

Sigma: A case study of an enduring centre for excellence

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Introduction

In 2003, the Government published a white paper entitled *The future of higher education* (DFES, 2003). This white paper contains a chapter entitled 'Teaching and learning – delivering excellence'. At the heart of this chapter is the principle that "All students are entitled to high quality teaching" (p.46) and one of the key proposals to bring this about is the establishment of Centres of Excellence:

"We should also celebrate excellent practice in teaching departments. The very best will be designated as Centres of Excellence and given funding of £500,000 a year for five years to reward academics and to fund extra staff to help promote and spread their good pedagogical practice ... Their status will help to raise the profile of excellent teaching" (p 54).

In 2004, the Higher Education Funding Council for England (HEFCE) issued a call for proposals for Centres for Excellence in Learning and Teaching (CETLs). 259 proposals were submitted and after a two-stage selection process, 74 CETLs were established each with funding for 5 years from 1 August 2005 to 31 July 2010. The funding awarded to CETLs was large. The total funding available for the programme was £315 million, with individual CETLs receiving revenue funding of up to £500,000 per year and capital funding (which had to be spent in the first two years) of up to £2 million.

²⁹ Presentation of contributors in Norwegian page 173.

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In the guidance relating to drafting proposals, the major emphasis was put on establishing existing excellence and on the plan of activities for the five year funding period. CETLs were expected to develop teaching practices which would further enhance their existing excellence. Bidders were specifically encouraged to be innovative and explore 'risky' developments (particularly with regard to the use of new technologies) which, it was accepted, might not succeed. Although the white paper had focused on reward for academic staff who had delivered excellence and funding for additional staff to help "spread their good pedagogical practice", reward and dissemination appeared to be less significant in the bidding guidance.

One of the CETLs established through this process was **sigma**, Centre for excellence in university-wide mathematics and statistics support. **sigma** was a collaborative CETL between Loughborough and Coventry Universities³⁰. This case study records the history of **sigma** during its time as part of the CETL programme (2005-2010) and its development since the end of the CETL programme (and accompanying funding). The vast majority of CETLs ceased to exist as discrete entities after July 2010, **sigma** on the other hand has flourished securing funding from both host institutions to maintain the work it had carried out directly with students. In addition, **sigma** has continued its cross-sector activities, initially through participating in the National HE STEM Programme (2009-2012) and, following that, with a project funded by HEFCE specifically aimed at developing a sustainable mathematics and statistics support community (2013-2016). Having traced the development of **sigma** from 2005 to date, the case study will close by looking to anticipated future developments.

Context

Throughout the 1990s, there was growing disquiet in a number of organisations (universities, professional bodies, learned societies) about the state of mathematics education in England. Following the publication of several influential reports, such as *Measuring the Mathematics Problem* (Engineering Council, 2000), the Government established a national enquiry into post-14 mathematics education under the chairmanship of Professor Adrian Smith. The report of this enquiry made a number of wide-ranging recommendations and, although focused on secondary school education, did address some issues in higher education. One comment is particularly telling: "Higher Education has

³⁰ Duncan Lawson was a co-Director of Sigma, He no longer works at Coventry University, but is still a Director of Sigma (editors remark).

little option but to accommodate to the students emerging for the current GCE³¹ process” (Smith, 2004, p.95).

Universities had already realised this for themselves and were making this accommodation in a number of ways. One of these ways was through the establishment of ‘mathematics support centres’. The most common model of such centres was that of the ‘drop-in centre’. In this model, the centre is staffed for a set number of hours per week and during these hours students can ‘drop-in’ to seek assistance with mathematics from the duty tutor. In addition to the opportunity to speak one-to-one with tutors, mathematics support centres also, typically, provided self-learning resources such as hand-outs and online materials.

One of the first such centres in higher education was the BP Mathematics Centre at Coventry University, which was established in 1991 with funding from the BP Engineering Education Fund to provide assistance in mathematics to engineering students. Over the years, the remit of this centre had expanded from a focus on engineering students, through all students taking a mathematics or statistics module as part of their programme, to any student in the university needing assistance with any aspect of mathematics, statistics or quantitative methods. Although funding from BP had ended in the mid-90s, the (renamed) Mathematics Support Centre received a small amount of central funding from the University in order to provide this service to students.

