SCHOOL OF INFORMATICS

School Strategy and Plan 2017/18 to 2019/20

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SCHOOL OF INFORMATICS

SCHOOL STRATEGY

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 in the current (2016) iteration is 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.
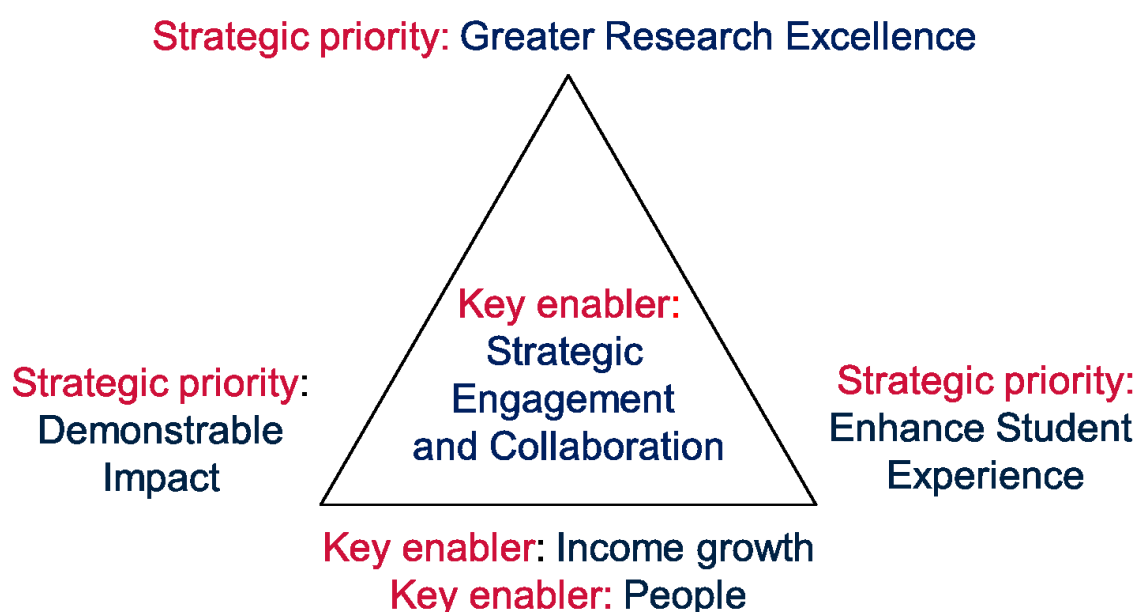
Strategic objectives:

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

Strategic priority: Demonstrable Impact

Key enabler: Strategic Engagement and Collaboration

Strategic priority: Enhance Student Experience

Key enabler: Income growth
Key enabler: People

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[1] 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.

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 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.

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.

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,

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[1] The term 'researchers' is used to refer collectively to academic staff and research staff. The term 'academic staff' refers to Lecturers and Senior Lecturers, Readers, Research Fellows and members of the Professoriate. The term 'research staff' refers to staff who are funded by research grants, usually designated as 'Research Assistants'.

students and those elsewhere with expertise and experience, to explore how we can develop a distinctive Informatics approach to learning, teaching and student experience.

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.

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.

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:

- Maintain UK leadership in Informatics and Computer Science Research in REF2021.
- Maintain Athena SWAN Silver Award at next renewal in 2020 as part of the School's commitment to equality and diversity.
- Achieve results higher than the overall University of Edinburgh average in student surveys.
- Achieve student recruitment projections detailed in the 2017-20 School Plan.
- 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.
- Increase the number and scope of strategic engagements with academic collaborators, industry and public sector bodies.

UNIVERSITY OF EDINBURGH – STRATEGIC VISION

In 2016, following wide consultation, the University published its Strategic Vision 2025.

The University's Strategic Vision sets out a series of expectations, reproduced below.

