An Academy of Mathematical Sciences: the community view

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Executive summary

An Academy for Mathematical Sciences should be instigated with mission "the health of the mathematical sciences in the whole of the UK", with primary focus on the external interfaces of UK mathematical sciences. The Academy should:

- Advocate for the whole of the mathematical sciences
    - Proactively lobby governmental and non-governmental organisations
    - Respond in a timely manner to relevant government and other initiatives
    - Celebrate high calibre and diverse research and knowledge exchange
    - Develop a strong presence in all regions of the UK
- Develop the mathematical sciences brand
    - Communicate how mathematics underpins many exciting developments
    - Demonstrate the power of mathematics in society
    - Produce engaging material for wide dissemination
- Support the learned societies
    - Coordinate campaigning efforts
    - Amplify the efforts of individual societies, and remove unnecessary duplication
    - Harness distinction to the benefit of mathematical sciences more widely
    - Represent the interests of devolved countries not just mathematical science based in England
- Coordinate discipline-wide and life-long mathematical sciences education
    - Incorporate mathematics education into the remit of the Academy
    - Integrate the activities of many organisations aimed at maintaining excellence in mathematics education
    - Advocate for pre-university mathematics education
    - Support HE establishments to engage with mathematical sciences education nationally
- Support mathematicians at all career stages and in all areas of employment
    - Run research and professional development meetings
    - Facilitate collaboration between academia and industry/government
- Confer Fellowships by Distinction
    - Fellows must support the external facing mission of the Academy, with the expectation that the fellowship would **not** be limited to research-oriented mathematicians in UK higher education institutions
    - It will be important to build a Fellowship which displays diversity, broadly defined.
- Act as a funding body
    - Raise and award funds to support all of the Academy's activities
    - Support UKRI in distributing mathematical sciences funding

Frequently asked questions

Q: Can't we achieve these aims with existing institutions?
A: There is a clear need for a single institution taking ownership of the above functions for the whole discipline instead of a fragmented approach. The CMS is overly constrained in its constitution, and restricted by its remit and resourcing.

Q: The need for advocacy is immediate, whereas setting up an Academy could take many years before it is effective. How can we avoid having a lot of noise but no effect in the initial years.
A: One could imagine bringing together the existing whole-discipline institutions (CMS, INI, ICMS, etc) to ensure sufficient activity on a realistic timescale without adding to the multitude of institutions already working in this space.

Q: Where do resources come from?
A: This is not in the remit for this report, but ideas that have been suggested are: a research funding body, government, wealthy individuals, and subscription payments by Fellows.

Q: Do we need to have a Fellows by distinction model? What does it mean to be a Fellow?
A: Actually, the community does not seem to be too enthusiastic about the concept of Fellows. However, the subscriptions, and the time contributions, of a Fellowship seem to be the most obvious mechanism to sustain the existence of an Academy. As such, Fellows must be expected to commit to the objectives of the Academy.

Q: Will an Academy be independent?
A: It is important that any Academy is entirely independent from the outset. Once established, additional funding can be sort from various sources, including government at a later stage.

Q: Would an Academy only represent England or the UK?
A: An Academy should also represent the interests of all the countries of the UK and not be limited to just England.

Summary of approach

We were tasked with exploring what benefits the mathematical community might wish an Academy of Mathematical Sciences to provide. We arranged discussions with a series of organisations, detailed below; we did not have sufficient resource to poll the entire mathematical community for opinions. In the course of these discussions, the question of how to achieve success with an Academy was inevitably discussed, and this document reports a summary of those opinions.

Our discoveries can be summarised as follows. Respondents universally felt that the mathematical sciences need better advocacy, and better branding. A policy-focused, externally-

facing Academy could potentially deliver this, although everybody was nervous about introducing yet another representative body into an already crowded space, and sceptical about our ability to receive sufficient funding for an academy to succeed. Nobody expressed a desire to suppress or replace the learned societies, but CMS is seen as being too constrained to deliver what many would like it to achieve. Discipline-wide education might usefully be situated within an Academy, with ACME potentially moving from its current home in the Royal Society. The other national whole-discipline bodies (Isaac Newton Institute and International Centre for Mathematical Sciences) consider their role to nurture the discipline, in contrast to an Academy providing advocacy and branding to gain external support.

Who was consulted

- The Council for the Mathematical Sciences
- The individual learned societies affiliated to the Council of the Mathematical Sciences (LMS, IMA, RSS, ORS, EMS)
- The Isaac Newton Institute
- The International Centre for Mathematical Sciences
- Advisory Committee on Mathematics Education
- Royal Academy of Engineering
- Academy of Social Sciences
- Academy of Medical Sciences
- Institute of Physics
- Conference Board of Mathematical Societies (umbrella organisation of USA mathematical societies)

We thank representatives of each of these bodies for their time and frank opinions. We also attempted to find other Academies of Mathematical Sciences, but discovered that there is only one, in Malaysia.