Several universities visited the Centre at Coventry, including, in 1996, colleagues from Loughborough University. Following this visit, the Mathematics Learning Support Centre, based extensively on the provision at Coventry, was established. As at Coventry, the Centre received a modest amount of central funding in order to cover its operational costs (primarily staffing costs).

In the period from 1996 through to the call for CETL proposals in 2004, colleagues from Coventry and Loughborough had collaborated together on several projects, most notably the mathtutor and mathcentre projects³². The mathtutor project developed an extensive set of learning resources, based around instructional videos, relating to mathematics at the transition from secondary to higher education. The mathcentre project established an online

³¹ GCE stands for General Certificate of Education and represents the final stage of secondary schooling. The typical GCE qualifications are known as A Levels (Advanced Levels).

³² www.mathtutor.ac.uk and www.mathcentre.ac.uk

mathematics support centre providing an extensive range of resources for use directly by students or by academic staff providing mathematics support (thereby saving multiple ‘reinvention of the wheel’ since the topics that students struggled with tended to be the same at all universities).

When the call for CETL proposals was made in 2004, Loughborough and Coventry were able to present a record of substantial experience in relation to the provision of mathematics support and, unlike several other collaborative proposals, evidence of existing collaboration over a period of several years with many tangible outputs. Although the guidance for development of proposals concentrated much more on establishing excellence and the planned activities during the five years of funding than on dissemination, the Loughborough / Coventry proposal had a significant external focus built into it from the outset. Following the two round selection process, which required a short application followed by a “full application” (but no site visit), the proposal was successful and **sigma**, Centre for Excellence in University-wide Mathematics and Statistics Support was established.

sigma: the CETL years (2005-2010)

Student-focused work

A key focus of **sigma**’s activity was the work that it did directly with students in the two host institutions. This revolved around, but was not limited to, the drop-in centres. Using the capital funding, a completely new centre was created at Loughborough whilst at Coventry, extensive refurbishment took place. The outcome in both institutions was large, attractive learning spaces with technology-rich teaching spaces close by.

The CETL funding enabled the staffing provision in the drop-in centre to be increased, meaning that a high quality of service could be offered to students.

The reaction from the students was very positive. In 2004/5, the year before the CETL began, the total number of visits by students to the drop-in centres across both institutions was just over 6,000. By 2008/9 (i.e the 4th year of **sigma**’s existence as a CETL), this total had risen to well over 12,000 – it had more than doubled. Qualitative feedback also illustrated the value that students place on the maths support centre. The quotes below are typical of the feedback received from students:

“The Centre’s service is nothing short of excellent. The friendly, welcoming staff are always available to support your studies where no query, question or problem is ever too much.”

“My memories of using the Maths Support Centre can be summed up in one word – Excellent.”

A more in-depth analysis of the ways students perceived and used maths support can be found in Solomon et al (2010).

A new service, the Statistics Advisory Service (SAS) was introduced. It was acknowledged that often students’ needs in statistics support could not be satisfactorily met through a short interaction with a tutor in a drop-in centre. Where students were undertaking large scale projects which involved gathering and then analysing large amounts of data, what was needed was a longer appointment where the tutor could focus solely on the one student, gaining an understanding of the overall nature of the project in order to give meaningful support. The SAS therefore did not operate on a drop-in basis, but through bookable appointments which guaranteed students uninterrupted one-to-one support.

Traditionally, users of the drop-in centres had come mainly from students of engineering and mathematics but with the new centres and the new services such as the SAS, the discipline base of students widened considerably. This was achieved partly through the attractiveness of the new facilities and the relevance of the new services. But, in addition, there was also a focused campaign to deliberately target subject areas, such as Nursing and Midwifery and Political Science, which had not engaged to any great extent with maths support previously. Students were key in this advertising campaign.