We expect to see:
- A unique Edinburgh offer for all of our students:
  - all of our undergraduates developed as student/researchers with clear, supported pathways through to Masters and PhD;
  - all our students offered the opportunity to draw from deep expertise outside their core discipline;
  - a highly satisfied student body with a strong sense of community.
- Strong and vibrant communities within and beyond the University – making the most of our unique offer of world-leading thinking and learning within one of the world's most attractive cities
- A larger, more international, staff who feel valued and supported in a University that is a great and collegial place to work, develop and progress.
- More postgraduate students – underpinned by the best support in the sector to ensure we attract the brightest and best regardless of ability to pay.
- A more international student body – offering all our students an international learning experience; enabling us to make a truly global impact through educating the brightest and best from and across the world.
- A strong culture of philanthropic support focussed especially on our students and on outstanding research capabilities.
- Many more students benefiting from the Edinburgh experience (largely or entirely) in their own country – supported by deep international partnerships and world-leading online distance learning.
- Sustained world leading reputation for the breadth, depth and interdisciplinarity of our research supported by strong growth in research funding and strong international partnerships – drawing from well-established and less well developed sources.
- An estate that matches expectations, responds flexibly to changing student and staff needs, and showcases the University.
- A deeper and earlier collaboration with industry, the public sector and the third sector – in terms of research; knowledge exchange; and in giving our students the best possible set of skills for their future.

We are a very broad and diverse institution and do not expect all Schools to tackle the above broad aspirations in the same way. But we hope and expect that our combined efforts will mean that we achieve this strategic vision across the University as a whole.

The actions included in the School Plan 2017-20 demonstrate how the School of Informatics will contribute to the achievement of the University's Vision 2025.

SCHOOL OF INFORMATICS

HIGHLIGHTS 2015/16

Some notable achievements and success over the period 2015/16 include:

- We welcomed Valkyrie, NASA's ground breaking humanoid robot, to the Edinburgh Centre for Robotics, attracting national TV, radio, newspaper and online media attention, including the cover of Edinburgh Research and Innovation's flagship publication, Infinite. Research by Maurice Fallon, Alex Li, Michael Mistry and Sethu Vijayakumar will help NASA prepare to go to Mars.
- Building work began on the new Data Technology Institute (Thomas Bayes Centre), which will be a hub for data-driven innovation within and beyond the University when it is completed in 2018. Jon Oberlander was appointed as Director and became Assistant Principal for Data Technology.
- Edinburgh Centre for Robotics received a further £902K equipment funding as part of the UK-RAS network EPSRC Capital Award.
- Bob Fisher is PI for the Horizon2020 four-year project TrimBot, which started in January 2016, with £883K awarded to Edinburgh. The project aims to develop a robotic hedge trimmer.
- Informatics students won the Scottish University Cyber Challenge and came top in the European Spring 2016 Season of Major League Hacking for having the most hackathon attendees in Europe.
- The School achieved its second Athena SWAN Silver Award, recognising our ongoing commitment to advancing the careers of women in technology, which has resulted in higher than average numbers of women students and an increased the number of women within our professoriate.
- In addition to our well-established Sutton Summer School for S5/Year 12 pupils, we held our first INSPIRE Summer School, the only INSPIRE event for S4/Year 11 girls to be held in Scotland this year, organised at UK level by the Engineering Development Trust. The three-day residential event was fully booked and will run again this year.
- Sharon Goldwater won the BCS Roger Needham award for outstanding interdisciplinary research contributions across natural language processing, machine learning, and computational cognitive science. In particular, her work on Bayesian models for probabilistic machine learning has broken new ground in unsupervised learning of linguistic structure.
- Alumnus Andrew Blake, first Director of the Alan Turing Institute, won the BCS Lovelace Medal for increasing understanding and advancement of Computing, for his impact on the IT industry, and for his academic research.
- Sethu Vijayakumar was awarded the University's Tam Dalyell Prize for Excellence in Engaging the Public with Science, became a judge on the cult TV show, Robot Wars and took part in the lesson launch of BBC micro:bit, a national coding initiative in which a handheld, programmable computer was given free to every Year 7 or equivalent child across the UK.
- Retiring as our Director of Commercialisation, alumnus Colin Adams received the University's highest honour, the Principal's Medal, for his significant contribution to the technological community in Edinburgh.
- Areti Manataki won a coveted Head of College Prize for Outreach, in recognition of her introduction to programming workshops and 'Code Yourself!', a Massive Open Online Course (MOOC) run in association with ORT University, Uruguay, which has attracted over 120,000 participants.
- The RemIX project, involving Peter Buneman, Mahesh Marina and Marwan Fayed, a colleague from Stirling, won the 'Future-proof and quality of service' category of the

European Broadband Awards for providing a broadband service across a 2000 km^2 area of the rural Highlands - the only UK project to win an award from 66 entries.

