Network of Teaching Excellence in Computer Science Final Contract Report to DfE
March 2018

About this report

Through competitive tender, DfE awarded BCS a three-year contract to ‘maintain the Network of Excellence (NoE) to support:

• the subject of computing becoming firmly established in all primary and secondary schools
• teachers of computing, at both primary and secondary level becoming confident, enthusiastic, possessing the subject knowledge and skills to be effective and become active participants in local communities of practice.’

The initial contract ran from April 2015 – March 2016 with a contract variation covering the period April 2016 -March 2018

As part of that contract BCS has produced this final report, which measures success against the objectives and key tasks agreed in this contract, provides a quantitative assessment of impact and provides options for the future sustainability of the NoE. It sets out some of the
key challenges identified over the period of the contract and draws together any lessons learnt that might inform future support programmes for computing teachers.

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Executive summary

Headlines

<table>
<thead>
<tr>
<th>Schools supported by the CAS Network of Teaching Excellence (the NoE) have attracted more students to GCSE Computer Science and they have achieved higher grades than students in schools not supported by the NoE.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The most common grade for schools supported by the NoE is grade B, compared to grade C for schools not supported by the NoE. This has been true for each of the last three years of the NoE programme and has been achieved at a cost of less than £25 per teacher CPD hour.</td>
</tr>
<tr>
<td>An additional 222 CAS Master Teachers have been recruited, trained and supported providing a good regional spread across the country. This is 11% above the target and makes the total number of CAS Master Teachers recruited and trained 630, with 500 still registered.</td>
</tr>
<tr>
<td>In Year 1 (April 2016 to March 2017) the Network of Excellence provided 46,710 teacher-hours of CPD and support to 14,445 teachers in 5475 schools across the country. This is 56% above the target for the year.</td>
</tr>
<tr>
<td>In the first three quarters of Year 2 (April 2017 to December 2018) the Network of Excellence provided 33,617 teacher-hours of CPD and support to 9982 teachers in 3963 schools across the country. This is 12% above the target for the year with one quarter of the year still to go.</td>
</tr>
<tr>
<td>Approximately 90% of the funding provided by DfE went directly to the 10 Regional Centres to recruit the educational teams (experienced primary and secondary computing teachers) needed to support and train the CAS Master Teachers.</td>
</tr>
</tbody>
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1 Figures for the final quarter are being validated.
The big picture

1 To be effective, capable and safe citizens in this ever-changing digital world it is essential that every child in the UK has access to a high-quality computing education. A prerequisite for such an education is highly motivated and professionally capable teachers in all our schools.

2 The NoE is part of the Computing At School group (CAS) administered by BCS The Chartered Institute for IT. It was first established in 2012. Its dual purposes are to enable teachers in England to become confident, effective and enthusiastic teachers of computing, and to develop and articulate a vision for the subject of computing at the national level.

3 The NoE is now recognised within government strategy to ensure all students have the digital skills required for the UK to prosper in the 21st century\(^1\). Government through the DfE has ‘provided funding for the Computing at School Network of Teaching Excellence in Computer Science, whose network of over 350 Master Teachers can provide continuing professional development to teachers needing to further develop their computing expertise’, to ensure that young people leave school able to take their place in the digital economy.

4 In *After the Reboot*, the Royal Society reported that ‘The existing university-based Computing At School Network of Excellence has been successful with minimal resources through a model built on enthusiastic volunteers developing a mutually supportive community of practice.’

5 DfE funding of £1.2 million per year helps grow the NoE through the recruitment and training of CAS Master Teachers and provides them with a localised support infrastructure through part-funding of 10 CAS Regional Centres based in universities. Phase 1 of the DfE contract ran from April 2015 to March 2016. This was the first year of the current model. The contract was extended into the current phase which runs from April 2016 to March 2018.

6 The NoE model of school to school support enabled through collaboration with world class universities working in partnership with CAS Master Teachers has attracted considerable further financial support from key global technology companies such as Google, Microsoft, Cisco and BT, has provided national initiatives such as the BBC’s micro:bit programme with a means to reach teachers at scale, and has attracted interest globally from countries as diverse as Japan, South Korea, Canada, Australia, Hungary, Netherlands, South Africa and the Western Balkan States among many others.

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The NoE has proved to be highly effective, impactful, scalable and value for money. The NoE has improved teachers’ confidence, their subject knowledge expertise, and their pedagogical expertise. In secondary schools offering GCSE Computer Science supported by the NoE there are larger cohort sizes taking GCSE Computer Science and they obtain higher grades than schools not supported by the NoE.

At the same time despite the considerable external funding and other support the NoE has attracted, it could not exist without the vital core funding provided by DfE to make sure the infrastructure underpinning the NoE is sustainable.

Key performance indicators

The contract extension introduced a number of key performance indicators against which progress could be measured. These are:

- **KPI 1:** Ensure a good geographical spread of support and provide focused support in “cold spot” areas.
- **KPI 2:** Grow the Network of Excellence by recruiting, training and supporting a further 200 Master Teachers so there are a minimum of 450 by the end of the contract.
- **KPI 3:** Provide a minimum of 30,000 hours of CPD support to teachers in each year of the contract, including training of new Master Teachers, as well as support to other teachers.
- **KPI 4:** Through the Network, support a minimum of 8,500 teachers in each year of the contract from a minimum of 2500 schools.

All these KPIs have been exceeded by a significant margin in both years of the contract with a good regional spread. This reflects the strength of the overall support model, with university-based CAS Regional Centres providing training and support to CAS Master Teachers and CAS Hubs, thus achieving economies of scale and local reach.

The components of the NoE model

CAS Master Teachers based in lead schools continue to provide effective local support to teachers in their areas. They champion computer science in schools and the wider teaching profession, act as specialist lead computing teachers for their areas, provide training, mentoring and coaching to teachers in their local communities, and foster collaboration between schools and universities and lead in developing CPD provision from universities to schools.

Recruiting CAS Master Teachers/Lead schools requires local knowledge. CAS Regional
Centres have proved effective at recruiting, training and supporting CAS Master Teachers in their regions. They provide mentoring and coaching, and quality assurance of trainee and new CAS Master Teachers.

13 The BCS certificate has provided a focus and benchmark for Master Teacher training. The continuing support of the regional centres has proved essential, without this continuing support, few Master Teachers are confident enough to continue in the role. CAS Regional Centres report that recruiting MTs is becoming more challenging.

14 The NoE approach is in line with DfE guidance on professional development and it builds on the CAS model of CPD. It uses an integrated approach that meets the teachers where they are by providing intensive, face to face, ongoing, peer-led, local support connected to their practice. It focuses on the teaching and learning to maximise impact on pupils and builds strong relationships between the teachers themselves. These continuing relationships are an essential means of support as teachers (who may be the only identified computing teacher in their schools) implement and develop the knowledge rich computing curriculum in their schools.

Impact

15 ‘The Network of Excellence for computing teachers has proved itself effective, despite operating within the constraints of its limited budget.’ (Royal Society) Consistent evidence gathered through survey feedback from computing teachers supported by the NoE demonstrates that it delivers quality professional development that has lasting impact on children’s education. 65% of teachers report that their subject knowledge or understanding had improved, with others identifying improvements in understanding issues such as assessment, and the mean base confidence of teachers before receiving CPD was 4.1 on a 1-10 scale which rose by 3.7 points on this scale to 7.8 by the end.

16 Analysis of the impact of the NoE in secondary schools using DfE data on results in GCSE Computer Science in 2016, 2017 and 2018 demonstrates that supported schools:

a. enter more students for GCSE Computer Science
b. achieve better results with a higher proportion of students reaching the higher grades needed for further study (the modal grade improving from grade C to Grade B.)

17 In particular, there has been a measurable improvement for schools in poorer communities that received support, compared to a measurable deterioration for schools in poorer communities not being supported. This improvement is measured in terms of the number achieving grade B or above in GCSE Computer Science as a percentage of the entire year group.
Case studies gathered through the BCS certificate programme demonstrate the impact of the NoE on teaching computing in primary schools.

**Value for money**

The value for money of the programme is measured in two ways. Firstly by benchmarking the cost per teacher hour of CPD with other schemes, and secondly by quantifying the contributions made by other funders that the DfE’s support for the NoE leverages.

a. **Benchmarking costs**: the NoE delivered 46710 teacher hours of support over the 2016-2017. This equates to £24.61 per teacher per hour. This compares favourably with costs elsewhere in the sector.

b. **Leveraging other investment**: The scale and reach of the regional centres offers the opportunity to scale programmes run by others to build on their initial investment and to improve return on investment and maximise the impact of the DfE contribution. This happens in several ways. The universities add to this funding through staffing contributions as part of their outreach work, CAS Master Teachers and CAS Hub Leaders provide additional unpaid time, and BCS and the IT industry provide additional grants and support. The total additional contribution leveraged is approximately £1.50 for every £1 of DfE funding.

Approximately 90% of the funding provided by DfE went directly to the 10 Regional Centres to recruit the educational teams (experienced primary and secondary computing teachers) needed to support and train the CAS Master Teachers. In addition, the universities have provided additional in kind support equivalent to 15 full time equivalent members of staff.

**Sustainability**

Five options for sustainability were considered:

a. Cease central funding for the NoE
b. Continue with the existing model
c. Continue within the existing funding enveloped, but provide more in depth training to significantly fewer schools
d. Continue within the existing funding envelope, but go for breadth rather than depth to reach more schools
e. Develop a scaled-up training and support proposition that trains a critical mass of computing teachers sufficient to ensure that, from then on, there is sufficient capacity in the system to make it self-sustaining.
Our analysis demonstrated that without significant continued investment from central government progress in schools was likely to stall, or possibly regress as senior managers lost confidence that the challenges created by introducing the new curriculum could be met. This view was also recognised by the Royal Society, which called for a ‘A fully resourced national professional development programme building on the Network of Excellence requires a tenfold increase in funding from government and industry.’

BCS is delighted that, through the announcement of significant funding the new National Centre of Computing Education and its associated programmes, DfE and the government more widely is building on the successes of the NoE and the recommendation of the Royal Society.

Risks, issues and lessons learned

While the programme clearly exceeded the expectations set out in the KPIs, a number of external risks were identified which became issues and we are increasingly aware that the teaching of computing remains fragile in many schools. We believe that these risks and issues will also need to be considered by the new National Centre and its associated programmes.

Teachers value the teacher-to-teacher support offered by classroom based CAS Master Teachers. The regional model with leading universities recruiting, training, and supporting the CAS Master Teachers has proved effective in spite of difficulties with teacher release to take on the role.

While CAS Master Teachers have been successful in meeting the programmes objectives, it is clear that, because of a general lack of expertise in schools, they continue to require extensive support from the CAS Regional Centres to carry out the role.

Teachers value the informal opportunities to share practice in CAS Hubs, particularly as they implement in the classroom what they have learnt through more formal CPD.

The regional model with leading universities recruiting and supporting the CAS Hubs has proved effective, particularly when addressing ‘cold spots’.

The success of the CAS Regional Centres (CRCs) in their upskilling of teachers, support for schools and engagement with schoolchildren is in a large part because the CRCs are hosted in university Computer Science departments. Universities have the expertise in Computer Science that is so needed in schools, have long experience of education in this area, have the geographical spread to deal with schools locally, and have provided considerable added benefit. Computer Science undergraduates and postgraduates are also a vast resource of expertise and skills in computing.
29 **Teacher release**: Increasingly teachers are finding it difficult to be released from schools. Schools that cannot recruit computing teachers do not release existing computing or ICT teachers either to receive or provide CPD. CAS Regional Centres have responded by offering events on Saturdays or during the holidays, and by organising events aimed at teachers and their students. Distance and timing are the key factors discouraging teachers from attending CPD events. Data from attendance in rural areas shows that CPD sessions had to be organised within 20–30 miles of the location of the teacher to attract over half of potential attendees.

30 **Face to face support is important**: In spite of teachers’ difficulties getting released from school and the lack of funding for cover, the programme exceeded its targets for face to face support by a wide margin, underlining the value teachers place on face-to-face interaction.

31 **School Leaders**: The impact of a school leadership’s support for computing and the NoE is twofold: it determines how computing is implemented in the school itself, and the extent to which school leaders free up CAS Master Teachers in their schools to support others. Computing has a relatively low profile (for example) in DfE communications to schools. It is seen by school leaders as a ‘nice to have’. The launch of the new national centre offers a unique opportunity to raise the profile of the subject with school leaders.

32 **Qualifications**: In secondary schools, the introduction of new highly-demanding GCSE and A level courses has created challenges in many schools where the teachers lack the necessary subject knowledge. This leads to a vicious circle – the school doesn’t offer examination courses because the leadership team are not yet confident that the teachers will be able to produce good results; as a result, there is far less need to train their existing staff. Again, the recently announced large scale programme to train GCSE Computer Science teachers offers a unique opportunity to cut through this vicious circle.

33 **Competing demands in schools**: Implementation of more demanding curriculum and qualifications in other subjects reduces the management support and resource available for Computing. SLT support for CPD (eg supply cover) is focussed on higher priority subjects, so computing teachers are unable to call on the management support they need.

34 **Funding concerns in schools**: School leaders concerns over changes to funding (whether they are well-founded or not) lead to them not supporting teacher CPD (particularly in secondary schools) School leaders do not support computing teaching if they perceive that a commitment to timetabling computing will need to be supported by an unaffordable commitment to staff release.
35 **Underestimating the challenge:** School leaders underestimate the training needed to teach computer science effectively, particularly the programming aspects and limit teachers access to CPD.

36 **Moving beyond volunteering:** CAS Master Teachers are volunteers, and cannot be expected to carry on providing support indefinitely. Since 2014 approximately 10% of CAS Master Teachers have left the programme each year. In addition, a further 10% become dormant (i.e. Inactive and hard to reach). Without continuing support, this rate of attrition would lead to less than 100 CAS Master Teachers in 5 years. In addition, schools are increasingly unwilling to free up a precious resource without compensation.

