



THE UNIVERSITY *of* EDINBURGH  
**informatics**

# SCHOOL OF INFORMATICS

## School Strategy and Plan 2018/19 to 2020/21

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## SCHOOL OF INFORMATICS

SCHOOL STRATEGY [updated – updates in yellow]

### Introduction

Over the summer and autumn of 2015, the School of Informatics undertook a review of its strategic priorities. The outcomes of that review were presented in the 2016-19 School Strategy and Plan.

The revised School Strategy was generally well received. The one change included in the 2017-20 iteration of the School Strategy was the explicit inclusion of 'People' as a key enabler in the Strategic Framework (below). This was included as a 'cross-cutting theme' in the School's 2016-19 plan, however it did not feature in the strategic framework. Development of the School's (successful) application for renewal of its Athena SWAN Silver Award status, amongst other things, highlighted the importance to the School's future success of our approach to the recruitment, support and development of all staff (not just academics and research staff). This led to the inclusion of 'People' as a key enabler in the School's Strategic Framework.

### Strategic objectives:

The School's strategic objectives are:

- Promote Informatics as a coherent area of academic research, learning and innovation, encompassing the structure, the behaviour, and the interactions of natural and engineered computational systems.
- Further enhance our international leadership role in Informatics, including retaining the leading position in the UK.

### Strategic framework

Three strategic priorities and three key enablers provide us with the strategic framework for achieving our objectives.



### **Strategic priority: Greater Research Excellence**

Informatics at Edinburgh has international leaders in many areas of research. Our priority is to further develop the breadth and depth of that leadership by ensuring that all researchers<sup>1</sup> develop to their full potential, through support in their route to research leadership and in the continuance of their leadership roles, once achieved. The consequences of this are:

- We are in a leading position to shape the intellectual development of Informatics and are recognised in that role.
- Our leadership in Informatics places us in strong positions to gain research funding to push forward the intellectual development of our discipline.
- We are recognised internationally as a destination of choice for talented students, research staff and academic staff, and that flow of talent reinforces our leading role.
- Our research evaluation scores reflect this excellence and further strengthen our ability to secure the resources to extend our work and to sustain our leadership in our discipline.
- We are well placed to respond to initiatives, such as the challenges and opportunities arising from the current governmental focus on artificial intelligence, and to contribute to delivery of the Edinburgh Region City Deal.

### **Strategic priority: Demonstrable Impact**

The School has the leading research position in the UK and an international reputation for Informatics knowledge exchange and industry engagement.

We produce extraordinary science, scientists, and knowledge that is the source of disruptive change. Through our research, education, knowledge exchange and public engagement activities the knowledge that we create impacts upon the international academic community, upon policy and society, upon industry and businesses, upon our local community and upon individuals; as demonstrated by the roles in business, academic life and the public realm of our staff and student alumni.

We are continually growing our portfolio of industry partnerships, including sponsored research and development, consultancy and studentships. These include engagement with start-ups and growing businesses through to strategic alliances such as our Prosperity Partnership application with ARM.

We will take steps to capture more of our impact and reflect it back to informatics people, funders and industry, to promote a stronger understanding of the substance and impact of our research. A consequence will be greater preparedness for the impact component of the next Research Evaluation Framework.

### **Strategic priority: Enhanced Student Experience**

The School has made significant advances in learning and teaching and in student engagement in recent years. A key strength is our academic breadth, which allows us to offer a variety of multi-disciplinary programmes of study.

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<sup>1</sup> The term 'researchers' is used to refer collectively to academic staff and research staff. The term 'academic staff' refers to Lecturers, Senior Lecturers, Readers and members of the Professoriate. The term 'research staff' refers to staff who are funded by research grants, usually designated as 'Research Associates'.

We will continue to work with our student communities to further review our curriculum and its delivery and to ensure that student support, resources, and the physical and social environment all contribute to student achievement and satisfaction. A particular priority will be transition into the School and the development of strong mechanisms to provide support for students.

We believe that there are opportunities to innovate in the way that our student body is engaged, collectively and individually, in the learning process and experience. We will work with staff, students and those elsewhere with expertise and experience, to explore how we can develop a distinctive Informatics approach to learning, teaching and student experience. We will make more effective use of data and analytics to provide relevant and timely feedback on student learning and to monitor and assess the effectiveness of our approaches to learning and teaching.

There is considerable scope to build on previous and current initiatives to develop online learning materials, both to enhance the study options for on-campus students and to delivery learning to students who require flexibility in place and time of study.

**Key enabler: Strategic Engagement and Collaboration**

Information pervades the modern world, so opportunities for collaborative inter-disciplinary research abound. We will prioritise those interactions that have the capacity to contribute to our strategic objectives through generating the highest quality research and educational opportunities, and the greatest impact.

**Key enabler: Income Growth**

The School's strategic objectives and priorities can only be achieved from a position of financial strength. The School will continue to leverage its position as the UK leader in Informatics research and knowledge exchange to secure funding from public funders whilst seeking to further develop other sources, including funding from industry, charities and alumni. In addition, increased numbers in our student body, especially undergraduate and postgraduate taught students, will contribute to income growth. Increasingly, this growth will come from students enrolled in online programmes.

The priorities for the application of increases in income will be in additional academic staff and in postgraduate research studentships, to further enhance the breadth and depth of our academic community. Further investment in support services will ensure that research and teaching staff are relieved of administrative functions which are more appropriately undertaken by staff employed to undertake those duties.

**Key enabler: People**

Only by recruiting, supporting, developing and retaining the best academics, research staff and support staff can the School maintain and build upon its UK leading position and international reputation.

The School holds an Athena SWAN Silver Award for its contribution to gender equality amongst academic staff, researchers and students. The Silver Award was successfully renewed in 2016.

We will build upon this success to further embed all aspects of equality and diversity into our policies and practices. We will increase support for career development for all staff, academic, research and support. We will celebrate diversity amongst staff and students and implement our Athena SWAN action plan, to further address issues of gender imbalance within the School and our discipline.

## TARGETS

The School has set the following high level targets:

<b>Target</b>	<b>Progress</b>
Maintain UK leadership in Informatics and Computer Science Research in REF2021.	The School is progressing preparations for REF 2021 and anticipates submitting a significantly greater number of researchers as well as enhancing its impact and environment submissions.
Maintain Athena SWAN Silver Award at next renewal in 2020 as part of the School's commitment to equality and diversity.	The School is following its Athena SWAN implementation plan which will underpin its application for renewal of its Silver Award.
Achieve results higher than the overall University of Edinburgh average in student surveys.	The School's 2017 National Student Survey results fell below the target level. Results in other surveys of postgraduate taught and postgraduate research students are more varied. The School is taking actions, where necessary, that are expected to have a positive impact on survey results.
Achieve student recruitment projections detailed in the School Plan.	The School achieved or exceeded its 2017 student intake targets with the exception of postgraduate taught students, which were approximately 10% below target. Applications for the latter were more carefully managed because of previous concerns regarding unconstrained growth.
Increase research funding whilst also increasing the diversity of funding, so that no one funder accounts for more than one third over a three-year rolling average	Research grant success increased by approximately 40% in value year-on-year in 2016/17. This included a significant increase in funding from industry.
Increase the number and scope of strategic engagements with academic collaborators, industry, third sector and public sector bodies.	A number of new industry partnerships were established or extended, including with Huawei and IOHK (Hong Kong).

## SCHOOL OF INFORMATICS

### HIGHLIGHTS 2016/17 [Updated]

Some notable achievements and success over the period 2016/17 include:

- The University of Edinburgh was ranked #14 in the 2018 Times Higher Education World Computer Science subject ranking. This is only the second year Computer Science was included in the ranking as a separate subject area: previously University of Edinburgh was ranked #16.
- Dr Colin Adams, former Director of Commercialisation in the School of Informatics and Director of Informatics Ventures, has been made a Commander of the Order of the British Empire (CBE).
- Professor Jon Oberlander was the 2016 recipient of Tam Dalyell Prize for Excellence in Engaging the Public with Science. Professor Oberlander gave his prize lecture to a sold-out audience. It was a second Tam Dalyell Prize for a researcher from the School of Informatics in a row, and a third overall. Previous winners were Professor Sethu Vijayakumar (2015) and Professor Chris Bishop (2009).
- University of Edinburgh has been recognised as an Academic Centre of Excellence in Cyber Security Research, the only one based in Scotland and among 13 others around the UK. Academic Centres of Excellence specialise in developing the latest cyber security techniques and contribute to the UK's increased knowledge and capability in this field.
- The Edinburgh Huawei Research Lab was established, a joint research laboratory, dedicated to open research, with the School of Informatics at the University of Edinburgh. The liberal nature of the funding makes this laboratory unique in the world, and it has brought substantial benefits to the University.
- Blockchain Technology Laboratory, in collaboration with IOHK, a leading blockchain research and development company. The Laboratory will be led by Prof Aggelos Kiayias, Chair in Cyber Security and Privacy at the University of Edinburgh and Chief Scientist at IOHK.
- The Edinburgh Centre for Robotics – a partnership between the University of Edinburgh and Heriot-Watt University – will lead a £36 million UK consortium focused on applications in the energy industry.
- The School was successful in bidding to be a partner in three robotics research hubs. One hub, also involving the Universities of Oxford and Liverpool and Imperial College London, will seek to develop, deploy and validate robotics and AI (RAI) for the inspection, maintenance and repair of offshore oil and gas and renewable sector installations. The RAI Hub on Offshore Robotics for Certification of Assets (ORCA) has £14.6 million of investment from the Engineering and Physical Sciences Research Council. It also benefits from industrial support of more than £18 million and £3.6 million from its university partners. The second hub in space exploration will bring expertise of researchers at Edinburgh to a project focused on next-generation challenges in the space industry. This partnership will build on strong collaborative ties between the Edinburgh Centre for Robotics and NASA, forged by their ongoing Valkyrie humanoid project. The Future AI and Robotics Hub for Space (FAIR-SPACE), led by the University of Surrey, is funded by £6.7 million investment from the EPSRC and the UK Space Agency with matching contributions from industry. In the final hub in nuclear environments, Edinburgh researchers will make use of their own robots in a research hub focused on the nuclear industry. The £11.4 million National Centre for Nuclear Robotics (NCNR), led by the University of Birmingham, seeks to exploit RAI to tackle challenges in nuclear decommissioning, exploration and asset maintenance. Scientists and engineers at Edinburgh

will use robots they have developed, such as the four-legged ANYmal machine, to contribute research into navigating complex or extreme environments.

- Professor Perdita Stevens' paper "Bidirectional Model Transformations in QVT: Semantic Issues and Open Questions" has been selected as the most influential paper from MODELS 2007 Conference. The Models Steering Committee decided that with 10 years of perspective, Prof Stevens' paper turned out to have been the most influential from that particular year. Incidentally, the paper won the Best Paper award in the MODELS 2007 conference.
- Professor Wenfei Fan's team received the Best Paper Award from SIGMOD 2017 for their article "Parallelizing Sequential Graph Computations". ACM SIGMOD Conference on Management of Data (SIGMOD) is one of the top four international conferences on the subject of data management.
- Dr Pramod Bhatotia and his team received the best paper award at EuroSys'17, a top conference in computer systems for "SGXBounds: Memory Safety for Shielded Execution". SGXBounds proposes an efficient technique to achieve memory safety for shielded execution, which is most critical for ensuring software reliability and security.
- Alan Bundy's paper "The Use of Explicit Plans to Guide Inductive Proofs" from CADE-9 won the Skolem award for most influential paper at this year's CADE-26. The Thoralf Skolem Award was established in 2014 to reward a CADE paper that has passed the test of time, by being a most influential paper in the field.
- Dr Areti Manataki and colleagues from Moray House and Information Services have won Principal's Teaching Award for their project, Exploring flexible modes of online education.
- Paul Anderson, Timothy Hospedales, Ross McKenzie and Anna Wood (School of Education) secured funding from the Principal's Teaching Award Scheme for the project aiming at improving students' assessment process.
- Dr Sharon Goldwater's research into using Scots by pro-independence Twitter users garnered a significant interest from Scottish news outlets. In the first large-scale study of its kind in the UK, Dr Goldwater and her collaborators found that people whose tweets suggested they identify as Scottish nationalists were more likely to use language that reflected this.
- Dr Walid Magdy's research has attracted a lot of interest from news outlets around the world. Walid has written two research papers on Twitter dynamics during elections (US 2016 and UK 2017), and another one about Detecting Fake Accounts in Social Media.
- Over sixty news outlets around the world picked up the story about research into ants' navigational skills, which Prof Barbara Webb was involved in. The findings suggest ants can understand spatial relations in the external world, not just relative to themselves. The research was carried out in collaboration with scientists at the University of Lincoln, Australian National University, and the French National Centre for Scientific Research (CNRS).
- MInf student, Orisa Ngampakdepanich has been awarded 2nd place in the Young Software Engineer of the Year 2017 awards for her project entitled "Peter's Adventures: A tablet app to elicit pretend play with children with Autistic Condition Spectrum".
- Claire Doherty, MInf students in the School of Informatics is one of three women in the UK to be selected for the Amazon Women in Innovation Bursary. The Amazon Women in Innovation Bursary at Edinburgh University offers funding of £3,500 per year for one female student to take up a degree relating to high-tech innovation in the UK. The programme also offers mentoring and work placement opportunities at Amazon's UK Development Centre in Edinburgh.
- A team from School of Informatics competed in the National Finals of CyberCenturion, a countrywide cyber defence competition led by global security company Northrop Grumman

and Cabinet Office-backed Cyber Security Challenge UK, with support from the US Air Force Association.

