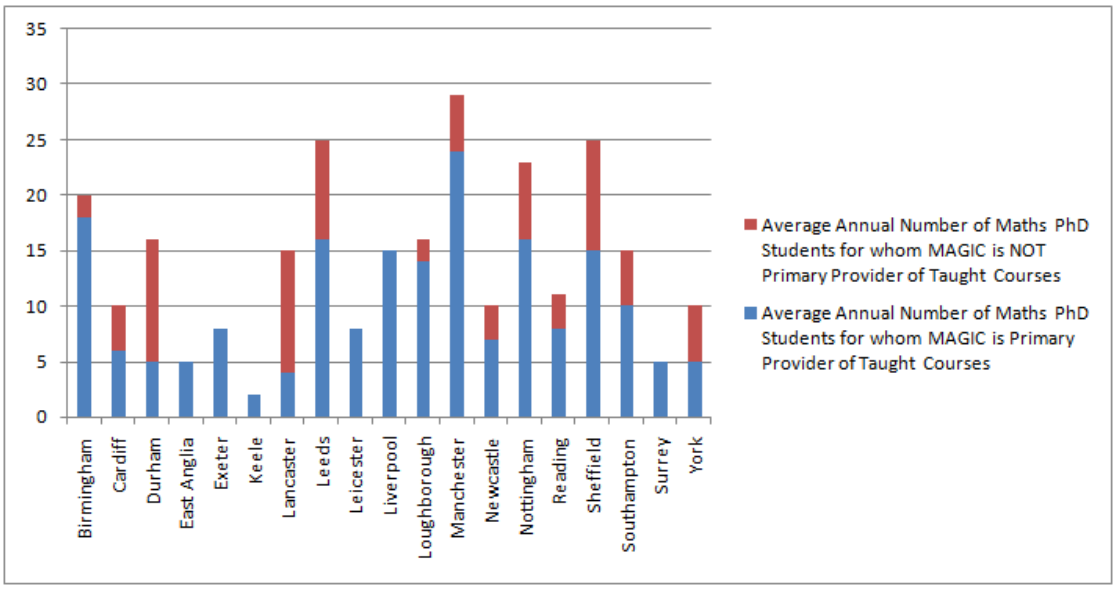


Table 2.2 Number of Maths PhD Students Recruited Annually by MAGIC Universities

University	Average Annual Number of Maths PhD Students Recruited	Average Annual Number of Maths PhD Students for whom MAGIC is Primary Provider of Taught Courses	Average Annual Number of Maths PhD Students for whom MAGIC is NOT Primary Provider of Taught Courses
Birmingham	20	18	2
Cardiff	10	6	4
Durham	16	5	11
East Anglia	5	5	0
Exeter	8	8	0
Keele	2	2	0
Lancaster	15	4	11
Leeds	25	16	9
Leicester	8	8	0
Liverpool	15	15	0
Loughborough	16	14	2
Manchester	29	24	5
Newcastle	10	7	3
Nottingham	23	16	7
Reading	11	8	3
Sheffield	25	15	10
Southampton	15	10	5
Surrey	5	5	0
York	10	5	5
Total	**268**	**191**	**77**

2.3 Management and Administration Structure

The management structure is shown in the diagram overleaf. The Scientific Advisory Committee (SAC) meets once a year and comprises the two Principal Investigators and representatives from outside the MAGIC Network to provide an external perspective on strategy and governance. The Academic Steering Committee (ASC) comprises the lead node contacts at all 19 member universities and meets at least twice a year. As there are 19+ members, meetings are usually held over the Access Grid. This is fine for endorsing proposals but is not an ideal environment for developing policy and strategy.

This is the reason why a separate Programme Committee was established as a sub-group of the ASC in 2010. There was a need to develop a more coherent course programme (see below) and a small group from the ASC was tasked with meeting more regularly to do this.

Day-to-day management is provided by the two Principal Investigators. It is difficult to quantify the amount of time this entails because it is not uniform throughout the year or even between years. For example, MAGIC has consumed more time than normal over the last year because of the involvement of one of the PIs in reorganising the course programme through the Programme Committee and the involvement of the other PI in procuring and managing the technology up-grade work. On the basis of information provided for the review, management of the MAGIC Network accounts for around 10% of the time of each PI in a busy year like last year, but would fall to about 5% of time in a quieter year. Thus, it lies with a range of 5-10% of two PIs or 10-20% of one PI.

MAGIC does not have any dedicated administrative support. The result is that much of this has been undertaken by the Principal Investigators with some administrative support being provided through a member of staff at Sheffield University to Professor Strickland. The MAGIC Network is designed to minimise administration. For example, students register on-line for courses through the MAGIC website and attendance is recorded electronically through the Access Grid. Nevertheless, there are many administrative tasks that arise such as dealing with queries, managing the website, preparing reports which add to the burden on the PIs because of the lack of administrative support.

2.4 MAGIC Syllabus

The MAGIC Network delivers approximately 30 courses per annum which are spread across two ten week semesters (autumn and spring). Courses are timetabled to run between 9am-2pm every day over these semesters. There are a mix of 20 hour and 10 hour courses. Prior to this academic year, the MAGIC Network invited proposals to run courses from member universities and the ASC selected those which should be included in the course programme for the forthcoming year. Some would be existing courses and others would be new courses. 57 courses had been developed and delivered prior to this academic year.

The problem with this approach to developing the syllabus was that it was driven by the academic interests of lecturers rather than the knowledge needs of PhD students. In Summer 2010, it was agreed that the MAGIC Network should develop a programme of core courses which would have wide applicability to the needs of students. These courses could be of either 10 or 20 hours duration (although the latter was expected to be the norm) and they should be transferable between lecturers. It was expected that 60-70% of the programme would comprise core courses and these would remain relatively stable going forward. In addition, there would be specialist courses outside the core programme to give students greater opportunity for broadening their knowledge which would be refreshed more regularly. Typically, these courses would be 10 hours.

The current course programme for this academic year is provided in Appendix B. There are a total of 32 courses of which 21 (65%) are core courses and 11 (35%) are specialist courses. 15 of the 21 core courses are new courses which had not been delivered in their current format previously. It should, however, be noted that some of the new core courses incorporate or combine material from 'old' courses run in the past. In contrast, only 2 of the 11 specialist courses are new courses.

The MAGIC Network uses EPSRC grant funding to pay £2,000 for the development of a 10 hour course and £4,000 for the development of a 20 hour course. This year, the funding has been linked to lecturers agreeing to deliver the course for at least three years (this undertaking was also received from lecturers delivering 'old' courses this year. Lecturers are expected to provide assessment material although there is no expectation that they should be responsible for assessing students themselves. The reality is that because most universities do not have rigorous formal course assessment requirements (as explained later), lecturers rarely need to assess student assignments for their courses.

2.5 Access Grid Technology

A key feature of the MAGIC Network is the use of Access Grid video conference technology to deliver courses remotely across the Network. This technology is also used by the Oxford-led TCC. As explained earlier, a large proportion of the original EPSRC grant was used to install Access Grid technology in the maths departments of the original 14 universities. The MAGIC Network acknowledges that there have been some performance issues with the technology. For example, audio quality and use of interactive whiteboards have been issues.

EPSRC has recently funded a technology upgrade across the MAGIC Network which should help to address many of the previous issues. Investment is being made to improve sound

quality and also to enable greater interactivity in lectures. For example, each node will have a visualiser which enables lecturers to work through examples as if using a blackboard and there will also be equipment whereby lecturers can annotate slides during a lecture.

The EPSRC grant for the upgrade is £367,000. Approximately £267,000 relates to the equipment upgrade as described above (around £14,000 per node). Approximately £100,000 is being used to purchase a three year maintenance contract (around £1,700 per node per annum). This provides for two preventative maintenance visits per year and a next day call-out service for equipment failure. This should have a significant impact on improving the reliability of the technology going forward.

3. The Level and Nature of Participation in the MAGIC Network

An access database was forwarded to DTZ, which enabled us to examine student registration and attendance data. This is the only population level data that we accessed centrally, other than the capital costs associated with the Access Grid infrastructure and the new maintenance contract.

It is important to flag up a health warning regarding this data in terms of:

- **Registrations** – this may understate course participation, because anecdotally we are aware that some students just dip into courses without registering. This is particularly the case when they have fulfilled their member university course requirements and are attending out of personal interest; and
- **Attendance** – again there is likely to be considerable under-reporting as the system is based on students signing in electronically. We know from student feedback that this does not always happen, especially when they join lectures late.

However, having examined the data we believe that the information is helpful in profiling course uptake if one makes allowance for the above caveats.

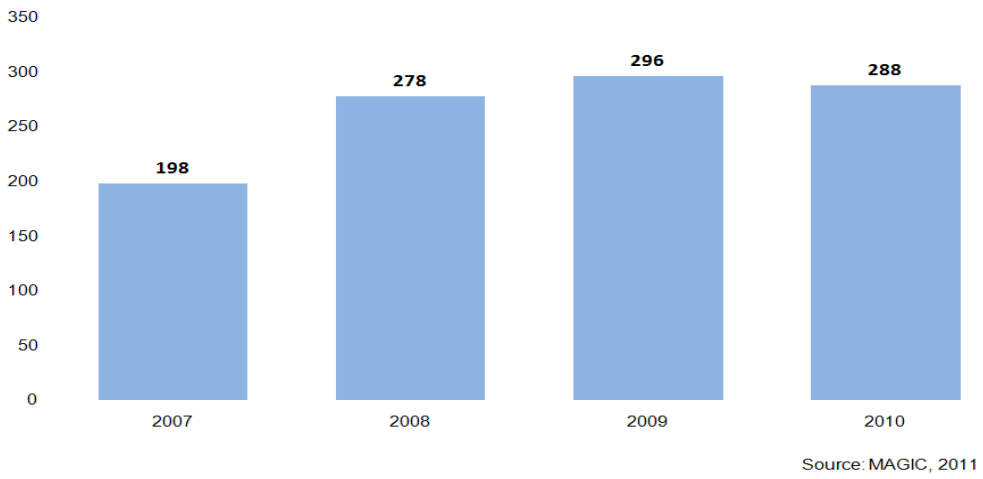
3.1 Student Registrations

Trend in Student Registrations – there was an average of 265 students registering[1] per annum over the last four academic years: see Figure 3.1. There has been a discernible ramping up effect over the last three years as the backlog of PhD students has been worked through the system.

We know that universities that participate in the MAGIC Network recruit around 190 PhD students per annum for whom the MAGIC Network is expected to be the primary provider of taught courses. Assuming that the majority of PhD students access MAGIC courses in the first two years of their PhD, this gives a potential 'customer base' of 380 PhD students per annum. An average annual figure of 265 students registrations per annum suggests around 70% of the potential student population that could be using MAGIC, are actually doing so.

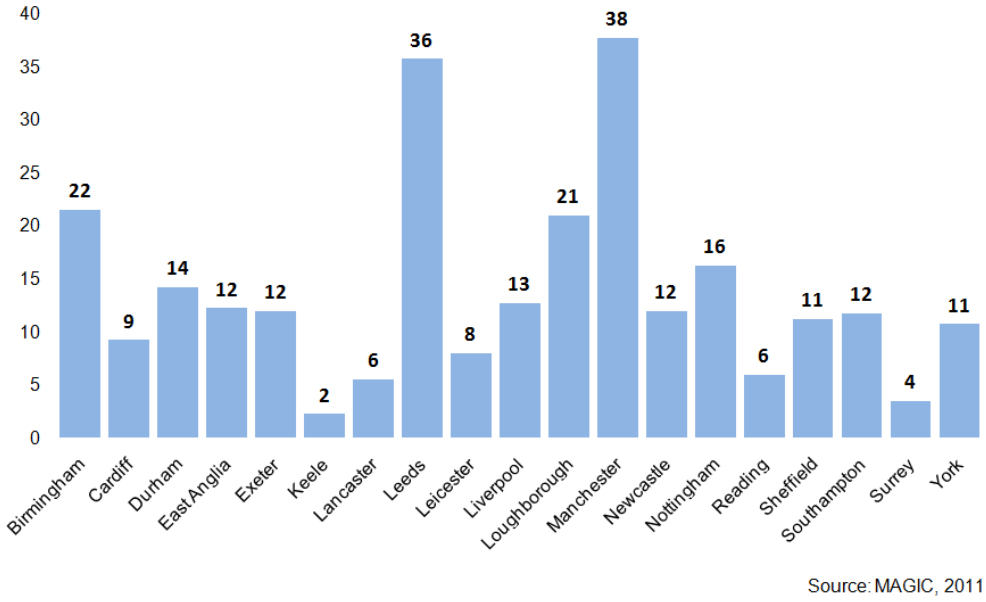
[1] **Note on classification of 'registrations'**: students registering in more than one year are counted as separate registrations, but students registering on more than one course in any single year are counted as a single registration.