Working with students

sigma engaged with students in a variety of ways. Some students were employed as ambassadors and summer interns. Ambassadors were given the role of promoting mathematics and statistics support to other students. They did this in a variety of ways including going to lectures on other courses and doing “shout outs” (with the permission of the lecturer concerned); running a ‘maths health check’ around the campus (dressed in white coats, operating theatre scrubs and brandishing stethoscopes); and designing publicity materials such as posters and postcards. One such poster features two students at a party with the young man trying to “chat up” the young lady. The slogan across the bottom of the poster read “What’s the **probability** he’s going home alone

tonight?” with information about the times and the place to get drop-in support in statistics underneath. Other ambassadors produced a short video clip, accompanied by the Beatles song “Help!”, featuring a student despairing of his mathematics and then visiting the drop-in centre and resolving his problems.

Summer interns worked on specific projects with members of **sigma** staff during the summer vacation. These projects covered a number of different areas such as the development of learning resources to support particular modules, questions to be used with personal response systems (“clickers”) during lectures and banks of questions for use in computer-assisted assessment software to allow repeated practice. Following the success of the summer internships, **sigma** moved on to offering year-long paid placements for students taking “sandwich degrees”.³³

Dissemination

As mentioned previously, the activity plan in **sigma**’s CETL proposal was outwardly looking from the beginning. The CETL bidding guidelines had suggested that bidders should plan to work with their relevant subject centre³⁴ to facilitate dissemination. For **sigma**, the relevant subject centre was the Maths, Stats & OR (MSOR) Network, based at the University of Birmingham. Unlike many CETLs (and several subject centres), **sigma** saw this as a significant opportunity, particularly for the first two levels of dissemination: for awareness and for understanding (Harmsworth and Turpin, 2000). The MSOR Network published a quarterly academic magazine, *MSOR Connections*, and **sigma** provided a regular column for this publication. The subject centre also attempted to bring together all the CETLs working in areas relevant to mathematics, statistics and operational research to share practice and encourage collaboration and **sigma** played a key role in these joint events.

One key outcome of the collaboration between **sigma** and the subject centre was the establishment of the CETL-MSOR conference (here the acronym stands for ‘Continuing Excellence in Teaching and Learning in Mathematics, Statistics and Operational Research). Although the subject centre no longer exists, **sigma** has

³³ A sandwich degree is a course which includes a paid period of employment in a position related to the subject being studied in the degree. A student on a sandwich degree follows exactly the same academic programme of study as students on a “standard” degree, but additionally has a placement meaning that their course is a year longer.

³⁴ The Higher Education Academy, a cross-sector body charged with enhancing learning and teaching in all universities, funded 24 subject centres to deliver discipline-specific learning and teaching enhancement.

maintained the conference (the 10th annual conference took place at the University of Greenwich in September 2015) and it has become established as the UK's leading conference on issues relating, not just to mathematics and statistics support, but to learning and teaching mathematics and statistics in higher education.

Towards the end of the CETL programme in 2009, as mathematics support was becoming established in many universities throughout the country, **sigma** introduced a prize scheme to recognise the Outstanding Contributor to mathematics and statistics support. Staff from Coventry and Loughborough Universities were prohibited from being nominated for the prize. In 2010, a second award, for the Rising Star in mathematics and statistics support was introduced.

Staff at **sigma** were aware that Coventry and Loughborough were not the only universities providing mathematics support and that there was much good practice at other institutions. In order to capture and spread this good practice, **sigma** offered 'secondment opportunities'. Colleagues in other institutions were encouraged to apply for secondment funding. Two kinds of secondments were available: short-term or long-term. For short-term secondment, the colleagues would visit **sigma** for a short period, typically one or two weeks, with a view to observing the way in which **sigma** approached a particular aspect of mathematics support (for example, advertising the service to students or evaluating the support provision) with a view to implementing, in their own institutions, the lessons learned during the visit. Long-term secondments did not require the secondee to actually visit **sigma**, but rather to specify a project relating to mathematics support that they wished to undertake that could be of benefit both in and beyond their own institution. A member of **sigma** staff would be assigned as a link person to the secondee to provide input (and progress monitoring). The costs of the secondment (travel and accommodation in the case of short-term and staff time and equipment in the case of long-term) were covered by **sigma**. These secondments proved an effective form of dissemination for action, enabling colleagues at many institutions to identify themselves with **sigma** and to produce resources that were shared throughout the sector.