- Harvey Stocks, Computer Science student, was part of a team who came second in a prestigious ethical hacking competition, Cambridge2Cambridge 2017, with over 100 students from some of the best universities in the US and UK working together over three days.
- Chris Mower, Wolfgang Merkt, and Theodoros Stouraitis, PhD students in Statistical Machine Learning and Motor Control Group won First Prize for Greatest Potential for Positive Impact at the Robots for Resilient Infrastructure Competition, an international robotics challenge held at the University of Leeds.
- PPar CDT student Ludovic Capelli has taken part in the prestigious Heidelberg Laureate Forum in September 2017. The Heidelberg Laureate Forum (HLF) gathers annually to connect promising young researchers in mathematics and computer science with the top scientists in their fields.
- ICSA PhD student Xenofon Foukas, was awarded the Brendan Murphy prize for 2017 at the 29th Multi-Service workshop (MSN), Coseners 2017, for his work "Towards Programmable and Virtualized Radio Access Networks".
- School of Informatics staff were involved in numerous events at the Edinburgh International Science Festival. Paul Patras, Sethu Vijayakumar gave talks, Aggelos Kiayias, Walid Magdy took part in panel discussions, Areti Manataki and James Garforth led workshops.
- School of Informatics staff took part in a grass root Pint of Science Festival speaking about their research to informal audiences in pubs around the city.

#### Institute for Adaptive and Neural Computation

- Prof Chris Williams is part of the team awarded funding to study alternative diagnostic techniques. A team led by Dr Kev Dhaliwal (UoE, School of Clinical Sciences) has recently received £2M from the Wellcome Trust and will receive up to £0.9M (US \$1.12M) from CARB-X, a major international initiative to tackle antibiotic resistance co-funded by the US Government and Wellcome Trust.
- Members of the Institute for Adaptive and Neural Computation are part of Simons Foundation Initiative for Autism Research. The programme is funded by an initial 5 year grant of £20m and will bring together inter-disciplinary research teams from across the University to develop new treatments for autism
- Aleks Stolicyn, Neuroinformatics DTC student has received the Best Article Award for his paper in "Cognitive, Affective, and Behavioral Neuroscience": "Conditioned task-set competition: Neural mechanisms of emotional interference in depression", A. Stolicyn, D. Steele and P. Seriès. The Psychonomic Society Clifford T. Morgan Best Article Award honours individuals for the best paper published in each Psychonomic Society journal in the last year.
- Researchers working on the enhance project have been awarded the Best Work in Progress award at ACM Designing Interactive Systems 2017 for their paper 'Co-Designing Innovations for Energy Saving in Large Organisations'.

#### Institute for Perception, Action and Behaviour

- Statistical Machine Learning and Motor Control Group secured three grants in funding to tackle challenges in dynamic motion planning in pick and place tasks in cluttered environments. DST-UKIERI joint project with IIT-Kanpur, India titled "Learning Robotic Motor Skills, Visual Control and Perception for Warehouse Automation" (£119,000 UoE Share), EIT Digital grant 'iLEVATOR: intraLogistics Enabled by autonomous Vehicles cooperATING with

Operators and Robots' (£158,000 UoE Share) and Hitachi funded translation project on 'Motion Planning for Intelligent Warehousing Solutions' (£120,000).

- Dr Kartic Subr won a prestigious grant from the Royal Society for his CAT-SPATS project, which addresses the escalating problem of human-wildlife conflict, focusing on trends in India.
- Dr Subramanian Ramamoorthy was awarded over £400K for his Project COGLE (Common Ground Learning and Explanation). This is a \$7 million project involving multiple universities and industrial partners and is funded by the US agency, DARPA.
- Dr Michael Mistry and partners were awarded EU H2020 funding for their project THING - subTerranean Haptic INvestiGator that aims to create a robot capable of a high degree of mobility, while able to exploit legs and feet for active perception: probing, stroking and feeling the shape, compliance, and friction of the world as it interacts with it.
- The EU H2020 project MEMMO: Memory of Motion was awarded a total funding of 3.96M Euros (UoE: Euros 500K). This project aims to exploit massive pre-computations of optimal control solutions that are recovered and adapted online to deal with unexpected disturbances using multiple sensor based state feedback, to enable real time optimality driven solutions in such high dimensional robotics platforms for the first time.
- Dr Timothy Hospedales and partners secured funding for DREAM (Deferred Restructuring of Experience in Autonomous Machines), an EU Horizon 2020 FET project. The DREAM project aims to improve the ability of robots to learn new tasks and adapt to new situations by incorporating sleep and dream-like processes in the robot's cognitive architecture.

### Institute for Computing Systems Architecture

- Professor Mike O'Boyle has been awarded £100K as a partner in a multi-institution European technology transfer project TETRAMAX (Technology Transfer via Multinational Application Experiments). The major objective of TETRAMAX is to provide an implementation of the European Smart Anything Everywhere (SAE) initiative in the domain of customized low energy computing for the Internet of Things.
- Dr Christophe Dubach from Institute for Computing Systems Architecture secured funding from Huawei Technologies to work on generating Efficient Neural Network code on mobile GPUs. This project will extend existing Lift compiler, developed in Edinburgh.
- Researchers from ICSA at the School of Informatics were recognised at the prestigious co-located International Symposia on Code Generation and Optimization (CGO) and High-Performance Computer Architecture (HPCA) in Austin, Texas in early February. Six research papers from ICSA were presented at the conference: four papers on a range of topics including new developments on a novel programming language Lift, developed at Edinburgh were presented at CGO; two papers were presented at HPCA. Moreover, Mike O'Boyle's 2007 paper "Rapidly Selecting Good Compiler Optimizations using Performance Counters" has won the CGO Test of Time award 2017.
- Dr Christophe Dubach has been awarded a Google Research Award for the third consecutive year. Christophe is the only systems researcher in Europe to receive the award this year. Google Research Awards are highly competitive - only 15% of applicants receive funding - and each proposal goes through a rigorous Google-wide review process.
- Dr Paul Patras led a study that found that the security of wearable fitness trackers could be improved. The findings were presented at the International Symposium on Research in Attacks (RAID) in September.

## Institute of Language, Cognition, and Computation

- Professor Steven Renals and partners won over £1M from EPSRC to fund their project Ultrax-2020. It is a partnership between the Centre for Speech Technology Research at the University of Edinburgh, Speech and Language Therapy at the University of Strathclyde, Edinburgh-based SME Articulate Instruments, NHS Lothian, NHS Grampian, and NHS Greater Glasgow and Clyde.
- Professor Mark Steedman has been awarded £1.5M from ERC for his project SEMANTAX to tackle some of the most persisting problems in natural language processing.
- Dr Adam Lopez has won a \$60,000 grant from Amazon for his project titled: 'Machine Translation on GPUs' that aims develop a prototype machine translation system where GPUs (graphic processing units) are used as practical accelerators.
- Dr Desmond Elliott and Professor Mirella Lapata have won a \$68,000 grant from Amazon for their project titled: 'Effective Approaches to Multitask Multimodal Translation'. The aim of the project is to develop a framework for translating from a source image and its description into many languages.

## Laboratory for Foundations of Computer Science

- QUANTICOL, recently finished EU-funded project co-ordinated by Professor Jane Hillston has been recognised by being featured on the CORDIS web site. The project developed a descriptive language for 'smart networks', building on recent breakthroughs in the field of Formal Methods.
- Professor Leonid Libkin has been awarded an EPSRC grant, valued at £1.42M, for developing new foundations for managing incomplete databases.
- Dr James Cheney has been awarded an ERC fellowship grant from the European Commission, valued at £1.37M, for designing programming language for scientific data curation.
- Dr Myrto Arapinis and her co-PI Professor Elham Kashefi, have been awarded a grant valued at \$1.6M from the U.S. Air Force Office of Scientific Research, for investigating quantum technology for computation on encrypted data and quantum verification.
- Professor Aggelos Kiayias has been awarded a grant valued at £1.34M by the IOHK, to found and lead the Blockchain Technology Lab, which will explore the power and potential of blockchain technology.
- Professor Wenfei Fan has been awarded a grant valued at £360K by Huawei Technologies, to study efficient methods for analysis of big data graphs.
- Professor Aggelos Kiayias has been awarded an EU H2020 grant from the European Commission, valued at £355K, as one of the partners in a large European consortium, on exploring privacy aspects of distributed ledger technology.

## Centre for Intelligent Systems and their Applications

- CISA sponsored and organised Conference on Intelligent Computer Mathematics, which offers a venue for discussing and developing solutions to the challenges posed by the integration of areas such as automated reasoning, computer algebra, mathematical publishing and user interfaces.
- The article Linked Data Notifications co-authored by CISA student Amy Guy won "Best Student Paper" prize at the 2017 Extended Semantic Web Conference
- The University of Edinburgh was awarded funding for the EU H2020 project DARE, which will deliver new methods and tools for data-powered collaborative research at extreme scales. This builds on the sustained collaboration between EPCC and the School of Informatics initiated in the e-Science era and on EU projects ADMIRE and VERCE.

## **SCHOOL OF INFORMATICS**

PLANNING SUBMISSION 2017/18 to 2019/20

### **Introduction**

For its 2016-19 plan, the School refreshed its high-level strategy and developed a more action-oriented approach to planning. As noted in the 2016-19 and 2017-20 plans, many of the actions identified span more than one year and this plan will reflect on success to date in implementing those actions and add new and updated actions, where necessary.

Delivery of the plan is monitored by the School's Strategy Committee with detailed implementation and monitoring of areas of activity (eg research; learning, teaching and student experience; student recruitment; equality and diversity; etc) delegated to the corresponding School committees.

This plan briefly considers the operating environment before going on to consider each of the main areas of activity of the School, identifying existing strengths, opportunities and consequent actions. Inevitably, such a plan cannot cover everything in which the School is engaged; however it is intended to provide a sense of direction that will assist in the allocation of resources and prioritisation of actions, over the planning period. As ever, the plan will be continually reviewed and updated annually.

### **Environment**

The external environment continues to be one of some uncertainty and challenge.

To the issues identified in the 2016-19 School Plan, largely replicated below, is the added and very significant uncertainty created by 'Brexit'. This already has had some impact on our ability to recruit academic staff. 'Brexit' has also raised concerns amongst current staff who are EU citizens, regarding their ability to remain in the United Kingdom in the longer term. The University has taken steps to reassure EU staff, as far as it can, and to lobby for an early and positive resolution to their status. The School supports these initiatives. The high visibility of the University in support of its EU staff has been widely welcomed and has gone some way to allaying their anxieties.

So far, there is little evidence of an impact on demand for Informatics courses from non-UK European students (although this is not uniform across other Schools), however this is unlikely to be the case should such students require study visas and be subject to higher fees, in the future. This is of particular concern given the relatively high proportion of the School's student intake, at all levels, who are EU citizens. The School is keen, therefore, to collaborate with others within the College and within central Recruitment and Admissions to increase the proportion of applications and entrants from those domiciled in Scotland. Also, it is important that in the interim, pending an eventual outcome to 'Brexit', the University and the Scottish Government continue to provide undertakings to EU entrants regarding their fee status, for the duration of their programme of study.

Similarly, the School has continued to be successful in applying for EU research funds. Indications from the continued lobbying efforts of the Universities and Learned Societies make us optimistic that there will be some continued access to European funding even after the formal withdrawal, certainly within the transition period and possibly beyond that. This access is important as the potential loss of access to such funds, post-'Brexit', would add to the challenge of maintaining and growing research funding in a context of increasing competition for reducing real terms funding. In these circumstances, it is essential that the School maintains its reputation and leading position in informatics in the UK, whilst further enhancing our international profile.

The increasing role of 'Global Challenge' funds in research presents a further challenge for the School, as the nature of much of the School's research does not easily meet the criteria for such funding. This has required the School to seek opportunities for collaboration with colleagues in other Schools within all three Colleges of the University, an approach that has produced some success.

In contrast, as part of our diversification of research funding we have substantially increased funding from industry and this leaves us well placed to take advantage of opportunities presented by the Government's Industrial Strategy. Recently this has been evident in success in the Robotics Hubs but there are a number of other promising strategic partnerships in development in the School and these articulate well with the ambitions of the School for its Centres for Doctoral Training

The 2016-19 plan identified the challenges posed by UK Visas and Immigration (UKVI) and its requirements in recruiting non-European staff and students. This included the increasing costs, including NHS charges, being placed upon those entering and remaining in the United Kingdom. In the case of staff, the University has introduced a policy of reimbursement of these costs, which is especially welcome in the case of early career researchers, at lower grades.

The effective devaluation of the pound sterling, against most other currencies, should improve the affordability of University of Edinburgh programmes of study to non-EU/EEA students. The School has strong recruitment of overseas students to undergraduate and postgraduate taught programmes. These students make an important contribution to the School, in many ways. Further judicious planned growth in this segment will provide some mitigation for a potential decline in EU/EEA entrants.

Whilst there are clearly challenges and threats on the horizon, as noted above, current demand for the School's taught programmes continues to be strong and increasing, as evidenced by our recent student intakes, especially of postgraduate taught students. This growth, though welcome in many ways, has presented the School with a number of challenges as growth in student numbers has outpaced growth in academic and support staff and has required the School to review its processes and systems. The School also needs to be aware that trends can change quite rapidly and therefore longer-term sustainability needs to be considered.