- A team of our PhD students was chosen by Amazon to compete for the inaugural $1.5M Alexa prize, receiving $100k in sponsorship to build a socialbot that can engage people in conversation.

- More than 35 students took part in the first Informatics Summer of Code, working over the summer on mentored open-source coding projects to enhance their programming skills
- Several members of staff won grants worth over £1m:
  - James Cheney received nearly $2m in ERC Consolidator Grant funding to develop Skye, a programming language bridging theory and practice for scientific data curation.
  - Mirella Lapata began her five-year €1.9m ERC Consolidator Grant for her translation and text simplification project, TransModal: Translating from Multiple Modalities into Text.
  - Wenfei Fan was awarded an ERC Advanced Grant of £1.6m to investigate the challenges of querying big graph data with limited resources.
  - Leonid Libkin received a £1.14M EPSRC Fellowship for MAGIC: MAnaGing InComplete Data, a project to deliver new understanding of uncertain and incomplete information in data processing tasks.
  - Steve Renals, Shay Cohen and Lexi Birch were awarded a £1.3m share of a $6m Horizon 2020 grant for SUMMA: scalable understanding of multi lingual media. The aim is to create a platform to automate the analysis of media streams across many languages.
- Bea Alex, David Aspinall, Claire Grover, Charles Sutton and Maria Wolters became Fellows of the Alan Turing Institute, which goes from strength to strength, having announced partnerships with Lloyds Register Foundation, GCHQ, Intel and HSBC.
- Our EPSRC Centres for Doctoral Training (CDTs) in Pervasive Parallelism and in Robotics and Autonomous Systems each hosted successful one-day industrial engagement events to connect their PhD students with industry leaders.
- Nearly 200 delegates from industry and academia, including representatives from Amazon, Bloomberg, Google, Morgan Stanley and Tesco Bank, the Financial Times, BBC and Walt Disney Corporation, attended the annual Data Science Research Day hosted by our CDT in Data Science.
- We showcased our expertise in speech and language technologies, robotics and autonomous systems, design informatics, innovation and entrepreneurship to 26 senior delegates from a range of multi-national corporations, when we hosted a meeting of Gartner's Research Board.
- Jon Oberlander and Ram Ramamoorthy joined the Principal at the University's Pop Up Campus in Stanford USA, impressed tech-centric contacts at their California Bay Area meet-up, and further boosted membership of our growing Linked In Group, Edinburgh Informatics Alumni, which currently stands at 1,933 people.
- Our Twitter following rose from just over 1,000 to just over 1,500, and Facebook from 500 to 900 over the course of the year.
- Fifteen of our staff, six students who tutor and three of our courses were nominated for EUSA Teaching Awards.
- Martino Sorbaro Sindaci secured a prestigious Google European PhD Fellowship in Computational Neuroscience.
- We welcomed our first Stanford Bing study visit, arranged by Henry Thompson in association with 2006 PhD alumnus Professor Mykel Kochenderfer, now director of the Stanford Intelligent Systems Laboratory.

- Research student Sorcha Gilroy spoke at Edinburgh's first Soapbox Science event.
- Final year undergraduate Thomas Kerber came second in the international security programming contest, 'Build it, Break it, Fix it.'
- Over half a million tried but Artificial Intelligence alumnus David McBryan was one of only three people who came close to solving the GCHQ Christmas puzzle.