Figure 3.1: Number of Students Registered on MAGIC courses by Year



Student Registrations by University – there is a considerable variance in the average number of registrations; from 2 at Keele to 38 at Manchester as shown in Figure 3.2. However, this is what would be expected given the significant variation in the annual number of Maths PhD students recruited by different universities

Figure 3.2: Average Number of Student Registrations p.a. (2007-2010) by University



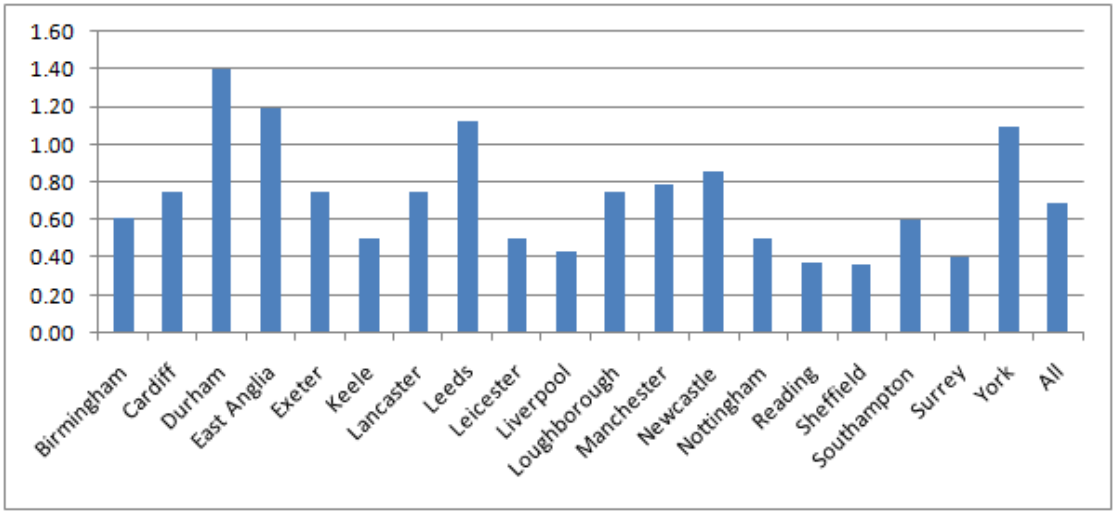
It is interesting to look at average annual number of student registrations as a proportion of the potential 'customer base' at each university – this is assumed to be the number of first and second year PhD students since most universities report that MAGIC courses are taken mainly in the first and second year of a PhD. However, we know from the fieldwork

programme that many PhD students in their third and fourth years also attend MAGIC courses so the potential customer base at each university could be larger than what has been assumed.

Figure 3.3 shows there are some anomalies in that the average annual number of student registrations at Durham, East Anglia, Leeds and York for example, is considerably greater than the average number of first and second year PhD students at the university. Perhaps this is because many third and fourth year PhD students are also participating in the programme.

Overall, the general picture is of participation at or around 70%. It is greater than this at some universities and lower at others.

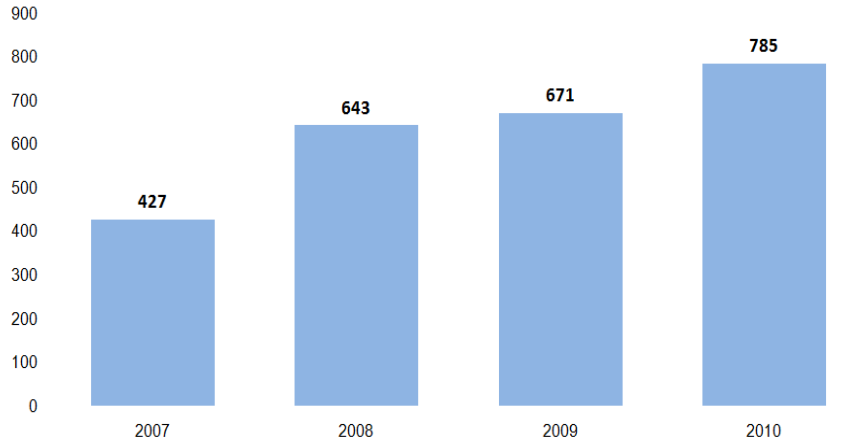
Figure 3.3: Average Number of Student Registrations (2007-2010) as Proportion of Eligible Student Base



3.2 Course Registrations

Trend in Course Registrations – there was an average of 630 course registrations per annum over the last four academic years: see Figure 3.4. It is interesting that unlike the levelling off of student registrations, the number of course registrations has continued to increase, which means that more courses per student are being taken.

Figure 3.4: MAGIC Course Registrations per Year



Source: MAGIC, 2011

This works out at an average of 2.4 courses per student per annum: see Table 3.1. This appears to be a low uptake, but when one considers the following factors, it may be quite close to what is happening 'on the ground' due to:

- A number of member universities requiring their students to take courses over 2 or more years;
- That some universities only require a total of 2 MAGIC courses per student over the course of their PhD; and
- The fact that the majority of universities will allow non-MAGIC courses to count towards their 'taught course allocation', including MSc level courses, graduate level courses (non-MAGIC) and reading groups.

However, it is clear that the average number of courses taken by PhD students is on an upwards trend.

Table 3.1: Average Number of Courses (2007-2010)

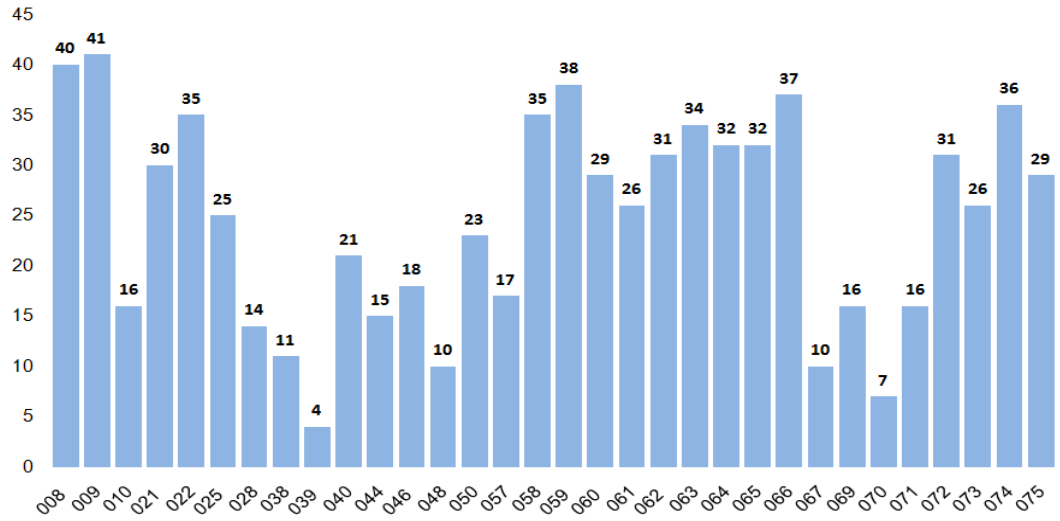
	2007	2008	2009	2010	Total
No. of Courses	427	643	671	785	2,526
No. of Students	198	278	296	288	1,060
Average	2.2	2.3	2.3	2.7	2.4
Source: MAGIC, 2011					

Number of Registrations by Course – this data provides a really interesting insight into the popularity of the different courses being run as part of the 2010/11 programme: see Figure 3.5. One is struck by the variation in the level of registrations by course, from:

- Introduction to Quantum Graphs (ref 039) – a specialist course with only 4 registrations; to

- Category Theory (ref 009) and Lie Graphs and Lie Algebras (008) – core courses with 40+ registrations. [See Appendix B for course codes].

Figure 3.5: Registrations by MAGIC course (2010/2011)



Source: MAGIC, 2011

Analysis of core versus specialist courses gives the reassuring evidence that the uptake of core courses is more than double that for specialist courses: see Table 3.2.

Table 3.2: Average Uptake of Core vs Specialist Courses (2010)

Course Classification	No. of registrations	No. of courses	Average no. of students per course
Core	636	21	30
Specialist	149	11	13
Total	785	32	24
Source: MAGIC, 2011			

With two exceptions (067 Integrable Systems and 069 Quantum Theory) all the core courses run in 2010/2011 have attracted in excess of 20 registrations and most have 30-40 registrations. Overall, there is evidence that MAGIC now has a programme of core courses that have wide applicability and are attracting good student numbers, although there is scope to improve this further.

A lower level of registrations would be expected for specialist courses. However, one must question whether it is cost-effective for a lecturer to be delivering 10 hours of lectures where there are only four registered students. Thought should be given to the setting of a minimum number of student course registrations to justify a course proceeding e.g. 10 students.

There will be a need for on-going review and modification of the specialist course programme (as for the core programme) to ensure that the most appropriate courses are being provided to students.

3.3 Attendance

Attendance statistics have been analysed for five randomly selected courses in 2009/10:

- MAGIC 004 - Applications of model theory to algebra and geometry
- MAGIC 010 - Ergodic Theory
- MAGIC 025 - Continuum Mechanics
- MAGIC 041 - An Introduction to Singular Perturbation Theory
- MAGIC 053 - Sheaf Cohomology

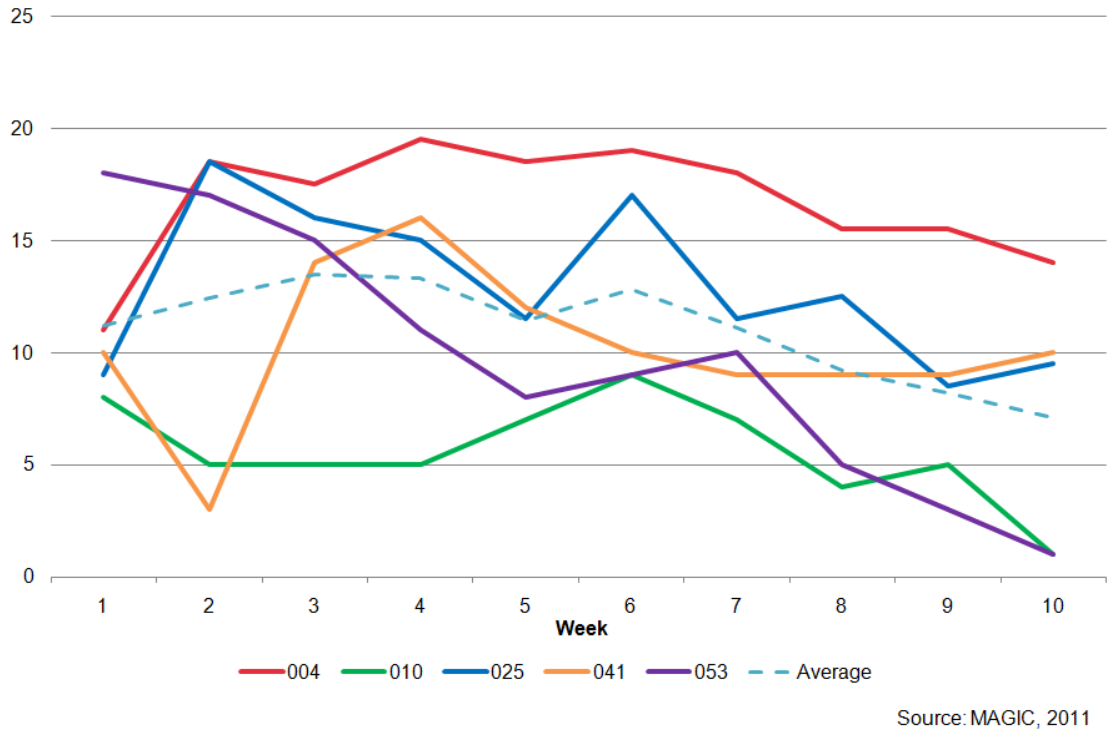
The weekly attendance statistics are detailed in Table 3.3 and graphically in Figure 3.6. It is clear that there is a discernible downward trend, but perhaps not as pronounced as we were led to believe from anecdotal evidence.

Table 3.3: Weekly Attendance by Course (2009/10)

Week	Course					Average
	004	**010**	**025**	**041**	**053**	
	20hr	*10hr*	*20hr*	*10hr*	*10hr*	
1	11	8	9	10	18	11
2	18.5	5	19	3	17	12
3	17.5	5	16	14	15	14
4	19.5	5	15	16	11	13
5	18.5	7	12	12	8	11
6	19	9	17	10	9	13
7	18	7	12	9	10	11
8	15.5	4	13	9	5	9
9	15.5	5	9	9	3	8
10	14	1	10	10	1	7
Total	167	56	129	102	97	
Average	17	6	13	10	10	11

Source: MAGIC, 2011
Note: For 20 hour courses a weekly average attendance has been taken where there is more than one lecture per week.

Figure 3.6: Weekly Attendance by Course (randomly selected courses from 2009/10)



Source: MAGIC, 2011

Of greater interest is the analysis of attendance hours against the total quantum of student teaching hours delivered: see Table 3.4. The percentage of available teaching hours[2] attended by students varies from:

- A low of 29% for Ergodic Theory; to
- A high of 76% for "Applications of Model Theory to Algebra and Geometry" (interestingly this course was not run in 2010/11).

The mean figure across the five randomly selected courses is 50%, which is lower than one would wish for given the goal of broadening education. However, it could reflect students not recording their attendance accurately as highlighted earlier. It could also reflect students registering for a course more out of personal interest, when they have fulfilled their taught training course requirements, and thus dipping in and out of lectures.