New Centres and Regional Hubs

The annual conference, the prize scheme and the secondments were all designed to move to the third level of dissemination: dissemination for action (Harmsworth and Turpin, 2000). These were all ways of involving colleagues from other institutions in mathematics support and of creating in them a sense of involvement in the work of **sigma**.

However, from the outset, **sigma** had built in an even stronger form of dissemination for action. The original proposal contained a commitment to work with the University of Leeds (a university that had no mathematics support provision) to establish a support provision there. This was to be paid for from **sigma**'s CETL funding for a period of two years. This experience would be used to develop a blueprint that other universities could use for initiating mathematics support. The proposal also contained an undertaking to offer funding to two other universities that did not have mathematics support to enable them to establish their own provision.

The development with Leeds went ahead as planned. A drop-in centre was established and funded by **sigma** for two years. During this period, the centre was able to demonstrate its value to the University management who continued to provide resource for the centre when the **sigma** funding had ended. The experience of establishing this drop-in centre provided many valuable lessons and an informal blueprint was developed and then refined as **sigma** assisted in the support of other universities through its CETL activity and work within the National HE-STEM programme (discussed later). This led to the publication of a guide *How to set up a mathematics and statistics support provision* (Mac an Bhaird and Lawson, 2012).

In order to meet the commitment of establishing two further centres, **sigma** ran a competitive bidding competition. Universities wishing to secure the funding had to set out their proposals, indicating that they had identified a need and had well-thought out ways of addressing this. Furthermore, there had to be institutional support for the proposal, evidenced by the provision of matched funding for the two years of **sigma** funding. The funding was allocated to Bath and Sheffield Universities who both submitted very well worked through proposals. Again, with these two drop-in centres, by the time **sigma** funding ended, the value of the support provided was so clear that both universities provided resources to continue the work.

In the latter stages of the CETL programme, colleagues from the recently established maths support provision at Bath University approached **sigma** with a suggestion that they be designated as a **sigma** regional hub. The number of universities providing mathematics support was steadily increasing, but in many institutions this was delivered on very limited budgets. Often the entire responsibility fell on a single individual. The colleagues from Bath argued that it would be good for such individuals to be able to interact with colleagues from other universities who were providing mathematics support to share good practice and receive moral support. Furthermore they reasoned, this support needed to be available relatively locally (without the need for a trip to Coventry or Loughborough). Their idea was that as a regional hub, they would facilitate one or two staff development and networking events each year and promote relationships whereby isolated individuals knew a number of other maths support providers who could assist them when they needed help. This proposal was accepted by **sigma** who provided funding to pilot the idea and the South-West regional hub was created.

CETL funding came to an end for all CETLs on 31 July 2010. At earlier stages of the CETL programme, there had been suggestions from the funders that continuation funding might be available to enable the more successful CETLs to continue, but this never materialised. On 1 August 2010, many CETLs ceased to exist as identifiable entities. However, **sigma** was not one of these.

Relationships with Senior Management and Continuation

sigma had cultivated effective relationships with senior management in the two host institutions during the five years of the programme. The **sigma** Board was co-chaired by Pro-Vice-Chancellors from the two universities. The **sigma** directors ensured that the two Vice-Chancellors were regularly apprised of **sigma**'s activities, through short emails, through newsletters and by inviting them to give short addresses at workshops and conferences, particularly if notable external colleagues were present.

In 2010, with the end of CETL funding in sight, a key publication outlining **sigma**'s achievements during the programme, *Celebrating success in mathematics and statistics support* (**sigma**, 2010) was produced. The two Vice-Chancellors were invited to write a joint Preface for this document and they both willingly accepted. This report prominently displayed a quote from a senior Irish academic made during the opening address of an Irish conference on Mathematics Learning Centres:

*“We stand on the shoulders of giants. From our point of view, the giants are Coventry and Loughborough Universities and **sigma**. We have unashamedly copied our ideas from them.” (sigma, 2010, p.2)*

This served as a timely reminder to the Vice-Chancellors of the contribution that **sigma** was making to the reputation of their institutions, not only in England but internationally.