37 **Ensuring continuity:** There is a need to reassure teachers and school leaders that they can plan on the basis of support being available at the time it is needed. Few school leaders would offer GCSE Computing unless they were absolutely confident in their teachers’ access to the ongoing training and support they will need.
Section 1: Background

The challenge and the opportunity: the computing curriculum

The importance of computing for individuals, society and the economy

1 On September 1st 2014 Computing became a new statutory subject in state maintained schools in England. The new computing curriculum is significantly different from the old ICT curriculum. It ‘represented a considerable change from the old ICT curriculum; the computer science elements were new to almost all primary school teachers and many secondary teachers, a large number of whom were not previously ICT specialists.’ (DfE Contract)

2 The computing curriculum goes beyond basic user skills with the aim that young people emerge from their education with the subject knowledge to be potential producers of new digital products and services, not just consumers, and a better understanding of how our digital world works. “A high-quality computing education equips pupils to use computational thinking and creativity to understand and change the world.” (National Curriculum for England).

3 The computing curriculum, with its focus on creating (rather than simply using) digital products and services is a key component of government’s strategy for the digital economy. “The introduction of computing in the national curriculum means that our school children will be taught the knowledge and skills that employers will need.” (UK Digital Strategy)

4 The ambition is to translate the vision embodied in the programme of study into a vibrant reality in every school.

Teachers’ subject knowledge and confidence in the classroom

5 The increased rigour in its focus on subject knowledge, particularly in computer science, significantly ‘raises the bar’ for teachers who need:

• sufficient breadth and depth of subject knowledge
• the pedagogical understanding needed to teach this in a way that is both rigorous and motivational; and
• the confidence to use this knowledge and understanding in the classroom.

6 With over 3,300 Secondary schools and 17,000 Primary schools across England, equipping teachers with knowledge and skills they need is a significant challenge, given that:

• Over 75% of existing teachers do not have an academic background in computer science (compared to 25% of science teachers and 48% of physics teachers). Additionally, ‘there is a national shortage in computer science teachers that
justifies schools recruiting from abroad’. (Home Office Migration Advisory’s Committee (MAC)).

• A survey of its members carried out by TES found that 9% of secondary teachers teaching computing were subject specialists and that the confidence of non-subject specialists scored 38%. This compared with a reported confidence level of 64% for those who described themselves as non-specialists in mathematics and 65% in science.

• This shortage of suitably qualified computing teachers is not being addressed through recruitment to initial teacher training. A report from the House of Commons Education Committee found that recruitment in computing missed the target for the academic year 2016/7 by the biggest margin of all English Baccalaureate (EBacc) subjects.

7 It is against this backdrop that the current approach to providing the CPD and ongoing support computing teachers need to implement change in the classroom was developed.

The response: the Network of Excellence in Computer Science

Establishing the Network of Excellence: a community of practice

8 In support of the introduction of the new computing curriculum the BCS with £150,000 funding from DfE established the Network of Excellence in Computer Science (NoE) in 2012. The NoE is part of the Computing At School group (CAS), it aims to enable teachers in England to become confident, effective and enthusiastic teachers of computing, and to develop and articulate a vision for the subject of computing at the national level.

9 The design of the NoE recognises that teachers learn best from and with other teachers. The NoE aims to achieve these ends by creating a ‘self-improving, school-led system’ built on a ‘community of practice’ - a group of people who share a common concern, a set of problems, or interest in a topic and who, come together to fulfil both individual and group goals.

10 This approach is in line with the DfE standards for teacher CPD. It builds on a broad evidence base and combines formal CPD programmes to develop subject knowledge and pedagogy with sustained structured collaboration with peers, including challenge from external experts, to implement teaching practice in the classroom.

11 Within the CAS community of practice, computing teachers are able to access ongoing CPD and support from ‘CAS Master Teachers’: excellent computing teachers who understand the realities of the classroom, and the crucial face-to-face support needed for the implementation of new teaching through CAS Hubs, which provide
opportunities for computing teachers to learn from each other as they introduce the knowledge-rich computing curriculum in their schools.

12 The grant from DfE funded the release of teachers to train as CAS Master Teachers. This funding proved essential for securing school senior leadership teams’ support for teachers taking on the role. The network created an initial cohort of 28 CAS Master Teachers with 120 schools committing to becoming lead schools. The NoE forged links between schools, universities and employers and harnessed pro bono support from other organisations such as tech companies.

13 Since 2012 the Network of Excellence, through CAS, has grown and adapted to changing circumstances in schools to become an effective community of practice which both provides teachers with access to subject and pedagogical expertise, and supports them as they implement the new curriculum. This model of school to school support has attracted support from key global technology companies, has provided key support for national initiatives and has attracted interest globally.

The approach to teacher CPD within the NoE

14 The approach to professional development adopted within the NoE draws on the work of Aileen Kennedy of Strathclyde University (reference available) and reflects the standards issued by DfE in July 2016, which state that professional development:

- should have a focus on improving and evaluating pupil outcomes.
- should be underpinned by robust evidence and expertise.
- should include collaboration and expert challenge.
- should be sustained over time.
- must be prioritised by school leadership

15 Dr Sue Sentance of King’s College London, and member of the Royal Society working group, identifies the following components of the CPD approach and maps them onto the constituent parts of the NoE as shown in figure 1.

![Figure 1: Mapping between a community of practice and the CAS model](image)
The different contributions made by these constituent parts is set out in the later sections of this report.

2013-2015: developing the NoE model

Building on the success of the previous year, DfE awarded £2.085 million for 2 years (2013 to 2014 and 2014 to 2015) to BCS to extend the NoE. The prime objective was to grow the NoE by recruiting more CAS Master Teachers to increase the confidence of some 16000 teachers. 380 CAS Master Teachers were recruited and trained, with the funding from the DfE covering their release from school as well as the training costs.

Regional coordinators (8 secondary, 1 primary) were appointed to manage the work of the new and existing CAS Master Teachers. These regional coordinators were part of the initial cohort of CAS Master Teachers appointed in the previous year. Partnerships were formed with 89 UK universities (78) in the UK.

The number of teachers participating in the NoE grew from approximately 2000 midway through 2012 to just under 18,000 in March 2015. This was far in advance of the requirement of the grant. Feedback from participating teachers indicated that, on average, the CPD they received from CAS Master Teachers raised teachers’ confidence by 3.3 points on this scale (1-10) from 4.1 at the beginning to 7.4 after training. However, while teachers’ confidence had increased, this could only ever be the first step on the journey towards becoming an effective computing teacher.

The success in this period is reflected in increasing numbers being entered for GCSE Computer Science. The 2014 Informatics Europe Best Practices in Education Award was awarded to Computing At School. Subsequently Prof. Carlo Ghezzi, Chair of Software Engineering, Politecnico di Milano Italy, President of Informatics Europe, wrote to the Secretary of State for Education saying: “The UK is now, in effect, establishing computing as a brand-new school subject, from primary school onwards. Doing so requires a major, sustained programme of teacher training, and our award is partly based on CAS’s leadership in doing so.”

With the NoE having demonstrated the effectiveness of the CAS Master Teacher model, DfE issued an invitation to tender to carry on the work of the NoE for a further 3 years. ‘The Government believes that development of new resources and training should be sector-led and that schools are best placed to decide which resources and training to access. In the case of computing we recognised that in computing the scale of change is considerable and that there is a strong case for the Government providing the sector with extra support to ensure that teachers develop the skills and knowledge necessary to become effective computing teachers.’ (DfE Contract).
Putting in place a scalable infrastructure of support for the NoE (The current contract 2015 - 2018)

22 After a competitive tendering process, BCS won the contract to maintain the Network of Excellence to support:

- the subject of computing becoming firmly established in all primary and secondary schools
- teachers of computing, at both primary and secondary level becoming confident, enthusiastic, possessing the subject knowledge and skills to be effective and become active participants in local communities of practice. (DfE contract)

23 Recognising the challenges that CAS Master Teachers face engaging with schools and that the CAS Master Teachers also need their own CPD and support, the NoE grew to include 10 university-based CAS Regional Centres. These CAS Regional Centres were recruited through a competitive process and are contracted by BCS to provide a point of focus for schools and teachers in their regions while offering a degree of national coverage. They are highly respected within their communities and effective at galvanising engagement. The roles of the CAS Regional Centres and how they support the work of the NoE are set out later in this document.

24 Given the greater focus on key performance indicators within the contract extension, each university’s contract includes:

- £60,000 per year to provide the CAS Regional Centre’s core services (listed in the section on the CAS Regional Centres below, with payment on the basis of satisfactory delivery of those services, and
- £2000 for the training and support of each new CAS Master Teacher, up to a maximum of 10 new CAS Master Teachers in each year, with payment on the basis of each new master teacher recruited, quality assured and trained.

25 Approximately 90% of the funding provided by DfE went directly to the 10 Regional Centres. In addition, the universities have provided additional in kind support equivalent to 15 full time equivalent members of staff. Table 1 lists the universities awarded the contract to act as the CAS Regional Centre in each region.

<table>
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<tr>
<th>CAS Region</th>
<th>University</th>
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<tbody>
<tr>
<td>CAS East of England</td>
<td>University of Hertfordshire</td>
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<tr>
<td>CAS East Midlands</td>
<td>Nottingham Trent University</td>
</tr>
<tr>
<td>CAS London</td>
<td>Kings College London/Queen Mary’s College</td>
</tr>
<tr>
<td>CAS North East</td>
<td>Newcastle University</td>
</tr>
<tr>
<td>CAS North West - Lancaster</td>
<td>Lancaster University</td>
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</tbody>
</table>
The regional centres also ensure a regional spread (see Fig 2) and offer a mechanism for effective management of the DfE funding with the flexibility to match resource to regional need.

<table>
<thead>
<tr>
<th>CAS North West - Manchester</th>
<th>University of Manchester</th>
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<tbody>
<tr>
<td>CAS South East</td>
<td>University of Southampton</td>
</tr>
<tr>
<td>CAS South West</td>
<td>Plymouth University</td>
</tr>
<tr>
<td>CAS West Midlands</td>
<td>Birmingham City University</td>
</tr>
<tr>
<td>CAS Yorkshire and the Humber</td>
<td>University of York</td>
</tr>
</tbody>
</table>

*Table 1: University location of CAS Regional Centres*

26 Phase 1 of the current DfE contract ran from April 2015 to March 2016 with £750 000 funding from DfE. This was the first year of the current Network of Excellence model and operated with reduced funding, meaning that the recruitment and training of new CAS Master Teachers was not possible. In addition, the funding to schools to release CAS Master Teachers was no longer available.

27 Despite this, by the end of the year, all ten university NoE regional centres were fully operational and the new NoE model had doubled the level of CPD taken up by teachers compared with the previous period, delivering over 14 200 teacher hours of face-to-face CPD to over 4100 teachers. Teacher satisfaction remained high with 99% of teachers benefiting from CPD from Master Teachers reporting that the CPD provided was high quality, implementable and would have an impact in the classroom, and 50% of
teachers who received CPD from the NoE identified improvements in their pupils’ learning within 10 weeks of a CPD session.

29 In addition, At least 393 CAS Hub meetings were held in 190 hubs. These were attended by 5505 teachers. The hub leaders’ volunteering time provided £50k worth of additional contribution to the NoE. 15 new CAS Master Teachers were recruited, quality assured, trained and approved and the new model stimulated an additional £550k of support for the teaching of computer science from industry.

30 Phase 2 of the DfE contract extension ran from April 2016 to March 2018. In this phase, sufficient funding was provided by DfE for the CAS Regional Centres to recruit, train, support and quality assure an additional 200 new CAS Master Teachers. The BCS contracts with the universities introduced an element of payment by results with each university able to draw down £2k per CAS Master Teacher recruited, trained and supported up to a maximum of 10 in each year.

31 In addition, new key performance indicators (KPIs) were introduced. These are:

<table>
<thead>
<tr>
<th>KPI 1: Ensure a good geographical spread of support and provide focused support in “cold spot” areas.</th>
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<tr>
<td>KPI 2: Grow the Network of Excellence by recruiting, training and supporting a further 200 Master Teachers so there are a minimum of 450 by the end of the contract.</td>
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<td>KPI 3: Provide a minimum of 30,000 hours of CPD support to teachers in each year of the contract, including training of new Master Teachers, as well as support to other teachers.</td>
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<tr>
<td>KPI 4: Through the Network, support a minimum of 8,500 teachers in each year of the contract from a minimum of 2500 schools.</td>
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32 To ensure a regional spread, the CAS Regional Centres were set performance targets setting out their contributions to these KPIs depending on the number of schools in their region and their geographical spread. The contracted core funding provided to the CAS Regional Centres was conditional on them meeting these targets.

33 Section 2 sets out the progress made against these KPIs.
Section 2: Developing and delivering the NoE 2016-2018

The approach: a community of professional practice.

1 The contract variation letter from DfE (17 May 2016) sets out the underlying approach adopted within the NoE:

‘In the light of the policy direction set out in Educational Excellence Everywhere, the renewed contract for the Network of Excellence will have a much greater focus on school-led improvement with local Master Teachers responding to local need, rather than focus on topdown mechanisms that the university centres should use to provide training and support.’

2 As set out earlier, the NOE is built on a model of teacher-to-teacher support through the recruitment, training and support of CAS Master Teachers and setting up local CAS Hubs, with regional coordination and support provided by CAS Regional Centres in leading universities. Taken together, these components make up the community of professional practice that is the NoE. These various components are explored in more detail in this section.

CAS Master Teachers: the backbone of the NoE

Key Performance Indicator

3 CAS Master Teachers are at the centre of the NoE’s model of continuous improvement through teachers’ active participation in CPD and a community of practice. They are local champions for their subject, and work in collaboration with the university-based CAS Regional Centres (who have the responsibility to recruit, train and support them), and CAS Hubs. Their support forms an essential part of developing a community of professional practice, alongside the other activities initiated by local CAS Hubs and the CAS Regional Centres. As well as the subject and pedagogical knowledge CAS Master Teachers help teachers develop, a key part of the role is building a supportive relationship among colleagues.

4 It is essential to grow the pool of CAS Master Teachers in each region. There is a natural ebb and flow of individuals’ contributions over time and a need to stay fresh and relevant by finding and developing enthusiastic teachers who want to develop their practice. New CAS Master Teachers not only grow the reach of CAS they also grow the pool of expertise, and contribute to increasing the understanding of the subject as they develop their knowledge, skills, understanding and experience.

For this reason, a key deliverable in the contract extension with DfE is to grow the Network of Excellence by recruiting, training and supporting a further 200 Master Teachers so there are a minimum of 450 by the end of the contract.
Over the two years of the contract extension 222 Master Teachers were recruited, trained and supported, with over 500 currently registered, which exceeds the requirements of this KPI.