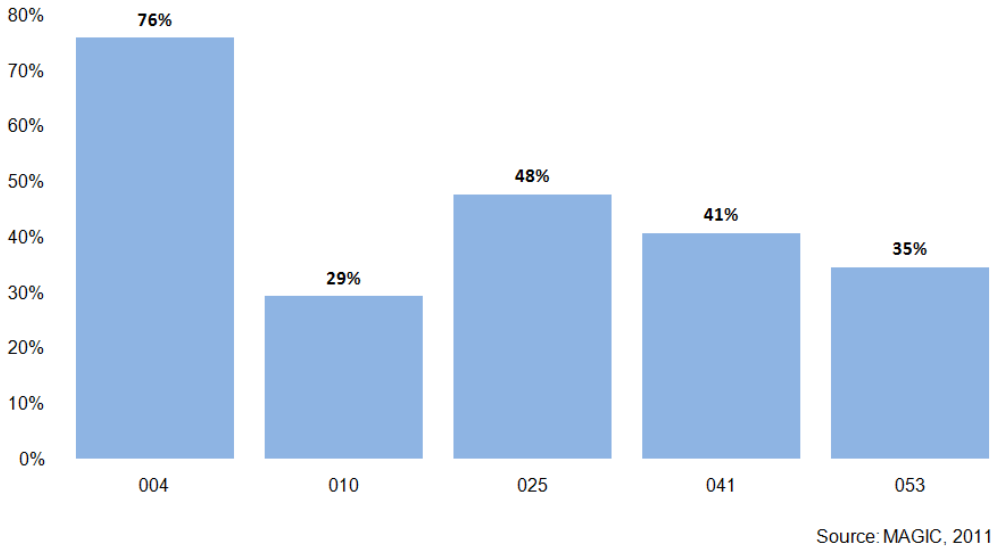
Table 3.4: Attendance as a Percentage of Taught Hours

Courses	**004**	**010**	**025**	**041**	**053**	**Average**
	20hr	*10hr*	*20hr*	*10hr*	*10hr*	
No. of students registered on course	22	19	27	25	28	
No. of teaching hours	440	190	540	250	280	1,700

[2] 'Teaching hours' is defined as (the number of registered students) x (number of course hours)

Table 3.4: Attendance as a Percentage of Taught Hours						
No. of attendance hours	334	56	258	102	97	847
% of teaching hours attended	76%	29%	48%	41%	35%	50%
Source: MAGIC, 2011						

Figure 3.7: Percentage of Teaching Hours Attended



Participation in the MAGIC Network - Key Points

- There has been an average of 265 students registering for MAGIC courses per annum over the last four academic years.
- DTZ estimates that this represents about 70% of the potential student base in MAGIC universities, although there is variation across universities.
- An average of 2.4 courses are taken by each registered student per annum. This seems quite low but is probably quite close to what is happening 'on the ground' due to students typically undertaking courses over two years and some universities having quite low taught course requirements as explained in the next section.
- There is evidence that MAGIC now has a programme of core courses that have wide applicability and are attracting good student numbers, although DTZ believes there is scope for improving uptake and participation further, as discussed in Section 4.

4. Operation of MAGIC

The objective of Section 4 is to review how maths departments in member universities have implemented MAGIC taught course provision. The philosophy of MAGIC is based on the provision of a suite of courses, and the lecturers and technology to deliver them; but it is up to individual institutions as to how they utilise this service. We were aware before the review commenced that there was considerable variation in the policies and operational practices adopted across the MAGIC Network.

Consultation with all 19 members has therefore enabled us to examine the operation of MAGIC at the grass roots level, giving for the first time a comprehensive review and understanding of the network. We have presented our findings under the following headings:

- **Training Requirements** – what policies the universities adopt in terms of the number of courses to take, their timing, and whether this is mandatory or discretionary;
- **Course Selection** – how courses are selected;
- **Course Attendance** – evidence on course attendance at member universities and their views on this; and
- **Course Assessment** – the nature of course assessment adopted by universities and the pros and cons of alternative models.

4.1 Training Requirements

Table 4.1 summarises the key parameters of 'mathematical sciences taught course provision' uptake for each member university. Unless otherwise stated the statistics for number of hours of taught course provision and number of courses relate to total uptake – MAGIC and alternative provision. The vast majority of universities permit alternatives to MAGIC, although this usually represents a minority of hours/courses attended. It is important to state that these are minimum taught course requirements – often students will undertake more courses out of personal interest.

Mandatory vs Optional – all universities other than Durham, Lancaster and Surrey make taught course provision 'mandatory' – albeit that the level of required training is very variable. This is usually stipulated in a Departmental Guidance document for PhD students and is reinforced through induction and/or guidance from supervisors.

Even at the universities above there is an expectation that students will attend some MAGIC courses but there is not a fixed requirement to undertake x hours of MAGIC training or x MAGIC courses. Instead, training needs are identified by the supervisor and student and a bespoke training plan is agreed.

Table 4.1 – PhD Student Training Requirements						
University	**PhD Training (MAGIC plus alternatives if they apply)**					
	Mandatory /Optional	**No. of Hours**	**Timing**	**No. of courses**	**MAGIC Proportion**	**Alternatives to MAGIC**
Birmingham	M	80 - 100	Yrs 1 & 2	5	80 – 90%	✓
Cardiff	M	100	Yr 1 – 60 hrs Yr 2 – 40 hrs	5+	Main provider	✓
Durham	O	Flexible	Flexible	Flexible	Flexible	✓
East Anglia	M	50*	Yr 1 – 30 hrs Yr 2 – 20 hrs	3 – 4	Main provider	✓
Exeter	M	60 - 80	Yr 1	4	50%	✓
Keele	M	60 – 80*	Yr 1 – 50% Yr 2 – 50%	4	Main provider	✓
Lancaster	O	80 - 100	Yr 1 – 60% Yr 2 – 40%	5	Main provider	✓
Leeds	M	20 – 66	Yr 1	2	50% +	✓
Leicester	M	20 – 40	Yr 1	2	Main provider	✓
Liverpool	M	40*	Yr 1 – 50% Yr 2 – 50%	2 – 4	100%	✓
Loughborough	M	100*	Yr 1 – 70 hrs Yr 2 – 30 hrs	5+	Main provider	✓
Manchester	M	80 –100	Yr 1	4 – 5	Main provider	✓
Newcastle	M	80	Yr 1 – 40 hrs Yr 2 – 20 hrs Yr 3 – 20 hrs	4 – 5	Main provider	✓
Nottingham**	M	Flexible	Yr 1 Yr 2 (half only)	Flexible	< 50%	✓
Reading	M	80	Yrs 1 & 2	4 – 5	Main provider	✓
Sheffield	M	40	Yr 1	2 – 3	Main provider	✓
Southampton	M	80 - 100	Yrs 1 & 2 (mainly)	6	c. 50%	✓
Surrey	O	Flexible	Flexible	Flexible	Flexible	✓
York	M	60	Yr 1	3 – 5	c. 65 – 80%	✓

Source: DTZ Survey, 2011

Notes: *MAGIC specific hours; actual number of hours of training can be greater than this due to uptake of alternative provision by students.

**Nottingham requires PhD students to undertake 6 training units, part of which can be MAGIC courses.

Number of Hours and Number of Courses – the variance is extreme: from 20 to 100 hours per student of taught course provision. This involves between 2 to 6 plus courses. The universities can be grouped into three broad categories of 'intensive', 'moderate' and 'low': see Table 4.2

Table 4.2: Models of Taught Course Training		
Classification	**No. of Hours per Student**	**Universities**
Intensive taught course training requirement	80 – 100	Birmingham Cardiff Loughborough Manchester Newcastle Reading Southampton
Moderate taught course training requirement	50 - 80	East Anglia Exeter Keele Nottingham York
Low taught course training requirement	20 - 50	Leeds Leicester Liverpool Sheffield
No mandatory taught course training requirement (although there is expectation that some MAGIC courses will be undertaken)	Unknown (but Lancaster for example expects students to undertake some MAGIC courses and five is normal)	Durham Lancaster Surrey

Timing of Taught Course Provision – university policies on when taught course provision should be taken varies significantly:

- *All in Year 1* – (six universities) – the philosophy here is to try and tackle the training requirements at the outset of the PhD programme and 'get it out of the way'
- *Focus on Years 1 & 2* (nine universities) – the objective of this policy is to 'spread the pain' of taught course provision over a longer period of time. The goal is to minimise the distraction from the student's PhD research work; and
- *Stretched Policy over 3 years* (four universities) – this more holistic approach recognises that taught course provision can apply with equal merit at any stage in the student's PhD programme.

However, it is important to point out that university policies relating to the quantity and timing of taught course provision usually represent the minimum expected. Students are free to take additional courses above the minimum number of hours and in later years, and we identified examples of this through our site visits and consultations with students.

MAGIC Provision vs Alternatives – the norm is for universities to allow students to take alternative taught course provision to MAGIC. The main alternatives which students subscribe to include:

- M.Maths /M.Sci – in particular 4th year courses which are at MSc level
- Graduate level courses run by individual universities
- Reading groups/seminars organised by students

- Summer schools
- Individual reading
- Other TCCs such as APTS and NATCOR[3]

However, notwithstanding this range of alternative provision, for 13 out of the 19 universities, MAGIC still represented the majority of taught course provision. For five universities it represented 100% of provision.

4.2 Course Selection

Process of Course Selection - the norm across the MAGIC universities is for the student to agree their taught course provision with their supervisor. In 14 out of the 19 member universities there was explicit reference to the strong guiding role of PhD supervisors in assisting students to identify their training needs and how best to address these – either from MAGIC courses or alternative provision. For the remaining five universities there was no explicit reference to the role of supervisors, but our view is that they will most probably have been involved, even if only in a light touch supporting capacity.

In addition to the supervisor role, there were examples of more formalised agreement and sign-off approaches for taught course provision which we believe are helpful in making the process more transparent:

Examples of Formal Recording and Approval Processes for Taught Course Provision

Cardiff
All students must have a formal programme of study set out for the first year of their PhD. This is prepared with their supervisor and sets out what taught courses they should attend, along with requirements such as IT training and literature review work.

Nottingham
The Department wants to put more emphasis on structured training for PhD students and so from Autumn 2011 it is proposing that all students should have a training portfolio that comprises more units of formal structured training.

Southampton
The agreed course and training provision is entered onto the student database which logs their planned development programme over the three years of the PhD.

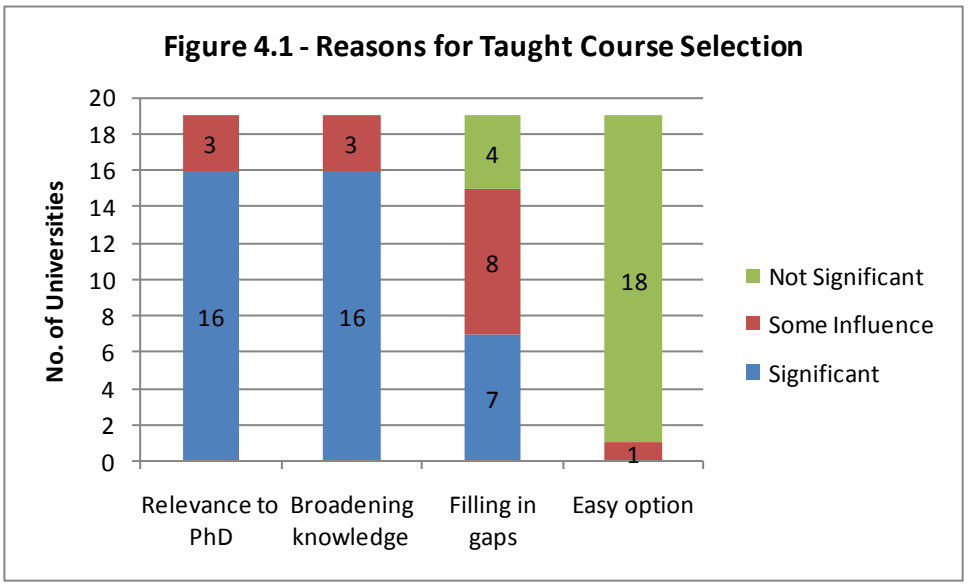
York
The student reviews the MAGIC website and then meets with their supervisor to discuss taught course provision and options. This is then discussed and signed off by the Thesis Advisory Panel (TAP) in November/December. The TAP comprises the supervisor and two other academics at York.

[3] These are the two national residential taught course centres for statistics and operational research: APTS (The Academy for PhD Training in Statistics) and NATCOR (The National Taught Course Centre in Operational Research).

Drivers of Course Selection – for the mandatory element of taught course provision, the supervisors have a very strong influence in guiding students. The feedback from the interviews with the node representatives is illustrated in Figure 4.1. The two most important drivers in course selection are:

- Choosing subjects which are supportive of the students' PhD research area (16 out of 19 universities); and
- Choosing subjects which broaden out the students' mathematical knowledge base (16 out of 19 universities).

Figure 4.1 - Reasons for Taught Course Selection



The norm is that supervisors require students to take the one or two courses in the MAGIC syllabus (or alternative provision) which are most directly related to their PhD subject area. However, beyond that the main focus in on broadening mathematical education. 'Filling in gaps' was also quite a common driver in course selection. However, only one university out of the 19 thought that 'taking the easy options and selecting courses with which they were familiar' was an influencing factor.