In relation to research students, there is a similar high dependency on non-UK EU/EEA applicants. Demand from overseas students is high, also, however the difficulty in securing funding for the relatively high fees means that the School's ability to accommodate such students is limited. The School is pleased to be taking part in the introduction of the 'Edinburgh Enlightenment Scholarships' which is intended to make it more affordable for postgraduate research students from overseas to undertake their doctoral studies at Edinburgh. The School continues to believe that, because of the high fees for overseas research students, there is a missed opportunity to recruit excellent students who could make a very significant contribution to the School and to the discipline. As a consequence, the School has invested a significant proportion its increased core funding for doctoral students to bridging the gap between UK/EU/EEA fees and overseas fees, for such students.

Our research, researchers and graduates are in high demand, also. Both governments and the private sector are investing heavily in research and in product development in our discipline areas. Government and the private sector are our funders, customers and collaborators but also our competitors. It is important therefore that we continue to focus on quality and on our reputation to provide us with our competitive edge when competing for resources and for people.

Industry, in particular, is able to offer packages far in excess of what the University can provide and this increases the challenge in retaining and recruiting staff. We are seeing an increase in the number

of staff who hold part-time appointments in industry as well as with the School and also staff who spend periods, such as sabbaticals, in industry employment. Such arrangements bring benefits to the School, providing that they are not seen as a stepping stone from full-time employment in academia to full-time employment in industry.

A significant element in our competitive edge is our reputation for engagement with industry, from spin-outs and start-ups to unicorns and multi-nationals. Initiatives such as the Data Lab Innovation Centre, The Alan Turing Institute and the University's new Bayes Centre for Data Science and Technology provide opportunities for the School to further enhance its industry engagement and profile.

Due to open in Summer 2018, the Bayes Centre will provide a new physical and intellectual environment for the School, adding much-needed space to accommodate successful PhD and CDT (Centres for Doctoral Training) programmes, plus space for groups associated with the Alan Turing Institute; but also catalysing new collaborations within and beyond the University. The six floors are intended to house the following academic-based groups:

- The International Centre for Mathematical Sciences
- The Maxwell Institute Graduate School for Analysis and its Applications
- The DataLab Innovation Centre
- The Alan Turing Institute
- Edinburgh Parallel Computing Centre
- The School of Informatics:
  - Robotics and Autonomous Systems, Pervasive Parallelism, Data Science, Commercialisation
- The School of Design:
  - Design Informatics

A whole floor of the new building, at the heart of the interdisciplinary environment, is reserved for strategic corporate R&D partners from industry. As a major stakeholder in the Bayes Centre, the School will contribute to development and delivery of the Bayes Centre industry engagement, commercialisation and business development programme, building on the School's track record of success in these areas, including through the Informatics Ventures programmes.

The School has returned its dedicated teaching space, along with staff of the teaching organisation, graduate school and computing, to the re-clad and refurbished Appleton Tower. After two years of decant, the return to the upgraded facilities has been widely welcomed. An internal reconfiguration has increased student desk spaces by over 60%, however the additional space is already fully committed due to the growth in the student cohort, over recent years. In addition to the work already undertaken, the School has plans to further upgrade teaching spaces in Appleton Tower to meet modern teaching needs.

The most disruptive work on the Bayes/DTI project is now complete and the School, along with others, is planning for the occupancy of the new building. Meantime, the School's commercialisation and industry engagement team, along with some others, remain decanted to the Wilkie Building.

There are no current internal works in the Informatics Forum, however further reconfiguration will be required over the coming year to accommodate growth in staff and an increased requirement for meeting spaces.

There are a significant number of change initiatives within the University, including the Service Excellence programme, currently addressing student administration, human resources administration and finance. Student recruitment and admissions are also under review. Additionally, the University is introducing a new resource allocation methodology. Potentially, these will provide improved management information and greater transparency as well as improving effectiveness and efficiency. It is important that the School, along with other Schools, contributes to these initiatives in order to make sure that the proposals and outcomes meet the operational needs of those at the delivery end of the University, as well as meeting the strategic objectives of senior management. The School experience, as a pilot School for the introduction of Worktribe, provides a clear example of the necessity of taking into account the operational needs of Schools when undertaking such initiatives. The School will therefore pro-actively engage with the various project teams, however the number and concurrency of these initiatives places a significant demand on the time, in particular, of staff in support roles at all grades, on top of their day-to-day duties.

## **Research**

Informatics is a young and continually evolving discipline, with new subfields emerging, driven by both basic questions and technological advances. Moreover the pace of development is accelerating. This creates opportunities for investment. It is crucial that the School maintains breadth as well as depth in its research, and that it is sufficiently nimble to be able to invest in emerging areas. This is particularly important in an uncertain and changing funding landscape.

On the other hand, there are also threats from this rapid evolution and it is equally important that the School retains core expertise in fundamental areas needed to underpin the emerging fields. The expansion of the School also poses challenges for keeping a sense of community amongst the researchers in order to ensure that opportunities for cross-disciplinary research are not missed. Furthermore, fostering stronger communication and awareness across the broad areas of research activity within the School will strengthen the support and peer-mentoring for all researchers, leading to greater success.

Our objective is to retain and enhance our standing as an internationally leading research centre for Informatics. We will build on our existing strengths and seek to create an environment that allows all our researchers to reach their full potential. The School maintained its position as the lead institution in Informatics in the 2014 UK-wide research excellence framework (REF) and we aim to keep this position in the next REF. We are not complacent about this, as we know that our competitors are also developing in both volume and quality, and we must do the same. Impact is an area within the REF where we have scope for improvement and we have put in place the mechanisms within the School to ensure that we can maximise our impact in the broadest sense.

### Review of previous year

The number of academic staff within the School continues to increase with a total now in excess of 120 compared to fewer than 100, at the last REF census date.

We have introduced new research themes within the School in the Internet of Things, Deep Learning, Programming Languages and Data-centric Systems. These enhance cross-Institute linkages through a challenge-led approach to research. The School's focus on the Internet of Things led to two university-wide workshops which brought together a wide range of researchers from across the University, providing both a technical and applications perspective.

We improved our grant capture success by over 40% in value, year-on-year. Further analysis of research award performance is provided in the section on College growth targets, towards the end of this document.

A renewed focus has been placed upon mentoring of research staff, especially those at an early stage in their career, with encouragement to make independent grant and fellowship applications.

We have also supported a small number of external candidates in preparing applications for personal fellowships with a view to hosting them at Edinburgh.

A particular area of success has been in significantly increased research funding for Robotics, secured by existing and new staff. The School's strength in this area, and our partnership with Heriot-Watt University in the Edinburgh Centre for Robotics, attracts both attention and funding.

The arrival of the ANYmal robot in early 2017, added to the Valkyrie humanoid robot from NASA, represented an additional capacity within the Robotics group. The group has continued productive industrial engagement with a number of key industrial partners including Hitachi, Honda and Kawasaki. Industrial engagement has also been increasing in other parts of the School, including the ARM Centre of Excellence being established in the Institute of Computer Systems Architecture (ICSA). Further industry funded partnerships were established with Huawei and with IOHK (Hong Kong), the latter creating a new blockchain technology laboratory.

The School was very pleased to be awarded Academic Centre of Excellence status in Cyber Security, following an application led by Prof David Aspinall. This brings visibility and new opportunities for research funding in this important topic, which we are seeking to exploit. Additionally we are a member of the SICSA Cyber Security Nexus, a Scottish Government funded project to enhance cyber security awareness and networking across Scotland.

We have increased our engagement with the Alan Turing Institute, with a number of staff being awarded ATI Faculty Fellowships.

To encourage cooperation between researchers in the School and those in the Edinburgh Parallel Computing Centre, seed corn funding for exploratory research projects has been provided. At least one of these has led to a full funding application to UKRC.

We continue to place focus on grant applications, key success factors, diversification and grant value. With respect to the latter, we currently have four programme grants in development.

We held our second 'Research Day', open to all researchers and research support staff within the School. This provided a forum for those involved in research to meet with others, across Institute and organisational boundaries. It was an opportunity to discuss research challenges and opportunities and to elicit views on the direction of research within the School. This year's event was attended by a representative of EPSRC, which was a particular achievement for the School.

The series of 'research lunches' has continued, where researchers from all Institutes can consider and discuss current issues relevant to the research community. Themes have included Research Data Management and Ethics and Integrity.

### Existing Strengths

- Based on 'research power' the School of Informatics is the UK leader in Informatics research with an international reputation and unparalleled multi-disciplinary breadth.

- We are a joint venture partner in the The Alan Turing Institute, confirming our leading position in Data Science and Artificial Intelligence and further enhancing the profile of the School.
- Our three EPSRC funded Centres for Doctoral Training are now in their third year of recruitment and are well established with excellent academic and industry reviews. We are seeking their continuation through new bids to the 2018 EPSRC CDT funding call.
- Our full cohort of postgraduate research (PGR) students, including all students not yet graduated, is around 330. This is one of the largest PGR cohorts in the UK and its scale is a significant factor in attracting further students and high calibre staff to the School.
- We participate in five EPSRC programme grants and one platform grant, bringing £7.3m in funding to Edinburgh.
- Through its Robotarium, the School provides a Robotics research and education facility, unparalleled in the UK, and partners with Heriot-Watt University in the Edinburgh Centre for Robotics. The School is a partner in the recently announced EPSRC-funded research hubs in nuclear decommissioning, in space robotics and in oil and gas.
- The School retains strong track record of securing research grant income from a range of funders, including the United Kingdom Research Councils (RCUK), the European Union, UK and overseas Government bodies and industry. The School has secured recent growth in funding from industry which is seen as a key to future sustainability as well as providing a foundation for future Industrial Strategy Challenge Fund opportunities.

#### Opportunities

- Artificial Intelligence is currently a very dynamic topic with many exciting opportunities. Moreover it has been identified by the UK Government as a pillar of its Industrial Strategy. Based on REF2014 data, the School of Informatics is the largest grouping of AI researchers in the UK. Thus we are well placed to take advantage of opportunities in this area and are poised to do so.
- One of the themes of the Edinburgh and Region City Deal is data-driven innovation and the School is well placed to contribute across areas such as Fintech, robotics and creative industries, amongst others.
- The Edinburgh Futures Institute provides a framework for expanding our collaboration with Schools within the College of Arts Humanities and Social Science and especially with the Business School. Current focus is on potential teaching and CPD opportunities, but the increased interaction between the Schools will lead to research opportunities, also.
- There is wide and increasing recognition of the relevance of Data Science and Informatics to other fields of study, providing opportunities for the School to selectively and strategically establish partnerships and to extend the inter-disciplinarity of the School's research and teaching.
- The University is developing the Bayes Centre adjacent and contiguous to the Informatics Forum, completing the development of the Potterow quadrangle. The new building provides additional space for multiple groups within and beyond Informatics, along with significant new lab space for the Robotarium, which will be the new home to the School's NASA Valkyrie space robot, and for Design Informatics.

- As well as space for research and doctoral training, the Bayes Centre seeds opportunities to interact and develop alliances with the other research communities and industry partners who will be co-located. The presence of the University's Edinburgh Parallel Computing Centre presents particular opportunities for closer collaboration. Bayes also will facilitate strengthened interdisciplinary links with Edinburgh College of Art (eg through Design Informatics) and with the School of Mathematics as well as new opportunities for industry links.
- Our fundamental strengths in foundations, programming languages, databases, system architecture, robotics, machine learning, artificial intelligence and natural language processing mean that we are well placed to contribute to the development of innovative applications.
- As the centre piece of NASA's Space Robotics Challenge, the Valkyrie platform allows our robotics group to closely collaborate with leading research groups in the field from Florida's IHMC, MIT and Northeastern University.
- The breadth of disciplines and research within the University of Edinburgh provides opportunities to collaborate with other Schools in inter-disciplinary research, such as that funded through the Global Challenge Research Fund.

### Actions

1. We will continue to invest in our fundamental areas of strength, including seeking to fill the vacant chair in Computer Science (Algorithms and Complexity) providing that a suitably strong candidate or candidates can be identified.
2. We will identify and evaluate opportunities in developing new areas of research to ensure that the School remains at the leading edge of Informatics. Current research drivers include (in no particular order):
  - Internet of Things
  - Big data
  - Privacy and security
  - Human-robot interaction
  - Speech and language processing
  - Explainable AI
  - Human- data interaction
  - Post-Moore computing
  - Algorithmic foundations of data science
  - Cloud computing and virtualisation
  - Health and biomedical informatics
  -

These stimulate new foci for foundational research in areas such as algorithms and complexity, databases, machine learning, distributed computation, and software and systems architectures.

3. We will maintain our grant success rate by:
  - a. Identifying and sharing success factors and through more structured mentoring for early career academics by more senior staff.
  - b. Improving our engagement with funders so that we may better understand and articulate the alignment between their objectives and the School's research capability.
  - c. Reviewing our grant profile and explore the scope for increased focus on larger grants.

