Written evidence submitted by the Institute of Mathematics and its Applications (GAP0006)

Summary

- The IMA is the professional and learned society for mathematics in both industry and research. It is in a privileged position to ascertain the mathematical skills shortages that exist, and ways in which these shortages could be addressed.

- A number of studies, most recently the PISA survey, indicate a skills shortage in mathematics that affects all sectors of industry.

- Strong growth is predicted in advanced manufacturing, life sciences and pharmaceuticals, the low carbon economy, professional and financial services, the digital economy, and engineering and construction. All of these sectors are informed by mathematics.

- In response to this situation the IMA created the MathsCareers website in 2004. The site promotes mathematical careers across a range of sectors and abilities.

- This is achieved by highlighting not only the variety of applications of mathematics but also the career opportunities that the subject affords.

- The site has grown to become very popular, and is regularly used in schools. Visitor numbers currently average over 40k per month globally, with 15k monthly UK visitors.

- The IMA recommends that an increased focus should be placed on mathematics careers advice with particular focus on assisting careers advisors who do not have STEM backgrounds.

Introduction – The IMA.

1. The Institute for Mathematics and its Applications (IMA) is the professional and learned society for mathematics in both industry and research. Since its formation the IMA has sought to increase awareness of the importance of mathematics and STEM in general. This has frequently been achieved via joint working between education and industry. The IMA has long had a broad range of contacts within both sectors. This places us in a privileged position to ascertain the mathematical skills shortages that exist, and ways in which these shortages could be addressed.

The STEM skills that were needed but were found to be in short supply or missing;

2. It is widely accepted that the UK faces a growing shortfall of young people qualified in Mathematics; for science, engineering and commerce. While those involved in these activities are well aware that such careers can be fascinating, stimulating and well-paid, this message is not well understood within schools. A recent report from the Council for the Mathematical Sciences (CMS) analysed the importance of mathematical qualifications across a defined base of employment sectors and found that for 2 million employees, a Mathematical Sciences qualification was essential, and for an additional 3 million employees a Mathematical Sciences qualification was desirable. (‘The Mathematical Sciences People Pipeline’ CMS, 2015). This skills shortage affects all layers of society and industry.
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**GCSE or equivalent level qualifications**
3. A report from NESTA has highlighted that at a general level as many as three in five of those in higher managerial and professional occupations do not have mathematical skills at GCSE A*-C level. As a result they are unequipped to meet the mathematical or statistical demands of their roles (‘Analytic Britain: Securing the right skills for the data-driven economy’ Nesta, 2015).

4. To address this it is vital that school mathematics programmes equip more young people to know more about mathematics beyond GCSE, and to be confident in applying their knowledge.

**Mathematics at A -level or equivalent.**
5. The Advisory Committee on Mathematics Education (ACME) have stated that many more university courses in many disciplines are becoming increasingly quantitative. In addition there is also a steady shift in employment away from manual and low skill jobs towards those requiring higher levels of management expertise and problem-solving skills, many of which are mathematical in nature. ACME estimated that of those entering higher education in any year, some 330,000 would benefit from recent experience of studying mathematics (including statistics) at A-level beyond GCSE but fewer than 125,000 will have done so.

6. The ACME report also states that many 16-year-olds decide not to continue mathematics post-GCSE because universities tend not to indicate the mathematics to be encountered within their degree programmes. This means that the advantages to be gained by further study of mathematics have been not been made clear to them. Similarly, those who do take mathematics (e.g. at A-level) are often unaware of the options that would best suit them.

7. Within the same report employers emphasized the importance of people having studied mathematics to a higher level than they will actually use, as this provides them with the confidence and versatility to use mathematics in unfamiliar situations. (‘Mathematical Needs’ ACME, 2011)

**Maths degrees**
8. The need for mathematics graduates at undergraduate level and higher has been well illustrated by a number of government and industry reports over the last few years.