Institute for Adaptive and Neural Computation (ANC)

- Amos Storkey was awarded €680,876 from Horizon 2020 to contribute deep-learning and compiler optimisation expertise to a three-year, €7.4m project called 'Bonseyes' which aims to deliver improvements in smart cyber physical systems.
- Post doctoral research associate Giulio Caravagna was a member of the team that won Silver at the 10th Open Source Software (OSS) World Challenge.
- PhD student Andreas Kapourani won best paper at the prestigious European Conference on Computational Biology (ECCB).

Centre for Intelligent Systems and their Applications (CISA)

- Malcolm Atkinson and Michael Rovatsos teamed up with GeoSciences and other partners from the University on a NERC-funded building resilience project for high resolution shake forecasting and emergency aftershock research for communities in post-disaster, developing countries.
- Sofia Ceppi presented a paper at IJCAI 2016 in New York, one the major international conferences in AI. The paper, titled "Online Mechanism Design for Vehicle-to-Grid Car Parks" is based on research done with colleagues at Microsoft Research, and makes important contributions to strategy-proof coordination mechanisms for charging electric vehicles.
- Michael Rovatsos won a £218k share of a £1.1m 5-year EPSRC grant for UnBias, Emancipating Users Against Algorithmic Biases for a Trusted Digital Economy. The project will develop fair data analysis and resource algorithms, and a toolkit of youth-led solutions for teaching critical thinking about online environments.
- Vaishak Belle has had two papers accepted at the prestigious AAAI conference, one titled "Open-Universe Weighted Model Counting" that explores using open-world models in probabilistic knowledge bases, and another one titled "The Symbolic Interior Point Method" introduces new symbolic methods for solving optimisation problems.
- CISA staff have organised, together with overseas colleagues, workshops at the top European AI conference (ECAI) on "Diversity-Aware AI" (Rovatsos) and at the upcoming AAAI conference "Symbolic Inference and Optimization" (Belle).
- The AI Planning MOOC on the Coursera platform, led by Austin Tate, was run for the third time, attracting a total of 113,565 students. The MOOC has been made an Open Education Resource (OER) on University servers.
- Austin Tate continues to play a leading role in the Virtual University of Edinburgh (Vue) virtual world facilities in Second Life and OpenSimulator, which has now been in operation for 10 years, and is a virtual educational and research institute bringing together all those interested in the use of virtual worlds for teaching, research and outreach related to the University of Edinburgh.
- Together with colleagues from the €4m ESSENCE network, Michael Rovatsos has successfully organised the network's third Summer School in Como (Italy), which attracted 60 participants from around the world. This edition had "Creativity and Evolution" as its focus, and featured 19 lectures, tutorials, and artistic workshops.

Institute for Computing Systems Architecture (ICSA)

- Boris Grot was inducted into the MICRO Hall of Fame, the list of researchers with eight or more papers at the International Symposium on Microarchitecture.
- Six papers from the Institute were accepted for the International Symposium on Code Generation and Optimisation and International Symposium on High-Performance Computer Architecture.
- ICSA was selected for the Intel Hardware Accelerator Research Program.
- Ronan Turner was Highly Commended in The Undergraduate Awards, an international programme that recognises innovation and academic excellence at undergraduate level.
- Hugh Leather relaunched Compucast: monthly podcasts from Edinburgh, Lancaster and St Andrews, by computer scientists for computer scientists.
- Ludovic Capelli was interviewed about his experiences as a student in Edinburgh in an article in the Herald newspaper.

Institute for Language, Cognition and Computation (ILCC)

- Simon King, Junichi Yamagishi and Oliver Watts received £666k from EPSRC for SCRIPT: Speech Synthesis for Spoken Content Production. They will work with the BBC World Service to create high quality, controllable synthetic voices for a range of languages, such as Swahili, Hausa, Somali, and Amharic.
- Kenneth Heafield has won funding from Amazon, Facebook, Google and eBay to improve customer experience by making their processes faster.