4. Where appropriate, we will continue to mentor, encourage and support research staff to submit grant applications as Principal Investigators, to assist in their personal development and to increase the potential volume of our REF2021 submission.
5. We will encourage Fellowship applications and support applicants through peer-mentoring. We will backfill positions of those who are successful as a means to secure further quality and increase volume in the lead up to REF2021.
6. We will review opportunities for further programme grants.
7. We will review the scope and structure of our Institutes to ensure that they continue to cover the range and balance of activities reflective of our rapidly developing academic disciplines, whilst also providing an effective management structure for the School's research.
8. Furthermore, we will seek to enhance cross-institute linkages through challenge-led research themes. We will foster multidisciplinary research through strategic appointments.
9. Work will continue on preparation for REF 2021 (see below) and the resources available and required to support the School's REF submission will be reviewed as planning progresses. We will participate in the planned mock REF in 2018, which will inform our further REF preparations, thereafter.
10. We will consider an investment in a new research group in Applied Robotics, led by an externally advertised chair.

#### REF 2021

The School has appointed a REF Coordinator and an Impact Coordinator, in anticipation of the 2021 Research Excellence Framework submission. Together with the Director of Research, the Director of Professional Services and the Research Data Manager, these two posts form the School's REF planning and preparation team, with others co-opted, as required. The group meets fortnightly and reviews preparations and identifies necessary actions.

The School participated in the University-wide REF-readiness exercise in 2017. This identified only a small number of cases where there was concern regarding REF eligible outputs and those staff are being supported in bringing their outputs to an acceptable level.

It has been agreed that independent researchers in EPCC will be included in the Informatics and Computer Science Unit of Assessment. The School has been offering support and advice to facilitate their participation. The School will also work with EPCC to identify any potential REF impact case studies arising from their work.

The School has well-developed structures, policies and processes to support the recording of data in PURE and to ensure that publications are made available as open access, and recorded as such, within the set timescales. Reporting on the data held in PURE shows the School to have a very high level of compliance in relation to open access.

#### **Research Training**

The School has one of the largest cohorts of postgraduate research students in the UK. The factor of scale is a significant attractor of academic staff and of further research students.

### Review of previous year

In response to student feedback, the School has taken steps to increase the sense of community amongst research students, through additional events and opportunities for cross-Institute interaction.

The Graduate School is continuing to focus on increasing the proportion of students submitting within four years of study. This includes a structured approach to identifying those at risk of exceeding this timeframe and earlier intervention where interruptions are appropriate because of a student's particular circumstances.

In line with the stated intent, the School increased its core funding of PGR studentships for 2016/17 and has continued this in 2017/18. This is in addition to funding studentships for new academic staff. Core funding for PGR studentships is planned to increase further for 2018/19 and beyond. Some of the increased funding has been used to allow the School to recruit additional overseas students, for whom PGR fees are significantly higher than UK/EU students.

The School is piloting the University's new Edinburgh Enlightenment Scholarships for PGR students. We are hopeful that this will allow us to further increase the proportion of non-EU PGR students within the School.

During the year, proposals were developed to adopt a more focused, School-wide, approach to PGR recruitment and admissions. This included the launch of new School-funded scholarships. This is meant to simplify the proposition and process for new applicants and consequently enable the School to attract the best applicants and to improve conversion.

### Existing Strengths

- The reputation and profile of the School and its staff, linked to the scale of the PGR cohort, are major attractors of high quality applications for postgraduate research studentships.
- The School hosts three EPSRC-funded Centres for Doctoral Training, one in collaboration with Heriot-Watt University, each of which has received excellent academic and industrial reviews.

### Opportunities

- The financial position of the School has made possible a significant increase in core funds for research student intakes.
- Each year, the School turns away applications from outstanding candidates for research studentships because of the relatively high fee level and limited funding for those subject to overseas fees. The Edinburgh Enlightenment Scholarships, and additional School funding for PGR students will allow the School to increase its intake of such students.
- The performance to date of the School's Centres for Doctoral Training provide a degree of confidence that the School is well-positioned in relation to the new EPSRC funding round for CDTs.

### Actions

1. Subject to the financial performance of the School being as projected, we will continue to increase the current level of core School-funding to the annual intake of postgraduate research students. This is in addition to the School's funding of CDT student intakes and funding provided by Institutes.

2. We will take steps to ensure that an increasing proportion of doctoral students submit within no more than four years study, through better use of data on progress and enhanced monitoring.
3. We will seek to enhance the experience of all PGR students, taking advantage of the opportunities and experience provided through the CDT model of student engagement and support.
4. In the forthcoming round of EPSRC CDT funding, we will seek continuation of our existing Centres for Doctoral Training and we will make application for up to two additional CDTs.
5. In the event that the School is successful in hosting future CDTs, we will seek to further integrate them within the Graduate School structures and to seek improvements in resilience in their administration, through greater sharing of resources.

### Centres for Doctoral Training (CDTs)

The School's current Centres for Doctoral Training (in Data Science, Pervasive Parallelism and Robotics and Autonomous Systems, the latter led by Heriot-Watt University) have all proved very popular with students and have received excellent academic and industrial reviews. The School places a high priority on research training and therefore we will make applications for continuation of the existing CDTs, with appropriate revision to their scope and operation. In addition, we consider that we have capacity for up to two further CDTs and we will make applications in areas in which the School has existing and developing research strengths and which are consistent with the themes identified by EPSRC in the funding call.

### **Innovation, Knowledge Exchange and Impact**

As well as its foundational research, the School undertakes translational research that has and will have significant industry, social and policy impact.

The School has a strong reputation for industry engagement, commercialisation and entrepreneurial support.

The School has three major activities in business development:

1. The core School of Informatics business development team which leads the business development activities for the Schools' institutes and the three CDT's.
2. The Informatics Ventures team which leads the national programme of technology entrepreneur support funded by Scottish Enterprise and University of Edinburgh.
3. The School is also responsible for the newly formed Bayes business development team which, working with other Bayes Centre stakeholders, will build new partnerships for the Bayes Centre and support the commercial activities of the Alan Turing Institute in Scotland - which will be based in the Bayes Centre.

With other sources of funding under threat and/or increasingly competitive, it is important that the School continues to develop collaborations with industry in research, consultancy and studentships.

### Review of previous year

1. The business development team successfully won a £2.75M investment from Scottish Enterprise: the Bayes Innovation Programme (BIP) - Project A. This is the initial phase of the Bayes Innovation

Programme that will focus on company engagement and entrepreneurship to generate new strategic corporate collaborations, create and scale high growth ventures, attract new investment and deliver economic benefit through Data Driven Innovation (DDI).

The BIP - Project A is a key initial component of the overall Bayes Centre for Data Science and Technology (Bayes Centre) that UoE and partners are developing to support Edinburgh City Region's ambition to become the "Data Capital of Europe".

The £40M Bayes Centre building is scheduled for completion in 2018. It will enable the co-location of teaching, research, commercialisation and knowledge exchange staff from a broad range of data-related disciplines, alongside Industry R&D staff.

The BIP - Project A will build on the successful track record of delivery in knowledge exchange by UoE Informatics business development team.

The BIP - Project A will deliver six SMART objectives:

- Attracting 15 corporate R&D teams to establish a presence in or near Bayes
- Securing a minimum of 90 new jobs by attracting these corporates
- Establishing 6 additional high-growth ventures
- Supporting a minimum of £45m in investment in high-growth companies
- Generating over £17m of revenue to support research, innovation and entrepreneurship
- Delivering a business case for the follow-on Project B

BIP – Project A is funded until December 2020

2. The Informatics Ventures technology entrepreneur support programme for startups, SME's and scaling companies has seen a further successful year, with its flagship EIE (Engage, Invest, Exploit) technology investor programme delivered annually. It is the largest technology investor showcase of its type outside London and has helped tech companies pitching at it to raise in excess of £400 million in the period since 2008.

In the period since its inception in 2008, highly significant intellectual capital has been built up in Informatics Ventures – its people and their skills, know-how and expertise, its relationships with investors and their networks across many borders, not to mention the strong and vibrant relationships with technology companies all across Scotland. The Informatics Ventures brand is now well-recognised, not only in Scotland but also further afield.

In 2017, significant progress has been made on a number of fronts, not least engaging corporate partners in sponsorship deals – by EIE 2017, the number of corporate partners had risen from five to eight and sponsorship income has risen to £95,000, up 110% on 2016. Longstanding sponsors like MBM Commercial and Royal Bank of Scotland renewed their sponsorship but at a higher level and new sponsors came in at an even higher level still and include the blue-chip firm, Cazenove Capital, the wealth management services of Schroders plc, managing almost £34 billion annually. The cash value of these corporate relationships aside, the Informatics Ventures team has leveraged and will leverage access to their extensive network of high net worth individuals and affiliated organisations to drive investor interest in Scotland's growing technology sector.

For 2017, from the data on attendee numbers, we would highlight the following:

- Transitioning EIE to a paid-for model in 2017 has had minimal negative impact on overall numbers attending in 2017 – 844 vs. 927, i.e. 91% of the 2016 figure.

- The percentage of those who registered but did not attend on the day has reduced significantly, from >30% in 2016 to just 6% in 2017 thereby minimising waste and cost.
- The percentage of investors attending is more or less stable at 25% (relative to 27% in 2016) and gives us our baseline from which we can grow in coming years.

The experience of 2017 gives us a firm foundation to build on into 2018 and beyond, to materially and positively impact on how technology entrepreneurship is supported in Scotland. In preparation for EIE 2018, we have now secured 11 Gold Sponsors, many on multi-year terms.

3. 2017 has seen a number new and enhanced industry partnerships and engagements, including the following (the list is not exhaustive):

- ORCA Hub (Offshore Robotics Certification of Assets)
- National Centre for Nuclear Robotics (NCNR)
- Space (FAIR-SPACE)
- IOHK Blockchain Technology Laboratory
- Huawei – Framework Agreement and IP collaborations
- Huawei – Research Laboratory
- Synopsys – Broader engagement
- Toshiba
- Samsung Polska
- Booking.com
- UBS
- FiveAI – Broader engagement

#### Existing strengths

- The School has an excellent reputation for industry engagement and commercialisation.
- The School has an Industrial Advisory Board for Curriculum and each of the three CDTs has a very active industry/research day and associated IABs;
- We are widely recognised as one of the originators of the local technology entrepreneur and innovation ecosystem represented by the Edinburgh technology cluster (now the largest in the UK outside of London) and have active links with over 100 companies, including local, national and global businesses. The School itself has been the originator of some 70+ new spin-outs and start-ups in the last ten years and is one of the leading Schools in the UK in this area;
- We host incubator space for early stage start-ups, facilitating staff and student business creation and opportunities for interaction between the start-ups and staff and students;
- The Scottish Enterprise funded Informatics Ventures technology entrepreneur support programme enhances the School's industry profile and creates opportunities to extend industry networks. Through its EIE (Engage Invest Exploit) events it provides a forum for start-ups, SME's and scaling companies to gain access to finance. It also has become a platform for alliances with other leading institutions – e.g. EIT Digital – because of our leadership in this area;
- The School and our staff and students undertake and participate in many outreach and public engagement activities, including in the Edinburgh International Science Festival. As one example among many, the School's Robotics research receives extensive coverage in external events and through the media, including television.

#### Opportunities

- The reputation of the School's research and its relevance to many aspects of modern business and life create myriad opportunities for industry and community engagement;
- These factors combine to make the School a very attractive partner to private and public-sector organisations wishing to access the intellectual capital of the School;
- The Centres for Doctoral Training and, more recently, the School's involvement in The Alan Turing Institute, all based in part upon our strong industrial support, have created further opportunities for industry engagement;
- The Bayes Innovation Programme – Project A will provide new opportunities to develop strategic alliances with major private sector players who are expected to base research and development teams within the building, help promote the creation of new high-growth potential technology companies and continue Informatics Venture essential role in supporting and promoting Scotland's technology ecosystem.
- The opportunity and challenge is to leverage these 'attractors' with an efficient and structured approach that optimises the benefits to our staff and students, and to the School in general.

### Actions

1. We will pull together multiple strands of our industry engagement into a structured programme which maximises benefits to Informatics and its close connections. This will include co-development with Scottish Enterprise of the Bayes Innovation Programme;
2. Having successfully secured funding for the next phase of the Informatics Ventures (IV) programmes, including the EIE investor readiness programme, we have a solid basis for the coming three years and beyond. The EIE franchise will be developed and refined both in Scotland and further afield in collaboration with, for example, the Governments of Nova Scotia and Ontario in Canada, as well as relaunching a technology company showcase event for investors in London based on our experience and expertise in delivering EIE London;
3. We will continue to develop a database of industry, public engagement and outreach activity. This will include identifying, monitoring and tracking potential case studies to underpin an enhanced impact submission to REF2021.
4. We will raise the profile of our public engagement and outreach activity and improve alignment with our own objectives and those of the University.

### **Learning, Teaching and Student Experience**

The relative youth of Informatics forces the need for continuous review of our teaching and learning to take account of the diffusion of research into the curriculum. A reflective process is underway to review our pedagogy, simplify our programme structures, and achieve efficiencies in our delivery (including in assessment). Our goal is to engage the whole School community (Students, Academics, Administrators and Support Staff) in this process. This will transform our approach to Learning and Teaching over the next three years. Some of this is already being implemented but we anticipate more significant change in AY 2018/19

Our planning is aligned with the seven actions identified in the University Learning and Teaching strategy. These are listed below together with the main actions we are taking to implement the strategy in the School of Informatics.