The role of the CAS Master Teachers.

CAS Master Teachers continue to provide a wide range of support to colleagues in their areas. They are part of the local community of practice and work alongside their CAS Regional Centres and the local hubs to support teachers of computing in their local area, enable their professional development, and support curriculum change. Specifically, they:

- champion computer science in schools
- provide training, mentoring and coaching to teachers in their local communities
- support collaboration between schools and CAS Regional Centres.
- act as specialist lead computing teachers for their areas
- respond to requests for advice and guidance from other teachers and provide one to one and support

In addition, they provide support that aligns with local priorities. For example, CAS Master Teachers in Yorkshire and Humber are supporting:

- Code clubs at both primary and secondary level
- Cyber-security and digital forensics club
- Mentoring through Schools Direct Computer Science
- Staff training in their own schools

CAS Master Teachers are unpaid and the demands of the role require serious commitment from themselves and their schools. The following short case studies illustrate the support provided by CAS Master Teachers.

Chris Coetzee (North East Kent) during his first academic year: concluded a 10 week course teaching Java to 25 teachers who have never programmed before; visited 2 other local secondary schools to help plan Computing at GCSE; hosted a session with heads of department from 4 other secondary schools to help plan introducing Computing; visited the Google Campus to learn about mobile app teaching and how to roll this out on a limited budget; spoke at another school’s teachers conference on Computing for primaries; and hosted 2 conferences for primary and secondary teachers.

Jamie Edmondson (Specialist Teacher of Computing and Computing Subject Leader, Our
Recruitment of new CAS Master Teachers  
CAS Regional Centre staff have recruited CAS Master Teachers through school visits, and attending CAS Hub meetings and events across their regions to source colleagues with the necessary skill set. For example, two of CAS London’s most recent recruits were asked to apply for Master Teacher status following their attendance at CPD events. CRCs do not accept all teachers who apply to be CAS Master Teachers, and are careful to take only teachers who show existing expertise, experience and motivation to contribute. Others are supported to develop for the future.

One clear advantage of the university-based regional model is the universities’ status with teachers and school leaders. The CAS Regional Centres have explored ways of using this status to motivate excellent computing teachers to apply for the role and to secure their release from their schools. For example:

- CAS Yorkshire and Humberside has negotiated with the University of York that Master Teachers will be awarded an association with the University. This means that they will be a CAS Teaching & Learning Expert in association with the University of York. This will provide MTs with some added opportunities to enhance their CVs showing engagement with a Russell Group University.

- CAS West Midlands provides CAS Master Teachers with free places on all CAS courses at the university, and the university also gives support to events for their Computer Science students. This supports the ‘elevated’ status of the Master Teacher with their head teacher which results in a more supportive school.

The following case study shows how one CAS Regional Centre which covers a geographically disparate area is recruiting and supporting its CAS Master Teachers.
across the county and A level training and mentoring to CAS Master Teachers and other teachers in the region. The CAS regional centre supports CAS Master Teachers by providing opportunities for them to deliver workshops, for example at hub meetings and the regional conference, and by supported training hosted by master teachers (notably training a network of SEN teachers in physical computing). The CAS Tenderfoot training materials are used as the basis for a rolling programme of training for CAS Master Teachers and teachers from lead schools.

Criteria for selection

11 Computing teachers wishing to become CAS Master Teachers must fulfil the following criteria:

- They are active members of Computing At School with good subject knowledge.
- They hold QTS and be working (for at least 2 full days a week) in a state-funded Primary, Middle, Secondary school or FE College
- They will have received ‘Good’ or ‘Outstanding’ from their most recent performance appraisal
- Their Head teachers must state a willingness to support the teacher in the role of a CAS Master Teacher

12 In addition, CAS Master Teachers, and their Head Teachers, agree to a number of ground rules. These are to:

- Build, and actively contribute to, a community of practice in association with your CAS Regional Centre, local hub network, University Partners and local schools
- Provide training and support to meet local need and demand for teachers of Computing, and to be professional in all dealings with those requiring support and help
- Share all resources used during CPD events on the CAS Community site (using a Creative Commons license)
- Respect copyright when producing resources to support CPD
- Comply with CAS guidance when working with external organisations
- Keep a record of relevant and related activity each term and complete an annual audit.
- Agree to their names and contact details being published on the public register of active CAS Master Teachers.
- Maintain their own professional development in computing education.

13 Should a CAS Master Teacher no longer meet the basic requirement of a practising teacher, active in his/her local CAS Community, CAS reserves the right to withdraw use of the title.
14 Where a CAS Regional centre received an unsolicited application, a member of the CRC team either visited and observed them teach or interviewed the candidate before deciding to appoint. They are then directed to the CAS induction days and training, if appropriate.

15 Several potential secondary master teachers have started the application process but have then withdrawn. There are two reasons for withdrawal. Firstly, because they underestimated the effort required to be involved in training to become a master teacher. Secondly, because their senior leadership team have decided to not support their application as they are not prepared for these members of staff to have time out of school. Developing the subject knowledge of CAS Master Teachers is a priority and several applicants have been rejected by their CRC because they did not have sufficient subject knowledge.

CAS Regional Centres Supporting CAS Master Teacher’s Development

16 It is expected that CAS Master Teachers will (with the support of their Head Teacher) spend approximately three hours each week fulfilling their role in a way that supports their own personal professional development and benefits their own school. This support may take the form of low-cost training sessions and other mentoring and coaching opportunities. This support helps CAS Master Teachers develop their own teaching while providing support to others as this case study illustrates.

17 The training of CAS Master Teachers is provided through:

- an induction day
- support for the BCS Certificate in Computer Science
- Master Teacher training days through the year
- specialised training for delivering effective CPD
- teaming experienced Master Teachers with new/potential Master Teachers
- providing feedback and support.

New CAS Master Teacher Induction Days

18 All new CAS Master Teachers undertake a programme of CPD and support which begins with an induction day using centrally developed materials to ensure a coherent presentation of the role. The training delivered includes both information about the role and ethos of a CAS Master Teacher, various administrative tasks required for the role, and how to run effective CPD with colleagues in their local community. In addition, the CRC works with them to develop individual CPD development plans. These identify strengths and areas for training and agreed opportunities for both sharing their specific specialisms and expertise with other as well as finding means to bridge any gaps through peer mentoring or CPD provided by the CAS Regional Centre.
The BCS Certificate in Computer Science Teaching

19 Many CAS Regional Centres are using the BCS Certificate as a means of training their new CAS Master Teachers. The Certificate is designed to create confident teachers of the computing curriculum. It gives professional recognition accredited by BCS, The Chartered Institute for IT. It is evidence-based and teachers complete it by putting together evidence of classroom and subject-based activity.

20 Running BCS certificate support courses for new Master Teachers provides a strong next step of professional development after the induction day. The components of the certificate are set out figure 3 below.

![Figure 3: Components of the BCS Certificate](image)

21 CAS Regional Centres provide local training sessions to support the completion of the accreditation. These sessions are run over several months as twilight drop in sessions. CAS Regional Centre staff lead the teachers through the process and give them help deciding on their projects. Most importantly they give the teachers time and motivation to pursue the certificate.

22 Existing CAS Master Teachers have also been invited to undertake the certificate as well. They therefore have benefited from the training sessions and have also had opportunity to network with new Master Teachers.

23 As well as focusing on improving and accrediting expertise, the BCS certificate sessions develop the region’s community of Master Teachers, bringing new and existing Master Teachers together.

24 Table 2 shows the progress that new CAS Master Teachers have made through the certificate.

<table>
<thead>
<tr>
<th>CAS Regional Centre</th>
<th>Underway</th>
<th>Passed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>East of England</td>
<td>9</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>East Midlands</td>
<td>11</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>London</td>
<td>17</td>
<td>17</td>
<td>34</td>
</tr>
</tbody>
</table>
Two CAS Regional Centres have implemented alternative approaches to CAS Master Teacher training. These build on existing programmes and relationships and illustrate the added value that the universities are able to bring to the role. These are described below.

**CAS North West (Lancaster) Honorary Teaching Partners scheme**

CAS North West (Lancaster) is running an Honorary Teaching Partner scheme at the university where primary and secondary teachers meet up to six times a year to receive training and support from the university. The scheme began in 2015 with 10 secondary school teachers from the North West. It aimed to foster a close working relationship between the School of Computing and Communications and school subject leaders in the locality and develop the teachers’ subject knowledge to cover the demands of teaching the new subject.

In 2016 the university extended the Honorary Teaching Partner scheme, inviting 10 primary teachers and 10 secondary teachers to join the university for 6 dates throughout the year 2016/2017 and to attend one conference. This has provided an effective channel for recruiting and training master teachers in a lowly populated area.

**Yorkshire & Humberside CAS Regional Centre Partnership with the National STEM Learning Centre**

Yorkshire and Humberside CRC has entered into a formal partnership with the National STEM Learning Centre (NSLC) to deliver CPD and develop its Master Teacher pool and pilot a programme for sustainable paid CPD for Master Teachers.

As part of this pilot, newly recruited and existing CAS Master Teachers can attend a CPD Course Leaders training programme at the NSLC in York. This training programme is designed to give Master Teachers the necessary skills to lead and deliver high quality CPD to teachers in the region and beyond, as well as how to evaluate the outcomes of their training using the NSLC impact frameworks.

This training is funded in part by the ENTHUSE funding that is available to NSLC courses, a pool of money that is provided by relevant science and engineering industries for development of teachers. Further funding is being provided by the CRC for purposes of
providing cover to Master Teachers to release their time in schools. Once completed, attendees of this course have the opportunity to deliver CPD as consultants for the NSLC either on site, or in courses offered around the region.

**Delivery partnerships for CAS Master Teacher Training**

31 CAS Regional Centres are collaborating on CAS Master Teacher training to achieve economies of scale, for example CAS East of England collaborate with London CRC to provide induction for new CAS Master Teachers. They are also forming partnerships locally and nationally to extend their reach and achieve value for money.

**Additional Training for CAS Master Teachers**

32 Alongside the core training for CAS Master Teachers, CRCs also provide courses that focus on specific issues related to the role. For example, CAS South East runs CPD for CAS Master Teachers throughout the region (Brighton, Dover, Guildford, Swindon) on how to design CPD to have greater impact.

33 CAS London’s Diving Deep primary computing course is available to both new and existing CAS Master Teachers as well as hub leaders, university contacts and other expert teachers in the field. It builds on current research and the university’s ability to draw on academic staff who are actively undertaking computer science education research.

34 Teachers are only accepted if they are already experienced in teaching primary programming. The course lasts three days, is face to face and runs over several months. The course requires teachers to reflect on and implement learning from the CPD between the days and report back on what has or has not worked. Feedback from the course has been very favourable and four cohorts of some seventy teachers have now taken part. Other regional centres have sent their Master Teachers on the course, as well as regional centre leads attending so they can then cascade the course across the country. We have also had teachers from overseas attend the course.

35 CAS Master Teachers attending courses developed by CAS London start to then codeliver the course to subsequent cohorts. This gives them further insight into the material so that they can then confidently deliver and pass it on. All material from the course, including workshop plans (divided into 90 minute parts - for ongoing delivery), presentations and activities is available for Master Teachers, hub leaders and other CRCs to use and develop.

**CAS Regional Centres providing continuing support**

36 CAS Regional Centres continue to support their CAS Master Teachers as they grow into the role. The following case study illustrates how one CAS Regional Centre identified a mentor for a new CAS Master Teacher.
CAS Master Teachers Creating Resources

37 CAS Master Teachers are required to share any teaching or training resources that they generate publicly through the CAS website where they are freely available to download under a creative commons license. To date, the CAS Master Teachers recruited under this contract period have created and shared over 430 resources.

Monitoring performance

38 The CAS central team collects feedback from teachers on the CPD sessions they attend. Should an issue be identified over the performance of a CAS Master Teacher, the appropriate CAS Regional Centre is informed. The CAS Regional Centre then works with the CAS Master Teacher to address the issues. If the issue can not be addressed, the regional centre informs the CAS central team who can then remove the individual from the register. To date it has not been necessary to implement this process and CAS Regional Centres have intervened early before issues arise.

Retention of active Master Teachers

39 CAS Regional Centres support retention through an active CRC team, keeping in touch with all Master Teachers, and a continuing programme of meetings and training events. Support activities for Master Teachers are determined by their needs as assessed through questionnaires and feedback.

CAS Master Teachers’ reflections on the role

40 We have compiled a set of responses from teachers at different stages in their Master Teacher journey and feel this reflects the wide range of experiences and contributions provided.
“Being a CAS Master Teacher has provided me with access and funding for training which I would not have otherwise completed, an example of this includes the BCS Certificate in Computer Science Teaching. I have also been given the opportunity to visit various schools and provide training in terms of teaching practical programming skills, standardising exam paper marking and advising on resource design, curriculum design and Computing pedagogy.”

“The initial training for being a Master Teacher has inspired me to come up with excellent ideas that I have now passed on to many teachers through school-based meetings, and email contact. Feedback from CPD sessions I have run on A level teaching have been very positive with all agreeing that my delivery and instruction would impact positively on their teaching.”

“Over 4 years ago pushed by an email forwarded from my head teacher I decided to enter myself to become a Master Teacher. As an ICT leader for many years I had a good working knowledge of IT and had a flare for creative use of technology but as an Early Years trained teacher often found it hard to interact with other IT leaders or offer training due to having a lack of KS1/KS2 teaching. By becoming part of CAS I was offered 5 days training at University College London which opened my eyes to how much I had to share with other teachers and how my views and insights were valued, from that training I become more confident to share my good practice with others this led to me training other teachers within my school to training in my local borough and then all over London.”

Churn in CAS Master Teachers

One CAS Region lost four Master Teachers in recent months for a range of reasons, including teachers leaving the profession and others having career progression into senior management roles, something that was supported by the leadership experience the teachers gained as part of their participation in the Master Teacher programme. This reflects the “churn” that can be expected within this voluntary workforce, and indicates the need to continue recruiting new members into that community in the future.

Progress against the KPI

The following table (Table 3) lists the numbers of CAS Master Teachers recruited within the period of the contract by each CAS Regional Centre.