For courses that students take beyond what the university stipulates as mandatory, their selection is driven by what interests them and this therefore fits under the 'broadening knowledge' heading.

4.3 Course Attendance

Central Monitoring of Attendance – there is an electronic log-in box for students to tick on the Access Grid system, but we know from feedback that compliance with this by students is variable, despite the node representatives encouraging them to do this. This will result in under-reporting of the attendance data presented in Section 3. However, there are also students who attend who are not registered and this may result in an element of over-reporting. Given the lack of a robust centralised monitoring system, we have been forced to supplement this with feedback from the node representatives from the survey.

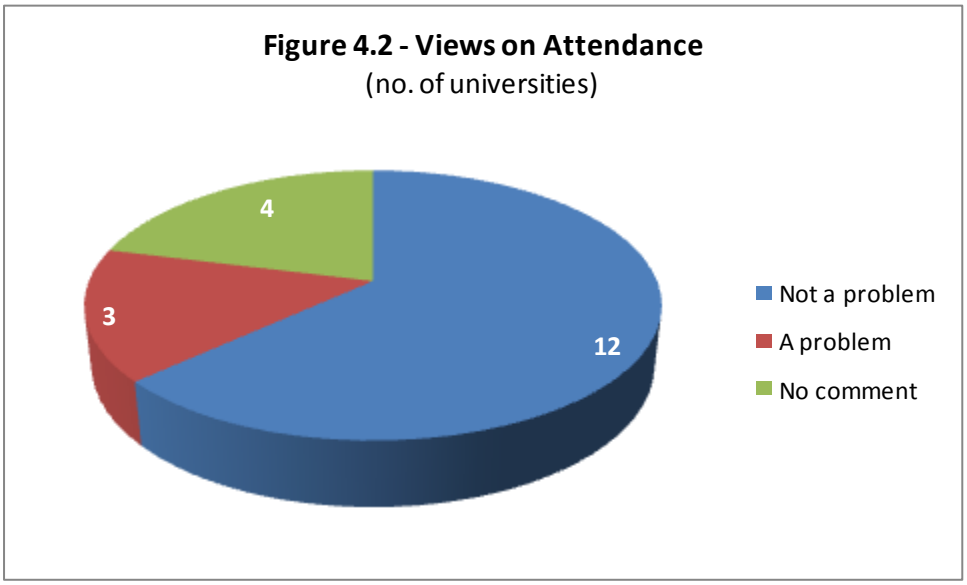
Local Monitoring of Attendance – none of the 19 member universities had a formal monitoring system for MAGIC courses. However, one university does monitor attendance for courses which their Department is responsible for delivering. This provides quite hard hitting data on the level of attrition during courses: see Table 4.3. Interim attendance ranged from 50 – 67%, and final attendance ranged from 25 – 50%.

These figures support the central monitoring statistic for the percentage of teaching hours attended from five randomly selected courses, which yielded a mean figure of 50% and a range of 29% to 76% attendance – see Table 3.4.

Table 4.3: Attendance on MAGIC Courses Taught (2010/11)*

Course	No. of Students Registered	Interim Attendance	Final Attendance
Specialist course	20	50% at around week 5	25%
Specialist course	20	50% two to three weeks into course	20%
Core course	34	67% two-thirds into course	33%
Core course	41	67% two-thirds into course	50%
Note: * Monitoring data collected by one university for courses it delivers			

Views on Attendance – given what appears to be quite strong evidence on high levels of attrition, it is somewhat surprising to find that this is not considered to be an issue by the majority of institutions. Only 3 out of 19 believed that attrition was an issue that needed to be addressed: see Figure 4.2.



Illustrative comments from node representatives which help explain their satisfaction with the status quo include:

"*My feeling is that there is some attrition, but it is OK as it is. Some students drop a course that is 'just not working for them'. If it is not valuable and interesting, they will take up different courses*."

"*There is no sign-in system or checking of attendance by the Department itself. This is not appropriate for PhD students who need to be self-motivated*."

"*Attrition levels are significant, but they are not out of line for courses of this nature and for the student profile*."
"*Attendance is not an issue in our Department. The big issue is motivating students to participate in MAGIC courses in the first place*."

If the attendance statistics are reasonably accurate, then this raises the question as to why member universities are not concerned. The possible explanations include:

- Lack of knowledge on what the actual attendance and attrition levels are (we believe this to be quite a significant issue). If better informed, then there may be more concerns aired; or
- The node representatives are aware of the significant attrition levels, but they accept these contributory factors. This could be interpreted as a complacent attitude if one is serious about the delivery and uptake of taught course provision with the goal of broadening mathematical education.

Factors Influencing Attendance – the following factors were quoted as influencing attendance:

- *Monitoring* – lack of formal monitoring systems
- *Assessment* – if students are assessed formally, then this has a major impact on attendance. This was corroborated through feedback at the student workshops.
- *Quality* – the higher the standard of the lecturer and course materials the better will be the attendance. This is linked to the standard at which the course is pitched.
- *Timetabling* – there are genuine time-tabling conflicts for students, when they have to meet deadlines for PhD deliverables, or if they have teaching commitments.

"*Students know that they are required to attend taught courses and that their knowledge of these courses will be assessed – so they have a reason to maintain good attendance*." (node rep comment)

"*Of course the quality of the lecture may have an impact on attendance. I received feedback that one lecturer raced through 600 slides in a 20 hour course and in such situations students may give up*." (node rep comment)

"*I like to be able to dip in and out. It allows you to go and find out if they are interesting. You can also have timetabling conflicts with teaching or projects where MAGIC has to take a back seat."* (student comment)

Suggested Enhancements – the following suggestions were put forward by node representatives:

Attendance - Recommendations from Node Reps

University A

"*Through a carrot rather than stick approach. The route to good attendance is through the provision of high calibre courses pitched at the right level, rather than taking a tough monitoring approach*."

University B

"*We are in the process of developing a new monitoring system to track student progress through their PhD. There is the option to include taught course information such as:*

- *Training courses planned*
- *Quarterly review meetings with supervisors*
- *Assessment performance*
- *1st year report, etc*."

University C

"*Yes, attendance should be improved. This will require a three-pronged strategy:*

- *Improving the syllabus – in progress through the Programme Committee*
- *Making attendance mandatory*
- *Ensuring there is a formal assessment process*."

4.4 Course Assessment

Classification of Assessment Methods – Table 4.4 summarises the different approaches to assessment across the 19 member universities. The assessment process can be classified into three models: see Figure 4.3.

Figure 4.3 - Assessment Models
(No. of Universities)

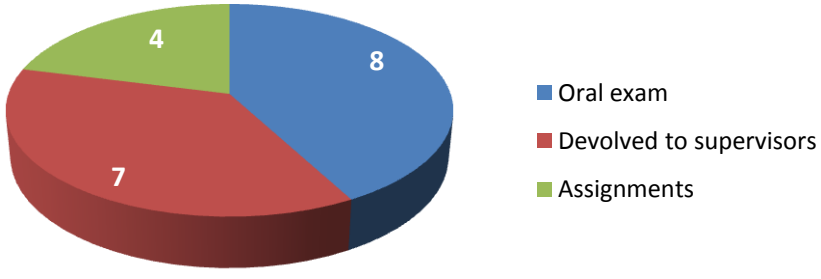


Table 4.4: Assessment Requirements				
University	**Level of Assessment**			**Description of Assessment System**
	Rigorous Formal	**Light Touch Formal**	**Informal**	
Birmingham		✓		**Oral exam** – all 5 courses assessed. 15 min presentation to class; 5 min Q&A.
Cardiff		✓		**Oral exam** – year 1 courses only. Viva style examination to check on student progress
Durham			✓ **(Var)**	**Devolved to supervisor** to decide what assessment is appropriate – generally informal
East Anglia		✓		**Oral exam** – questioning of student report at end of year 1 by supervisor & another academic
Exeter		✓ **(Var)**		**Oral exam** – questioning of student report at end of year 1 by 3 academics (excl supervisor)
Keele			✓ **(Var)**	**Devolved to supervisor** to decide what assessment is appropriate
Lancaster			✓ **(Var)**	**Devolved to supervisor** to decide what assessment is appropriate – generally informal
Leeds	✓ (applied)		✓ (pure)	**Assignments** – M. Maths home completion; assignments marked & graded; pure is informal
Leicester			✓	**Devolved to supervisor** to decide what assessment is appropriate
Liverpool			✓ **(Var)**	**Assignments** – completion and discussion with supervisor
L'borough		✓ **(Var)**		**Oral exam** – year 1 courses only. Viva style examination to check on student progress
Manchester		✓ **(Var)**		**Oral exam** – questioning of student report at end of year 1 by supervisor & another academic
Newcastle	✓			**Oral Exam** – notes submitted to supervisor; oral exam; pass/fail; central logging of performance
Nottingham	✓			**Assignments** – marked by MAGIC lecturer, central logging of performance
Reading	✓			**Assignments** – marked by lecturer; if not, local assessment organised by supervisor
Sheffield			✓	**Devolved to supervisor** to undertake assessment gained from training; informal
Southamp-ton			✓	**Devolved to supervisor** to assess each course - 'light touch'
Surrey			✓	**Devolved to supervisor** – based on review of 6-monthly student progress reports with oral questioning
York		✓ **(Var)**		**Oral exam** – questioning of student report in April of year 1 by Thesis Advisory Panel
Total	4	7	9	
Note: Var = Variable level of rigour of the assessment process within the defined category.				

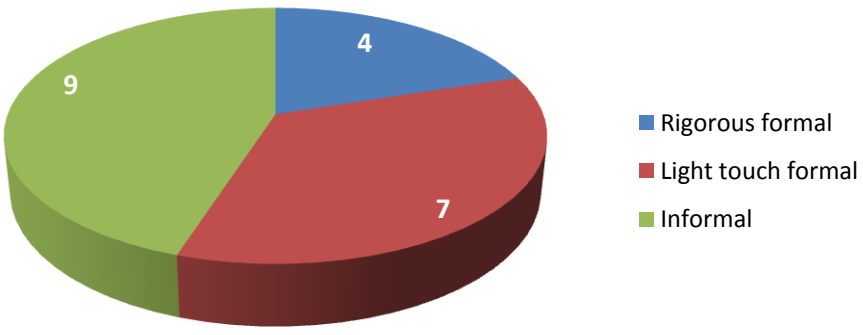
Oral Exam – this model is implemented by 8 universities. The normal format is for the student to prepare a written report towards the end of year one, which profiles the taught course provision and progress on the PhD. He/she is then examined orally, usually by the supervisor and one or more other academics. However, there are variations on this including the exclusion of the supervisor from the 'mini-viva', to the inclusion of a presentation element. One of the main objectives is to test whether the student is 'fit to progress' to year 2 and that they have the skills, abilities and commitment to satisfactorily complete the PhD programme. The level of rigour of the assessment process in the oral exam can be quite marked; both between and within institutions. Some questioning on the taught course elements are at best perfunctory, whilst for others there is a serious academic probing of what has been learnt (although the scope to do this properly depends on the research expertise of staff).

Devolved to Supervisors – this model has been adopted by 7 universities. This more laissez faire approach is characterised by what is usually an informal assessment process and is down to the judgement and commitment of the supervisor. One of the key distinguishing features of this model is that the process is 'invisible' to the department as no third parties are involved outside the student and the supervisor. This makes it very difficult to know what assessment is happening and how rigorously it is being enforced.

Assignments – this model has been adopted by 4 universities. It is based on the completion of assignments by the student relating to the courses taken. The level of formality in the assessment varies widely from an informal discussion between the student and the supervisor; to formal marking by the lecturer of the course.

Classification of Assessment Rigour – in addition to the method of assessment we have attempted to classify universities according to the rigour of their assessment: see Figure 4.4. The classification terms are explained below.

Figure 4.4 - Assessment Rigour
(No. of Universities)



Rigorous Formal – to achieve this classification there must be a formal marking system and a pass/fail assessment which is shared within the Department. This latter point is particularly important in that the assessment process has a high level of visibility. Only four universities met this criterion and they tended to be those that based their assessment on a formal marking of assignments. The one university which based their assessment on an oral exam applied a central logging of the performance of all their students.

Light Touch Formal – this is defined as some form of 'formal' assessment, but which stops short of marking and the logging of performance centrally. All eight universities adopting this system used the oral exam route. We believe that the requirement to prepare a report and be subject to an oral exam introduces an element of formality. However, the extent to which university departments actually follow through is highly variable, with some adopting a very 'light touch' approach, resulting in some students not being questioned about the taught course work at all.

Informal – this is defined by the devolving of responsibility for assessment to supervisors, with no other academic members involved. By its very nature this assessment is invisible as there is no logging of what assessment has taken place. However, node representatives believe that in most cases this tends to be very informal in nature. Nine universities were classified as having informal assessment processes (nearly 50% of MAGIC members).