The summative evaluation report of the CETL programme (SQW, 2011, p. v) identified “the need for good senior management links and institutional visibility” as key elements in success. This was something that **sigma** had realised from the outset. The steps that **sigma** took to engage senior management at the two institutions were not a campaign of “spin” but rather one of ensuring that **sigma**’s achievements were noticed.

As the end of CETL funding drew near, **sigma** negotiated with senior management at both institutions for funding to continue its work. Before the CETL programme, both universities had provided funding for mathematics support. During the period 2005-2010, **sigma**, using CETL funding, had provided a much higher level of service to students within the two universities and there was ample evidence that the students highly valued this provision. Both universities recognised this and agreed to provide substantial amounts of resource (far in excess of what had been provided prior to the CETL programme) to enable **sigma** to continue to operate within the host universities. This work has continued to the present day and will continue for the foreseeable future – however, the remainder of this case study will not focus on further developments of the work with students in Coventry and Loughborough Universities, but rather will focus on the role that **sigma** has continued to play in terms of supporting the sector in its development of mathematics and statistics support.

In these internal negotiations, the **sigma** directors made clear that they were only seeking funds to continue providing mathematics support **within** the host institutions. As illustrated above, **sigma** had taken on a significant cross-sector role, but **sigma** stated plainly that it would not be appropriate for Coventry and Loughborough Universities to fund this cross-sector work and that other sources of funding would be used for this work. This was not simply a negotiating tactic or empty rhetoric since such funding had already been secured, from the National HE STEM Programme. The national work that **sigma** undertook within this programme is described in the following section.

sigma within the National HE STEM Programme (2009-2012)

The National HE STEM Programme

The National HE STEM Programme was a £12 million project funded by the English and Welsh funding councils (HEFCE and HEFCW) which ran from 2009 to 2012. The purpose of the programme was “to support Higher Education Institutions in the exploration of new approaches to recruiting students and delivering programmes of study within the Science, Technology, Engineering and Mathematics (STEM) disciplines”³⁵.

A government report, carried out by the National Audit Office in 2007, had identified that mathematics was a major barrier to the retention of students on STEM courses in higher education:

“Many students require some additional academic support, especially in the mathematical skills required in science, mathematics, engineering and technology.” (NAO, 2007, p.33);

The leaders of the National HE STEM Programme were aware of the work that **sigma** had been carrying out as a CETL in terms of assisting other universities to establish mathematics support provision. It therefore invited **sigma** to be responsible for a strand of activity within the overall programme.

In this strand of activity, **sigma** was commissioned to further establish mathematics and statistics support within the sector. The plan that **sigma** put forward to achieve this included: provision of further funding (which would need to be matched by the bidding institution) to establish new mathematics support in institutions which had no support; a competitive bidding process to allocate funds for projects to enhance mathematics support in institutions which already had some provision; national rollout of regional hubs (following the success of the pilot in the south-west at Bath University); the continuation of the CETL-MSOR conference and the **sigma** prizes; maintenance and further development of the resource websites mathcentre and statstutor³⁶; and the development of a range of resources for staff involved in the provision of mathematics support.

³⁵ www.hestem.ac.uk

³⁶ www.statstutor.ac.uk

New Centres and Regional Hubs

A first call for funds for new centres took place and this resulted in funding being awarded to five further universities: Central Lancashire, Kent, Lincoln, London Metropolitan and York. All these universities received funding for two years, which had to be matched by the institution, who also had to give a commitment to consider long-term funding for the provision once **sigma** funding had ended.

In order to provide a support mechanism for the growing number of relatively inexperienced mathematics and statistics support practitioners, the regional hub concept, which had been piloted in the South-West at Bath University, was rolled out nationally. England and Wales was divided into six regions (North-West and North Wales; North-East and Yorkshire; Midlands; South-West and South Wales; Eastern and South-East) and, in each region, a university was commissioned to act as the regional hub. The key responsibilities of regional hubs were to organise at least two events a year where good practice could be shared and staff development take place; to act as a coordinator and point of contact for all mathematics support practitioners in the region; and to be the liaison point between the region and **sigma** centrally.

The National HE STEM Programme had designated a small number of universities throughout England and Wales to have a key role within the delivery of the programme – these were called “spokes” and received funding from the lead university (University of Birmingham) to undertake this work.