<table>
<thead>
<tr>
<th>CAS Regional Centre</th>
<th>2016-2017</th>
<th>2017-2018</th>
<th>Total Recruited</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS East</td>
<td>11</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>CAS East Midlands</td>
<td>10</td>
<td>8</td>
<td>18</td>
</tr>
</tbody>
</table>
The following table (Table 4) lists the total number of CAS Master Teachers currently registered by region. It identifies numbers based in primary and secondary schools. Some CAS Master Teachers work from schools that are cross phase.

<table>
<thead>
<tr>
<th>CAS Regional Centre</th>
<th>Primary</th>
<th>Secondary</th>
<th>Total Registered</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS East</td>
<td>16</td>
<td>35</td>
<td>53</td>
</tr>
<tr>
<td>CAS East Midlands</td>
<td>24</td>
<td>16</td>
<td>41</td>
</tr>
<tr>
<td>CAS London</td>
<td>34</td>
<td>33</td>
<td>68</td>
</tr>
<tr>
<td>CAS North East</td>
<td>6</td>
<td>17</td>
<td>25</td>
</tr>
<tr>
<td>CAS North West (Lancaster)</td>
<td>12</td>
<td>20</td>
<td>33</td>
</tr>
<tr>
<td>CAS North West (Manchester)</td>
<td>12</td>
<td>20</td>
<td>33</td>
</tr>
<tr>
<td>CAS South East</td>
<td>16</td>
<td>49</td>
<td>71</td>
</tr>
<tr>
<td>CAS South West</td>
<td>32</td>
<td>26</td>
<td>59</td>
</tr>
<tr>
<td>CAS West Midlands</td>
<td>20</td>
<td>20</td>
<td>41</td>
</tr>
<tr>
<td>CAS Yorkshire &amp; Humberside</td>
<td>15</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>205</td>
<td>279</td>
<td>500</td>
</tr>
</tbody>
</table>

Table 4: CAS Master Teachers Registered by Region

The total CAS Master Teachers recruited now stands at 222 which exceeds the target of 200 for the two years of the programme, and there are over 500 registered, which exceeds the target for the total number registered.

Regional Spread

A key requirement of the contract is to ensure a good geographical spread of support. As can be seen in the Map (Figure 4), there is a good spread, which largely reflects local geography. This is discussed later in this report. At this point it is sufficient to note that the strategy of using university-based CAS Regional Centres to recruit CAS Master
Teachers has proved successful. It has both met the numerical target as set out in the key performance indicator, and the requirement to achieve a distributed network of support across the country.

Fig 4: Locations of CAS Master Teachers by CRC

Feedback on CAS MTs

45 Teachers attending CPD delivered by CAS Master Teachers are asked to evaluate the quality of the CPD they received. Many respondents also provide written feedback. Examples include:

“Thank you. V interactive and well-structured session on Python.”
“Lots to take away practically.”
“Excellent. Lots of ideas and references for follow-up.”
“Lots of opportunity to practice in a “safe” environment. Guided learning. Good starter activity.”
“Great session - great to have a go and learn at the same time.”
“Good sense of humour - extremely good resources.”
“Excellent range of differentiated practical activities and resources.”
“Well-organised and informative. Never done or heard of it before.” “Really useful with time to explore.”

Lessons Learned

Teachers value the teacher-to-teacher support offered by classroom based CAS Master Teachers.

The regional model with leading universities recruiting, training, and supporting the CAS Master Teachers has proved effective in spite of difficulties with teacher release to take on the role.

While CAS Master Teachers have been successful in meeting the programmes objectives, it is clear that, because of a general lack of expertise in schools, they continue to require extensive support from the CAS Regional Centres.
CAS Hubs: providing local support

About the CAS Hubs.

46 The CAS Hubs provide teachers with a local forum (Hub) to share ideas and mutual interests. CAS Hub meetings are for teachers, run by teachers. CAS Hubs run a minimum of 3 meetings per year to share good practice and they aim to provide those attending with (at least) one idea that can be taken away and tried in the classroom. They are organised and led by volunteer hub leaders and provide the main mechanism for reaching parts of the country that are geographically distant from the CAS Regional Centre. In many cases they are run by a local CAS Master Teacher and hosted in the CAS Master Teacher’s school, however, a number of CAS hubs are operated by volunteers from academia or industry.

47 The CAS Hubs seek to provide the opportunity for teachers to meet in a relaxed and informal atmosphere with refreshments

- to share ideas and resources
- to receive informal training
- to gain mutual support from discussing teaching methods with colleagues.

48 CAS Hubs continue to play an important role in the Network. The less formal setting for CPD and information sharing between teachers is well regarded by those attending and the Hub leaders. In particular, they have proved valuable in supporting teachers as they implement what they have learnt in more formal CPD sessions. Many past CPD programmes fail to achieve impact in the classroom because this essential support for implementation is missing.

49 The following case study illustrates the work of the CAS Hubs.

The South Lincoln Primary Hub is situated in the East Midlands CAS region and was set up in 2017 in Fosse Way Academy. The Hub Leader is a CAS Master Teacher who has recently completed the BCS Certificate in Computer Science Teaching. The Hub aims to run one meeting per term and to provide support to around 50 local teachers. CAS Hub meetings are planned in collaboration with other. This included inviting someone from the local university to present on programming. Teachers attending Hub meetings complete a feedback form and the results of this are used to inform the planning of future meetings. If appropriate the CAS Hub shares their meeting resources with the wider CAS Community (via the forum) as they feel that this will provide support for other teachers beyond their own Hub.
Geographical Spread: CAS Regional Centres Growing the hub network

CAS Regional Centres have re-energised the hubs in their regions, and recruited hub leaders and launched new CAS Hubs to fill gaps. Master Teachers are actively encouraged to engage with and support their local Hub(s), or to help establish one if there is not one in their area. Materials have been produced to ensure that new CAS Hubs can get up-and-running smoothly and quickly. CAS Master Teachers (and others) are supported and encouraged to set up ‘CAS Hubs’ to facilitate peer to peer support in their localities. CAS Regional Centres continue to play an active role in both supporting existing CAS Hubs and establishing new ones.

As part of the CAS Regional Centre programme of support, hub leaders are invited to attend termly Master Teacher meetings – providing updates, CPD and opportunity to collaborate and share successful practice. Funding is available for hub leaders’ supply cover and travel for these meetings. Other support for hubs includes regular communication and 1-1 meetings, particularly targeted at hubs with low levels of activity; access to or support to purchase equipment to enhance activity; regular updates and communiques about opportunities and news; and input to hub meetings by the CRC team. The following case studies illustrates how one CAS Regional centre has supported a hub in its region.

There are now 263 local CAS Hub, providing extensive geographical coverage with a focus on cold spots and the opportunity areas (see below). The map (figure 5) shows the locations of the CAS Hubs.

Figure 5: Location of CAS Hubs
Lessons Learned

Teachers value the informal opportunities to share practice in CAS Hubs, particularly as they implement in the classroom what they have learnt through more formal CPD.

The regional model with leading universities recruiting and supporting the CAS Hubs has proved effective, particularly when addressing ‘cold spots’.

CAS Regional Centres: a focus for support in the regions

The Role of the CAS Regional Centres

Alongside their role recruiting, training, supporting and quality assuring CAS Master Teachers in their regions, the CAS Regional Centres increase capacity and reach and also add value to the Network of Excellence by:

- acting as a catalyst for generating teacher engagement with computer science across their region
- providing leadership and coordination of NoE activity at a regional level
- providing further CPD and support to their CAS Master Teachers
- facilitating face-to-face mentoring and coaching opportunities for MTs
- supporting teacher CPD through large scale events
- encouraging university-school links (e.g. undergraduates working in local schools
- developing and sharing best practice locally and sharing across the network of Regional Centres

- adding value to the network through links with existing activities and relationships
- providing the capability to deliver large scale one-off events or to roll out a national scale (England-wide) programme
- developing and sharing best practice locally and sharing across the network of CRC.

Why universities?

The move to a more rigorous knowledge based curriculum with higher expectations creates challenges for many schools. Expertise in computer science is largely located in universities, for this reason the CAS Regional Centres are located in some of our leading universities, all of which share a commitment to developing the academic discipline of computer science in schools. The universities were selected through a competitive process to ensure coverage across the country. In all cases, taking on the role built on existing activity such as outreach or training programmes.

Through the link with Computer Science departments, the CAS Regional Centres bring additional academic strength and rigour to bear in support of the NoE. This link with academic computer science is crucial in what is still a relatively new discipline in
schools. World leading academics have provided input to CPD events located at the CAS Regional Centres, particularly as part of the regional conferences they organise. Examples of the university academics providing this expertise include:

• Dr Shirley Atkinson, Lecturer in Information Systems, School of Computing and Mathematics (Faculty of Science & Environment), Plymouth University
• Dr Lynne Blair, Senior Lecturer, School of Computing and Communications, Lancaster University
• Dr. Helen Boulton, Associate Professor at Nottingham Trent University
• Dr Nick Cook, School of Computing, Newcastle University
• Professor Paul Curzon, Professor of Computer Science, Queen Mary University of London
• Professor Janice Griffiths is Director of Enterprise and of the Mathematics and Science Learning Centre at the University of Southampton.
• Duncan Maidens: Senior Technologist/Lecturer in the School of Computing and Digital Technology, Birmingham City University
• Dr Chris Powers: Associate Professor (Senior Lecturer) in Human Computer Interaction, Department of Computer Science, University of York, UK.
• Dr David Rydeheard, Senior Lecturer in the Formal Methods Group of the School of Computer Science, University of Southampton
• Dr Sue Sentance, Senior Lecturer in Computer Science Education, Kings’ College London
• Sue Sissling, Director, Centre for STEM Education, University of Hertfordshire

For example, to successfully fulfil its role as a CAS Regional Centre, the University of Hertfordshire draws on:

• pedagogical knowledge and expertise within the School of Education
• the Centre for STEM Education track record of providing high impact CPD to educators from the primary and secondary sectors
• subject knowledge, innovation and research in computer science within the School of Computer science
• partnerships with schools, employers and STEM stakeholders
• university services such as marketing and the web development
• venues for CPD, meetings and conferences, which are at no additional cost to the programme.

The Network benefits from using university branding to increase the attractiveness of NoE events and activities to teachers in each region. By providing a centre of activity around which other local/regional initiatives can cluster and with which they can be aligned, the shift to university led regional centres allows the NoE to benefit from the
existing networks and relationships that have been developed by the universities over time and to leverage other relevant activities being run by them. Some of the universities have been able to make CAS Master Teachers affiliates of the university or offer similar ‘guest staff’ status to them, so increasing the value and kudos of the Master Teacher role.

Benefits of the CAS University Regional Centres

58 Setting up the CAS Regional Centres enabled a strategic change to the CPD operating model being run by the NoE. The Network can now fully support the end-to-end teacher CPD journey, from awareness through adoption to implementation and finally long term impact in the classroom. This is possible because universities are able to deliver support at scale that raises teacher awareness and develop initial engagement, coupled with the bespoke support from Master Teachers when there are specific school issues that need to be addressed. This means the NoE can maximise the impact and effectiveness of the Master Teacher base, which is important because given that Master Teachers are a high value, high impact but very scarce and time-poor (volunteer) resource.

59 As well as providing an immediate and very significant increase in capacity, the establishment of the university based Regional Centres is conferring other benefits, including the ability to run conference style events and workshops to teachers. This capability adds considerable value to the Network.

60 The establishment of the regional centres and the role they are now playing is an important strategic development for the NoE, and CAS, which both enables and supports a crucial change in the role of the Master Teachers. Instead of Master Teachers concentrating their effort organising the more formal CPD events and potentially duplicating effort, they are being actively encouraged to use their expertise and classroom experience to provide direct and practical support to other local teachers. Some will continue to provide formal CPD, especially where supported by the CRC but their role is evolving away from one of being an organiser and deliverer of formal CPD sessions towards that of being a mentor and coach.

Multiplying impact of the Network through industry partners

61 The Noe is able to support initiatives on a national scale coordinated through the CAS Regionals Centres. This has already been used to great effect with the delivery of 11 Micro:Bit workshops for teachers around England, organised in association with Microsoft and the BBC. This series of events was attended by over 560 teachers around England. The programme has spawned a cascade of further Micro:Bit themed Hub meetings and Master Teacher led sessions.
The BBC have found that by working with the CAS Regional Centres they have been able to gain valuable insights into how best to help teachers incorporate the Micro:Bit into the school curriculum. Both the initial workshop sessions and the cascade sessions are also valuable in terms of stimulating teacher interest in the NoE in general and driving demand for further CPD activities and workshops, with Java programming and MicroPython programming being the subject of frequent teacher requests.

**CAS Regional Centres raising profile**

A key role of the CAS Regional Centres is to raise the profile of computing more widely to stimulate interest in schools. In addition to their programme of school visits, CAS Regional Centres have engaged in a variety of awareness raising events, as the following case study illustrates.

**CAS North West (Manchester) organises school visits throughout the period by the CRC team, and also by 80 students from the University of Manchester, to support schools and teachers. In addition, the university has been involved in a wide range of public activities to engage with schoolchildren and teachers, including:**

- activities for the public in the largest shopping centre in the NorthWest,
- the bluedot music festival at Jodrell Bank – providing opportunities for the festivalgoers to program the Raspberry Pi and interacting with robots,
- Chill Factor – the largest indoor snow centre in the North of England - have invited us to take part in their education programme,
- Oxfam invited our Master Teachers and the CRC to support their development of Computer Science resources in the curriculum,
- computing activities for girl guides and brownies at the National Football Museum, and also at the Manchester Museum of Science and Industry,
- long-term collaboration with Manchester Museum of Science and Industry to provide activities for STEM teachers and schoolchildren.
- visit of some of the CRC team to an event at St. James’s Palace hosted by HRH The Duke of York in recognition of their contribution to the development of the Raspberry Pi in schools.

**Support for GCSE and A level**

Unsurprisingly, the introduction of new GCSE and A level courses has created challenges in many schools where the teachers lack the necessary subject knowledge. The end of GCSE ICT, a perceived confusion over vocational courses and the increasing demand of GCSE Computer Studies has had an impact on the Key Stage 4 curriculum in many schools. CAS Regional Centres have responded in several ways depending on local circumstances. For example:

CAS East Midlands led a series of 3 one day events for secondary teachers focussing on teaching GCSE computing and are planning a series of 4 one day events focussing on the teaching of A level computing.
66 CAS South East’s Awarding Organisation event in December saw all four exam boards offering guidance on the new spec in the morning with 5 Master teachers delivering training in a range of subjects (including cyber security) in the afternoon to over 50 delegates.