[Note: Leeds University employed two different assessment models: a 'rigorous formal' for its applied students and an 'informal' for its pure students]

Views on Assessment Models – in general, universities were comfortable with the assessment models they had adopted. The most common observation was their strong resistance to move towards a more formal assessment system which involved marking and grading of students. The objections to this included:

- The time involved in assessment for time-pressured academic staff – and how this will be funded and absorbed
- The time involved for students, as the priority is to get them through the PhD within the four year window
- The difficulty involved in assessing students consistently across universities and courses. Who would actually do the assessment?
- What do you do with students who fail? Implications for re-sits, etc.
- The great variety in taught course provision – it is not just MAGIC courses but also M.Maths, MSc, reading groups, etc. How do you ensure consistency and fairness?
- The consequences within individual universities if there is a move to formal assessment. For example, this could result in assessment coming within the jurisdiction of QA Committee.

Notwithstanding this opposition to a 'rigorous formal' assessment, there were some universities who were keen to tighten up their assessment process:

Moves to More Formal Assessment

Reading
The Department is moving to a more formal approach to course assessment. It does not want to examine students, but it does want to make sure that students have engaged properly with courses. Thus, from the 2010/11 academic session it is a requirement that all MAGIC courses are assessed. Students are encouraged to ask the lecturer to undertake the assessment. If this is not possible, some type of assessment must be organised locally by the supervisor.

Sheffield

Their assessment of knowledge and understanding is informal, being based on a signed form from the supervisor. They would be sympathetic to creating more of a hurdle at the end of year 1, where the student has to write a report and/or make a presentation on their progress, including taught course training.

Interestingly, a number of the students consulted via workshops said they would welcome a more formal assessment process. Even if they were not in favour of this, they clearly confirmed that such a system would ensure that course attendance, study of course materials, and completion of assignments would be taken a lot more seriously.

It is also likely that EPSRC will set a minimum taught course training requirement for DTA PhD students which must be formally assessed in the future.

4.5 Operation of MAGIC – DTZ's Assessment

Having presented our research findings and the views of the consultees, we conclude Section 4 with DTZ's assessment of the evidence, making recommendations where appropriate. These views are not meant to be prescriptive and are put forward for debate and discussion within the MAGIC network.

Operation of MAGIC in Member Universities - DTZ's Assessment

Training Requirements – if MAGIC members are serious about the goal of broadening mathematical knowledge, then we believe the following principles are important:

- To make taught course provision mandatory.
- To require a minimum threshold of training to achieve broadening. Under the current PhD funding model this would be 80 – 100 hours of MAGIC courses or equivalent. If a more generous funding environment was possible, then 120 hours would be the ideal target
- This would require a minimum of 5 MAGIC courses or equivalent
- The practice of providing alternative options to MAGIC we believe is appropriate, but they should not be seen as a 'soft option' and should be at least equivalent in scope and rigour to MAGIC provision
- For appropriate students the expectation is that MAGIC courses would comprise at least 75% of subject-specific taught course provision (we appreciate there may need

to be some flexibility for one-off cases, especially where alternative taught course provision to MAGIC is quite time-intensive).

- In terms of timing, we believe the optimal model is to concentrate provision in year 1, as this links into the viva-style assessment at the end of year 1, and gives a robust platform for the assessment of students and their ability for going forward to year 2. However, it may be appropriate to retain flexibility over years 1 and 2 for the delivery of training, especially under the current PhD funding model.

Course Selection – we endorse the current model whereby supervisors work with students to determine the most appropriate courses. However, drawing upon what we believe is good practice in the MAGIC Network, we would recommend the following supplementary elements:

- Students produce a development plan in conjunction with their supervisor, which includes taught course provision
- Universities take responsibility for the logging of student taught course plans on a Departmental database or formal written record held centrally, which would give visibility as to what is planned
- This information should then be monitored and updated at key stages such as course completion, assessment performance, etc.
- A third party is introduced to the course selection process to review and validate the taught course proposals for students. An example is the Thesis Advisory Panel at York.

Course Attendance – notwithstanding the lack of really robust monitoring data, on the basis of the quantitative and qualitative evidence reviewed, we believe that there is a serious problem in attrition due to registered students dropping out of courses. If c. 50% of the subscribed teaching output is being rejected by registered students, then something needs to change. Suggestions include a combination of a carrot and stick approach:

- *Assessment* – this will make sure that students treat courses seriously, attend, study and learn – see further details below.
- *Monitoring* – ironically, we do not think that local monitoring by member universities should be introduced. It is the responsibility of PhD students to attend and/or draw down lecture notes and study. However, measures should be taken to encourage students to tick the attendance box – robust central monitoring information is important; rather than 'big brother' local monitoring.
- *Quality* – continuing to work on course level, breadth and depth to meet the requirements of PhD students as per the work of the Programme Committee
- *Selection* – ensuring that courses that are selected are the most appropriate for students and are not driven exclusively by the interests of supervisors. We noted anecdotally that there is a strong correlation between supervisor delivered courses and the uptake by their students.

Assessment – there are two options we believe should be considered, each with their own pros and cons:

Option 1 - A 'light touch formal' assessment at the university level will deliver a cost-effective solution. However, this will require effective compliance by supervisors in the departments, and past experience has demonstrated that this has been difficult to achieve. Specific

recommendations include:

- Delivery of course write-up and/or assignments by students to their supervisor
- Oral examination – short presentation to academics additional to the supervisor; and this must include formal Q&A on the taught course syllabus
- The formal recording of student performance relating to taught course provision

Option 2 – A more formal assessment involving the marking of course assignments by the lecturer. This would ensure compliance and it would also ensure that the individual with the best subject knowledge is involved in the marking, ensuring consistency. The independence of the lecturer would also ensure objectivity. The big drawback of this option is the time commitment for lecturers, with some of the core modules having 30 – 40 students.

Conclusion – clearly, the precise details underpinning the above recommendations would need to be worked up in more detail and fine-tuned based on feedback from MAGIC members. However, we believe the direction of travel is right.

One other specific recommendation which we believe is critical to effecting a step-change in the performance of taught course provision is the **buy-in by individual supervisors**. They are the fulcrum around which the success of MAGIC hangs. There is clear evidence from our consultations and workshops that the awareness of, buy-in and commitment to MAGIC by supervisors varies enormously within institutions – probably more so than between institutions. Departmental guidance, communication and recognition for MAGIC is essential to ensure that supervisors support their students in:

- Selecting the right courses
- Encouraging them to attend the courses
- Monitoring their performance informally
- Assisting with their assessment
- Communicating management information on student progress to their Department.

It was interesting to find out that a number of supervisors were not au fait with the MAGIC website, had never sat in on a MAGIC lecture and thought that taught course provision was a distraction to the research focus with their PhD students. Cultural change is required and this must come from the top down.

5. Critique of MAGIC

Section 4 examined the implementation of the MAGIC from the perspective of the member universities and how they have implemented taught course provision on the ground. Section 5 now examines MAGIC from the perspective of member universities as customers of the MAGIC service offer. We present the views of node representatives, supervisors and students across four central components of MAGIC:

- The course syllabus
- Course delivery
- Network structure
- Governance and management

5.1 Course Syllabus

Programme Committee – Universities were unanimous in their praise of the Programme Committee and its contribution to the restructuring of the MAGIC syllabus. Their focus on sorting out the core courses was appropriate and this has resulted in a suite of courses that are 'fit for purpose'. The following quote is illustrative of the views held by member universities:

"*The Programme Committee has done an excellent job in putting together a comprehensive programme. There are no obvious improvements to be made – it is a great step forward from the previous position*."

Core Courses – all 19 universities assessed core course provision to be 'about right'. In terms of gaps, very few were identified, other than:

- Combinatorics
- General relativity
- Quantum field theory.

One group of students also felt that Mathematical Physics should be a 20 hour course rather than a 10 hour course. The extent to which these represent gaps, or should be classified as core rather than specialist, DTZ is not qualified to comment on.

Specialist Courses – again, there was a high level of support for specialist courses and the value that they bring to the MAGIC syllabus. However, a number of Programme Committee members consulted did recognise that further work was required to review the specialist courses:

"*They suffer from the fact that they have been developed bottom up rather than top down. The consequence is that specialist courses tend to reflect the interests of the academic and his/her specialist subject. They tend to think that everyone should be as fascinated and interested in the subject as they are – and this is often not the case. Hence the number of students registered can be very low, with participating students often tending to come from the lecturers' own student base. It can also lead to problems in the course syllabus:*

- *Being too high level – the nature of the specialist content is 'above the heads' of the students; and/or*
- *Being too broad – in terms of trying to squeeze 20 different topics into one hour slots – they try to impart too much information*."

Given that specialist course have not been subject to detailed scrutiny by the Programme Committee, the suggestion is that this should be their next challenge for 2011/12.

Course Information – under the old syllabus, a common criticism from students was the difficulty in understanding what the nature, level and scope of the course was from the title. Introducing the core/specialist classification has helped considerably:

"*This year you can see that a real attempt has been made to make the courses more accessible. There is more information on what prior knowledge students are expected to have before starting a course. This is useful and, if possible, should be expanded and continued*."

5.2 Course Delivery

Feedback on course delivery was also very consistent across the member universities. The key findings are summarised below:

- **Course materials** – these include lecture notes, presentation slides and course assignments. In general, consultees, including students, considered the standard to be good across the board. For example, one of the Programme Committee members reviewed lecture notes for 10 – 12 core courses and they were 'almost all very good'. One area identified for possible enhancement related to worked examples:

  "*Some courses have excellent worked examples; but others are set at too low a level (3rd year undergraduate) and some others are way too difficult.*" (node representative)

  "*Their difficulty varies quite widely. Some are more open-ended and are very difficult; not really examples – much tougher than undergraduate*." (student)

- **Recording lectures** – there were strong demands from all quarters for the recording of lectures, particularly from students. The perceived advantages include:

  - The provision of a record of courses which can be accessed in the future when delivery is discontinued;
  - Providing flexibility for students to view lectures at times convenient to them. This is particularly important when the student cannot make the lecture due to time-tabling clashes, illness, etc.

  However, the general view from lecturers and node representatives was that recorded lectures should not take the place of live delivery, as the former is less effective and not as engaging for students. The good news is that Manchester Research Computing Services have secured funding to put the recorded lectures on the MAGIC website.

- **Lecturer performance** – as one would expect, there is quite a wide variation in the performance of lecturers in terms of their lecturing style and skills in imparting mathematical knowledge, but this reflects the normal distribution one expects across universities – MAGIC is neither better nor worse than other subject areas. Suggestions to improve performance include:

    - Lecturers should be encouraged to engage more with their audience and invite questions. The reverse is also true, in that students must also be challenged to ask questions and engage more. Silence is the norm during lectures, but it does not have to be like this. There is a need for interactivity;

    - Lecturers should be encouraged to use a combination of writing and overheads. Too often lecturers go too fast when just using overheads – by writing down the maths this slows down the lecture and makes student engagement easier.

- **Use of technology** – however, one particularly important area where performance could be improved is the skills of lecturers in the use of the Access Grid technology. It was clear from sitting in on AG lectures, and from feedback from students that further training is required to ensure effective use of the technology:

  "*There is a huge variation in lecturer performance. Some lecturers are comfortable with all the technologies. For example, lecturer X is really excellent. Others are less so.*"

  This often relates to quite basic things such as the correct positioning of microphones, and the use of presentation equipment. There were also comments that lecturers 'fiddle with the settings' which results in audio problems and feedback. Finally, they need training in how to deliver a lecture effectively using what is quite a complex suite of audio/visual technologies.

- **Access Grid Technology** – the historic problems with AG kit, in particular the audio problems, were universally cited by consultees. However, emerging feedback from the new upgraded kit rolled out in February 2011 has been very positive, even if still early days at the time we conducted our interviews. The audio problems claim to have been solved, but we did sit in on a couple of lectures where the sound quality was very poor. We believe this may be more to do with the correct use of the equipment that the equipment per se (see comments above relating to lecturers poor use of the technology).

- **Access Grid Maintenance** – there was a lot of variability across the universities in terms of how the AG kit was maintained prior to the current contract. Lessons learned from this period include the importance of training local staff and students in the correct application and operation of the technology; and having an emergency response service to address problems that arise, as per the current contract.

- **Web site** – this is an invaluable asset for students. "*It is easy to use – the materials are there, it is well organised and you can get previous course notes*."

- **MAGIC Conferences** – students provided very favourable feedback on MAGIC conferences. Their main advantages include:

    - *Communication* – this is the only opportunity students get via MAGIC to meet students from other universities. They really value this engagement and some asked whether other face-to-face events could be organised. For example, end of course seminars/ assignment workshops were suggested;
    - *Presentation skills* – the recent Leeds conference involved extensive student participation in the delivery of papers/topics which is good training for an academic career and building presentation skills more generally
    - *Generic competencies* – the MAGIC model of the conferences being initiated, organised and delivered by students provides excellent generic skills training for the organising committee.

    Another suggestion to help student interaction was the introduction of tutorials / seminars outside the core timetable but held over the Access Grid, led for example by one of the post-docs in the lecturer's team.

5.3 Network Structure

Network Size – all 19 member universities would like to retain the current network and maintain the status quo. Indeed, a number of respondents expressed very strong views against any attempt to restructure, such as debundling into smaller networks.

Advantages of Current Network – the main advantages relate to the breadth of the academic curriculum that can be offered and the economies of scale due to the 'pain' of course development and delivery being shared across so many institutions. The MAGIC model is particularly important for universities with small mathematical departments, which would suffer very badly if they had to either fend for themselves or organise alternative taught course provision with a smaller number of members.