The Welsh spoke had seen the importance of mathematics support and was disappointed that no Welsh universities were funded in the first funding call (none had applied). They invited **sigma** to act in a consultative capacity to universities throughout Wales, supporting them to initiate mathematics support with funding from the Welsh spoke. Working in this way, **sigma** provided staff development for colleagues who would manage mathematics support centres and training workshops for PhD students who would act as tutors within these centres. In this initiative, **sigma** assisted in the establishment of eight mathematics support centres at universities throughout Wales.

Some universities had initiated mathematics and statistics support without financial support from **sigma** (although many had made use of resources produced by **sigma** and had sought advice from experienced colleagues within the **sigma** network). As these centres already existed, they could not bid for funding to set up a new centre, but several of them were running on small budgets and could benefit from development funding. So, **sigma** ran an

“enhancement scheme” whereby universities could bid for funding (which again needed to be matched by the home institution) for a project to improve an already existing mathematics support provision. Six universities received funding to carry out such projects.

As the National HE STEM Programme progressed, it became clear that there was a significant underspend on the total budget available. Areas of the Programme which were recognised as successful were encouraged to bid, within the Programme, for further funding to expand their successful activities. As a result, **sigma** was allocated further funding for another round of competitive bidding to establish new centres. In this second round, a further nine universities received funding to set up mathematics support. Having learnt from the experience of the first round, when some new centres struggled to establish themselves, each of these nine new centres was allocated a mentor. The mentors were experienced mathematics support practitioners who provided advice and guidance to the new centres through a programme or visits throughout the two years of funding and by being available for phone conversations to discuss problems or proposed new ventures. In this way, many of the teething problems that were present in the first round were dealt with before they became significant in the second round.

Staff Development and Community Building

It was clear that the mathematics support community was growing rapidly. During the National HE STEM Programme, **sigma** had provided direct assistance in establishing 22 new mathematics support centres and in enhancing six existing centres. A vast array of learning resources for students was available to the new centres on the mathcentre website, but there was a need for developmental resources for staff too.

To address this, **sigma** produced a series of guides addressing key issues for those running mathematics support provision, including:

- How to set up a support centre (Mac an Bhaird and Lawson, 2012)
- How to train support centre tutors (Croft and Grove, 2011)
- Gathering feedback from students (Green and Croft, 2012)
- Evaluation of mathematics support provision (Matthews et al, 2012).

These guides were written as practitioners’ handbooks rather than academic articles and were widely downloaded from the **sigma** network website that had been developed as part of the National HE STEM Programme.

The CETL-MSOR conference continued on an annual basis throughout the period 2009-2012, acting as a key focal point for the development of the growing mathematics support community. The conference attracted delegates not only from England and Wales but from further afield. Inspired by the effectiveness of the **sigma** network, colleagues in Ireland created the Irish Mathematics Learning Support Network³⁷ and in Scotland the Scottish Mathematics Support Network³⁸ had also been created. The home pages of the websites of both these networks acknowledge the support of **sigma**.

External Recognition

The Times Higher Education (THE)³⁹ is a weekly magazine dedicated to Higher Education. The THE awards prestigious prizes annually in a range of categories, such as Outstanding Digital Innovation, Widening Participation Initiative of the Year, and Outstanding Support for Students.

In 2011, **sigma** won the THE award for Outstanding Support for Students. The judges' citation stated:

“sigma is a fantastic example of institutions recognising genuine concerns in standards and acting in a positive way to address them. Students' reports about the support they received were exceptionally positive. Loughborough and Coventry should be incredibly proud of delivering support for students in a positive, innovative and transferable way.”

Another element of recognition came through 'Access Agreements'. In England, if a university wishes to charge fees above £6,000, they must prepare an Access Agreement and have it approved by the Office for Fair Access⁴⁰. The Access Agreement must set out how the institution plans to improve and sustain fair access to higher education – this includes not only recruitment onto courses but also support provided to enable students to succeed. Fletcher (2013) reported that 14 English universities indicated that the provision of mathematics support was part of their fair access strategy. For example, the University of York stated “The York Maths Skills Centre has been set up to provide University-wide support” (*ibid*, p.46).