9. The Science Council predicts that advanced manufacturing, life sciences and pharmaceuticals, the low carbon economy, professional and financial services, the digital economy, engineering and construction will continue to be growth sectors over the coming decades. The Mathematical Sciences significantly inform, and in many cases are crucial to, every one of these sectors. (‘The current and future UK science workforce’, Science Council, 2011).

10. Big and Open Data are exciting new sectors that the British Academy predicts will contribute an additional £147bn per annum to GDP across the economies of the European Union by 2020. The Mathematical Sciences will be of central importance to ensuring that the workforce has the required skills for the UK to be a leading force in the data revolution and
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to maximise its potential economic output. (‘Count Us In: Quantitative skills for a new generation’, British Academy, 2015). Nesta also reports problems in the recruitment of data analysts, with two thirds of data-active companies struggling to fill at least one data analyst vacancy, potentially catastrophic for this emerging industry (‘Skills of the Datavores: Talent and the data revolution’, Nesta, 2015).

11. However, after some years of steady increase, the overall number of Mathematical Sciences graduates fell between 2012-13 and 2013-14, and this decrease was particularly marked for postgraduate qualifications (‘Higher Education Statistics for the United Kingdom 2013/14’, HESA, 2015).

12. Recent PISA survey results ranked the UK 27th for mathematics, the lowest position it has ever occupied. By comparison, the Pisa ranking for science was 15th place. Since mathematics underpins STEM, and much wider fields of endeavour, this shows that maths education and the promotion of careers which require maths is a national priority.

How this particular skills need has been addressed, including specific details of the measures introduced.

13. While the figures above are current, there has been a skills shortage developing within the mathematical sciences for some time. This shortage of mathematically qualified individuals prompted the IMA to launch the MathsCareers website.

Encouraging everyday maths and numeracy skills

14. MathsCareers provides specific support and encouragement for those who do not plan to go on to higher education. By focussing on the practical mathematics involved in activities such as learning a trade or running a business, we show that mathematics is still vital for those who may not consider themselves to be mathematically gifted.

Encouraging graduates

15. For those who are planning a university career the site encourages the study of A-level and core maths. This helps general performance in higher education even in non-mathematical subjects. By highlighting the valuable role that post-16 mathematics qualifications can play in developing mathematical, logical and analytical thinking skills, we hope to raise attainment by all graduates.

16. We support more students to become STEM graduates by highlighting the diverse range of career opportunities available to those with a STEM degree. By highlighting the variety of intersections between mathematics and subjects as varied as computer science and biology we highlight to readers that their study of mathematics could take them in a number of different directions.

17. Finally, the MathsCareers website encourages readers to study mathematics at degree level and beyond. Our Career Profiles focus a wide range of employment paths that normally require an initial mathematics degree. By doing this we hope to increase the number of students graduating with a mathematics degree, and encourage those who have graduated to consider further study in the area.
18. Since its launch the site has grown to become the most popular mathematics careers website, and in recently has averaged over 40k visitors per month globally, with 15k monthly UK visitors.

The cost of the measures and how they have been funded.
19. The site currently costs c£40k each year to operate, and this is reflective of the annual cost for the 12 years the site has been in operation.

20. While the site was initially funded with contributions from Gatsby, and the DfE, there is no ongoing financial support for the site. A recent sponsorship campaign has targeted financial institutions and Government agencies including DfE and DBIS, however the operation of the site is primarily funded by the IMA.

The results of any evaluation of the measures / schemes introduced.
21. One way of measuring the success of a web project is to examine the visitor statistics. By these measures the MathsCareers project has been enormously successful. We have grown our audience to over 40,000 global and 15,000 UK visitors a month. Posters and other information about the career options offered by mathematics were sent to a number of schools in 2016.

22. We recommend that an increased focus should be placed on mathematics careers advice. In part this can be done with improvements to the MathsCareers websites for a modest cost [£50k-£100k]. Particular focus should be on additional content for careers advisors [anecdotally most careers advisors do not have extensive STEM expertise]; and a greater emphasis on designing materials that can link classroom curriculum content to applications of maths and the need for and the utility of maths across the great majority of career options.

January 2017