Disadvantages of Current Network – the main issues are:

- *Management* – the difficulty of co-ordinating inputs from the 19 member Academic Steering Committee. The ASC bi-annual meetings are held via video-conference and they are not effective (see further discussion on this under 'governance and management' below. The size of the Network concentrates an unreasonably large management and administrative burden on the two Principal Investigators).

- *Student Interaction* – the inability for students to meet up cost-effectively from across member universities; and the increased difficulty of interaction during lectures. The idea of Regional MAGIC Groups was put forward by one university. This would work on an informal basis whereby the member universities in a logical geographic catchment could organise group events for students, meet up, etc.

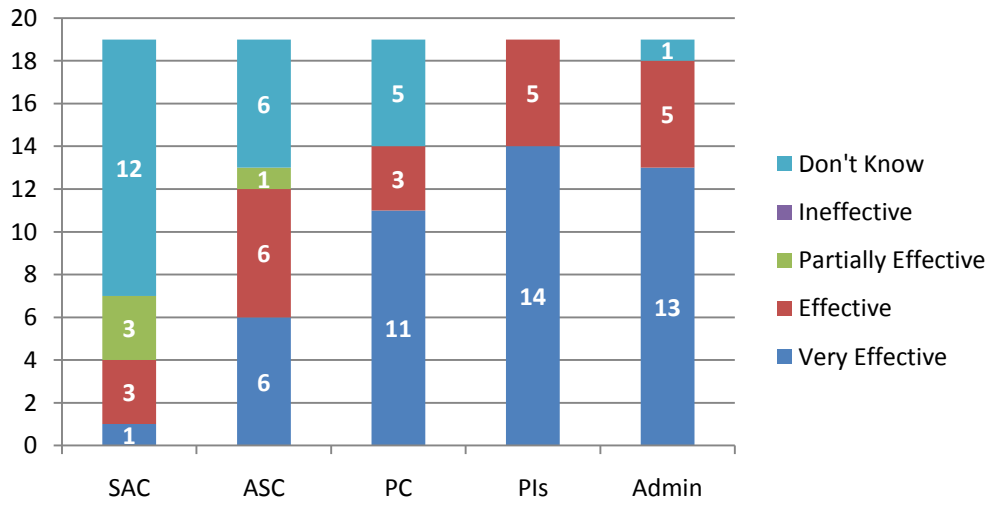
Conclusion – leave the MAGIC structure as it is and work on ways to improve communication both at a management and student level.

5.4 Governance & Management

Performance Assessment – the node representatives were asked to rate the performance of the governance, management and administration for MAGIC: see results in Figure 5.1. The following conclusions can be drawn:

- *Scientific Advisory Committee* (SAC) – only 7 out of the 19 node representatives could give an informed view on the performance of the SAC, and this in itself tells a story. This committee only meets once per annum and, as a result, its ability to provide a substantive and meaningful contribution is limited. It certainly does not have high visibility within the Academic Steering Committee and node reps were often unclear as to its rationale and what its remit is. For those that were able to express a view, the results were mixed: three node representatives thought that their performance was 'partially effective' and four thought it was 'effective/very effective'.

Figure 5.1 - Management Performance Assessment



- *Academic Steering Committee (ASC)* – the performance assessment of the ASC was much stronger with 12 out of the 13 node reps that could make an assessment, rating their performance as either 'effective' or 'very effective'. However, we were asking the representatives to assess their own performance, so this is perhaps not the most objective assessment. When one drilled a bit deeper a number of consultees did acknowledge that the operation of the ASC was constrained by its size and the fact that all meetings are held via video-conference:

  "*The current ASC does not operate as an effective 19 person committee. Some members get things done, but the Committee as a whole is not performing. It suffers from meetings being held via AG nodes. You don't know what node reps are really thinking via this 'distributed committee'. There is a lot of communication by e-mail. There is a complete lack of informal communication and the ability to meet other members face-to-face.*"

- *Programme Committee* (PC) – this newly formed Committee received a very strong endorsement, with the 14 node reps who could pass judgement, assessing its performance as either 'effective' or 'very effective'. This reflects their achievements in sorting out the MAGIC syllabus and launching the programme of core courses in 2010/11 – see the critique of their performance at the start of this section. This model of forming a sub-committee with a focused remit and a manageable number of members is recognised as a successful format which could be replicated.

- *Principal Investigators* (PIs) - all 19 node reps rated the two Principal Investigators' performance as either 'effective' or 'very effective'. This is a very strong finding.

  "*The PIs are very efficient – I don't get any hassle and everything runs smoothly, which is an indication they are doing a good job."*
  "Day-to-day central management and administration provided through Jitesh and Neil is very good."
  "Really impressed with what they cover – a huge amount of work"

- *Administration* – the main issue is the lack of administrative and IT support for the two PIs. The administrative performance was rated as either 'effective' or 'very effective', but it was widely recognised by consultees that this was not a cost-effective solution. All of the work is being handled by the two PIs. Indeed, when pressed on their interest in taking on such responsibilities the response from the node reps was by and large negative. They recognised that under the current funding model, the member universities are acting as 'free riders' knowing that their Departments are benefiting from the non-funded management and administrative support provided by Manchester and Sheffield Universities.

Critique of MAGIC – DTZ's Assessment

Course Syllabus – the development of the new set of core courses has been highly successful. It is recommended that the Programme Committee conducts a similar review for the specialist courses, to be ready for the 2011/12 academic session.

Course Delivery – the following actions should be considered to enhance course delivery:

- *Course assignments* – the Programme Committee should review the academic level and fitness-for-purpose of the assignments (to the extent that this task was not covered by the 2010 review of core course provision)
- *Recording lectures* – the current initiative to record MAGIC lectures should be maintained to provide 100% coverage of taught course provision. A policy should then be developed for the provision of recordings internally to students and staff; and externally to other customers.
- *Training of lecturers* – a training programme for lecturers across the MAGIC network should be introduced. This should focus on:
  - Communication skills with students – verbal and written
  - How to exploit the multi-media environment most effectively
  - Learning how to operate the AG technology effectively.
- *Conferences* – these are very valuable forums for student communication and should be supported on an ongoing basis. This will require appropriate budgeting.

Network Structure – the current 19 member network should be retained. The scope for inclusion of additional university members, should there be the demand now or in the future, should be reviewed, so that MAGIC has a clear policy on this issue.

Governance & Management – DTZ recommends a significant restructuring of the current model, the key elements of which are:

- **SAC** – this should be disbanded
- **ASC** – this should be retained, to meet via AG nodes annually. Its role will be to review and sign-off the management plan prepared by the Management Team. To provide the required external governance element, it is proposed that one or two external members be invited to join the ASC. It will be chaired by the Director of MAGIC.
- **Management Team** – this will be an executive body comprising c. 5 – 8 representatives from across the 19 member network. These should be volunteers with the interest and skills to contribute to the management of the MAGIC network. Detailed proposals include:
    - Its remit will include policy and operational management issues associated with membership, web site, recording of lectures, etc.
    - It will have the latitude to create task-oriented committees, such as the Programme Committee
    - The Team should meet face-to-face – initially quarterly, moving to six monthly once the recommendations from the review have been implemented.
    - Rotation – there should be a process for members to retire and the recruitment of new members on a rolling three year basis
    - The preparation of an Annual Management Plan for submission to the annual meeting of the ASC. This would review progress during the year, plans for the forthcoming year, financial reporting, etc.
- **Programme Committee** – this should remain, with the same modus operandi as at present
- **Director of MAGIC** – there should be one overall Director of MAGIC, eliminating the current dual PI structure. This post should have funding to cover the management time involved in the delivery of this post. There should also be a rotation policy of around three to four years. To assist with this, another member of the Management Team should be appointed as Deputy Director to form part of a succession plan and to provide cover for the Director. This is good risk management practice.
- **Supporting Staff** – additional administrative and IT support should be provided to support the Director in the day-to-day delivery of the MAGIC service, operation of the web site, communication across the university network through field visits, provision of IT training, etc.

Section 6 provides a costing estimate for the implementation of the above governance and management structure.

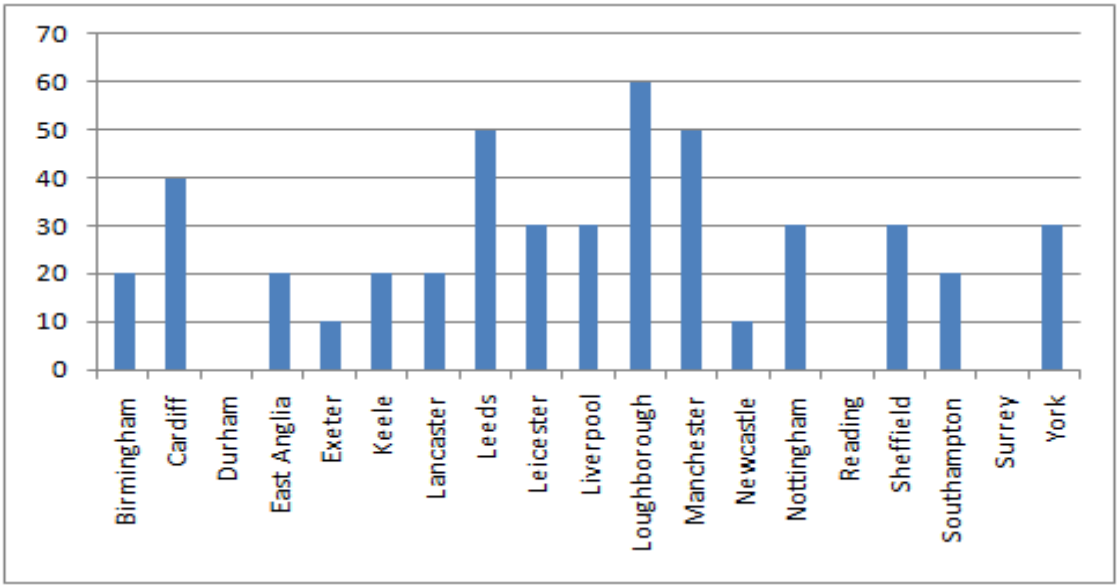
6. Costs of Operating MAGIC Network On Top Of EPSRC Grant

The EPSRC grant does not cover the full costs of operating the MAGIC Network. Member universities are also making crucial in-kind contributions to the Network. The purpose of this section is to identify and consider these in-kind contributions, since they are essential to the future sustainability of the Network.

6.1 Course Delivery

The EPSRC grant provides funding for course development. However, there is no funding for delivering MAGIC lectures. Universities are expected to provide the required staff time. Figure 6.1 shows the level of staff time that is being provided by each university to deliver the 2010/11 course programme. It shows the burden is spread fairly evenly across member universities with the larger departments generally having the largest lecturing commitments. Those with no lecturing commitments tend to be smaller departments and some have delivered lectures in the past but are not involved in the programme this year.

Figure 6.1: Number of MAGIC Lecture Hours Provided for 2010/11 Course Programme



However, not all universities offset MAGIC lectures against other teaching commitments. Some do not recognise MAGIC lectures as part of departmental workload and staff at these universities are essentially providing lectures in their own time. Other universities make some allowance for MAGIC lectures but not at the same level as for other courses, which means staff are essentially putting in some of their own time at these universities as well.

Table 6.1: Extent to Which Universities Recognise MAGIC in Teaching Workloads	
Full Recognition	**Partial Recognition**
Birmingham Cardiff Durham* East Anglia Keele Lancaster Leeds Manchester Reading* Sheffield Southampton Surrey*	Leicester Loughborough Newcastle Exeter Nottingham York Liverpool
* These universities are not delivering MAGIC lectures presently but recognition would be given	

All the academic staff involved in the 2010/11 course programme have committed to delivering their course for at least three years. In principle, all universities say they are prepared to maintain their current level of teaching commitment in the future. Thus, the sustainability of the Network in terms of staff time to deliver lectures appears reasonably secure.

However, DTZ recommends that these commitments should be formalised when the sustainability plan for the MAGIC Network is agreed. There needs to be a formal commitment by each university to make staff time available for supporting the MAGIC Network (including delivery of lectures) and that this needs to be recognised as a legitimate activity within the department ie. offset against other teaching commitments. The Network should not have to rely on staff giving up their own time to continue in the future.

An issue is whether guidance should be given on the amount of teaching time universities are expected to contribute. One approach would be to set minimum guide requirements relating to the number of Maths PhD students recruited by different universities annually and hence, the potential benefits to the university from being part of the Network. There would, however, be nothing to stop universities contributing more time as appropriate.

Table 6.2: University Categories		
University Categories	**Universities**	**Minimum Guide Teaching Requirement per annum**
Small – 10 or less PhD students recruited annually (for whom MAGIC is expected to be the primary provider of taught courses)	Cardiff Durham Keele East Anglia Lancaster Surrey Exeter Leicester Newcastle Reading Southampton	0-30 hours

Table 6.2: University Categories		
University Categories	**Universities**	**Minimum Guide Teaching Requirement per annum**
	York	
Large – 11+ PhD students recruited annually (for whom MAGIC is expected to be the primary provider of taught courses)	Birmingham Leeds Loughborough Liverpool Sheffield Manchester Nottingham	40+ hours

This is not too dissimilar to the teaching commitments already made by universities and it would be used as an indication of the broad level of teaching commitment required, with flexibility to increase or decrease according to circumstances.