67 The end of AS level led many schools to be cautious about A level. In the past the opportunity for a ‘break point’ reduced the risks associated with this demanding A level for teachers and students. Initial feedback from schools suggests that this may have a negative impact on whether A level computing is offered in schools.

68 CPD events supporting A level courses are continually oversubscribed, indicating a need to support A level teachers and schools who are failing to provide A level courses to meet student need. CAS Regional Centres London are particularly well suited to provide A’ level training. For example, the Kings College London team have a strong research based ITT experience and the QMUL team long standing high quality Computer Science experience. Both groups have been delivering A’ level Computer Science training for many years through KCL PGCE and Master Programs and QMUL/KCL Teaching London Computing CPD. The course they have developed is now being used by CAS North West (Manchester), which has arranged a series of “Master Classes” in which university academics present A-level subjects to teachers and school students.

Improving take up

69 Increasingly teachers are finding it difficult to be released from schools. CAS Regional Centres have responded in two ways. Firstly, by offering events on Saturdays or during the holidays. For example, CAS London coordinated two Saturday events focused on primary and secondary teachers. Both events sold out. CAS North West (Manchester) offers CRC mini-conferences at Edge Hill University run on Saturdays throughout the year. Secondly, by organising events that are open to both teachers and students, such as the A Level Master Classes offered by CAS North West (Manchester).

Using others’ expertise

70 All CAS Regional Centres are building local partnerships that increase the CPD support available to teachers. For example, the University of Plymouth (CAS South West) has used, grass roots events such as the TecAdemy run by Software Cornwall, where industry practitioners alongside Master Teachers have supported the local teacher community.

71 All universities have something to contribute to supporting schools and teachers, and they can provide a more local service than the regional CAS team. For example, CAS Manchester has developed a schools’ support network which includes the University of
Manchester, the University of Liverpool, Liverpool Hope University, Chester University, Manchester Metropolitan University and Edge Hill University. This has been a very positive development and much appreciated by schools and teachers.

Collaboration with Teacher Training organisations.

Recruitment into teaching in many STEM subjects is problematic, and this is particularly so for Computer Science. Few, if any, Computer Science graduates choose teaching as a career. The regional centres are attempting to tackle this long-term problem, firstly by setting up a national working group, and secondly by collaborating with teacher training institutions and national organisations, including Teach First, to encourage computer science graduates to consider teaching as a career.

Equipment libraries

Some CAS Regional Centres have created equipment libraries in a number of hubs across the region. Equipment covers all ages and includes exciting items such as a range of robots, 3D printers, Primary kits, microcomputers and programmable vehicles. This has allowed more teachers to access equipment. They can then try out the equipment without the initial financial outlay. Teachers who borrow the equipment then create resources and share these with other teachers. This has proved extremely popular with teachers and the library is in great demand.

Lessons learned

CAS Regional Centres have provided an effective infrastructure supporting the components of the NoE (CAS Master Teachers and hubs).

The university status, access to academic expertise and outreach has helped establish computing as a credible academic discipline in schools.

Universities’ ability to achieve synergy with their other programmes and partnerships has leveraged significant additional support.

The regional model with leading universities recruiting and supporting the CAS Hubs has proved effective, particularly when addressing ‘cold spots’.

The success of the CRCs in their upskilling of teachers, support for schools and engagement with schoolchildren is in a large part because the CRCs are hosted in universities.

The CAS Central Team

The NoE is managed by a small central team. This team;

- Manages the project ensuring CAS Regional Centres deliver against their contracts
- Report progress to the DfE quarterly, identifying risks and putting in place any mitigations
• Develops and publishes central guidance for consistency eg on role of CAS Master Teachers
• Creates and manages back office systems to achieve efficiency, such as the central CPD booking system
• Maintains the CAS website as the first point of entry for teachers seeking support from the NoE runs an annual conference for CAS Members
• Leads on Industry liaison and strategic partnerships nationally.

75 The search function on the CAS website allows teachers quickly to identify the support that is available locally.
SECTION 3: Reach into schools: performance against the KPIs

The amount of support provided

1. The contract extension covering April 2016 to March 2018 required the NoE to:

   Provide a minimum of 30,000 hours of CPD support to teachers in each year of the contract, including training of new Master Teachers, as well as support to other teachers.

2. In Year 1 (April 2016 to March 2017) the Network of Excellence provided 46,710 teacher-hours of CPD and support. This exceeded the requirement for the year. The NoE had delivered 22,980 teacher hours of teacher CPD. In the first two quarters of the second year of the contract. The following table (Table 3) shows the number of teacher hours of CPD delivered in total in each region in quarter 3 (from October to December 2017). Totals for the period January-March 2018 are being reviewed currently.

<table>
<thead>
<tr>
<th>CAS Regional Centre</th>
<th>Total teacher hours of CPD provided 2017-2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS East</td>
<td>2420</td>
</tr>
<tr>
<td>CAS East Midlands</td>
<td>613</td>
</tr>
<tr>
<td>CAS London</td>
<td>1384</td>
</tr>
<tr>
<td>CAS North East</td>
<td>759</td>
</tr>
<tr>
<td>CAS North West (Lancaster)</td>
<td>649</td>
</tr>
<tr>
<td>CAS North West (Manchester)</td>
<td>2712</td>
</tr>
<tr>
<td>CAS South East</td>
<td>121</td>
</tr>
<tr>
<td>CAS South West</td>
<td>870</td>
</tr>
<tr>
<td>CAS West Midlands</td>
<td>833</td>
</tr>
<tr>
<td>CAS Yorkshire &amp; Humberside</td>
<td>286</td>
</tr>
<tr>
<td>Total</td>
<td>10,637</td>
</tr>
</tbody>
</table>

Table 5: Teacher Hours of CPD by Region

3. In the first three quarters of Year 2 (April 2017 to March 2018) the Network of Excellence provided 33,617 teacher hours of CPD and support. This has again exceeded the requirement of the year.

4. As can be seen, the level of activity broadly matches the demographics in the regions. There is a higher level of activity in regions with higher populations and higher population density such as the Manchester conurbations or West Midlands. There is less activity in sparsely populated areas with large travelling distances.
Examples of the support provided

Table 6 lists the CPD activity taking place in one day in May 2017.

<table>
<thead>
<tr>
<th>title</th>
<th>venue_name</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS Birmingham South Primary Hub Meeting</td>
<td>Yardley Wood Community Primary</td>
</tr>
<tr>
<td>West Horsham Computing Primary Network Meeting</td>
<td>Tanbridge House School</td>
</tr>
<tr>
<td>CAS Plymouth Primary Hub Meeting</td>
<td>Glen Park Primary School</td>
</tr>
<tr>
<td>CAS Leicester North (Primary) Hub Meeting</td>
<td>Rushey Mead Primary school</td>
</tr>
<tr>
<td>CAS Leicester Hub Meeting</td>
<td>Rushey Mead Academy</td>
</tr>
<tr>
<td>SKE for IN SERVICE Secondary teachers</td>
<td>CAS London</td>
</tr>
<tr>
<td>CAS Merseyside Hub Meeting</td>
<td>Hugh Baird College</td>
</tr>
<tr>
<td>CAS Hackney Hub Meeting</td>
<td>The Tomlinson Centre</td>
</tr>
<tr>
<td>CAS East Shropshire (Telford) Hub Meeting</td>
<td>Holy Trinity Academy</td>
</tr>
<tr>
<td>CAS Croydon Hub meeting: HTML</td>
<td>Oasis Academy Shirley</td>
</tr>
<tr>
<td>CLOUT (Computational Logic for Use in Teaching)</td>
<td>Imperial College Shirley</td>
</tr>
<tr>
<td>Scratch programming in primary school - Reading</td>
<td>Stem Learning</td>
</tr>
</tbody>
</table>

Table 6: CPD activity 18/5/2017

The number of teachers and schools supported

In addition to specifying the number of teacher, the DfE contract requires the NoE to:

support a minimum of 8,500 teachers in each year of the contract from a minimum of 2500 schools.

In Year 1 (April 2016 to March 2017) the Network of Excellence supported 14445 teachers in 5475 schools across the country. This exceeded the requirement for the year. In the first half of year 2 the NoE supported 5598 teachers in an estimated 2072 schools. The following table (Table 4) shows the number of teachers and schools supported in each region in the third quarter (October-December 2017).

<table>
<thead>
<tr>
<th>CAS Regional Centre</th>
<th>Teachers reached</th>
<th>Schools reached</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS East</td>
<td>847</td>
<td>282</td>
</tr>
<tr>
<td>CAS East Midlands</td>
<td>649</td>
<td>216</td>
</tr>
<tr>
<td>CAS London</td>
<td>356</td>
<td>239</td>
</tr>
<tr>
<td>CAS North East</td>
<td>464</td>
<td>210</td>
</tr>
<tr>
<td>CAS North West (Lancaster) (See note above)</td>
<td>142</td>
<td>115</td>
</tr>
<tr>
<td>CAS North West (Manchester)</td>
<td>921</td>
<td>522</td>
</tr>
<tr>
<td>CAS South East</td>
<td>134</td>
<td>46</td>
</tr>
<tr>
<td>CAS South West</td>
<td>277</td>
<td>20</td>
</tr>
</tbody>
</table>
8 A total of 4384 teachers in 1891 schools have been supported by the NoE in the third quarter this year. As a result, a total of 9982 teachers have been supported this year, so the target for the year of 8500 teachers being supported has been met.

9 The number of schools reached includes estimates. Where we have numbers of teachers attending CPD events without the corresponding school data we assume that each school sent 4 teachers. This ratio clearly underestimates the actual number of schools participating as few schools would send 4 teachers to a training event. Therefore, we estimate that 3963 schools have been reached this year. Again, the target for schools reached has been met. Maintaining a geographical spread of support

10 The DfE contract requires the NoE to:

| Ensure a good geographical spread of support and provide focused support in “cold spot” areas. |

11 The 10 university-based CAS Regional Centres have provided a good degree of regional coverage, tailoring their recruitment of CAS Master Teachers and CAS Hubs to address ‘cold spots’. (See earlier maps). Wherever possible, the URNs for schools that have been supported by the NoE are collected. While the teacher-to-teacher model does not always allow this as many teachers do not know their schools URN, over 3000 URNs have been collected and the locations of these schools is shown in the map below. (Figure 6) As can be seen, while there is clearly clustering around the major centres of population, a good geographical spread of support has been achieved.
### The impact of travelling distances

12 CAS South West (serving a rural region) surveyed its teachers to identify the impact of travelling distances on teachers’ participation in CPD. The results are summarised below.

#### What might stop you from attending sessions?

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>School will not authorise leave</td>
<td>37.3% (Blue)</td>
</tr>
<tr>
<td>I cannot afford the travel</td>
<td>3.4% (Red)</td>
</tr>
<tr>
<td>The sessions are too far away from me</td>
<td>47.5% (Orange)</td>
</tr>
<tr>
<td>Other</td>
<td>11.9% (Green)</td>
</tr>
</tbody>
</table>

#### What time would you like your sessions?

<table>
<thead>
<tr>
<th>Time Range</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.30-17.30</td>
<td>18.6% (Blue)</td>
</tr>
<tr>
<td>16.00-18.00</td>
<td>30.5% (Green)</td>
</tr>
<tr>
<td>18.00-20.00</td>
<td>5.1% (Purple)</td>
</tr>
<tr>
<td>I don’t mind</td>
<td>30.5% (Red)</td>
</tr>
<tr>
<td>Other</td>
<td>15.3% (Purple)</td>
</tr>
</tbody>
</table>

*Fig 6: Map showing location of schools supported by the NoE*
How far are you prepared to travel?

- Within 5 miles 8.5% (Blue)
- Within 10 miles 18.6% (Red)
- Within 20 miles 35.6% (Orange)
- Within 30 miles 28.8% (Green)
- Other 8.5% (Purple)

*Fig 7: Teacher feedback on timing and location:*

13 On the basis of this data, CPD sessions in rural areas need to be organised within 20-30 miles of the teacher.

**Opportunity Areas**

14 The 12 ‘Opportunity Areas’ have been prioritised by the CAS Regional Centres as areas potentially requiring further support. CAS regional Centres have targeted these areas for awareness raising (for example, Lancaster University ran specific events in Blackpool) and recruiting CAS Master Teachers and CAS Hubs.

15 To monitor the support available, we have selected a particularly deprived postcode in each of the opportunity areas and identified the level of support available within reach of that postcode. Table 8 shows the distance in miles to the nearest CAS Lead School, Hub, or Master Teacher to that postcode.

<table>
<thead>
<tr>
<th>Opportunity Area</th>
<th>Post code used</th>
<th>Distance (miles) to the nearest:</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lead School</td>
<td>Hub</td>
</tr>
<tr>
<td>Blackpool</td>
<td>FY3 0AA</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Scarborough</td>
<td>YO11 1UU</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Derby</td>
<td>DE24 9DE</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Oldham</td>
<td>OL1 2RG</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Norwich</td>
<td>NR3 2BA</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>West Somerset</td>
<td>TA24 5SH</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>Bradford</td>
<td>BD3 ODW</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Doncaster</td>
<td>DN12 4AB</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Fenland &amp; East Cambridgeshire</td>
<td>PE13 4RJ</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Hastings</td>
<td>TN34 3PY</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Ipswich</td>
<td>IP2 9EG</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
As can be seen there is access to support within 5 miles in the more urban opportunity areas. We have RAG rated these ‘green’. The exception is Hastings where the nearest support is in Eastbourne.

As would be expected, the two rural areas with low population densities are less well served. However, the West Somerset and Fenland post code now has a CAS Master Teacher within 1 mile and East Cambridgeshire has support within 15 miles, which is within the 20 mile limit.

We have targeted a specific intervention based on the BBC micro:bit to stimulate interest in computing in the opportunity areas. However, we are concerned that our activity does not compete with other priorities in those areas.

The following case study illustrates one CAS Regional Centre’s work in the opportunity areas in its region.