Institute of Perception, Action and Behaviour (IPAB)

- Edinburgh Centre for Robotics signed a contract with Honda Research Institute Europe to fund a PhD studentship in learning control and manipulation using tactile information.
- Enterprising PhD student Sandy Enoch scooped several awards and media attention for Marty, a robot that children can build and programme for themselves.
- Bob Fisher was selected as one of the two UK representatives to the International Association for Pattern Recognition.
- Edinburgh was selected to host the 2020 European Conference on Computer Vision (Fisher and Ferrari are two of the General Chairs).
- Subramanian Ramamoorthy was appointed Research Theme Leader for Cyber-Physical Systems within The Scottish Informatics and Computer Science Alliance; a two year appointment.

Laboratory for Foundations of Computer Science (LFCS)

- Philip Wadler won the ACM SIGPLAN Distinguished Service Award.
- Stuart Anderson was awarded a £110k share in a £1.7m Horizon 2020 grant for SCIROCCO: Scaling Integrated Care in Context. Project partners NHS 24 (Scotland) and universities and healthcare organisations in Belgium, Spain, Italy, Sweden and the Czech Republic
- Domagoj Vrgoc's dissertation was highly commended in the BCS Distinguished Dissertation Competition.

SCHOOL OF INFORMATICS

PLANNING SUBMISSION 2017/18 to 2019/20

Introduction

The School's 2016-19 plan reflected on the transition to a new Head of School, the shift of focus from REF2014 to REF2020 (now likely to be REF2021) and the temporary decant from Appleton Tower.

For its 2016-19 plan, the School refreshed its high-level strategy and developed a more action oriented approach to planning, as a result. As noted in the 2016-19 plan, 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.

So far, there is little evidence of an impact on demand from non-UK European students, 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, however 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 requires the School to seek opportunities for collaboration with colleagues in other Schools within all three Colleges of the University.

There are proposals that Government funding for 'home' students might in future be based upon a teaching equivalent to the research excellence framework (a 'TEF'). Whilst we would wish to be, and are, constantly seeking to enhance our curriculum offering, its delivery and the student experience, regardless of external drivers, a potential 'TEF' provides a further incentive to do so.

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 prospect of the re-introduction, in Scotland, at least, of student post-study work visas would seem to have receded. Such visas would significantly boost the international competitiveness of Scottish higher education whilst, in the case of Informatics amongst other disciplines, addressing a serious skills gap in the workforce in Scotland and in the UK.

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 2015/16 and 2016/17 student intakes, especially of postgraduate taught students. This is again reflected in early data on applications for 2017/18.

In relation to research students, there is a similar high dependency on EU/EAA 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 proposed introduction of the 'Edinburgh Enlightenment Scholarships' was intend to help address the cost of fees for overseas research students, however the introduction of this scheme has been postponed for one year. 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.

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.

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 Data Technology Institute (DTI, aka the

Bayes Centre for Data Science and Technology) provide opportunities for the School to further enhance its industry engagement and profile.

Due to open in Spring 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, and a project to engage them is under co-development with Scottish Enterprise.

Partly as a result of the construction of Bayes/DTI, the School's physical environment is currently subject to some disruption. As well as Bayes, adjacent to the Informatics Forum, there are continuing internal works within the Forum and, with the continuing work on Appleton Tower, there is the decant of teaching to Forrest Hill, and of commercialisation and much of computing services to the Wilkie Building. These projects inevitably cause physical disruption as well as absorbing a significant amount of management resource.

The external works on the Appleton Tower are now complete and the School plans to use the period between now and re-occupation of the Tower to reconfigure and upgrade internal areas to provide more space and an improved environment for teaching and student facilities, including the fit-out of the new level nine as an independent study suite for taught students.

There are a significant number of change initiatives within the University, including the Service Excellence programme, currently addressing student administration, student recruitment and admission, human resources administration and finance. Additionally, there are proposals for 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 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 of, in particular, 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, whilst also adapting our strategy to reflect the changes likely to result from Lord Stern's review of the Research Excellence Framework. Impact is an area within the REF where we have scope for improvement and we will be reviewing the mechanisms within the School to ensure that we can maximise our impact in the broadest sense.