6.2 Local Management

The impression gained from talking to lead node contacts is that local management of the MAGIC Network consumes a small proportion of time – typically 2-3% for the lead node contact. The role is more to do with overseeing and liaison, rather than active promotion and management.

One exception is at Newcastle University which operates a policy of formal assessment of MAGIC courses. All PhD students must undertake 80 hours of MAGIC lectures and students must submit formal notes on each course to their supervisor, who then carries out a mini oral examination to test their knowledge. A pass or fail grade for each course is reported to the lead node contact who is responsible for collating the information and submitting it to the Department's Postgraduate Committee.

It is likely that the workload for lead node contacts will increase in the future as EPSRC requires all its students to undertake a minimum level of taught course training (implying a greater need for promotion of the MAGIC Network) and more formal assessment of MAGIC courses. An expected contribution of management time should be formalised when the sustainability plan for the MAGIC Network is prepared and DTZ would suggest this should be around 3-5% of a senior academic.

6.3 Technology Support

The level of technology support varies considerably across universities. Some universities have access to extensive IT technician support. Others have very limited support of this kind and although there is a nominated IT technician who knows about the technology, day-to-day operation tends to be in the hands of students and lecturers. This student comment is typical of many that were made during the fieldwork programme:

"It is clear that people at many nodes do not know how to make best use of the equipment or to deal with problems. They turn off the audio, or do not use the microphones properly or the batteries run out in the microphones and this causes disruption for everyone."

Each node needs a properly trained technician who as a minimum should undertake the following:

- Train lecturers to use and optimise the equipment available
- Be on-call during lectures delivered from the university to deal with any problems that arise. The greatest disruption arises when things go wrong at the node from which the lecture is being delivered.
- Train students to start-up the equipment for lectures broadcast from other nodes and be on hand to deal with any problems that occur.

An expected contribution of technical support time should be formalised when the sustainability plan for the MAGIC Network is prepared. DTZ would suggest 5-10% of an technician or the equivalent. For example at **Loughborough University**, three PhD students have received in-depth training on using the Access Grid and they are paid by the department to ensure one of them is present at the start of every MAGIC lecture to ensure the equipment is set up and working properly. One of them will also be present for every lecture given by a Loughborough academic so they can deal with any problems that come up. The annual cost of this is about £3-4,000.

6.4 Other Costs

The other main cost incurred through being part of the MAGIC Network, but which is not covered through the EPSRC grant, is the use of teaching space within the university to link into MAGIC lectures. Most member universities provide a room which is equipped with the Access Grid technology and is booked for MAGIC lectures when required and used for other purposes at other times. The use of these rooms for MAGIC has become well established in the universities and there are no issues of concern relating to the sustainability of this in-kind contribution.

7. The Sustainability of the MAGIC Network

All 19 member universities are committed to being a member of the MAGIC Network in the future. They recognise the Network gives students the opportunity to receive training from leading academics across a broad range of subject areas. The size of the Network also means that teaching is spread across many universities so no one has an unduly large burden. If future costs escalated or there were continuing problems with the technology after the upgrade, a small number of universities said they might look elsewhere such as at the Oxford-Led TCC. However, all universities are currently committed to being part of the Network in the future.

The sustainability of the Network depends on universities continuing to make their crucial in-kind contributions. All universities said they were, in principle, prepared to continue current in-kind contributions. However, DTZ has suggested that the MAGIC sustainability plan should formalise these commitments as described in the previous section.

The sustainability of the MAGIC Network also depends on having sufficient funds to cover the direct financial costs of operating the MAGIC Network after EPSRC core funding ceases in Autumn 2011.

7.1 Financial Models

DTZ has prepared three future financial scenarios for the MAGIC Network:

- Basic – coverage of only essential costs
- Enhanced – coverage of all costs including future replacement of equipment
- Hybrid – coverage of all costs but just a 50% contribution to future replacement of equipment.

The Basic Central Costs Scenario

Table 7.1 sets out the essential annual costs that need to be covered to ensure the future sustainability of the Network, along with the assumptions on which they are based. The key requirements that need to be funded are:

- Management – currently this lies within a range of 5-10% of two PIs which is equivalent to 10-20% of one PI. Assuming that provision is made for administrative support in the future, a buy-out of 10% of time should be adequate.
- Administration – a part-time administrator (0.6 FTE) is needed to manage student registrations, prepare management reports, liaise with lead node contacts and deal with queries. Ideally to be based at the same location as the lead PI.
- Technical Support – a part-time IT professional (0.4 FTE) to take over Prof. Neil Strickland's role of managing and developing the website, to deal with technical problems and to be pro-active in visiting node locations to ensure the technology is working effectively and staff and students are trained to use it in the optimal way. Possibly this role and the administrator role could be combined if a candidate with the right mix of skills could be found.

- Course Development. It is assumed that the core course programme will continue with little additional investment in new courses – since the intention is that these courses should remain relatively stable from year to year. The specialist course programme will need to be refreshed but there is a considerable back catalogue of courses which can be used for this. It is therefore assumed that no new core courses and a maximum of one new specialist course are developed each year.
- Course Refreshment. Lecturers need an opportunity to refresh existing courses periodically (taking account of new developments and student feedback) and to be given an incentive to 'sign-up' to deliver them again for another specified number of years. It is suggested there is an allowance of £1000 to do this for every course at three yearly intervals.
- Contingency – there needs to be some contingency funding to deal with technology and other issues that might arise.

Table 7.1: Direct Annual Financial Costs of Continuing the MAGIC Network Basic Costs Scenario

Cost	£	Assumptions
Management	10,000	TES (2009) reports average salary of Professor as approx £70,000 in 2007/08. Taking account of salary increases since this time and add-on costs - 10% buy-out of time assumed to represent approx £10,000 pa.
Administrator (0.6 FTE)	15,000	Assume 60% of FTE cost £25,000
Technical Support (0.4 FTE)	12,000	Assume 40% of FTE cost £30,000
Course Development	2,000	Assume 1 specialist course per annum at £2,000 each
Course Refreshment	13,000	Assume £1,000 to refresh @ 40 courses every three years. Thus, £40,000 / 3 = approx £13,000 per annum
Contingency	5,000	
Total	**57,000**	

The basic central costs scenario projects annual costs at around £57,000 per annum.

There are relatively limited funds as part of this scenario for curriculum development. However, as noted above there is a considerable back catalogue of course material. Consultees also suggested that MAGIC should explore opportunities for the following subject to timetabling issues:

- Incorporating more modules that are already being delivered at member universities (for example as part of a Masters course) into the MAGIC programme.
- Linking into the Oxford-Led TCC which also uses AG technology.

The Enhanced Costs Scenario

The additional cost components are:

- Course development – this allows for more investment in new courses assuming one new core course and two new specialist courses per annum.
- A reserve fund to replace/upgrade AG equipment in the future – the current equipment will need to be replaced in the future. The capital cost of the current upgrade was £267,000 excluding the maintenance element. Assuming the equipment has a life of 5

years, it would be prudent to aim for a fund in the region of £325,000 to upgrade the equipment at this time.

Table 7.2: Direct Annual Financial Costs of Continuing the MAGIC Network – Enhanced Costs Scenario

Cost	£	Assumptions
Management	10,000	TES (2009) reports average salary of Professor as approx £70,000 in 2007/08. Taking account of salary increases since this time and add-on costs - 10% buy-out of time assumed to represent approx £10,000 pa.
Administrator (0.6 FTE)	15,000	Assume 60% of FTE cost £25,000
Technical Support (0.4 FTE)	12,000	Assume 40% of FTE cost £30,000
Course Development	8,000	Assume 2 specialist courses per annum at £2,000 each and 1 core course per annum at £4,000 each
Course Refreshment	13,000	Assume £1,000 to refresh @ 40 courses every three years. Thus, £40,000 / 3 = approx £13,000 per annum
Contingency	5,000	
Reserves to fund AG Equipment Replacement	65,000	Assume aim is to achieve a fund of £325,000 / 5 years.
Total	**128,000**	

The enhanced central costs scenario projects annual costs at around £128,000 per annum. The most sensible course of action would be to base the budget on the enhanced costs scenario since it will be essential to replace / upgrade the equipment in the future. However, departments may feel that AG technology will be so widely used across universities in the future that there is no need to 'save' for this. Instead, it will always be possible to use university AG technology or its equivalent to link into the MAGIC Network. For example, four of the five universities which joined the MAGIC Network after it had been established used AG infrastructure that was already in place at their university.

However, there is risk associated with this approach in that there is no guarantee that the resources will be available to replace / upgrade equipment when required and it may be difficult to ensure compatibility if every university does its own thing.

The Hybrid Costs Scenario

This final scenario is the same as the enhanced costs scenario but is based on accumulating only 50% of the funds needed for equipment replacement assuming the remainder will be provided by universities at the time.

Table 7.3: Direct Annual Financial Costs of Continuing the MAGIC Network – Hybrid Costs Scenario

Cost	£	Assumptions
Management	10,000	TES (2009) reports average salary of Professor as approx £70,000 in 2007/08. Taking account of salary increases since this time and add-on costs - 10% buy-out of time assumed to represent approx £10,000 pa.
Administrator (0.6 FTE)	15,000	Assume 60% of FTE cost £25,000
Technical Support (0.4 FTE)	12,000	Assume 40% of FTE cost £30,000
Course Development	8,000	Assume 2 specialist courses per annum at £2,000 each and 1 core course per annum at £4,000 each
Course Refreshment	13,000	Assume £1,000 to refresh @ 40 courses every three years. Thus, £40,000 / 3 = approx £13,000 per annum
Contingency	5,000	
Reserves to fund AG Equipment Replacement	32,000	Assume aim is to achieve a fund of 50% of £325,000 / 5 years.
Total	**95,000**	

It is important to stress that the financial models above do not include equipment maintenance costs. This is because the current technology upgrade provides for a three year maintenance contract. After this time, universities would need to cover this cost which is approximately £33,000 per annum or £1,700 per annum per node.

7.2 Revenue Generation

Once EPSRC funding ceases, there are three main ways in which revenue can be generated to cover these costs:

- University Subscriptions – each university would pay a subscription to be part of the MAGIC Network and to benefit from the service it provides
- Student Charges – there would be a charge for each student registration
- Commercial income – there may be opportunities to generate revenue through company sponsorship or through charging universities outside the Network to access courses / recordings.

The current PI (Prof. Jitesh Gajjar) is exploring opportunities to generate commercial income and there are encouraging prospects in the pipeline. These include potential interest from companies in the defence and banking sectors which have discussed the purchase of MAGIC course provision. Approaches to Cambridge University Press have not proved fruitful so alternative publishers are going to be approached. Given the potential to raise significant sums of money (£30k plus), this pursuit of commercial income should continue to be a priority for the future.

However, in the short-term the revenue generation depends on either introducing university subscriptions or student charges. Overwhelmingly, consultees preferred the former to the latter. It was felt that student charges would be too complex and bureaucratic to administer and could deter participation.

If the direct financial costs of continuing the MAGIC Network were shared equally between member universities the annual cost would be:

	Annual University Subscription*
Basic Costs Scenario	£3,000
Hybrid Scenario	£5,000
Enhanced Costs Scenario	£6,750
* The cost of an equipment maintenance contract would need to be added to this after the current contract runs out in three years.	

This is a simple and straightforward approach. However, some would argue that it would not be equitable to apply a standard subscription across all universities since some have more PhD students than others and thus derive greater benefit from the Network. Table 7.4 shows the level of subscription that would be payable by individual universities if this was linked to the proportion of PhD students recruited annually for whom MAGIC is expected to be the primary provider of taught courses.

Table 7.4: Annual University Subscription Linked to PhD Numbers at Different Universities

	Basic	Hybrid	Enhanced
Birmingham	5358	8930	12032
Cardiff	1767	2945	3968
Durham	1482	2470	3328
East Anglia	1482	2470	3328
Exeter	2394	3990	5376
Keele	570	950	1280
Lancaster	1197	1995	2688
Leeds	4788	7980	10752
Leicester	2394	3990	5376
Liverpool	4503	7505	10112
Loughborough	4161	6935	9344
Manchester	7182	11970	16128
Newcastle	2109	3515	4736
Nottingham	4788	7980	10752
Reading	2394	3990	5376
Sheffield	4503	7505	10112
Southampton	2964	4940	6656
Surrey	1482	2470	3328
York	1482	2470	3328
Total	**57000**	**95000**	**128000**

It could be complicated to have a different level of subscription fee for each university so an alternative approach would be to charge two different levels of subscription depending on whether departments are classified as being small or large (see Table 6. 2). This would mean approximate subscription charges as shown in Table 7.5. There may need to be some flexibility around these subscription charges for the smallest and largest institutions.