³⁷ <http://supportcentre.maths.nuim.ie/mathsnetwork/>

³⁸ <https://sites.google.com/site/scottishmsn/>

³⁹ <https://www.timeshighereducation.co.uk/>

⁴⁰ <https://www.offa.org.uk/>

Shortly after **sigma** received the THE award, the then Minister of State for Universities and Science, David Willetts, visited Loughborough University. As part of this visit, he was taken to the mathematics learning support centre and learnt about the work of **sigma**. He was so impressed that he started referring to **sigma**'s work in speeches focusing on the importance of mathematical and quantitative skills, not only in the STEM disciplines, but also in other disciplines such as the social sciences. In 2013, in his publication *Robbins revisited: Bigger and better higher education* (Willetts, 2013), he praises the role **sigma** is playing across the sector (*ibid*, p.51).

sigma: the shoestring year (2012-13)

From August 2005 to August 2012, **sigma** had received considerable financial support, firstly from the CETL programme and then from the National HE STEM Programme. This had enabled the establishing of a community of practice, a network of mathematics support practitioners. Coventry and Loughborough Universities played a central role in this community, but as the community grew, other institutions, notably the regional hubs, took on increasing responsibilities.

In May 2012, **sigma** organised a one day workshop entitled “Looking to the future”, to which all the key members of the **sigma** network were invited. The purpose of this workshop was to prepare for a future in which funding for community activities would be limited – funding for continuation of mathematics support centres within institutions was, in most cases, secure. At this workshop, one of the **sigma** directors gave a presentation called “**sigma**: the last seven years”. After reviewing **sigma**'s achievements, he drew on the story of Joseph and Pharaoh⁴¹ in which Joseph interprets Pharaoh's dream as foretelling seven years of plenty followed by seven years of famine. **sigma** had enjoyed seven years of plenty and now had to plan for a future where famine was the outlook.

Members of the network committed themselves to maintaining as much activity as was possible. Each of the regional hub co-ordinators agreed to continue in their role and to maintain two events per year. A new post of Chair of the **sigma** network was created and one of the hub co-ordinators agreed to take on this role of maintaining an active community. The **sigma** directors agreed to continue to run staff development workshops, particularly tutor training, in order to assist inexperienced centre managers.

⁴¹ Genesis chapter 41.

The CETL-MSOR conference was maintained through on-going links with the MSOR Network. The 2012 conference had taken place in June so that funding from the National HE STEM Programme could be used to support it. Underwriting of the 2013 conference (which took place in the usual September slot) was the last act of collaboration between **sigma** and the MSOR Network as this organisation had also lost its funding and ceased to exist in 2012. However, no prizes were awarded in 2013, since there was no funding available.

Although this voluntary activity enabled key elements of **sigma**'s cross-sector work to continue, the **sigma** directors were working to identify other sources of funding to enable the level of activity to be expanded. In view of the interest being shown by the Minister of State for Universities and Science, the directors wrote to him, thanking him for his interest and kind words but pointing out that these were coming just at the time when **sigma** was losing all funding to operate on the national stage. The Minister invited the **sigma** directors to a meeting to discuss the future of mathematics support. At this meeting, he promised to speak to various organisations within higher education who might be able to fund further work in this area.

sigma: the HEFCE project (2013-2016)

Early in 2013, **sigma** was approached by HEFCE and invited to submit an application to the Strategically Important and Vulnerable Subjects fund. A proposal was duly submitted in which **sigma** set out a plan to establish a sustainable community of practice in mathematics and statistics support through a three year programme of activity. This programme of activity would include the maintenance of the regional hub network; a further funding call to establish new centre; continuation of the annual conference and prizes; resource development (particularly but not exclusively in statistics); and provision of funding for student internships to work on projects related to mathematics and statistics support. Apart from the staffing costs, the bulk of the funding received from HEFCE would not be retained by **sigma** centrally but be distributed to other universities.