Review of previous year

The last year had a number of research highlights both in terms of recognition for our results and the award of significant funding, particularly individual fellowships for a number of members of staff. For example Jon Oberlander was elected to fellowship of the Royal Society of Edinburgh, Sharon Goldwater won the BCS Roger Needham Award (the third member of Informatics to do so) and David Willshaw won the Valentino Braitenberg Award for Computational Neuroscience. Prof Wenfei Fan was awarded an ERC Advanced Grant, while James Cheney and Mirella Lapata were awarded ERC Consolidator Grants. Additionally Leonid Libkin was awarded an EPSRC ICT Established Career Fellowship. Test of time awards were given to Peter Buneman, James Cheney and Jean Carletta providing evidence of the lasting impact of research carried out in the School.

The arrival of the Valkyrie humanoid robot from NASA represented an additional capacity within the Robotics group which will be further enhanced by the arrival of the ANYmal robot in early 2017. 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 with an ARM Centre of Excellence being established in the Institute of Computer Systems Architecture (ICSA).

The University is a joint venture partner in The Alan Turing Institute and a number of staff were successful in securing fractional 'Faculty Fellowships' of the Institute. These will allow them to spend time at the ATI headquarters, at the British Library, in London, providing additional opportunities for collaboration with the other joint venture Universities.

Research funding has remained buoyant with a number of grant awards, including several from Horizon 2020 even after the 'Brexit' decision.

In 2016 we held a successful '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. Subsequently, a series of 'research lunches' has been introduced, where researchers from all Institutes can consider and discuss current issues relevant to the research community. Research Day will be repeated in 2017 and may become an annual event.

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.

- Our full cohort of postgraduate research (PGR) students, including all students not yet graduated, exceeds 340. 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 six EPSRC programme and platform grants, bringing over £8m in funding to Edinburgh, and are the lead institution for two of these grants.

- 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 hosts one of only four copies of the NASA Valkyrie humanoid (and the only European copy). Valkyrie is one of the most advanced humanoid robots in existence and enables world-leading research in high degree of freedom motion planning, whole body manipulation and motion transfer.

- The School has a 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.

Opportunities

- 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-discipliniarity of the School's research and teaching.

- The University is developing Bayes/DTI, 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 and Design Informatics.

- As well as space for research and doctoral training, Bayes/DTI seeds opportunities to interact and develop alliances with the other research communities and industry partners to be co-located. The presence of the University's Edinburgh Parallel Computing Centre presents particular opportunities for closer collaboration.

- 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.

2. We will identify and evaluate opportunities in developing and 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

   - 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 improve 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.

4. Where appropriate, we will 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. When appropriate, 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 and platform grants.

7. We will develop and enhance the capacity within the School to respond to Global Challenge Fund opportunities, working with other Schools and Colleges, where appropriate.

8. 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.

9. Furthermore, we will seek to enhance cross-institute linkages through challenge-led research themes. We will foster multidisciplinary research through strategic appointments.

10. 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.

REF 2021

The School has appointed a REF Coordinator and an Impact Coordinator, in anticipation of the (expected) 2021 Research Excellence Framework submission. Together with the Director of Research and the Director of Professional Services, these two posts form the School's REF planning and preparation team, with others co-opted, as required.

Work has been undertaken and is continuing to gather information on potential impact case studies and the School will participate in the University-wide REF-readiness exercise, in early 2017.

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. As the School's academic community continues to grow, so does the size of the PGR cohort. 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 introduced cross-institute 'student families' to increase the sense of community amongst the research student cohort. Subject to positive outcomes from monitoring and evaluation, this initiative will continue to be developed and supported by the Graduate School.

The Graduate School took steps, also, to increase the proportion of students submitting within four years of study. This included a more 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, in addition to funding studentships for new academic staff. Core funding for PGR studentships is planned to increase further for 2017/18 and beyond.

<u>Existing Strengths</u>

- 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.

<u>Opportunities</u>

- The financial position of the School has made possible a significant increase in core funds for the research student intake in 2017/18.
- 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/or alternative routes to improving affordability for such applicants would 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, with continued success, the School will be well-positioned in applying for continuation funding for the CDTs, should that be available, and in making applications for further CDTs or similar programmes.