Table 7.5: Annual University Subscriptions Linked to Broad Department Size Categories			
	Basic	**Hybrid**	**Enhanced**
Small – 10 or less PhD students recruited annually (for whom MAGIC is expected to be the primary provider of taught courses)	1,750	2,900	3,800
Large – 11+ PhD students recruited annually (for whom MAGIC is expected to be the primary provider of taught courses)	5,250	8,700	11,800
Total Revenue Generated	£57,750	£95,700	£128,200
Target	£57,000	£95,000	£128,000
Average cost per registered student p.a.*	£199	£331	£446
Note: * The average number of students registered on MAGIC for the last three years (287) has been used to calculate the annual average cost per student.			

The average cost per registered MAGIC student would only be £200 under the basic funding model. Even under the enhanced model the cost is still under £500. This represents good value for money compared to the cost of alternative teaching models. For example, last year non EPSRC PhD students paid a £120 registration fee plus travel and accommodation costs to attend just one APTS training week.

7.3 EPSRC Transitional Funding

As highlighted in Section 1, EPSRC has indicated that it will provide transitional funding to TCCs to support the transition to full self-funding in the future. This is dependent on TCCs demonstrating current satisfactory performance and having a robust sustainability strategy in place to which all member universities have signed-up.

It would not be unreasonable for the MAGIC Network to bid to EPSRC to cover 50% of the essential basic costs of running the Network in the future. This would be £28,500 per annum. If this funding was received, the level of annual subscriptions payable by member universities would fall substantially. Assuming a standard subscription charge across the Network the annual subscription fee would be:

	Annual University Subscription with EPSRC Transitional Funding*
Basic Costs Scenario	£1,500
Hybrid Scenario	£3,500
Enhanced Costs Scenario	£5,250
* The cost of an equipment maintenance contract would need to be added to this after the current contract runs out in three years.	

If subscription fees are linked to the broad size of departments in terms of the proportion of PhD students recruited annually for whom MAGIC is expected to be the primary provider of taught courses, the annual subscription fees would be:

	Basic	Hybrid	Enhanced
Small – 10 or less PhD students recruited annually (for whom MAGIC is expected to be the primary provider of taught courses)	875	2,000	2,950
Large – 11+ PhD students recruited annually (for whom MAGIC is expected to be the primary provider of taught courses)	2,625	6,100	9,200
Total Revenue Generated	£28,875	£66,700	£99,800
EPSRC Grant	£28,500	£28,500	£28,500
Total	£57,150	£95,200	£128,300
Target	£57,000	£95,000	£128,000
Average cost per registered student p.a.* assuming EPSRC grant of £28,500 pa	£100	£233	£348
Note: * The average number of students registered with MAGIC for the last three years (287) has been used to calculate the annual average cost per student.			

DTZ considers this level of subscription fee is within a range that would be acceptable to most universities. **The average cost per registered MAGIC student would only be £100 under the basic funding model. Even under the enhanced funding model the cost is only £350.** This represents good value for money compared to the cost of alternative teaching models. For example, last year non EPSRC PhD students paid a £120 registration fee plus travel and accommodation costs to attend just one APTS training week.

However, member universities have not been accustomed to paying for MAGIC and the current funding environment in universities is uncertain and constrained. It will need to be sold to universities on the basis that:

- EPSRC is likely to specify minimum taught course requirements which must be formally assessed for all its PhD students as part of the DTA in the future. Membership of the MAGIC Network enables departments to fulfil these requirements in a cost effective manner. It would be more expensive to organise provision locally.
- It is good marketing for the university's PhD programme to be able to offer such a breadth of training and learning opportunities.
- There may be opportunities to join other TCCs such as the Oxford-Led TCC but all are likely to be looking for member contributions as EPSRC core funding ceases.

7.4 Update on EPSRC Transitional Funding

EPSRC announced the call for follow-on funding on 10 March 2011. Up to £150,000 per TCC is available over a period of five years (£30,000 per annum) to ease the transition to self-sustainability.

The financial projections above assume EPSRC transitional funding of £28,500 per annum. However, no allowance has been made for the cost of setting up a legal structure that can hold subscription income from universities to fund the MAGIC Network. This is essential and it would be reasonable for MAGIC to bid for the full £30,000 per annum on the basis that funding will be required to set up an appropriate legal structure (contingency funding could also be used for this purpose).

Appendix A – List of Consultees

Steering Group

- Professor Jon Forster – Chair of MAGIC SAC, University of Southampton
- Professor Jitesh Gajjar – MAGIC Principal Investigator, University of Manchester
- Professor Neil Strickland – MAGIC Principal Investigator, University of Sheffield
- Professor Peter Ashwin – University of Exeter
- Professor Mary Rees – University of Liverpool

University Consultees

University of Birmingham

- Lead Node Representative – Warren Smith, Director of Graduate School, Lecturer in Applied Mathematics
- Supervisor/Lecturer
  - Professor Sergey Shpectorov, Professor of Pure Mathematics
- Students
  - Dr. James Spittles, Former PhD Student
  - Andrew Bailey, Third year PhD Student

Cardiff University

- Lead Node Representative – Professor Tim Phillips, Deputy Head, School of Mathematics

Durham University

- Lead Node Representative – Dr. Dirk Schüetz, Lecturer

University of East Anglia

- Lead Node Representative – Dr. Mark Blyth, Reader, School of Mathematics

University of Exeter

- Lead Node Representative – Professor Peter Ashwin, Head of Department
- Supervisors / Lecturers:
  - Professor Andrew Gilbert
  - Professor Mitch Berger
  - Professor Andreas Langer
  - Dr Nigel Byott
- Students:

- Nick Blackbeard – Third year PhD
- Congping Lin – Second year PhD
- Maria Marlove – First year PhD
- Dali Kong – Second year PhD
- Amrita Muralidharan – Fourth Year PhD
- Yiwei Zhang – Second year PhD

Keele University

- Lead Node Representative – Professor Graham Rogerson, Head of Department

Lancaster University

- Lead Node Representative – Professor Martin Lindsay, Professor of Pure Mathematics and Head of Research

University of Leeds

- Lead Node Representative – Dr. Alastair Rucklidge, PhD Programme Leader, School of Mathematics
- Senior Management Team:
  - Professor Charles Taylor – Head of School of Mathematics
  - Dr. Kevin Houston – Deputy Node responsibility
- Supervisors:
  - Professor Michael Rathjen – Post graduate Tutor, Pure Mathematics
  - Professor Chris Jones – Head of Applied Mathematics
  - Dr. Stephen Griffiths – Lecture and Director of MSc Programme
  - Dr. Oliver Harlin – Faculty Director of Graduate School
- Lecturers:
  - Professor Jonathan Partington – Head of Pure Mathematics
  - Professor Anand Pillay – Pure Mathematics
  - Dr. Grant Lythe – Applied Mathematics
- Students:
  - Heather – Second year PhD, Pure Mathematics
  - Julian – Second year PhD, Applied Mathematics
  - David – Second year PhD, Pure Mathematics
  - Tina – Fourth year PhD, Applied Mathematics
  - Charlotte – Fourth year PhD, Pure Mathematics

University of Leicester

- Lead Node Representative – Dr. Alex Clark, Reader, Pure Mathematics

University of Liverpool

- Lead Node Representative – Professor Mary Rees, Member of Programme Committee

Loughborough University

- Lead Node Representative – Dr. Alexey Bolsinov, Reader in Mathematics
- Supervisors/Lecturers
  - Professor Huaizhong Zhao, Head of School of Mathematics
  - Dr. Maureen McIver, Director of PhD Programme
  - Dr. Alex Strohmaier, Senior Lecturer
  - Professor Sasha Veselov, Professor of Mathematics
  - Professor Roger Grimshaw, Professor of Mathematical Sciences
- Students:
  - Third year PhD Student
  - Third year PhD Student
  - Second year PhD Student
  - First year PhD Student
  - First year PhD Student

University of Manchester

- Lead Node Representative – Professor Ralph Stöhr – Professor of Pure Mathematics, Director of Post Graduate Mathematics and PhD Supervisor

Newcastle University

- Lead Node Representative – Professor Peter Jorgenson, Professor of Mathematics

University of Nottingham

- Lead Node Representative – Nikolaus Diamantis, Associate Professor
- Lecturers/Supervisors:
  - Professor David Riley, Head of School
  - Dr. Madaline Gutar
  - Professor Detlev Hoffman
  - Dr. Sven Gnutzmann
  - Professor John Barrett
- Staff:
  - Helen Cunliffe, Research Secretary
- Students:
  - Third year PhD Student
  - Fourth year PhD Student

University of Reading

- Lead Node Representative – Dr. Tobias Kuna, Director of Postgraduate Research

University of Sheffield

- Lead Node Representative – Professor Neil Strickland

University of Southampton

- Lead Node Representative – Dr. Giampaolo D'Alessandro, Director of Graduate School and Lecturer in Applied Mathematics
- Supervisors/Lecturers:
  - Dr. Chris Howls, Senior Lecturer, Applied Mathematics

University of Surrey

- Lead Node Representative – Dr. Gianne Derks, Postgraduate Coordinator

University of York

- Lead Node Representative – Dr. Ian McIntosh, Senior Lecturer, Department of Mathematics and Postgraduate Training Manager
- Senior Management Team:
  - Professor Steve Donkin, Head of Department and MAGIC Lecturer
  - Professor Paul Busch, Chair of Graduate School Committee and MAGIC Lecturer
  - Dr. Chris Fewster, Chair of Examinations Board, Graduate School Committee
  - Dr. Tom Keef, Post doctorate, Acting Chair of EPSRC DTZ Panel, Leader of Mathematical Biology Research Group
- Supervisors:
  - Dr. Stefan Weigert
  - Dr. Vicky Gould
  - Dr. Simon Eveson
  - Dr. Eli Hawkins
- Students:
  - Neil Stevens, First year PhD Student
  - Tom Potts, Third year PhD Student
  - Robert Frizzle, First year PhD Student
  - Daniel Hunt, Third year PhD Student
  - Leon Loveridge, Third year PhD Student
  - James Wolferin, First year PhD Student

Appendix B – List of Courses 2010/11

Autumn 2010

MAGIC008 (Core)	Lie groups and Lie algebras (Alexey Bolsinov, Loughborough, 20 hours)
MAGIC009 (Core)	Category Theory (Jonathan Kirby, East Anglia, 10 hours)
MAGIC010	Ergodic Theory (Charles Walkden, Manchester, 10 hours)
MAGIC022 (Core)	Mathematical Methods (Jitesh Gajjar, Manchester, 20 hours)
MAGIC025 (Core)	Continuum Mechanics (Yibin Fu, Keele, 20 hours)
MAGIC044	Complex Differential Geometry (Roger Bielawski, Leeds, 10 hours)
MAGIC057	Spectral Theory of Ordinary Differential Operators (Karl Michael Schmidt, Cardiff, 10 hours)
MAGIC059 (Core)	Dynamical Systems I (Flows) (Alastair Rucklidge, Leeds, 10 hours)
MAGIC061 (Core)	Pure Functional Analysis (Martin Lindsay, Lancaster, 20 hours)
MAGIC063 (Core)	Differentiable Manifolds (Carsten Gundlach, Southampton, 20 hours)
MAGIC065 (Core)	Stochastic Processes (Alexander Veretennikov, Leeds, 20 hours)
MAGIC066 (Core)	Numerical Analysis (Jeremy Levesley, Leicester, 20 hours)
MAGIC067 (Core)	Integrable Systems (Marta Mazzocco, Loughborough, 20 hours)
MAGIC070	Singularities in symplectic and contact spaces (Vladimir Zakalyukin, Liverpool, 10 hours)
MAGIC071	Erlangen program in geometry and analysis: SL(2,R) case study (Vladimir V. Kisil, Leeds, 10 hours)
MAGIC072 (Core)	Number Theory (Neil Dummigan, Sheffield, 10 hours)

Spring 2011

MAGIC021 (Core)	Nonlinear Waves (Roger Grimshaw, Loughborough, 20 hours)
MAGIC028	Geometric Structures on surfaces and Teichmuller Space (Mary Rees, Liverpool, 10 hours)
MAGIC038	The algebraic theory of quadratic forms (Detlev Hoffmann, Nottingham, 10 hours)
MAGIC039	Introduction to Quantum Graphs (Sven Gnutzmann, Nottingham, 10 hours)
MAGIC040	Operator Algebras (Michael Dritschel, Newcastle, 10 hours)
MAGIC046	Introduction to equivariant bifurcation theory (Peter Ashwin, Exeter, 10 hours)
MAGIC048	Quantum Statistics (Madalin Guta, Nottingham, 10 hours)
MAGIC050 (Core)	Set Theory (Mirna Dzamonja, East Anglia, 10 hours)
MAGIC058 (Core)	Theory of Partial Differential Equations (David Harris, Manchester, 20 hours)
MAGIC060 (Core)	Dynamical Systems II (Maps) (Toby Hall, Liverpool, 10 hours)
MAGIC062 (Core)	Applied Functional Analysis (Cardiff, 20 hours)
MAGIC064 (Core)	Algebraic Topology (Andrey Lazarev, Leicester, 20 hours)
MAGIC069 (Core)	Quantum Theory (Paul Busch, York, 10 hours)
MAGIC073 (Core)	Commutative Algebra (Moty Katzman, Sheffield, 20 hours)
MAGIC074 (Core)	Algebraic Geometry (Steve Donkin, York, 20 hours)
MAGIC075 (Core)	Representation Theory of Groups (Kay Magaard, Birmingham, 20 hours)