In October 2013, HEFCE announced⁴² that it would provide funding of over £800,000 to **sigma** to enable it to carry out this work over the next three years. At the time of writing, **sigma** has held two further calls for the establishment of new centres and ten institutions have been awarded funding. In addition, one institution that had a very small mathematics support provision has also been

⁴² <http://www.hefce.ac.uk/news/newsarchive/2013/Name,93960,en.html>

awarded funding to increase the scale of activity. The new centres included two in further education colleges which provide higher education (so-called HE in FE). These institutions have encountered some different problems from those met in traditional higher education providers. Another of the new centres is at the University of the Arts, London. This is the first mathematics support provision that **sigma** has assisted in a specialist art institution. Their students are interested in a relatively small number of topics, particularly in geometry – which is not covered to any great depth in the school mathematics curriculum. As with the previous batch of new centres, these new centres were all provided with an experienced mentor to support them in the early stages of their development.

The funding of student internships revisits an initiative that took place with some success during the CETL years. Internships are allocated via a competitive bidding process. Experience has shown that interns tend to be more productive when they are part of a team (of at least two) rather than working in isolation. For this reason, **sigma** insists that the institution must allocate funds for a second intern to work alongside the **sigma** funded intern. Student interns are strongly encouraged to present at the CETL-MSOR conference and these student presentations have been of the highest quality.

The CETL-MSOR conference has continued, with more delegates each year, bringing the whole community together. The annual **sigma** prizes have been reinstated. The prizes provide evidence of the strength of the mathematics support community – ten prizes in total have been awarded since 2009 and all the recipients have come from different universities. The regional hubs have continued to provide local points of contact for networking and sharing of good practice.

As part of the sustainability strand which HEFCE insisted be part of this programme of activity, **sigma** commissioned a high level sector needs analysis. A sample of 23 senior managers (typically Pro-Vice-Chancellors for Learning and Teaching) were interviewed about their understanding of the needs of their students in relation to mathematics and statistics support. The 23 institutions represented in the sample were from all parts of the spectrum of universities, from research intensive to teaching intensive. However, despite the variation in the universities several common themes emerged. All universities reported that some of their students were challenged by the mathematical or quantitative elements of their courses and needed additional support. Most of the PVCs were aware of the work that **sigma** had undertaken and regarded **sigma** as the 'go-to' organisation for assistance. They highlighted the need for staff

development, in a discipline context, to assist academic colleagues in designing appropriate curricula and in developing approaches to teaching (particularly as some of these colleagues are themselves challenged by a quantitative approach to their discipline). A full report of this piece of work has been published by **sigma** (Tolley and McKenzie, 2015).

The **sigma** Network has already begun to plan for the future beyond the end of the current HEFCE programme. A draft constitution has been drawn up to establish the Network as a formally constituted association, whose goals will be to continue the community of practice as a place where good practice is disseminated, resources are shared and which champions mathematics and statistics support.

Conclusion

The summative evaluation of the CETL programme (SQW, 2011) records that there is little evidence of the impact of CETLs on the HE sector. For example, it states “specific evidence of the adoption of CETL approaches in non-funded HEIs is much scarcer” (*ibid*, p. iv). Subsequent articles used headlines such as “CETLs’ impact assessed: the sector hardly felt a thing” (Grove, 2012).

However, as this chapter has demonstrated, these comments do not apply to **sigma**. Institutions the length and breadth of the United Kingdom and further afield have adopted the approaches **sigma** has developed. These institutions have then in turn contributed to further development through participation in a vibrant community of practice.

The early days of mathematics support have been described by Kyle (2010, p.103) as “a form of cottage industry practised by a few well meaning, possibly eccentric individuals”. However, his article goes on to conclude that “Mathematics support came of age in the first decade of the 21st century” (*ibid*, p.104). It is hard to argue with the assertion that this ‘coming of age’ was due to the work of **sigma**.

In **sigma**’s final report for the National HE STEM Programme, David Youdan, Executive Director of the Institute of Mathematics and Its Applications, is quoted as follows:

*“It is hard to overstate the importance of the expansion of the **sigma** network ... The accepted position is that it is now a student’s right to receive support with the mathematical content of their degree.” (Fletcher, 2013, p.49)*

This message brings the focus back to where it should be when considering centres for excellence – the impact on students. Through the work of **sigma**, the learning experience of tens of thousands (possibly hundreds of thousands) of students has been improved. That surely is success.

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