<u>Actions</u>

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. We will seek continuation of the existing EPSRC funded Centres for Doctoral Training and will consider participation in future funding calls.

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 and commercialisation.

The School has its own dedicated business development team, as well as hosting the Scottish Enterprise funded Informatics Ventures technology business enterprise initiative.

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. Industry funding for fundamental research is particularly challenging, as this requires a longer term view, which is only really practicable for larger organisations. Nonetheless the School has had some recent success in securing industry funding for research and the development of the Bayes Centre will provide additional opportunities for such collaborations.

Review of previous year

The Informatics Ventures programme of technology business enterprise and up-scaling events and activities has seen a further successful year, with EIE (Engage, Invest, Exploit) technology investor events held in London and China, as well as the well-established Edinburgh annual event.

The School and individual staff have continued to develop strong links with industry. Amongst other outcomes, this has resulted in an increase in the level of consultancy activity and an increasing trend for staff to move between academia and industry (and vice versa), both on a long-term basis and for fixed periods.

The 2014/15 and 2015/16 School plans recognised the need to provide more structure and support for public engagement and outreach and a recent investment in an additional support post will assist in achieving this, in addition to ensuring that the wealth of activity undertaken is better captured and recognised.

The School's Director of Commercialisation, Dr Colin Adams, retired after nine years in post, at the end of August 2016. The process is underway to recruit a new Director of Commercialisation and Industry Engagement; the revised title reflecting the breadth of the role to be undertaken.

Existing strengths

- The School has an excellent reputation for industry engagement and commercialisation. Our approach has been studied and replicated by other European regions, for example the Flemish Government's programmes around Ghent and an Italian initiative in Trento, developing their industry engagement model/economic development based on research excellence in our field.

- 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 recognised as one of the originators of the local 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 3 initiative further 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 early stage start-ups to secure

venture funding. It also has become a platform for new alliances with other leading institutions – UCL and 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.

<u>Opportunities</u>

- 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.

- Bayes/DTI provides new opportunities to develop strategic alliances with major private sector players who are expected to base research and development teams within the building.

- 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.

<u>Actions</u>

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 Centre Industry Engagement Project (aka Data.ED).

2. We will investigate how Informatics Ventures (IV) programmes and the EIE events may be continued beyond the current funding period. This will include consideration of the relevance of IV activities to the company formation and up-scaling programmes being planned under the auspices of the Bayes Centre.

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.

Our planning is aligned with the four strategic principles of the College of Science and Engineering Learning and Teaching Strategy. These are listed below together with a summary of the main actions we are taking to implement the strategic principles

A. **A supportive, scholarly community of practice:** our review process is informed by best practice and the more effective induction of new staff together with our new teaching-only roles will encourage further reflective improvement of our practice. Continuing training of graduate tutors and training assistants further supports the development of our community.

B. **Learning independently, collaboratively and with a spirit of enquiry:** our work on distance learning will see new learning modalities emerging on campus. The re-design of our teaching accommodation in Appleton Tower is engaging with the whole community to ensure it supports effective and independent learning. Opportunities to participate outside of the standard curriculum also support independent learning.

C. **Appropriate assessment, effective feedback:** our review will ensure appropriate assessment workloads and distribution of effort through the academic year. In addition we will strengthen out monitoring of assessment and feedback to ensure we meet our declared targets.

D. **Learning in an international environment:** our environment is already highly international and uptake of opportunities for international learning is high. Our goal is to manage international demand more effectively so we can ensure that international students thrive and are successfully integrated and are successful in our community.

Distance Education

We now have five distance courses based on established on-campus courses: *Introduction to Vision and Robotics*; *Advanced Vision*; *Agent Based Systems*; *Introductory Applied Machine Learning* and *Introduction to Java Programming*. 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.

Review of previous year

We have implemented a standard course workload framework to ensure a consistent level of assessment appropriate to the point value of each course. In academic year 2016/17 we are trialing an end of semester one exam diet for some Honours courses. Initial response to this appears to be positive from students and participating staff. We plan to continue this experiment to learn more and will consult to consider extending the scheme. This is a significant step towards a fair, clear and manageable assessment structure.