**A) We will work in partnership with students to bring about enhancements to learning:** We are working closely with our student body in particular we are continuing with our weekly meetings with student representatives. We have enhanced support for InfPALS and we are working closely

with COMPSOC on community building events that reach out to all students. As our online cohort grows we will extend mechanisms to include this group. Our Teaching and Learning Enhancement Board also includes student representation and we will aim fully to engage with students in this activity.

- B) We will develop and enhance our curriculum:** We continue to develop our interdisciplinary approach: Design Informatics is now well-established and we are about to embark on a range of joint Masters programmes with the Business School including Fintech and Business informatics. In the context of Bayes and EFI we are also contributing to online learning at scale initiative in Data Science and Artificial Intelligence. The award of the Cyber-Security Centre of Excellence will see further development in this area and new hires have secured our Learning and Teaching in this area and provide a good basis for the development of courses linking to Internet of Things. City Deal also provides an incentive to develop further training in areas such as robotics. We are also working with Skills Development Scotland and Scotland IS on the development of Digital Skills training. Our curriculum review is rationalising the curriculum to ensure courses are well resourced.
- C) We will use the flexibility of the standard undergraduate degree structure to build a rounded learning experience:** We are exploring opportunities to extend more of our programmes to Integrated Masters. This will enable more project work and better linkage to research. In the area of Data Science we are exploring new collaborations with School of Mathematics to develop new undergraduate programmes and to incorporate the offer of Modern Apprenticeship positions that will allow extensive interaction with sponsoring companies throughout the programmes.
- D) We will offer our postgraduate taught students the opportunity to develop cutting edge and advanced skills and knowledge in their chosen field:** We are full participating in the DSTI programme and to initiatives in EFI and Bayes. We are exploring possibilities better to manage demand for our Masters programmes (we are seeing a 70% increase in applications in the current recruitment round). Our limiting factors are supervisory capacity and high demand for certain specialities (especially Data Science). We are looking to innovate in project supervision to see if we can increase capacity by considering project group supervision and workplace supervisions and we are revising the curriculum to give us better control over student numbers on courses. We are also investigating the development of a two-year MSc the first year of which could be done online with the option of completing a professional project if students decide to opt for a one-year 180-credit MSc instead of the two-year 240-credit Advanced MSc. This approach will be based on experience from our Advanced MSc in Design Informatics.
- E) We will nurture a learning community that supports students:** Our key initiative in the coming year will be to develop a much more comprehensive transition programme to support arriving students both at undergraduate and PGT level to adapt to the mode of working in the School. The goal will be to provide support in adapting to new study modes, new forms of assessment and the need for improved time-management. We will continue to expand our InfPALS programme and will also offer participation in our Programming Club to all first and second year students in order to help structure their acquisition of programming skills. We will also revise our PT structure to incorporate Student Support Officers who will aim to strengthen pastoral care and rationalise our approach to Special Circumstance to align with developments in the Service Excellence Programme. Our curriculum review and course framework will also ensure a more manageable workload for students.

- F) We will recruit and nurture excellent teaching staff:** We have recruited two FTE University teachers who are providing important support to lecturers on high demand courses and are developing their own teaching expertise. We anticipate additional hires based on an evaluation of the effectiveness of these posts. We have also hired a learning technologist whose main role will be to facilitate the adoption of University systems into our teaching delivery. We are encouraging PTAS activity and have two projects running at the moment aimed at exploring learning to program and the use of digital media in teaching and learning both of these will be showcased in the School. We are also identifying good practice and one of the roles of the University teachers will be to look at how to transfer good practice from course to course. One of our University Teachers is tasked with developing our tutoring and demonstrating training programme and we anticipate this will be extended further to provide additional development for more experienced tutors. We are also developing a new teaching allocation model that will improve transparency of this process.
- G) We will optimise academic and professional support staff time devoted to core learning and teaching activities:** We are working develop approaches that leverage University systems to allow us to optimise time spent on activities such as Tier 4 monitoring. This has led to a streamlining of our approach and to better monitoring and compliance. We are working closely with SEP in Student Administration and in Recruitment and Admissions to see how best we can utilise the improvements arising from this programme.

#### Online Learning

We now have seven distance courses based on established on-campus courses: *Introduction to Vision and Robotics; Advanced Vision; Agent Based Systems; Introductory Applied Machine Learning, Image and Vision Computing, Introduction to Java Programming and Performance Modelling*. The first two are offered through the new postgraduate online Data Science, Technology & Innovation programme. These courses will form the core of a postgraduate certificate (PgCert) in Informatics, currently in preparation. We are also involved in planning for micro masters in AI and Data Science and we are exploring participation in programmes associated with EFI and the Business School. We have paused the creation of new online courses awaiting the arrival of our Learning Technologist and the outcome of plans around the Distance Learning at Scale Initiative because having a clear view of the requirement of this initiative may require some reshaping of our online offering.

#### Review of previous year

We have rolled out end of semester examining more fully and continue to review this. We believe we will complete this process over the next two years.

We are investigating a new allocation of teaching duties process that is more closely related to student demand for courses. This is being refined at the moment and the results will be evaluated in the 2018/19 academic year.

We have thoroughly revised our approach to tier 4 monitoring and believe we have a more robust and manageable approach than previously. Initial indications indicate our approach is also more efficient than our previous processes.

We have implemented new processes to manage significantly increased applications for our courses, both undergraduate and taught postgraduate, both of which continue to show increases in demand. This will involve more extensive use of gathered fields and deposits for MSc courses. We are monitoring this to see if it improves our selection process.

We continue to tackle the need for improved programming skills in our students. We have significantly expanded our “Programming Club” activities this year and we are supporting new student societies including one devoted to competitive programming. Our goal is to provide a spectrum of opportunities that match the interests and abilities of our students.

We have developed a new system for the management of student projects and have reviewed this and introduced some changes for the current year so we can better meet the needs of staff and students.

We continue to work with students on the development of the teaching space in Appleton Tower. We anticipate a complete re-design of the level 5 laboratory and the development of more specialist teaching facilities.

#### National Student Survey

Our 2016/17 National Student Survey results were disappointing and did not reflect the significant effort that the School has made towards improving the student experience. We have reflected on the results and consulted with current students. The actions detailed in this plan address specific factors identified through that process and also feedback from the Postgraduate Taught Student Experience Survey. In addition the University has put in place the Informatics Teaching and Learning Enhancement Board and we are working closely with the Board to enhance Learning and Teaching in the School.

#### Existing strengths

- We are one of only three Computer Science schools in the UK with a silver Athena SWAN award.
- Our teaching is driven by world-leading research, highly attractive at undergraduate and masters levels, and informed by the latest research developments and emerging trends.
- Our extensive course portfolio covers the entire spectrum of Informatics, including foundations, technologies, cognitive science and cognitive neuroscience.
- Our core undergraduate disciplines are Computer Science, Artificial Intelligence, Robotics, Software Engineering, and Cognitive Science. We also offer a range of combined degrees. An integrated five-year Masters degree (MInf) provides a programme of study spanning theoretical foundations, programming languages, databases, systems architecture, machine learning, artificial intelligence, robotics and natural language processing.
- We offer seven taught one-year masters (MSc) programmes, with over 300 students enrolled in 2017/18, and contribute to the MSc in Speech and Language Processing, led by the School of Philosophy, Psychology and Language Sciences.
- We offer substantial project-based learning opportunities integrated in every degree programme.
- Staff within the School are active in outreach activities to increase interest in informatics and computer science amongst school pupils. This includes using material developed for the *Code Yourself!* MOOC (massive open online course) for use in schools and at science festivals.
- The School has strong links to industry, ensuring the currency and relevance of our curriculum to a wide range of careers and excellent graduate employability.

- The School produces highly skilled graduates, much sought after by industry. We are working closely with Skills Development Scotland on Digital Skills.
- We have effective structures and processes for student engagement and feedback and there is a strong sense of community within the student body.
- We are building strong interactions with School of Mathematics and the Business School through activities associated with the Bayes Centre and EFI.

### Opportunities

- Coding skills are highly valued by employers and we can further increase employability and market value of our graduates through ensuring that all students develop these skills through curricular and extra-curricular study and activities.
- We can further improve student satisfaction through continuous enhancement of our feedback and assessment. With the re-opening of the Appleton Tower we also have an opportunity to develop the environment jointly with the students better to meet their needs.
- There is the opportunity to simplify the curriculum through a review to identify a set of courses which provide core and underpinning knowledge and a complementary and more fluid inventory of specialist courses which add depth and flavour to our curriculum. Our curriculum review is bringing forward proposals that will see the implementation of revised curricula over the next two years
- There is the opportunity to develop a limited number of new specialist courses, especially at honours and masters level, which will maintain the currency of our offering. In particular we are developing cybersecurity and Internet of Things courses. We are also reviewing current provision and identifying potential for revision of course offerings.
- Developing additional Learning and Teaching roles: University Teacher, Student Support Officers and Learning Technologists provides better support for academic staff and enhances the delivery and consistency of student experience.

### Actions<sup>2</sup>

1. We will review our recruitment positioning, training, and environment to identify issues that could be resolved to improve our gender balance. [E]
2. We will continue the review of our curriculum with the goal of simplifying our offer and improving the efficiency of delivery, whilst maintaining its attractiveness to current and potential students. [B,C]
3. We will explore the potential for new programme offerings, in particular participation in micromasters online courses; the potential for a two-year masters with the first year undertaken online; the development of integrated masters for all our current degrees. [B,C,D]
4. We will consider further rollout, evaluation and consultation on the use of end of semester examining. [A,B,C]

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<sup>2</sup> The letters following each action refer to the component of the University Learning and Teaching Strategy..

5. We will strengthen formal consultation with potential employers by reinstating our Teaching and Learning Advisory board. [B,C,D].
6. We will continue recent initiatives to improve coding skills across the student cohort through deeper embedding of practical coding challenges in courses and targeted extra-curricular activities (Informatics Summer of Code, Coding Club, participation in International Coding Competitions). In particular we will significantly expand the Programming Club and support for Competitive Programming. [A,C,E]
7. We will continue to seek improvements in the timeliness and value of assessment feedback to students through close monitoring and reporting on performance. [C]
8. We will explore best practice and new models for student projects and project supervision in order to achieve more efficient use of staff time and scalability. [A,B]
9. Where there are very large numbers of students on courses shared between honours and masters programmes, we will investigate approaches to the resourcing of these courses to ensure good student experience. [A,D]
10. We will take forward the internal reconfiguration and enhancement of the School's teaching accommodation within the Appleton Tower, including re-purposing of space to increase the space dedicated to Informatics teaching, to match our increased taught cohorts. [A,C,E]
11. We will implement the outcome of our working party on online education in order to support the development of more blended education and to develop the capacity to support the range of online modes envisaged by the working party. [A,C,D,E,F]
12. We will evaluate our University Teachers to identify how we might best improve their effectiveness and enhance learning and teaching in the School while establishing a strong and supportive career structure for them. [A,E,F,G]
13. We will continue to work with College and the International Office to find ways to better plan, forecast and manage student intakes, focusing on overseas and PGT students, in particular. We have introduced several innovations this year and will evaluate their effectiveness and refine our approach based on this evaluation. [D]
14. We will review the mix of students within our taught cohort and take positive actions to further increase the proportion of students with Scottish domicile and those from disadvantaged backgrounds. This will be closely linked to the development of a strong transition programme that supports students transitioning into the School [E].
15. We will match increases in student cohorts with commensurate growth in academic and support staff, whilst continuing to seek improvements and efficiencies in business processes. Recent and future new academic hires in topics such as cryptography, security, quantum computing, software engineering and business informatics open up potential to strengthen the core curriculum and build new specialist courses. [A,E,F,G]
16. We will evaluate the introduction of a two-year Masters degree, with the first year offered online. [B,E]

New challenges are appearing on the horizon and our planning will factor in these challenges over the coming year. They include: the effects of BREXIT on student and staff recruitment and on the capacity to provide international experiences; the perception of Scottish Government that expenditure should

be rebalanced between HE and FE in FE's favour; achieving access targets set by the Silver report; delivering on the City Deal training targets; and meeting the burgeoning demand for our graduates.

### **KEY ENABLER: People**

The School is a multi-national and multi-cultural community encompassing a broad range of related academic disciplines. It comprises approximately 120 academics, over 100 research staff, over 330 postgraduate research students, 310 taught postgraduate students and 860 undergraduate students, plus technical, computing and administrative support staff.

Whilst there is some further modest scope for growth in the academic community within the School, we now foresee a period of consolidation. We are aware of the tensions as well as the benefits that have resulted from recent growth within the School. We are now working on ensuring that our structures, process and operational models are appropriate to the scale of the School.

For support staff, the University's change programme, Service Excellence, has put additional demands on staff time and, as with any change programme, has caused some concerns about future roles and security. Whilst there is wide recognition of the need for better access to information, improved and clearer policies and processes, all supported by fit-for-purpose IT systems, the early part of the process of achieving such gains has seen significant disruption to day-to-day operations with no tangible benefit, to date.

The School is over-dependent on a relatively small number of academic staff who take on senior leadership roles within the School and more widely. Whilst changes to support staff structures have been made to better support such roles, this still means that these staff carry a disproportionate management burden. A focus during the coming planning period will be a structured approach to developing future managers and leaders.

#### Review of previous year

During 2016/17, we introduced revised the Performance and Development Review documentation and our induction process and programme for new staff. Based on feedback, we have made further revisions for 2017/18. We have also revised recruitment processes and roles, especially for academic posts, and provided more detailed documentation. This has greatly assisted in clarifying roles and responsibilities.