During the late 2016-7 school year and 2017-8, determined efforts were made to promote CAS and engage schools and teachers in the Fenland / East Cambridge opportunity area. This included writing to head teachers to describe the benefits of engaging with the CAS network and offering school support, demonstration lessons and tailored school based or local CPD. Uptake of the original approach and follow up emails did not lead to school engagement. A regional conference in spring term 2018 was held at Cambridge to enable attendance by schools in the opportunity area and we hope to deliver CPD within the area next term.

Progress in increasing activity and engagement in Norfolk is good. University of East Anglia has hosted events; the Norwich hub is more active (events have been supported by CRC staff); and the regional conference in spring term 2018 was well attended. Targeted interventions also include support for local hubs and Master Teachers and provision of CPD. UEA will provide a session linked to the Norwich Gaming Festival. Competition prizes and event support are planned for the annual “Scratch Off” programming day for both primary and secondary pupils.

The Iron Man project was implemented in Ipswich in autumn term 2017 and spring term 2018. The project was successfully delivered by hub Leader Bob Higham, with resources purchased for the schools by the East of England CRC. Support was also provided during events by the CRC and CAS central.

The NoE has provided a good level of geographical support, including in opportunity areas.
Section 4: Impact in the classroom

Methodology

1. Our evaluation of the NoE explores the ‘theory of change’ that underpins the rationale for the NoE. Broadly speaking, the effectiveness of the NoE is determined by the extent to which it takes teachers on a ‘journey’ through the following stages:

| Stage 1: Support from NoE increases the teacher’s **subject knowledge** and **confidence**. |
| Stage 2: The teacher **implements** this in their teaching. |
| Stage 3: Improved teaching in turn leads to higher levels of **achievement** for young people. |

2. The speed at which teachers move through these stages will clearly be influenced by external factors. For example, the decision whether a secondary school offers examination courses in Computer Science will be influenced by the extent to which the school’s senior leadership team are comfortable about the possible impact of a new GCSE on the school’s progress 8 performance.

3. The NoE allows for a ‘natural experiment’, where the performance of one group (those schools that have received support from the NoE) may be compared with another group (those that have not). The data we collect on schools’ participation enables a distinction to be drawn between these two groups.

4. The evaluation focusses on impact in secondary schools as GCSE Computer Science performance data provides an objective assessment of impact where it matters, on young people’s achievements in computer science.

Data sources and research questions

5. Evidence for stage 1, whether support from NoE increases the teacher’s subject knowledge and confidence draws on feedback from teachers supported through NoE activities both immediately after and ten weeks after receiving support. While this is clearly self-reported, self-confidence is of itself a subjective issue. This suggests that the first research question for the evaluation of impact is: **Do teachers who have been supported by the CPD report increased confidence in their subject knowledge and ability to teach the subject?**

6. The extent to which secondary schools supported by the NoE are implementing GCSE is evidence for stage 2. Increases in teacher confidence and subject knowledge should lead to greater average numbers entered for GCSE Computer Science.). This suggests that the second research question for the evaluation of impact is: **Are secondary schools...**
schools that received support from the NoE more likely than other schools to offer Computing at GCSE level?

7 The relative performance of schools supported by the NoE in GCSE Computer Science compared with national averages is a good indicator of impact at Stage 3. This suggests that the third research question for the evaluation of impact is: Do secondary schools that have received support from the NoE achieve higher grades in GCSE Computer science?

8 Data on the state of computing education in secondary schools with regards to schools offering Computer Science GCSE is drawn from the DfE https://www.compare-schoolperformance.service.gov.uk/

Impact of the NoE on teachers’ subject knowledge and confidence

9 There is consistent evidence gathered through teachers’ feedback that the NoE is having an impact on teachers’ subject knowledge and confidence. 64.56% of teachers reported that their subject knowledge or understanding had improved, with others identifying improvements in understanding issues such as assessment.

10 The mean base confidence of teachers before receiving CPD was 4.13 on a 1-10 scale which rose by 3.67 points on this scale to 7.8 by the end. (See Figure 8).

![Figure 8: Impact of the NoE on participating teachers’ confidence](image-url)

11 There is also consistent evidence that these gains in subject knowledge and confidence would have a positive impact on teaching:
• 98.8% of teachers felt that they could implement what they had learned on the course
• 99% felt the course would have an impact on their practice
• 46.6% of teachers had used some of the ideas in the course in their teaching within 10 weeks, and
• a further 21.9% reported that the course had helped teachers in their planning. In addition,
• 82.4% of teachers said that they had shared their knowledge with their school colleagues.

12 Teachers receiving support from Master Teachers report positive impact on their confidence and skills

• “The workshop was extremely useful as a CPD session. He was extremely helpful and very generous with his excellent resources.”
• “Giving me the skills and confidence to mark my students’ coursework effectively.”
• “I feel more confident in my own coding”
• “Very relevant to teaching Computing - I used what we learned, with my class, the very next day!”
• “I had NO idea how to program before yesterday’s excellent lesson and now I can’t wait to show my class what I have learned!!”
• “I learned lots in a safe environment where you were free to ask questions and take things at your own pace.”
• “The workshops have given me confidence to give the technology a try.”
• “I am likely to use the ideas and knowledge to deliver similar sessions to my students but with a lot more confidence than I had prior to today.”
• “I now have the confidence to take it further from there.”

13 Teachers and head teachers report positive impact of the support on the quality of teaching:

• “great to show to SLT to show how computing can easily be incorporated into our teaching”
• “It was great to see that what took place in today’s session would be easily implemented in my school.”
• “This was a great workshop which helped refresh my knowledge and gain some fabulous ideas for lessons and teaching”
• “The workshop was really useful. I was new to barefoot computing so will be introducing it to staff at my school in the near future.”
• “Will try to use these same methods for teaching networking.”
14 Teachers and head teachers report positive impact of the support on pupil knowledge.

- “It was very useful and something that I would definitely try with my KS3 students”
- “Learnt how to tackle networking at an accessible level and got plenty of skills of how to adapt teaching strategies and flipped learning for pupils to access the skills they need”
- “I would like to apply what I have learnt and find ways to attract girls into technology!”
- “Developing the children’s resilience and encouraging a positive mindset towards making mistakes. I feel paired coding will be a really useful step forward.”

15 There is also consistent evidence in feedback collected after 10 weeks that teachers report the impact of their CPD on learners. 50% stated that improved student learning had already taken place and 25% said that the students were more motivated. A further 20% anticipated impact on student learning. Table 9 summarises these findings.

<table>
<thead>
<tr>
<th>Impact level:</th>
<th>Impact on Knowledge and Skills</th>
<th>Practice</th>
<th>Organisation</th>
<th>Learners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant</td>
<td>52%</td>
<td>42.9%</td>
<td>19.5%</td>
<td>25.3%</td>
</tr>
<tr>
<td>Moderate</td>
<td>38%</td>
<td>42.8%</td>
<td>50.6%</td>
<td>37.3%</td>
</tr>
<tr>
<td>A little</td>
<td>10%</td>
<td>11.7%</td>
<td>26%</td>
<td>18.7%</td>
</tr>
<tr>
<td>None</td>
<td>0%</td>
<td>2.6%</td>
<td>3.9%</td>
<td>18.7%</td>
</tr>
</tbody>
</table>

Table 9: Data collected from teacher feedback

16 Given these findings, it is possible to draw the following conclusion. Teachers value the support provided by the NoE, it has an impact on their subject knowledge, pedagogy and confidence, 99% felt it would impact on their practice and that over 80% of teachers believe it has an impact on students’ learning.

Impact of the NoE on the take up of Computer Science GCSE

17 95% of students in secondary education attend the following five major types of state maintained schools

- Academy - Converter Mainstream
- Community School
- Academy Sponsor Led
- Foundation School
- Voluntary Aided School
There are 2970 such secondary schools in England out of a total of 5134 (including independent schools). Our evaluation focusses on these major school types in order to exclude the distorting effects in the data of, for example, highly selective independent schools or schools meeting the needs of particular types of students. In 2015 43% of these schools entered candidates for GCSE Computer Science with 11% of their students taking the qualification. In 2016 this had increased to 71% of these schools offering GCSE Computer Science, with 11% of their students taking the qualification.

The following graph (Fig 8) shows the average cohort sizes for GCSE Computer Science (ie the number of candidates entered) in:

- NoE Lead Schools i.e. ones that have a CAS Master Teacher
- schools that have received face-to-face (F2F) support from the NoE
- schools that are members of the NoE but have not received face-to-face support,
- all NoE schools, i.e. the three categories above
- schools outside the NoE, and
- all schools.

It compares figures for 2015 and 2016 and shows the relative increases.

As can be seen in Figure 9, in both 2015 and 2016, schools in in the NoE had larger cohort sizes for GCSE Computer Science than schools not in the NoE, and schools with a CAS Master Teacher (i.e. NoE Lead Schools) had the largest average cohort size for CGSE Computer Science compared to the average for all other schools.

In addition, from 2015 to 2016 the numbers of candidates entered for GCSE Computer Science in schools supported by the NoE grew at twice the rate of schools outside the NoE (17% v 8%), with NoE Lead Schools growing their entry numbers by the largest amount (26%) in spite of starting from a higher baseline.
There is evidence that the NoE is has an impact across all the major types of schools by increasing the number of students studying GCSE Computer Science. This impact is strongest in NoE Lead Schools.

Impact of the NoE on students’ achievement in GCSE Computer Science

Comparing average GCSE point scores

Given the increase in take up of GCSE identified within NoE schools, we move on to discussing the impact on achievement for young people identified as the third stage in the NoE ‘theory of change’. Here the research question is: Are students in the major types of secondary schools that received support from the NoE more likely to achieve higher grades in GCSE Computer Science than students from other schools?

In the following analysis, GCSE grades are given the scores of A*:58, A:52, B:46, C:40, D:34, E:28, F:22, G:16. Using this scoring system comparisons can be made between the GCSE performance of NoE and other schools in the different major types of school.

Figure 10 shows the difference in performance between schools supported by the NoE and schools in general.

![Graphical comparison of average GCSE Computer Studies grades](image)

On the points system set out above, 6 points equates to 1 GCSE grade difference. In 2015 the average difference in performance between schools supported by the NoE and those not supported was 0.5 points (equivalent to 8% of a grade). By 2016 the difference had widened to 1.6 points (equivalent to 27% of a grade).

Comparing grade distributions

The DfE GCSE data allows comparisons to be made between the percentages of students achieving each GCSE grade. Table 9 shows the average number of candidates achieving each grade in GCSE Computer Science in 2015, 2016 and 2017. It compares schools reached by the NoE with those outside the NoE. This finding is particularly important as students who achieved the top three grades are the most likely to continue their studies of Computer Science at A level and beyond.
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A*</td>
<td>1.73</td>
<td>1.29</td>
<td>1.81</td>
<td>1.15</td>
<td>1.71</td>
<td>1.23</td>
</tr>
<tr>
<td>A</td>
<td>4.45</td>
<td>3.56</td>
<td>4.54</td>
<td>3.40</td>
<td>4.05</td>
<td>3.30</td>
</tr>
<tr>
<td>B</td>
<td>5.92</td>
<td>5.17</td>
<td>5.83</td>
<td>5.01</td>
<td>5.51</td>
<td>5.04</td>
</tr>
<tr>
<td>C</td>
<td>5.85</td>
<td>5.22</td>
<td>5.76</td>
<td>5.33</td>
<td>5.45</td>
<td>5.43</td>
</tr>
<tr>
<td>D</td>
<td>4.26</td>
<td>3.99</td>
<td>4.26</td>
<td>3.97</td>
<td>3.65</td>
<td>3.71</td>
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<tr>
<td>E</td>
<td>2.84</td>
<td>2.77</td>
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<td>2.75</td>
<td>2.00</td>
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<tr>
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<td>1.86</td>
<td>1.88</td>
<td>1.23</td>
<td>1.33</td>
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<tr>
<td>G</td>
<td>1.27</td>
<td>1.36</td>
<td>1.19</td>
<td>1.26</td>
<td>0.74</td>
<td>0.92</td>
</tr>
<tr>
<td>U</td>
<td>0.97</td>
<td>1.29</td>
<td>1.03</td>
<td>1.17</td>
<td>0.52</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Table 10: Grade distribution

Simplifying, the following chart (Fig 11) compares the average number of good grades (C or above) achieved in NoE reached and non-NoE reached schools for each of the three years.

Figure 11: Numbers achieving grade C or above

As can clearly be seen, while the average numbers achieving a good grade in GCSE Computer Science in schools that have not been supported by the NoE has remained virtually constant at 15 per school. In 2015 the average figure for NoE supported
schools was 16.72 (11.5% higher). By 2017 this had increased to 17.95 in supported schools in comparison with 15.24 in schools that have not received support, a difference of 18%.

There is evidence that the NoE is has an impact across all the major types of schools by increasing the number of students achieving grade C or above GCSE Computer Science.

**Impact in schools in disadvantaged areas**

Evidence from higher education shows that computer science provides a rewarding degree option that supports social mobility and access from black and minority ethnic groups. However, GCSE data from 2016 data shows that schools with more than twice the national average of pupils entitled to free school meals are 27% behind the national average in terms of the proportion of all students achieving grade B or above in GCSE computer science.

Table 11 shows the percentage of pupils achieving grade B or above in GCSE Computer Science. The percentages are those for the whole year group, not just those entered for GCSE Computer Science. This is chosen as the indicator because the ability to attract students to the GCSE Computer Science should be reflected as well the number of high grades achieved. The numbers are small reflecting the relatively modest entry figures.

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>All schools</td>
<td>5.1%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Schools with more than twice the national average of pupils entitled to free school meals</td>
<td>3.5%</td>
<td>3.8%</td>
</tr>
<tr>
<td>NoE schools with more than twice the national average of pupils entitled to free school meals</td>
<td>3.1%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Non NoE Schools with more than twice the national average of pupils entitled to free school meals</td>
<td>3.9%</td>
<td>3.9%</td>
</tr>
</tbody>
</table>

*Table 11: Achievements at Grade B or above as percentage of year group size*

In schools serving disadvantaged areas (ie ones with twice the number of pupils eligible for free school meals), the differences between those receiving support and those who were not was marked. In 2015 NoE schools in those communities were behind those schools in similar communities not reached by the NoE. By 2016 they had overtaken them.