What the community would clearly like from an Academy

Advocacy for the mathematical sciences

Advocacy was unanimously noted as both missing in the current landscape, and a critical role for an Academy. The CMS is constrained by a lack of resource and a need to reach unanimity between five learned societies. The former hinders any proactive lobbying for the discipline, for example for industrial challenges to explicitly include mathematical components. The latter hinders reactivity when government seek the view of the community.

The IOP, the Royal Academy of Engineering and the Royal Societies of Chemistry and Biology work together to lobby and represent their disciplines, whereas the mathematical sciences community (via CMS) is occasionally invited to meetings when one of the other bodies

recognises it is worth inviting us. The IOP inform us that their key staff are all policy people, not scientists; they know how to manipulate government, not the science community, and have people in the five countries of the British islands to ensure influence in devolved parliaments and Ireland.

We note here that several discussants, particularly learned societies, were very wary of an Academy trying to mute their own advocacy and policy statements. Many members of the OR Society do not identify as mathematicians at all, and the RSS have extremely active policy work on, for example, official statistics, which is not of generic mathematical relevance. However, a common concern can be paraphrased as follows: Until the mathematical sciences community stops washing its dirty laundry in public, nobody will take the community seriously, no matter what we try to set up. While the public voices of individual societies are extremely valuable, it is important that all work together to avoid conflicting messaging.

Proactive branding of mathematics

This is closely linked to advocacy, and was again unanimously recognised as a valuable function that an Academy could achieve. While the mathematical science community is very aware that mathematics underpins many exciting developments, and also of the enormous potential of mathematics to do much more, most others, including in government and industry, think of mathematics as little more than arithmetic. This has multiple negative consequences, not least that companies and government tend to reach out to other disciplines (computer science, engineering, physics) when they wish to connect with people to create solutions to problems that we could consider to be mathematical. An Academy should have a proactive mission to demonstrate the power of the mathematical sciences. Such a campaign would require the input of individuals both to identify topics worth addressing, presumably related to pertinent issues in the public domain, and to produce reports that are engaging and demonstrative. It is likely that such a branding effort would place greater emphasis on “short term useful” mathematical sciences; those in less applicable research areas would need to recognise that this is a means to the end of improving the health of the discipline as a whole and does not mean that the Academy only values immediately-applicable research.

Broad church

It did not come up in all discussions, but where it did it was clear that people believe that all forms of academic mathematics, as well as non-academic mathematicians, must feel supported by an Academy. All sub-disciplines are nervous about an Academy being dominated by another sub-discipline, and careful thought will need to go into the structure of the Academy to prevent this happening. The Royal Academy of Engineering has a Fellows’ election process which seems to have been designed to help ensure breadth is retained. One warning we received in our discussions with other academies was that it is important to avoid over-governing: governance structures must be appropriate for the level of activity and funding so that the staff of an Academy are left with some capacity to deliver something other than governance.

What the community would definitely not like from an Academy

An additional body

There is universal agreement that we mustn't simply add an acronym to the soup. People were generally of the opinion that either we should increase the scope and autonomy of CMS, or replace CMS with an Academy. The proposal here assumes an Academy that initially complements the CMS, leaving open the longer term relationship.

Disappointment

Everybody was nervous about the prospect of introducing an under-resourced Academy and raising expectations without capacity to actually make a difference. In addition, several other Academies cautioned that we should not expect quick wins within five years, since it takes time for the benefits to start flowing.

Displacement

There was near universal agreement that an Academy should not replace the existing learned societies. Certainly, most learned societies have aspects of their remit unlikely to be covered by an Academy for the whole discipline, and the diversity of focus as well as subject matter is valuable for the discipline as a whole. We are reassured by conversations with the Academies of Engineering and Social Sciences, which both work successfully with multiple sub-disciplinary learned societies and/or professional bodies. The learned societies in these disciplines have discovered that their efforts are amplified by working together through the Academies. The division of labour in those academies appears to be that the Academy tends to reach out of the discipline and engage with others, whereas the learned societies tend to focus in and work with their constituents. This does not map directly to the mathematical societies, with the RSS in particular having an extremely strong policy mission, but may be a useful starting point in trying to ascertain clear roles for both Academy and learned societies.