There is a recognition of the need to further improve support for staff development, especially for research staff, early career academics and support staff.

We have continued promotions workshops for academic staff as an annual feature of our staff development programme. These were well-received by staff who participated.

We have introduced contribution and grading workshops for support staff and an internal panel to review applications.

A total of 10 new academic appointments were made during the year, most commencing in post in 2017/18. All have been provided with mentors and are benefitting from our more structured approach to a six month induction process.

Our teaching and administration Work Allocation Model was updated during 2016/17 to provide greater clarity on expectations of all academic staff. The model operates on the basis of a standard work allocation, rather on an hours-based approach. The School believes that a non-hours-based

approach respects the professionalism of its staff. We are continuing to review the School WAM to make sure that it meets the changing needs of the School and that is equitable and transparent.

#### Existing strengths

- Our international reputation and that of The University of Edinburgh, allows us to attract high calibre staff from around the world.
- We have achieved Athena SWAN Silver accreditation and are continuing to embed policies, process and behaviours to ensure all staff and students contribute to a welcoming and inclusive community.
- We have established performance and development review as a standard process within the School, with completion rates increasing year-on-year to in excess of 99% completion.
- We have revised the standard documentation for academic performance and development reviews to explicitly address impact, learning and teaching, public engagement and management and admin duties.

#### Opportunities

- There are opportunities for continued measured growth in our academic community to take advantage of the many opportunities available within the breadth of Informatics research, education and outreach.
- Female staff and students are under-represented in our discipline areas. Our Athena SWAN accreditation provides a platform for us to continue to promote inclusion.
- We need to make performance and development review a more meaningful experience for more of our staff and ensure that more staff participate in the staff development opportunities available to them.
- There is the opportunity to more fully embed within the School some of the initiatives resulting from our Athena SWAN award and from our application for renewal.

#### Actions

1. We will continue to attract and invest in the best academic and research staff, wherever in the world they may be found.
2. We will undertake the actions detailed in the School's Athena SWAN gender equality action plan to further improve the gender balance across all groups within the School, as part of the School's approach to equality and diversity.
3. We will continue to enhance engagement with performance and development review and provide support and training to ensure that it is a meaningful and relevant process.
4. We will seek to raise awareness of the full spectrum of activities and success across the School, in order to further build a collective sense of community and recognise and value different forms of contribution to the School's and University's objectives.
5. We will continue the annual cycle of promotions workshops for academic staff.

6. We will continue the recently introduced workshops on support staff contribution and grading and the internal review of applications to ensure wider awareness and understanding of the processes and more equitable participation.
7. We will continue the programme of research lunches and workshops, as staff development opportunities for all staff but especially relevant to early career researchers, including those seeking their first research grant.
8. We will encourage and support academic staff to contribute to, and deliver in, the breadth of activity across the School including research, teaching, knowledge exchange, outreach and management roles.
9. We will introduce a structured management development programme, utilising University and College resources where available, to help identify, support and develop those within the School who have the potential to take on future leadership roles.
10. We will seek to implement the seven key principles of the Concordat to Support the Career Development of Researchers, developed by Universities UK, the UK Research Councils (RCUK), the UK Higher Education Funding Councils, the Wellcome Trust and several other funders of research.
11. We will seek to enhance support for career development for support staff, to prepare them for future career opportunities, either within the School or, where appropriate, elsewhere.
12. We will continue to review our support staff compliment and roles, to ensure that capacity and capability responds to increasing staff and student numbers and changing needs.

#### **KEY ENABLER: Income Growth**

To maintain its UK and international position, the School needs to be successful in securing both restricted income (such as research funding and studentships) and unrestricted income (for example, from overhead recovery and student fees).

A positive financial position provides the School with the ability to invest in new opportunities and to be responsive to changing needs and circumstances. Whilst the School does not seek to achieve substantial surpluses, maintaining reserves allows investment in the School estate and facilities, to the benefit of staff and students.

The University changed the way in which it distributes research overhead income in 2017/18. Whilst this makes School finances more vulnerable to fluctuations in such income indications to date is that the impact upon the School is positive.

The change by the University to a full contribution accounting model in 2018/19 has been mitigated by College maintaining some of the features of the previous model (notably student NPRAS). The full implications have been delayed, therefore, and are likely to be felt over coming years. It is not clear, at this stage, whether these will be positive or negative for the School.

#### Review of previous year

The School operated at a surplus in unrestricted funding in 2015/16 and 2016/17. A further surplus is forecast for 2017/18. This is a turnaround from a deficit position, in the 2014/15, and is largely as a result of increased, and better forecasting of, taught student intakes.

Research awards secured during the year showed a significant increase on the previous year and consultancy income and other income from industry (eg studentships) were positive, also. The pipeline of research funding applications provides some optimism for future increases in research income.

### Strengths

- The position of the University of Edinburgh, as one of the top 20 Universities in the world, puts the School in a strong position in developing partnerships and securing funding.
- The School's own national and international reputation, and the international recognition of many of the School's academic staff as leaders in their field, further strengthens the School's reputation.

### Opportunities

- The breadth and relevancy of informatics as a research discipline means that there are numerous opportunities to collaborate in research projects and funding applications with other Schools and colleagues in the other Colleges and beyond.
- The School's existing links with industry and new initiatives, including those linked to the development of the Bayes Centre, provide further opportunity for industry collaboration, including funded studentships, consultancy and research and development.
- There is limited scope to further increase recruitment of non-controlled taught student cohorts, however this is constrained by limitations on space and staff capacity, plus the imperative to maintain and enhance the quality of the student experience.
- Development of online cohorts are not constrained by physical limits and there is evidence of significant potential to grow in this area, supported by recruitment of appropriate staff.

### Actions

1. We will continue to seek opportunities to increase income whilst also diversifying income sources (both restricted and non-restricted) in order to mitigate risk.
2. Projected surpluses will allow the School to continue to invest in additional academic posts, whilst making additional appointments to support roles, in response to increases in staff and student numbers.
3. A further priority will be to increase core School funding of postgraduate research studentships with the objective of a ratio of three PGR students per full-time equivalent member of academic staff.
4. We will continue to use the School's reserves to invest in the estate, in order to adapt to changing needs, to enhance staff and student facilities and to improve efficiency in space utilisation.

### **CROSS-CUTTING THEME: Infrastructure**

The School is based across two main buildings, the Informatics Forum and Appleton Tower.

Recent growth of the School in terms of staff, students and space presents a number of challenges.

The reconfiguration of Appleton Tower has provided additional teaching space (over 60% more student desks) which addresses recent growth in student numbers. It has also allowed the School's computing services team to be co-located within one self-contained area on level 7 of Appleton Tower.

Within Appleton Tower, level 8 has been retained mostly for use by commercial tenants as business incubators whilst some space has been allocated to School research labs. The new student independent study suite on level nine will be available to UG4 students during semesters 1 and 2 and by PGT students over the summer period.

The School's commercialisation and industry engagement team remain decanted to the Wilkie Building, pending a move to the new Bayes Centre in summer 2018. Also pending the availability of space in the Bayes Centre, the Wilkie Building is being used as overflow space for research staff and students who would otherwise be located within the Informatics Forum.

Space within the Informatics Forum continues to be at a premium. Some relief will be provided by the Bayes Centre, however the very limited number of individual academic offices in the latter means that we will continue to look for further office reconfigurations within the Forum.

In addition, the School also is responsible for space within 15 South College Street, which accommodates Disney Research.

The School is planning for the occupancy of the Bayes Centre in summer 2018. The additional space is critical, in particular, to accommodating the School's 2018/19 PGR intake and growth in research staff, linked to recent research grant success.

One particular challenge is the increasing requirement for practical workshop space for research projects requiring specialist equipment and assembly. This includes space for industry collaborations.

As well as space, increase in scale brings challenges in communication, information management and business processes. These need to be addressed alongside maintaining current operations and continuity.

#### Review of previous year

During 2016/17, the School undertook further '3for2' conversions within the Informatics Forum, including those in the Wolfson Wing, to coincide with works taking place to link the Wolfson Wing and Bayes heating systems. In addition, two secondary stationery points were converted to meeting rooms and sound insulation issues, arising from previous office conversions, were addressed in some offices.

An internal reconfiguration of Appleton Tower was undertaken, following completion of the cladding project. This, along with the return of teaching and staff to Appleton Tower at the end of the project, was a significant undertaking in terms of planning, coordination and logistics. The changes made to Appleton Tower have been well received by students and staff. We have recently secured co-funding to equip some rooms in Appleton Tower to facilitate changing styles in teaching.

In addition, a number of staff have been involved in the planning for the DTI/Bayes Centre, in which the School will be a significant stakeholder.

With the lifting of restrictions on the use of the Informatics Forum, we have been able to host a wider variety of events however the focus remains on maintaining the ethos of the building as primarily research and research training.

#### Existing strengths

- Appleton Tower provides purpose-designed space for Informatics teaching with computing facilities served by the School's 'DICE' platform. Recent works have significantly increased the space available dedicated to teaching in Appleton Tower. The new level 9, in particular, is a significant addition to the facilities available to students.

- The School benefits from the modern dedicated facilities provided for research by the Informatics Forum, although space within the Forum to accommodate growth continues to be a challenge.
- The proximity of the Informatics Forum to the Appleton Tower, the majority of the School's teaching takes place, is both convenient and contributes to the sense of identity and community within the School. The location of both, within the central campus and close to the amenities of Edinburgh city centre, is attractive to both staff and students.
- The School's computing infrastructure, including 'DICE', enables us to meet the diverse needs of our large student body efficiently, reliably and securely, as well as underpinning the specialist computation needs of our researchers and providing commodity Linux computing to academic staff.
- The School has its own electrical and mechanical workshops, located in the basement of Appleton Tower, which support research and student projects.
- The School has well-established support staff structures for research, teaching and commercialisation and industry engagement. These help to advance the School's objectives and meet reporting and compliance requirements, whilst assisting to release academic and research staff time for productive activity.

#### Opportunities

- The Bayes Centre, scheduled for completion in 2018, will provide space for the further development of our research and commercialisation activity, and infrastructure to develop new opportunities for academic and industry partnerships.
- The Edinburgh Futures Institute may provide further scope for expanding the School's business-facing activities and translational research.

#### Actions

1. We will continue to review space utilisation within the Informatics Forum and take actions to ensure optimisation of use whilst maintaining the essential character of the building, including spaces for staff and students to gather and interact. This will include additional provision of space for small meetings, including virtual meetings.
2. We will work with the Bayes Centre team on the operation and occupancy of the building, including the logistics of the latter.
3. We will continue to review space configuration within Appleton Tower and adapt to changing approaches to teaching and pedagogy.
4. We will undertake a wider review of space requirements, in the context of the opportunities represented by the completion of the Bayes Centre and the Appleton Tower project, to identify medium to longer term needs both in the overall space requirements and in the mix of use cases of spaces.
5. The increasing scale of the School poses challenges in internal communication, management of, and access to, information and scalability of business processes. We will undertake a rolling programme to seek incremental improvement in all of these areas, whilst recognising the correlation with University-wide initiatives such as Service Excellence.

6. Over the next two years we will undertake a review of our computing needs and infrastructure to ensure that we continue to maintain pace with developments in our field. This will include a review of the extent to which current and future needs may be met by resources provided by the University's core Information Services.

### **CROSS-CUTTING THEME: Internationalisation**

The School has a wide range of international links and collaborations, many through the initiative of individual staff and as a result of collaborative research programmes.

In addition, the School has links with institutions in China and North America which result in relatively small, but increasing, numbers of full-time and visiting taught students studying in Edinburgh each year.

A review of the School's internationalisation activity was undertaken in 2017, looking at ways in which Informatics can support the "Influencing Globally" development theme of the University's Strategic Plan.

#### Review of previous year

Both the College and the University are actively working to expand existing connections and build new ones with major international institutions. The School took part in four efforts of this sort in the last year.

In May 2017, Don Sannella represented the School as part of a University delegation to Singapore and Hong Kong, conducting discussions on potential research and teaching links with NUS, NTU and A\*STAR in Singapore and four universities in Hong Kong.

In July 2017, Maria Wolters visited Peking University in order to discuss potential collaboration on Design Informatics. She has been invited to teach a two-week summer course there during a follow-up visit in 2018.

In November 2017, Don Sannella represented the School as part of a University delegation to Mexico, conducting discussions on potential research and teaching links, including collaboration on GCRF-funded grants, with seven universities in Mexico City and Monterrey.

In December 2017 Maria Wolters visited KAIST in Korea to discuss student exchanges, research and teaching links.

Closer to home, during the summer, we hosted an undergraduate research-intensive visiting programme for students from Peking University (four students for eight weeks).

We currently have seven students on course from three Chinese universities doing 2+2, 2+3 or 3+2 degrees.

#### Existing Strengths

- The international reputation of the School and many of its academics make it an attractive partner to overseas institutions seeking a collaborative partner and to students wishing to study or undertake postgraduate research.
- Both the staff and students of the School represent a multi-national, multi-cultural and welcoming community.

### Opportunities

- The School is in a position to further leverage its reputation as an international centre of excellence in Informatics research, doctoral training and education.
- There is the opportunity to develop some of the School's existing international links into a limited number of wider and deeper strategic alliances, with further benefits to both institutions.