Taken together this provides compelling evidence that the support of the NoE has led to higher achievement in GCSE Computer Science.
Section 5: Additional areas of focus

1 The DfE contract extension requires two other initiatives within the NoE gender equality and cyber security.

Gender Equality

2 All CAS Regional Centres see addressing the gender gap within computing as an important issue, and one that (in their role as universities) directly impacts on their ability to recruit young women into computer science degrees. Thus, all CAS Regional Centres are engaged in a variety of activity on this issue ranging from outreach work in schools to research (by their PhD students) on the underlying causes of the disparity of take up between girls and boys.

3 Throughout the contract period, CAS Regional Centres are experimenting with a variety of activities including:
   • Direct activity to engage girls.
   • Developing resources to engage girls.
   • Training computing teachers on gender issues
   • Ensuring CAS models effective practice
   • Research into gender issues in computing
   • Good practice guides

Direct activity to engage girls

4 CAS London supported the team organising ‘Wow Day’ a conference inspiring your women in digital and STEM work, by providing speakers and marketing support. Other initiatives include supporting the Barclays IT Girls Allowed Programme, The Sutton Trust’s Pathways to Coding (being run by Queen Mary University of London), Imperial Universities Aspire for Girls. In CAS North East, Newcastle University School of Computing Science and Thinking Digital teamed up to host the first “Thinking Digital Women” event (http://www.tdcwomen.com/). This focussed on women in STEM and had a range of male and female speakers.

5 CAS South East has a session at its conference in Reading from the CAS Include team and is at the planning phase for a day session aimed at encouraging girls into computing. They are exploring a collaboration with the Rutherford Appleton Laboratory, Didcot, and should be running joint provision this year.

6 CAS North West (Manchester) has have developed activities for schoolgirls to involve them in computing. There is a North West Action Group of teachers and university staff
which is developing guidance for all schools in the UK on ways of engaging girls in computing. CAS Girls events are now a regular feature of the Manchester CRC calendar with events being in great demand - all fully booked. Resource and materials are shared with teachers for use in schools.

7 The School of Computer Science at the University of Hertfordshire ran a ‘Girls in Computing’ afternoon for schoolgirls aged 11 - 17. This free event was jointly funded by the University's School of Computer Science and Computing At School (CAS). The purpose of this event was to encourage girls to consider Computer Science as a subject and the girls will give a presentation to their class on their return to school.

8 CAS North East contributes to a number of outreach events that are specific to girls, including Accenture's Girls annual girls in STEM event, the International Girls in ICT day, and the University’s annual MINT days for Year 9 girls interested in STEM.

9 CygNets is an existing community that is interested in gender equality in Computing that aims to create a funded network on gender in computing called diverCT. It has an initial membership of 50 who are highly active in EDI (equality, diversity and inclusion) work. Members represent CS and EE (computer science and electrical and electronic engineering) departments across the UK. The steering committee of 15 represents a diverse mix of UK HEI members in ICT departments and these project partners will act as hubs for dissemination of good practice. The aim of diverCT is to create a network which people can learn best practice about Equality and Diversity. Part of its remit will include the investigation of these issues at school level.

Developing resources to engage girls.

10 CAS London produced an issue of its ‘Computer Science for Fun’ magazine on Women in Computing, mailed to over 2000 school subscribers nationwide later in the year. Its annual conference included a stall giving free cs4fn resources related to women in computing including a 60 page booklet, a magazine on Ada Lovelace and a poster on women in computing.

Training computing teachers on gender issues

11 CAS North West (Manchester) regional conference hosted several workshops targeting engaging girls in computer science, such as one involving programming and dance. CAS Yorkshire and Humberside is introducing a gender focus into its CPD offer. A Guidance Booklet on methods of engaging girls in computing is being developed in collaboration with academics from The University of Manchester, Master Teachers and CAS. The aim is to deliver this widely to schools in the UK. The booklet provides concrete advice to schools to engage girls in computing.
Ensuring CAS models good practice

12 We have increasing the proportion of female CAS Master Teachers. The new CAS Master Teacher induction is to include unconscious bias awareness training.

13 One CAS Regional Centre has recently received funding from the university of Widening Participation Fund to undertake a pilot scheme to address gender in Computing Teaching. This funding will be used to intensively train six female teachers from our region so that they feel better equipped to teach GCSE Computing. The intention is that they will each mentor a number of other female Computing teachers. Psychology literature suggests that having a female teacher as a role model is an effective way of encouraging female students to engage and persevere with a subject. It will be interesting to see if this pilot has a long term impact on the number of female students taking Computing at GCSE and hopefully beyond.

Research into gender issues in computing.

14 The University of Newcastle (CAS North East) has begun research and other work with industry in the School of Computing Science on gender issues. Objectives include:

• To find if there is a gender bias in the design of integrated development environments.
• To investigate the learning environment for computer science in higher education and schools to see if there is a gender bias.
• To investigate the differences of cultures and perceptions students have about computer science before and after academic exposure to programming.
• To see if there are difference in the self-perceptions of computing ability of female and male students.

15 CAS South West are also researching gender and computing.

Good practice guides

16 The NoE (through CAS North West (Manchester) has developed a guidance booklet for schools (“Girls into Computing: Top Tips for Schools) detailing methods of engaging girls in computing. This booklet has been developed in collaboration with academics from the University of Manchester, Master Teachers and CAS. Some schools have been very successful in addressing the gender imbalance in the subject and we have collected successful technique for all schools to consider. It is now ready for publication and for distribution to schools across the region and, possibly, nationally. The aim is that CAS adopt this booklet and it is delivered widely to schools in the UK.
Cyber security

17 Cyber security is a key strength of all the universities’ computer science departments. For example, the School of Computing at Newcastle University is one of the 14 UK Centres of Excellence for Cyber Security Research, Birmingham City University is a leader in network security.

18 CAS Regional Centres have been actively promoting the teaching of cybersecurity in their regions. Broadly speaking the activity includes:

- Building on expertise within the university
- Linking with national programmes
- Developing resources
- Offering awareness raising and training events.

19 Examples of each of these are given below. Further examples are included in the individual CAS Regional Centre reports.

Building and training to support the teaching of cybersecurity.

20 CAS South West has a close connection to the Plymouth University Centre for Security, Communication and Networks (CSCAN) research group. Utilising this close connection, a hub meeting was provided that enabled resources to be shared. The event was recorded via webinar with the head of the research group providing a background to the topic, combined with discussions from exam board representatives. These materials were made available via the CAS community. CAS West Midlands, which is one of the regional centres with a specialism in this area, has supported other regions, for example, supporting CAS London’s training programme.

Linking with national programmes

21 CAS North West (Manchester) is pioneering a Cyber Security initiative in the North West with the National Crime Agency, and local police forces, to introduce into all schools in the North West material on preventing schoolchildren becoming involved in Cyber Crime, and also on careers in Cyber Security. In the south west, a series of Cyber Challenges across the region run by CyberSecurity Challenge and Tablet Academy, Bristol and Dorset being the key areas for this.

22 Master teachers have been involved in shaping cyber security resources for schools and

Developing resources

23 With the support of its CAS Master Teachers, CAS East Midlands has developed 60 minute lesson plans and resources for early years, primary and secondary. These are available online. CAS Master Teachers are using these lesson plans and resources in their meetings.
24 CAS South East has delivered both training and hub sessions on a variety of topics at training events including SQL injection, Digital Data Security, encryption and Caesar ciphers.

25 In the south west, a series of Cyber Challenges across the region run by CyberSecurity Challenge and Tablet Academy, Bristol and Dorset being the key areas for this.

26 CAS West Midlands, which is one of the regional centres with a specialism in this area, has supported other regions, for example, supporting CAS London’s training programme. The CRC has also facilitated free access to Cisco’s Packet Tracer network emulation application. However a big secondary pull has been to gain access to the cyber security teaching and learning materials and the materials that have been placed there to illustrate a range of cyber security issues including man in the middle attack, “black hat” interventions WiFi integrity etc. This is a very sophisticated but easy to use resource that has demonstrated success across a range of neurally diverse students.

27 Digital boxes and other unplugged teaching and learning materials and resources were provided and demonstrated to the Cyber Security Roadshow team in their recent pilot across the South West of England. These resources have been used by members of the CASWM regional team in schools with a range of neural diverse students with some degree of success.

28 CAS Regional Centres continue to liaise the e with Education team at GCHQ attending meetings with GCHQ team to inform strategy for new Cyber programmes. For example, CAS Yorkshire and Humberside funded one of its most active Master Teachers to attend the Cyber Defenders course run by GCHQ. Using her GCHQ connections the CAS Master Teacher has booked a guest to talk about the governments CyberFirst initiative.

29 In the new academic year we will examine how we can further coordinate master teacher activities with Youthfed such as:-

- Events to help address the gender divide in digital and cyber industries
- The ‘Cyber Rangers’ programme where IT professionals mentor young people who have been behaving unethically online.
- Working with the NCA to distribute consistent messages to schools about reporting cybercrime.
- Work around qualifications for young people around cyber security
- Cyber Hygiene Programme and Passport.
Section 6: Value for money

Programme costs and efficiency

30 The programme measures value for money in two ways. Firstly, it determines the cost to the programme of a teacher hour of CPD and benchmarks that with other provision. Secondly it determines the extent to which it leverages investment and support from others, including additional volunteering, in kind staffing contributions and support from the universities, and further funding from the private sector.

Benchmarking costs

31 Earlier in this report we identified that collectively the NoE had delivered 46710 teacher hours of support over the year. This equates to £24.61 per teacher per hour. This compares favourably with costs elsewhere in the sector. However, it must be recognised that any future programme with increased management costs associated with increased central control is unlikely to achieve a similar level of cost effectiveness.

Leveraging other investment

32 The scale and reach of the NoE offers the opportunity to scale programmes run by others to build on their initial investment, improve return on investment and maximise the impact of the DfE contribution. This leverage happens in three ways:

• the universities add to this funding through staffing contributions, synergy with other programmes and as part of their outreach work
• forming strategic partnerships to access other funding streams • additional volunteering by CAS Hub leaders and CAS Master Teachers
• further contributions from the IT industry.

Each of these is discussed below.

Additional university contributions

33 We estimate that the universities contribute an additional £200k per year through additional staffing, general support and synergy with other programmes. The following case study illustrates the scale of one university’s additional contributions to the NoE.

Newcastle University's School of Computing is one of the largest 12 suppliers of outreach events in the University. In an academic year, over 800 school students attend outreach events amounting to over 3000 student hours. These events are free to schools and state schools are eligible for a visit bursary from the University of up to £350 to contribute to the costs of travel and teacher cover. To date the university has delivered 6 challenge days and have more planned for the summer term. Combining
student and teacher events, and contributing to costs with the travel bursary, mitigates the difficulty for teachers to get time away from school for training.

6 academic staff have 10%-20% of their time allocated to school outreach work in their workload models. In addition, the university funded 20% of the admin and 60% of the academic lead for the CAS Regional centre plus 30% buy out of CAS Master Teacher time in the north and south of region.

Over 50 undergraduate students have volunteered for outreach workshops and other CAS related activities. Up to 15 students a year take a Stage 3 credit bearing Students into Schools module to work in a school for 70 hours and a similar number undertake computing education dissertation project.

The university is building its research capacity in computing education and currently have 8 PhD students working in this area, 3 of them funded directly by the School. One of the School-funded PhDs is working on gender in computing education (see section 5).

The School of Computing has provided very significant additional equipment resource both for CPD and for outreach workshops. Including access to 40 laptops for portable workshop labs, 20 Lego WeDo kits, 15 Lego Mindstorms, and 20 RaspberryPis. The School has also, in effect, match funded physical computing equipment purchased by the CRC. For example, for every robot kit purchased with CRC funding, the School purchased another kit from its outreach budget.

Strategic partnerships to access other funding streams

34 CAS London has received £50K from the Mayor of London for computing resource development. Again, this is a result of the CAS Regional Centre being the strategic focus for supporting computing education in the region.

Additional volunteering

35 We estimate that across the NoE, CAS Master Teachers and CAS Hub Leaders provide £250k unpaid preparation time per annum.

Support from industry

36 The following case study illustrates how CAS West Midlands used support from Cisco to make teaching resources freely available to schools across the country.

CAS West Midlands facilitated access to CISCO Net Academy resources developed alongside the CAS program to provide a progression pathway for development of teaching and learning resources supporting strands of the computing curriculum. These resources utilised additional money accessed, facilitating free and unlimited access to resources. The CRC developed and made freely available a set of resources to teach Computer Networking and Hardware. Teacher resources are via Cisco Network Academy Platform called NetSpace and student materials are via Open Learn Create. This has given schools unprecedented access to a global network of educational
Other funders have contributed to extend the reach and impact of the NoE, the estimated total is £2.249m between April 15 to end March 2017.

The total additional contribution leveraged is therefore approximately £1.50 for every £1 of DfE funding.
Section 7: Sustainability and recommendations for the future

Moving beyond volunteering

1 The vast majority of CAS Master Teachers are volunteers, and cannot be expected to carry on providing support indefinitely. Typically, alongside their teaching commitments and the enrichment activity they lead in their own schools, they coordinate the local area CAS hub and organise training sessions in their schools which are attended by teachers from nearby schools. This is a significant commitment if neither the CAS master teacher nor the school is compensated for the time spent.

2 Since 2014 approximately 10% of CAS Master Teachers have left the programme each year. In addition, a further 10% become dormant (i.e. Inactive and hard to reach). The data suggests that both the numbers becoming dormant and those actively standing down are set to increase. Without continuing support, this rate of attrition would lead to less than 100 CAS Master Teachers in 5 years. In addition, schools are increasingly unwilling to free up a precious resource without compensation.

Ensuring continuity

3 The experience of the various discontinuities and ‘breaks’ in service as the NoE moved between its various contractual phases indicates that the network of CAS Master Teachers is itself fragile, particularly given its dependence on good will from both the CAS Master Teachers and their schools. For example, it has taken the CRCs up to 2 years in some cases to re-engage CAS Master Teachers who dropped off the radar, and the period towards the end of the 2014-2015 financial year saw a significant decline in activity as CRCs considered their positions.

4 Alongside this there is a need to reassure teachers and school leaders that they can plan on the basis of support being available at the time it is needed. Few school leaders would offer GCSE Computing unless they were absolutely confident in their teachers’ access to the ongoing training and support they will need.