What the community is not so clear about

Fellows

Most assumed that an Academy would necessarily function on a Fellowship by Distinction model. On the other hand, nobody seemed particularly excited by the idea of Fellows. Charging approximately 400 Fellows a £200 pa fee, as other Academies do, would generate a steady income. But those Fellows would have to be convinced that (essentially) donating the fee for the greater good of the discipline is money well spent – few believe that the immediate personal return of Fellowship is worth paying for. However it is difficult to see how an Academy could provide its key functions (advocacy, branding) without support of committed volunteers, and Fellowship seems to be the obvious way to get commitment. Other Academies expect their Fellows to contribute to the Academy, and to the greater good of the discipline: the RAE even

give all new Fellows a one-day briefing on expectations, and gives 80-90% of new Fellows a job immediately.

Taking a position

An Academy would usually provide authoritative and arm's-length reports to government on difficult issues in order to justify receiving government funding (though note that neither IOP nor Academy of Social Sciences receive recurrent government funding). Nobody felt this function was undesirable, but many struggled to find sufficiently many mathematical issues that government would care about to induce government to support an Academy. Presumably with better advocacy and branding, this might change. Some respondents were nervous about an Academy muffling their own voice on areas of specialist expertise.

Education

An Academy might be expected to take views on mathematics education, as part of supporting the discipline. ACME currently consider education at a disciplinary level. They have been a standing committee of the Royal Society since 2017, but note that they are the only single-discipline education committee: other disciplines look after education in their own academies. There is an argument that the needs of education in mathematics are different from those of other disciplines, because they need to be more integrated into other, non-mathematics, parts of the curriculum.

Most of the learned societies already do education independently as well, although it is inevitably fragmented. Many would not be comfortable about handing this responsibility to an Academy. EMS expressed a concern that, since education is a devolved matter, any London-focused Academy (or learned society for that matter) would be in danger of failing to properly address education in Scotland. Presumably the same issue arises in the other devolved administrations. Several have noted that the mathematics education space is so crowded that to try to make a difference in this space would be time-consuming, and unlikely to produce quick wins.

Research support

An Academy would usually host research-level talks, workshops and conferences to help support the discipline. However, the learned societies already provide this service. Furthermore, both the Isaac Newton Institute and the International Centre for Mathematical Sciences provide support for the mathematical sciences community at a whole-discipline, whole-country level. Both these centres see their role as supporting the discipline internally, with an Academy being externally facing.

Funding

Everybody would like to have an additional source of research funding. But the level of resourcing required to achieve this is unlikely to be achieved in the short term. It is plausible that an Academy could take on a role supporting UKRI in awarding fellowships, assisting with bringing mathematicians into industrial strategy challenges and such like. One respondent is keen for the Academy to act as a point of contact for government and industry seeking

collaboration with mathematical scientists, but many felt this was likely to jeopardise cross-community trust.

Observations on whether and how to set up an Academy

Is it needed?

The people within the mathematical sciences community have, in the main, been lukewarm about the idea. Few have completely dismissed it, although we suspect politeness was all that prevented that response in some cases. Everybody recognises the need for better advocacy, and desires better branding. Many feel that a better-resourced, and more agile, Council for Mathematical Sciences could deliver these without needing to devote energy and resource to setting up an Academy. Others feel that an evolved CMS could not escape its shackles and deliver what is needed. The learned societies have no enthusiasm for contributing further resource to CMS, so it would need to develop an ability to generate income independently if this were to be plausible. It would also need to develop a greater number of independent contributors, since almost everybody on CMS is already heavily committed to a learned society.

Resourcing

The vast majority of people have been extremely sceptical about whether we can raise external funding for an Academy, whether it is directly from government or from a funding body. Most do not feel there has been a sufficiently strong case made that wider society will benefit from the setting up of an Academy of Mathematical Sciences. However some key people who understand how these things work are confident that either (i) a funding body could be persuaded to offer short term resources to set up an Academy, (ii) sufficient networking in government could find a set of champions of the idea who could then work with us to secure funding, or (iii) wealthy individuals with an affinity to the mathematical sciences might well make sizeable donations. (Each idea comes from a different person, and each dismisses the other ideas as highly unlikely!) As already noted, awarding Fellowship by distinction, and charging an annual fee for the privilege of volunteering, would generate steady, if not very substantial, income. EPSRC do not consider it their role to support an Academy.

Relationship with learned societies

It is critical that an Academy has the cooperation of relevant other bodies. Otherwise it will simply become an additional voice in the chamber. There needs to be agreed areas of focus that avoid conflict, and effective modes of working to bring the whole community along. The Academy should take over the coordinating role of the CMS, but should be an independent body, and take on the roles of advocacy and branding that the community see as critical. In the early phases, community support for an Academy is most likely to be generated by enthusiasm disseminated via the learned societies.