### Actions

1. We will continue to attract and invest in the best academic and research staff, wherever in the world they may be found.
2. We will continue to encourage staff to establish international links and collaborations, where these advance our objectives and contribute to our international profile and impact.
3. We will aim to improve the quality and diversity of overseas applicants through developing existing and new international institutional relationships, including working with other Schools, College and the International office to identify and exploit opportunities.
4. We will aim to increase the number of our students who take advantage of existing opportunities to undertake exchanges abroad.
5. We will work with others to seek ways to increase the affordability of our postgraduate research programmes to more international (non-EU/EEA) candidates. The University's new Enlightenment Scholarships, now due for introduction in 2018/19, may provide one means of achieving this objective.

## STUDENT RECRUITMENT

Planned full-time student intakes are shown in the table on the next page.

UG-SEU intake set by College. No change is anticipated, although this may be impacted in any change to fee status of EU/EEA students caused by 'Brexit'. The School has also been set a target of four 'SIMD 20' students within the total number. The actual 2017/18 UG-SEU intake was significantly higher than planned, due to higher than anticipated conversion. Conversion in 2018/19 will be monitored closely, as a result.

UG-RUK intake declined in 2017/18 following a previously upward trend. The planning figure assumes a return to the 2016/17 intake. Intake in this segment may have been impacted by the School's NSS performance.

UG-OSEAS intake has shown steady increases. These are anticipated to continue, in part due to 2+2 and similar arrangements. There is evidence of increasing demand, potentially in excess of the target numbers, therefore it may be necessary to place a restraint on recruitment of this segment due to capacity limits.

PGT-HOME intake is planned as similar to 2017/18 for 2018/19 and 2019/20 and then increasing slightly for 2020/21 and 2021/22. The School is operating gathered field admissions and a deposit on confirmation process for PGT intakes.

PGT-OSEAS intake is planned as similar to 2017/18 for 2018/19 and 2019/20 and then increasing slightly for 2020/21 and 2021/22. The School is operating gathered field admissions and a deposit on confirmation process for PGT intakes.

PGR intakes are for students enrolled prior to October in each academic year only (because of how the University counts its student intakes). They are not comparable with School data. CDT intakes assume continuation of the current CDTs or their equivalent. No allowance has been made for any additional CDTs in the planning figures.

In the case of postgraduate taught students and undergraduate overseas (non-EU/EAA) students, these are the numbers, along with corresponding students in later years of study, that are used to calculate incremental income to the School from student fees, through the NPRAS mechanism (which the College is continuing, at least for 2018/19). An adjustment is made to calculate School PGR NPRAS contribution from student fee income, which takes account of the anomalous way in which the University accounts for PGR intakes.

For planning purposes, the School has also set targets for part-time student intakes, however these are small and not significant to the overall picture.

Target intakes have also been provided for the School's courses which form part of the distance learning programme (DSTI) hosted by the College. Numbers on existing programmes have significantly increased year-on-year, albeit from a small base. There is significant potential for growth in this area, although the total scale and pace of growth has to be regarded with some uncertainty until further evidence and market intelligence is available.

Because of capacity and resource constraints, the School will need to manage any future growth very carefully. This may involve placing limits on certain cohorts and individual programmes, beyond arrangements already in place for PGT admissions. Such constraints are essential to maintaining and enhancing the student experience and the support of staff.

<b>UG - SEU</b>											
Attendance Level	Fee group	Subject Area	Academic year	Target Type	New - YR1	New - YR2	New - YR3	VISITING	Total intake		
FT	UG	SEU	School	2018/19	Budgetary	125	4	0	5	134	
FT	UG	SEU	School	2019/20	Budgetary	125	4	0	5	134	
FT	UG	SEU	School	2020/21	Budgetary	125	4	0	5	134	
FT	UG	SEU	School	2021/22	Budgetary	125	4	0	5	134	
<b>UG - RUK</b>											
Attendance Level	Fee group	Subject Area	Academic year	Target Type	New - YR1	New - YR2	New - YR3	VISITING	Total intake		
FT	UG	RUK	School	2018/19	Budgetary	35	2	0	0	37	
FT	UG	RUK	School	2019/20	Budgetary	35	2	0	0	37	
FT	UG	RUK	School	2020/21	Budgetary	35	2	0	0	37	
FT	UG	RUK	School	2021/22	Budgetary	35	2	0	0	37	
<b>UG - OSEAS</b>											
Attendance Level	Fee group	Subject Area	Academic year	Target Type	New - YR1	New - YR2	New - YR3	VISITING	Total intake		
FT	UG	OSEAS	School	2018/19	Budgetary	95	6	4	4	109	
FT	UG	OSEAS	School	2019/20	Budgetary	100	8	5	4	117	
FT	UG	OSEAS	School	2020/21	Budgetary	110	10	6	4	130	
FT	UG	OSEAS	School	2021/22	Budgetary	120	12	7	4	143	
<b>PGT - HOME</b>											
Attendance Level	Fee group	Subject Area	Academic year	Target Type	New - YR1				VISITING	Total intake	
FT	PGT	HOME	School	2018/19	Budgetary	100				0	100
FT	PGT	HOME	School	2019/20	Budgetary	100				0	100
FT	PGT	HOME	School	2020/21	Budgetary	110				0	110
FT	PGT	HOME	School	2021/22	Budgetary	110				0	110
<b>PGT - OVERSEAS</b>											
Attendance Level	Fee group	Subject Area	Academic year	Target Type	New - YR1				VISITING	Total intake	
FT	PGT	OSEAS	School	2018/19	Budgetary	215				0	215
FT	PGT	OSEAS	School	2019/20	Budgetary	215				0	215
FT	PGT	OSEAS	School	2020/21	Budgetary	230				0	230
FT	PGT	OSEAS	School	2021/22	Budgetary	230				0	230
<b>PGT - ADV. DESIGN INF. (YEAR 2)</b>											
Attendance Level	Fee group	Subject Area	Academic year	Target Type	New - YR1				VISITING	Total intake	
FT	PGT	ADI	School	2018/19	Budgetary	6					6
FT	PGT	ADI	School	2019/20	Budgetary	6					6
FT	PGT	ADI	School	2020/21	Budgetary	6					6
FT	PGT	ADI	School	2021/22	Budgetary	6					6
<b>PGR - HOME (non CDT)</b>											
Attendance Level	Fee group	Subject Area	Academic year	Target Type	New - YR1				VISITING	Total intake	
FT	PGR	HOME	School	2018/19	Budgetary	45				1	46
FT	PGR	HOME	School	2019/20	Budgetary	47				1	48
FT	PGR	HOME	School	2020/21	Budgetary	49				1	50
FT	PGR	HOME	School	2021/22	Budgetary	51				1	52
<b>PGR - CDT only</b>											
Attendance Level	Fee group	Subject Area	Academic year	Target Type	New - YR1				VISITING	Total intake	
FT	PGR	HOME	PGR - CDT	2018/19	Budgetary	25					25
FT	PGR	HOME	PGR - CDT	2019/20	Budgetary	26					26
FT	PGR	HOME	PGR - CDT	2020/21	Budgetary	27					27
FT	PGR	HOME	PGR - CDT	2021/22	Budgetary	28					28
<b>PGR - OVERSEAS</b>											
Attendance Level	Fee group	Subject Area	Academic year	Target Type	New - YR1				VISITING	Total intake	
FT	PGR	OSEAS	School	2018/19	Budgetary	24				0	24
FT	PGR	OSEAS	School	2019/20	Budgetary	24				0	24
FT	PGR	OSEAS	School	2020/21	Budgetary	24				0	24
FT	PGR	OSEAS	School	2021/22	Budgetary	24				0	24

## **STAFF RECRUITMENT**

### ***Academic appointments***

At the end of academic year 2017/18, it is anticipated that the School's academic complement will exceed 120 staff. This is a significant increase on the number of less than 100, at the census date for the REF2014.

The School will continue to replace any academic staff that leave or retire, although not necessarily on a like-for-like basis, as the School adjusts to changing research and teaching priorities. In addition, the School will continue its practice that any staff in receipt of a Fellowship will be back-filled.

Some further recruitment of additional academic staff has been included in the School Plan, amounting to two posts to start in academic year 2019/20 and two in 2020/21. Provision of two further posts, one each in 2019/20 and 2020/21 have also been identified, in line with growth in online learning provision.

The School recruited two full-time equivalent University Teacher roles in 2016/17. The School plans two further fte University Teachers for the start of 2018/19 to address continued growth in the undergraduate student cohort.

Additionally, a new category of University Tutor is envisaged to support delivery of online learning.

### ***Support post appointments 2017/18 and 2018/19***

In 2017/18, the School recruited a Learning Technologist to support staff in the development and delivery of online learning materials. Two further such posts will support growth in online learning for both on-site and off-site students.

A total of eight additional support posts are included in the business as usual investment priorities (six in 2018/19 and two in 2019/20). Some the posts are fractional. These and other posts are intended to strengthen student support, research support, the finance team and computing support.

The School recruited an apprentice trainee technician at the start of 2017/18, in order to provide succession planning in an area where it is difficult to recruit staff with the necessary skill sets. A further such post is planned in 2019/20.

## COLLEGE GROWTH TARGET

College has set an overall target of 40% growth on a 2012/13 baseline by 2025/26 (12 years).

### Students

Home (Scotland and EU/EEA domiciled) student numbers are capped by the Scottish Government and are therefore not subject to the growth target.

<b>Student cohorts and growth trajectories</b>				
	<b>12/13 baseline</b>	<b>17/18 act</b>	<b>17/18 %age</b>	<b>25/26 target (12/13 + 40%)</b>
<b>Undergraduate</b>				
RUK <sup>1</sup>	14	100	+614%	N/a <sup>1</sup>
Overseas	64	205	+220%	89
<b>PGT</b>				
Home	66	103	+56%	92
Overseas	92	213	+132%	129
<b>PGR<sup>2</sup></b>				
Home	129	156	+21%	180
Overseas	47	66	+40%	66
1 = 12/13 was the first year in which RUK fees were applicable – therefore cohort comprised year 1 students only 2 = Students for whom fees are payable				

All figures taken from diagonal tables

As can be seen from the above, growth in taught student numbers to 2016/17, in all fee statuses, significantly exceeds the 40% target (although RUK figures are not comparable as 12/13 cohort comprised year 1 students, only).

Some further incremental growth is projected in undergraduate student cohorts, especially as larger intakes progress through the years.

The School has capped postgraduate taught students at 315, in total. Further growth is constrained by both physical space and staff capacity, plus a wish not to overwhelm the UG4 cohort, with whom the PGT students share courses. Small further increases are forecast in later years, as recent and current academic staff recruitment increases capacity and the School adjusts the way, for example, that student projects are supervised, to adapt to larger numbers of students.

Growth in home research students to 2017/18 is at 21%. Growth in overseas research students is at 40%. The latter figure has benefitted from increased School funding of PGR studentships, in recent years.

It is intended to use the projected positive financial position of the School as an opportunity to further increase funding of PGR studentships, including for overseas students. This will result in further growth in these cohorts. The introduction of the Edinburgh Enlightenment Scholarships should also assist in recruiting more PGR overseas students.

Across all student cohorts, there is a relatively high proportion of EU/EEA students, which is a clear risk factor for the School, in relation to Brexit. There is strong and increasing demand from overseas students which goes some way to mitigate the dependency on EU/EEA students. Nonetheless, the School needs to improve performance in recruiting Scottish domiciled students. This can only be done

by working with colleagues within the College and with the University recruitment and admissions team.