Options for the future

5 Five options are considered:

   a) Cease central funding for the NoE
   b) Continue with the existing model
   c) Continue within the existing funding enveloped, but provide more in depth training to significantly fewer schools
   d) Continue within the existing funding envelope, but go for breadth rather than depth to reach more schools
Develop a scaled-up training and support proposition that trains a critical mass of computing teachers sufficient to ensure that, from then on, there is sufficient capacity in the system to make it self-sustaining.

Each option is discussed below.

OPTION 1: Withdraw DfE funding for the NoE

Should funding cease, three scenarios are possible.

- Scenario 1: An alternative funder such as one of the major charitable foundations or global technology companies steps in to fund the continued existence of the NoE.
- Scenario 2: The universities continue as CAS Regional Centres as part of their outreach work without central financial support
- Scenario 3: A market develops with schools purchasing the necessary CPD and support from commercial providers/trainers

Given the fragile state of computing in schools, our view is that the introduction of Computing as a new subject within the National Curriculum stalls (as evidenced by GCSE uptake), school leaders do not prioritise it, fewer pupils develop the skills needed to thrive in the digital world, and the move to a digital economy is put at risk by a shortfall in skills.

OPTION 2: Continue with the existing model

The advantage of this option is that the model is well understood and implementation would be straightforward. However, while this model continues to provide an effective means of reaching and supporting primary schools, progress in secondary schools would continue at a slower rate than over the last three years, with the current slowdown of the take up of GCSE continuing, and possibly declining as school leaders prioritise other things.

OPTION 3: Continue within the existing funding enveloped, but provide more in depth training to significantly fewer schools

This would provide a real solution in a few of hundred schools, but would be seen as unequitable with a ‘post code lottery’ for computing teaching and the teachers that have made a first step but who are not included may feel abandoned. At the same time it would fall far short of the numbers of teachers needed to address the need.

OPTION 4: Continue within the existing funding enveloped, but go for breadth rather than depth to reach more schools

While it would be possible for a network to deliver an awareness raising campaign at scale, the lack of any sufficient follow up training would leave those teachers without the necessary subject knowledge (particularly in secondary schools teaching high stakes
examination classes) unsupported. As a consequence the level of dissatisfaction within schools would increase and the overall numbers achieving GCSE would remain unchanged.

OPTION 5: Develop a scaled-up training and support proposition

12 This option would aim to increase the annual number of candidates taking GCSE Computer Science to 200,000 within 5 years by training a critical mass of computing teachers sufficient to ensure that, from then on, there is sufficient capacity in the system to make it self-sustaining. We estimate that 8000 teachers would need to be trained and that a scaled up CAS Master Teacher Network would provide the ongoing and pedagogical support needed to make a difference in the classroom. CAS Regional Centres, in line with the existing model could co-ordinate both strands and, as the deep subject knowledge exists in universities and few other organisations, they could lead on the SKE offer.

13 BCS is delighted that the newly announced National Centre and its associated programmes will provide a scaled-up solution for schools.
Section 8: Challenges faced by the programme

1 Our approach to managing the challenges faced in delivering the programme addresses two distinct areas:

• External risks: those arising from dependencies outside the control of the programme arising from the context in which the programme is being delivered
• Internal risks: those arising from any potential points of failure within the programme itself.

Each of these is discussed below.

Managing external risks.

2 The NoE is developing at a time of significant change in schools. Some of these changes are part of the implementation of Computing, such as the introduction of new GCSEs in computing, and have a direct impact on the NoE. Other changes, such as the changes to other GCSEs have an indirect impact in that they influence priorities within schools.

3 A key dependency is on the overall supply of computing teachers. Where schools cannot recruit this inevitably impact on the school’s ability to release teachers, either to receive or provide CPD. For example, in secondary schools where the only qualified member of staff is a CAS Master Teacher, the CAS Master Teacher’s prime responsibility will be teaching, with an additional responsibility to support those staff from other departments (such as geography) who have been drafted in to teach Key Stage 3 computing. This has a serious impact on the CAS Master Teachers’ ability to provide CPD and support to teachers in other schools.

4 Another dependency in secondary schools is on the availability of high quality curriculum and qualifications. The first part of this is addressed at Key Stage 3 through the National Curriculum programme of study for Computing. At Key Stage 4 and beyond it is the qualifications regime that is key.

5 Feedback from CAS Master Teachers, CAS Regional Centres and others identifies two significant changes at Key Stage 4 that have created delivery risks for the NoE. The first of these is the demise of GCSE ICT and the lack of a GCSE in IT.

6 The overlap between GCSE ICT and Computer Science is marginal, and moving from teaching ICT to teaching Computer Science is a significant step. Helping teachers make that step is a key purpose of the NoE, however, discussions with head teachers indicate that senior leadership teams are cautious and see offering GCSE as a risk given the support their existing ICT teachers need.
This leads to a vicious circle – the school doesn’t offer examination courses because the leadership team are not yet confident that the teachers will be able to produce good results; as the school has then decided not to offer GCSE Computer Science, there is far less need to train their existing staff.

This is further exacerbated by the level of demand in the new GCSE and A level specifications, which has increased in line with government policy to increase the level of rigour across the whole qualifications regime. While it is essential that qualifications set high expectations, it is inevitable that, given the newness of the subject for many schools, that schools will consider the implications before extending their GCSE offering.

At the local level these factors combined with others to create further risks around the programme. Key amongst these is the capacity of the school leadership and the CPD resources in the school to deal with implementing computing while other significant changes are being managed.

The importance of school leadership and its impact on curriculum, teaching and achievement was recognised in Education Excellence Everywhere. The impact of a school leadership’s support for computing and the NoE is twofold: it determines how computing is implemented in the school itself, and the extent to which school leaders free up CAS Master Teachers in their schools to support others.

There are indications that school leaders are not prioritising computing. Given that this summer sees the first examinations in the more demanding GCSE specifications, it is not surprising that school leadership teams are prioritising other subjects over computing. As a consequence, computing teachers have less access to funding for supply cover and training, other resources, and management support.

Further changes which at the local level also influence the degree to which the school leaders support the NoE’s peer-to-peer led model. CAS Master Teachers respond to
local need, however, as schools join multi-academy trusts this can have an impact on school leaders’ willingness to allow their teachers to support others outside the MAT.

13 Finally, school leaders concerns over changes to funding (whether they are wellfounded or not) lead to an additional degree of caution (particularly in secondary schools) if school leaders perceive that a commitment to timetabling computing will need to be supported by a commitment to staff release.

14 While the programme successfully delivered against this complex environment, we include the key risks identified throughout the programme as these are likely to continue to present challenges

<table>
<thead>
<tr>
<th>Risk</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER1 <strong>Staffing:</strong> Schools cannot recruit computing teachers.</td>
<td>Due to staffing pressures, schools do not release existing computing or ICT teachers either to receive or provide CPD through the NoE.</td>
</tr>
<tr>
<td>ER2 <strong>Qualifications:</strong> Secondary teachers lack the confidence to teach demanding high stakes examinations because of:</td>
<td>Given the high stakes and public accountability, schools decide against offering examination courses. Thus, Computing becomes a low priority in secondary school plans with implications for Key Stage 3, leading to a lack of take up of engagement with the NoE.</td>
</tr>
<tr>
<td>• a commonly-held perception that new specifications for GCSE and A level Computer Science are too demanding.</td>
<td></td>
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<tr>
<td>• the lack of a GCSE to replace ICT</td>
<td></td>
</tr>
<tr>
<td>• confusion over vocational qualifications.</td>
<td></td>
</tr>
<tr>
<td>ER3 <strong>Competing demands in schools:</strong> Implementation of more demanding curriculum and qualifications in other subjects reduces the management support and resource available for Computing.</td>
<td>SLT support for CPD (eg supply cover) is focussed on higher priority subjects, so computing teachers are unable to call on the management support they need to engage with the NoE.</td>
</tr>
<tr>
<td>ER4 <strong>Unwillingness to collaborate:</strong> As schools join multi-academy trusts school leaders are less willing to allow their teachers to support others outside the MAT.</td>
<td>CAS Master Teachers are not released to provide support outside the MAT leading to unevenness of support within the NoE</td>
</tr>
<tr>
<td>ER5 <strong>Funding concerns in schools:</strong> School leaders concerns over changes to funding (whether they are well-founded or not) lead to them not supporting teacher CPD (particularly in secondary schools)</td>
<td>School leaders do not support computing teaching if they perceive that a commitment to timetabling computing will need to be supported by an unaffordable commitment to staff release.</td>
</tr>
</tbody>
</table>
Underestimating the challenge: Teachers in schools and school leaders underestimate the training needed to teach computer science effectively, particularly the programming aspects, School leaders limit teachers access to the Network of Excellence so it fails to consolidate its impact.

Managing internal risks

15 Alongside the obvious risks inherent in any programme such as the likelihood and impact of personnel changes, or failure to meet quality thresholds, the main internal risks to the programme arise out of the distributed model that underpins the NoE. Large geographical areas are supported by a single university-based CAS Regional Centre. 10 regional centres create 10 potential points of failure, the impact of any failure within a CRC would have an impact across a significant geographical area, and the geographical spread of CRCs would prevent one stepping in to address issues in another region.

16 As noted earlier, the universities have provided existing resource to support the NoE so in practice, the normal internal risks have been well controlled.
Section 9: The Exit Strategy

1. As the contract for the Network of Excellence comes to an end, we wish to work with DfE on an orderly exit plan that ensures that the National Centre and its associated programmes can build on a secure legacy, while addressing all legal requirements.

Contracts

2. All contract with sub-contractors will be closed down ensuring no future liabilities.

Maintaining the availability of expertise.

3. All CAS Master Teacher, CAS Hub Leader and CAS Regional Centre contact details will continue to be publicly available through the CAS website.

Data

4. Copies of all data on the programme including data on CAS Master Teachers recruited, events held, feedback evaluation responses and URNs of schools that received support will be provided to the DfE. All personal data will be managed in line with BCS policies.

Resources developed by CAS Master Teachers and others during the programme.

5. All teaching and training resources created during the contract period will continue to be publicly available through the CAS Website under a creative commons license.

Disposing of assets

6. Approximately 1% of the programmes funding was used by CAS Regional Centres to purchase equipment for training purposes and for loan to schools. BCS holds a catalogue of these assets. CAS Regional Centres will be required to maintain these loan services for 5 years or dispose of the assets to local schools.

Reports

7. Reports (including this one) will be published in agreement with DfE.

Annexe 1: Case Studies

Angharad Costello (Ringwood School, Hampshire) has developed from being a Business and ICT teacher through to a Master teacher with the support of the CRC. Back in 2012, before recent curricular changes, Ani was concerned that she knew little or nothing about computing when she approached the Regional Centre for support. Initially, Ani attended the CRC’s in-service subject specialism training courses leading to participation in a number of courses, including the CAS South East BBC micro:bit Roadshow, GCSE Computing - Current Controlled Assessment Guidance and Introduction to the New Specifications and Computer Science Conference for KS3, KS4 and KS5 teachers. Ani has also worked one-to-one with the Centre and other Master
teachers to improve her knowledge until she became confident enough to apply for our 2016/17 Prospective CAS Master Teacher Training Programme. Ani is now a CAS master teacher and has set up and runs a CAS secondary Hub at Ringwood School, working with a primary colleague from the South West to offer secondary and primary Hub sessions.

John Lamb, Master Teacher at Monkwearmouth Academy Sunderland has been building links with feeder primaries. This includes mentoring primary teachers, workshops for primary pupils and CPD for other Monkwearmouth staff to deliver workshops etc. An example, is Grange Park Primary School doing the IET Faraday Challenge on coding for life with the microbit at Monkwearmouth Academy. Feedback from students and staff was excellent. A follow up visit to the school is planned to give out certificates to the students involved.

“I have been piloting a new approach to teaching coding based on the input I have received from the CRC. The teachers have responded well to teaching coding using this mixed approach and see a clear relationship with the pedagogy of other subjects. It has helped to develop their confidence. In supporting the teachers, I have followed the following model: written the scheme of work and create the resources. Each teacher receives an hour coaching session from me every term. I then teach a model lesson in each class, in each school. Then finally the teacher teaches a lesson where I support. The teachers then continue to teach the computing scheme and I’m available to support via email or phone call.” New Primary CAS Master Teacher

The Herts and Borders Primary Hub has been particularly successful in engaging teachers within the local area. Since setting up the Hub, a number of teachers have become Master Teachers and / or completed the BCS Certificate in Computer Science Teaching. Equipment has been lent to local schools to support the teaching of Computing, including micro:bits and Spheros, which has led to increased pupil engagement, enabled further cross-curricular links to established and allowed Hub members to deliver CPD to staff within their school. The Hub has also liaised with local partners, including Ocado, to demonstrate their programming technologies and get feedback on their development, and Cyber Prevent, which enabled teachers to examine opportunities for linking their resources into the primary curriculum.
The Norfolk Hub, which is hosted at the University of East Anglia (UEA), has been working with both primary and secondary teachers across the region for four years. Hosted by Master Teacher Jez Thompson, the sessions regularly include presentations from local teachers and allow the sharing of best practice. Two initiatives supported by the Hub have been particularly successful. Firstly, the annual Scratch Off programming competition welcomes pupils from local primary and secondary schools to the University to further develop their programming ability and the East of England CRC has been able to donate micro:bits as prizes over the past few years. Secondly, the Hub has worked with DevelopHER to promote coding sessions, in a safe environment supported by developers and university staff, for students aged 12-18 years. Most recently, the Hub was instrumental in recruiting teachers to the Regional Conference in the area.

St Helens Secondary Hub. This hub had been set up in 2016 and had been sporadically delivered and attended. The teachers in the region were still keen to have a hub. However teacher workload was having a detrimental effect on the leader’s capacity to organise meetings. With the encouragement and organisation of the CRC, teachers in the area got together to revive the hub and put a management in place. This gave teachers the flexibility to take it in turns to organise and host the hub meetings, which in turn has seen the hub meeting going ahead and attendance increasing.

South Manchester Hub: Under an initiative from the CRC, this hub now utilises a collaborative approach with both Primary and Secondary Master Teachers collaborating to organise and host the meetings. The content is driven by requests from the local teachers. The hub leader and Master teachers then source workshop leaders to deliver the hub meetings. An extremely successful innovation in this region is the use of the Equipment Library that is run by the CRC and managed by the hub leaders. This has made for a successful and thriving local educational community.