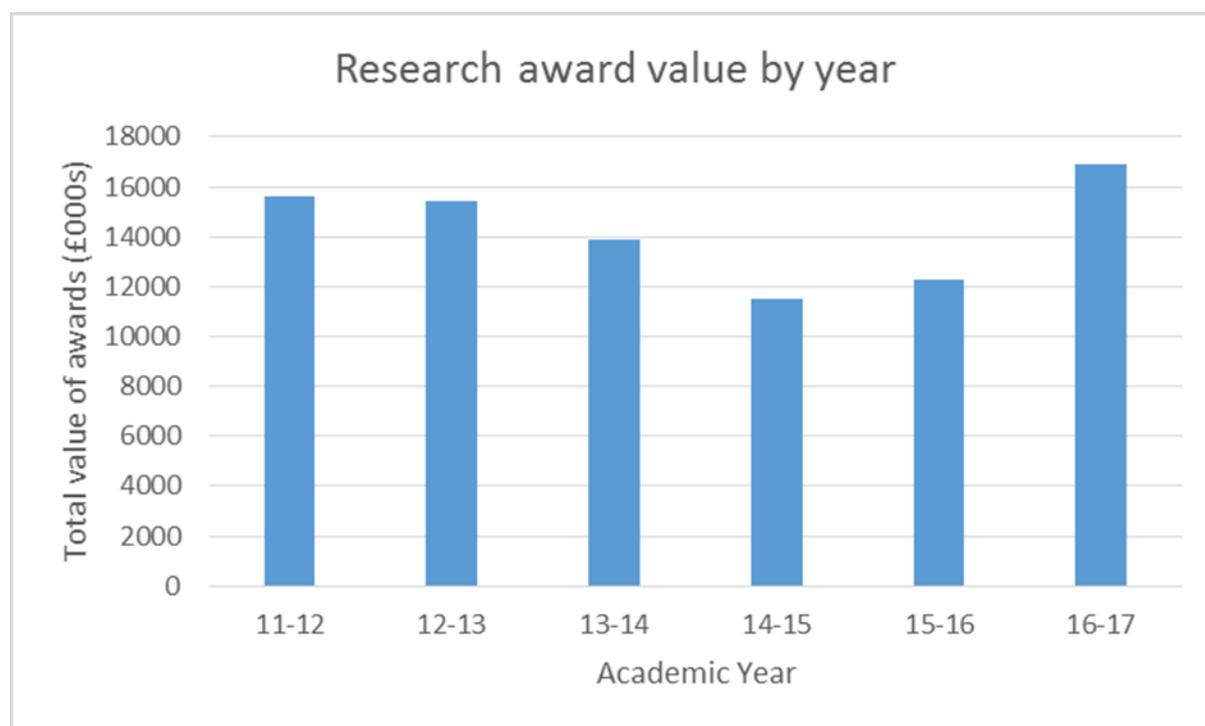
## Research

<b>Research awards</b>				
<b>000s</b>	<b>12/13 baseline</b>	<b>16/17 act</b>	<b>16/17 %age</b>	<b>25/26 target (12/13 + 40%)</b>
Charities UK	£3	£440	+14567%	£4
EU	£3,836	£4,615	+20%	£5,370
Government UK	£668	£512	-23%	£935
Industry UK	£307	£463	+51%	£430
Other sources	£2,225	£157	-93%	£3,115
Overseas (non-EU)	£1,179	£4,039	+243%	£1,651
RCUK	£7,204	£5,682	-21%	£10,086
<b>Total</b>	<b>£15,422</b>	<b>£16,889</b>	<b>+10%</b>	<b>£21,591</b>
Average award	£308	£217	-30%	£431

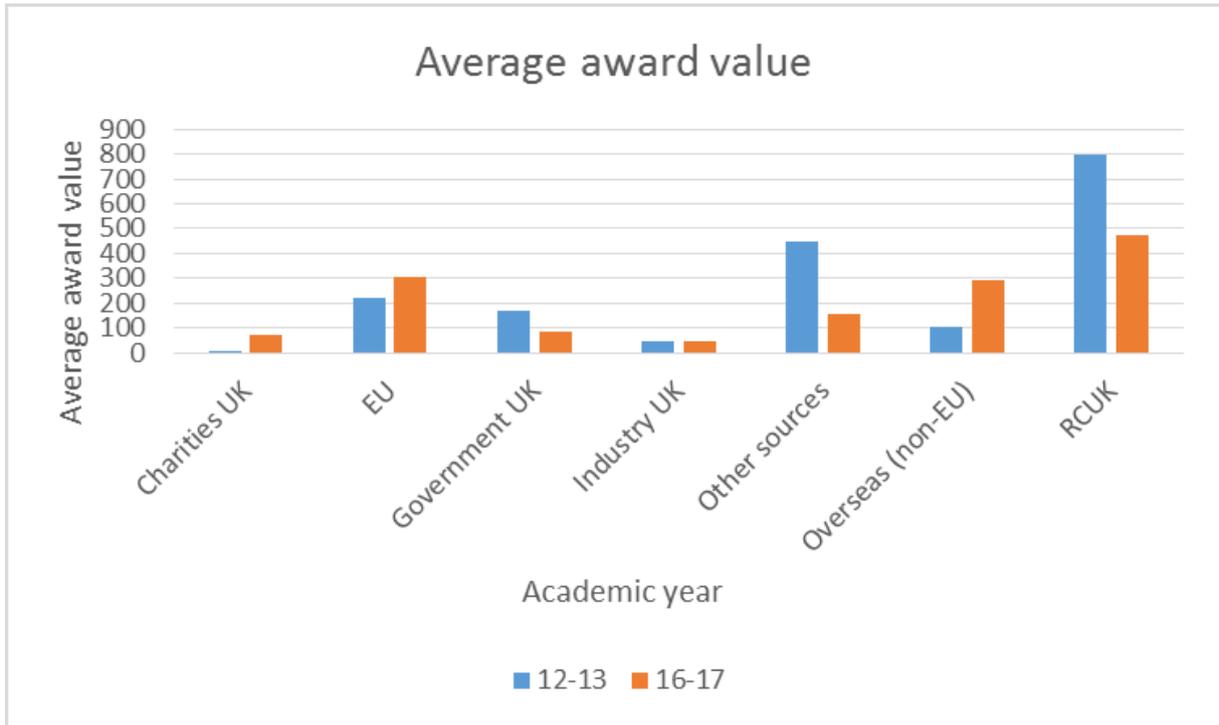
Source: CSE research dashboard

Following a dip, research applications and awards have shown significant increases, especially 2015/16 to 2016/17, year-on-year (see graph, below). Current year performance to date is indicative of further growth.

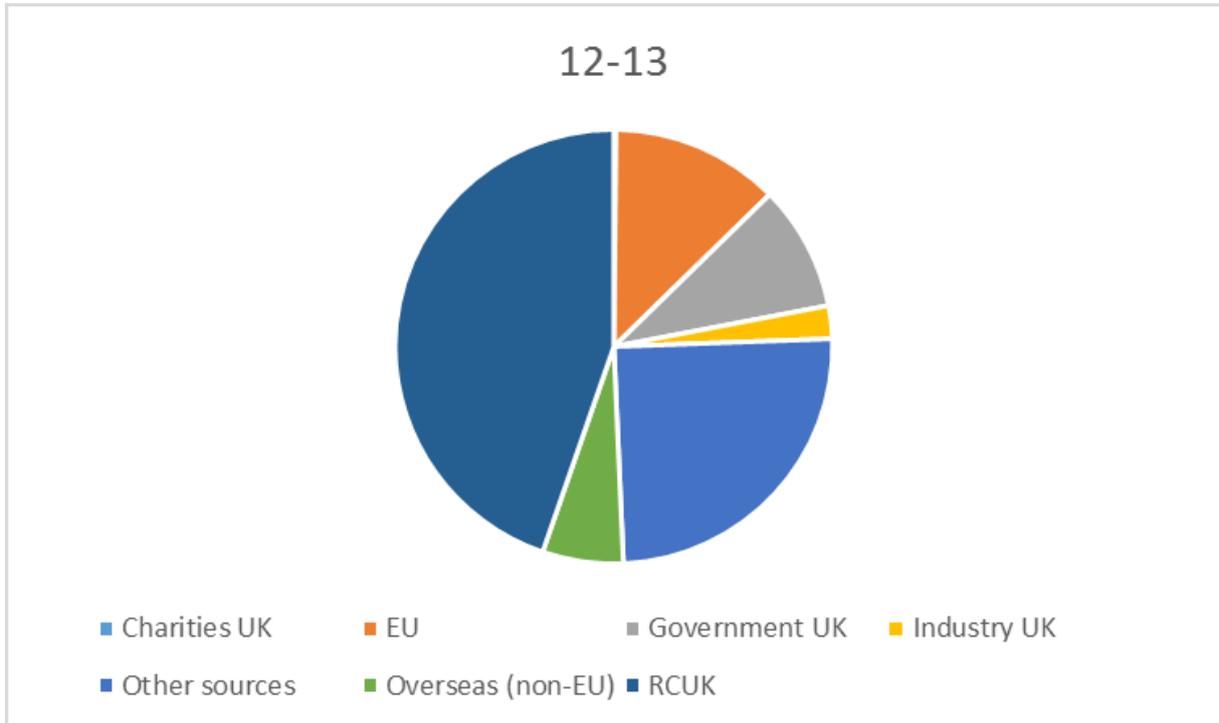
The above figures do not reveal the strong performance of the School in securing funding from non-UK industry, as these figures are not separated out in the dashboard.

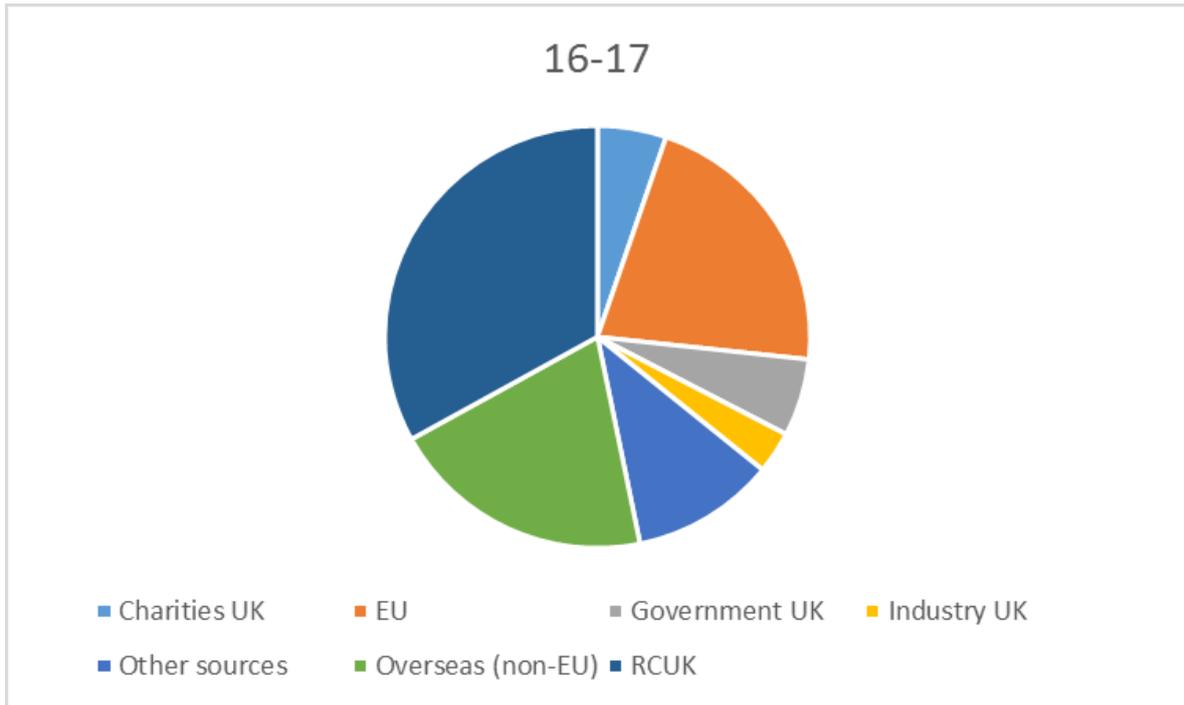


Average award value has fallen over the period (see graph, below). Whilst actions described elsewhere in this plan are designed to address this, some fall in average value is likely as a consequence of moves to diversify the research funding base of the School.



Over the period 12-13 to 2016/17, the School has succeeded in diversifying the spread of its research award income, as shown by the charts, below.





Overall, the School has shown a strengthening performance in research grant capture in recent years and there is evidence of this continuing. Recent and (more limited) planned growth in the total number of academic staff will contribute to future growth.

## APPENDIX - School of Informatics – SWOT Analysis

### Strengths

- Ranked #14 in the 2018 Times Higher Education World Computer Science subject ranking
- Excellence in research at scale (top in UK for research power in REF2014)
- Breadth of research and teaching within the School
- Strong demand from prospective students (especially overseas)
- Strong demand for graduates
- Strong industry links and track record of spin-outs and start-ups
- Well established and effective support structures for academic staff
- Dedicated research and teaching facilities in the Informatics Forum and Appleton Tower
- Athena SWAN Silver Award

### Weaknesses

- School is feeling the strain from recent growth in (taught) student numbers (taught) and in staff numbers – structures, processes, student load (teaching, personal tutors, etc)
- Work allocation model no longer fit-for-purpose and not able to adapt to changing patterns of demand
- Shortage of space for certain activities (eg server rooms, practical research labs, small meeting rooms); teaching space at or near capacity
- Performance in National Student Survey (although not reflected in anecdotal feedback from students)
- Variability in student demand across programmes/subject areas means uneven spread of load between staff
- Shortage of staff willing and/or able to take on senior academic leadership roles

### Opportunities

- New academic staff – increased research capacity/critical mass in key areas; increased grant capture, research collaborations and industry links; increased teaching capacity
- Online learning – to enhance learning for on-site students and deliver to students off-site
- Bayes Centre – opportunities for more interdisciplinary and industry collaborations, plus more space
- Edinburgh Futures Institute - opportunities for more interdisciplinary and industry collaborations, plus possibly more space
- Usher Institute - opportunities for more interdisciplinary collaborations
- City Deal (including linked to all of above) but detail not yet clear
- Strength in high profile areas of research and teaching which are attracting Government interest and funding – eg Security and Privacy, Artificial Intelligence
- Centres for Doctoral Training funding call – continuation of existing CDTs plus opportunity for up to two more
- Industrial Strategy Challenge Fund – building on existing strong industry partnerships

### Threats

- Loss of staff to industry and overseas institutions who can pay much higher salaries and offer attractive support packages
- High dependency on student fees for income and potential vulnerability to external factors
- Brexit – loss of access to staff and students; potential loss of existing staff if they do not feel welcome; loss of access to EU research funding

- UKVI – further restrictions/costs for visas for staff and students
- Increasing compliance burden on staff
- University change programmes (eg Service Excellence) if not well thought through, well-managed, and responsive to School needs (and, especially, seen to be beneficial to academic staff)
- Increasing competition from other Universities in the UK, Europe, USA, Far East and elsewhere (potential threat to UoE and Sol rankings and, thus, reputation/prestige)
- Potential changes to Government attitude towards Universities in terms of governance, funding (including student funding), etc