We continue to tackle the need for improved programming skills in our students. Several initiatives e.g. our 'summer of code', have helped improve student satisfaction and achievement. Initial feedback from students has been positive and we will continue to review and develop these initiatives.

We have reviewed and revised procedures and processes for the management of student projects, in response to the increase in honours and masters cohorts.

We have received approval for a programme of works to Appleton Tower will increase the space available for teaching to cope with our rising student numbers. Increased provision for independent study and enhanced facilities for students will provide a necessary refresh to our environment.

Our 2015/16 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.

Existing strengths

- We are one of only three Computer Science schools in the UK with a silver Athena Swan award. We plan to build on this to create a much more inclusive and discrimination-free environment that will help us build a more gender-balanced student body.

- 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 330 students enrolled in 2016/17, 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 actively 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 have effective structures and processes for student engagement and feedback and there is a strong sense of community within the student body.

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. There is scope for better and more timely feedback; satisfying the students' need for high quality feedback to support their learning success.

- 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.

- 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 as well as supporting growth in student numbers as we increase our staffing complement.

- Efficiencies in teaching (including project supervision) and assessment will assist in accommodating growth in student intakes and cohorts.

Actions[2]

1. 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. [A,B,C]

2. We will consult with students and academic staff and reflect on the success of the pilot move to some end of semester one assessment, and consider our approach to the timing of assessment for future years. [A,B,C]

3. 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). [A,B]

4. We will continue to seek improvements in the timeliness and value of assessment feedback to students through close monitoring and reporting on performance. [C]

5. 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]

6. Where there are very large numbers of students on courses shared between honours and masters programmes, we will identify ways of improving the experience of both cohorts, including creating separate classes, where appropriate. [A]

7. 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. [B]

8. We will establish a short-life working group to evaluate opportunities for extending our distance education provision, based on experience gained from current initiatives and on experience from elsewhere in the College and the University. [A,B]

9. We will appoint to two teaching-only roles on a fixed-term, three-year, trial basis. This will allow us to evaluate the effectiveness and sustainability of such posts. [A]

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[2] The letters following each action refer to the strategic principle in the College Learning and Teaching strategy that this action is directed to support.

10. 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. This will include a deductible deposit for PGT programmes to allow us to better predict and plan for PGT intakes in order to improve the student experience. [D]

11. 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.

12. 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,B]

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 consequences of the Shadbolt Review into Computer Science education; 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; 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 110 academics, 130 research staff, 340 postgraduate research students, 330 taught postgraduate students and 720 undergraduate students, plus technical, computing and administrative support staff.

Review of previous year

The key achievement of 2015/16 was the successful renewal of the School's Athena SWAN Silver Award. This is a recognition of the continued efforts by the School to promote gender equality in Informatics teaching and research.

During the year, we reviewed the Performance and Development Review documentation and our induction process and programme for new staff. 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 introduced promotions workshops for academic staff as an annual feature of our staff development programme. These were well-received by staff who participated.

A total of 13 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.

Existing strengths

- Our international reputation and that of The University of Edinburgh, allows us to attract high calibre staff from around the world.

- We secured renewal of our 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 in 2015/16.

- 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 monitor and review our revised induction processes and support for personal and career development, including the mentoring of early career academics by more senior staff.

4. 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.

5. 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.

6. We will continue the annual cycle of promotions workshops for academic staff.

7. We will continue the recently introduced 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 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.

10. 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.

11. We will continue to review our support staff compliment and roles, to ensure that capacity and capability responds to increasing staff and student numbers.

KEY ENABLER: Income Growth

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

A positive financial position allows the School to invest in further high quality academic appointments and in growth, more generally. This, in turn, enables the School to secure further funding and attract the most able students and researchers, thus further enhancing the School's reputation and financial position; creating a virtuous circle of success.

Review of previous year

The School operated at a surplus in unrestricted funding in 2015/16. This was a turnaround from a deficit position, in the previous year, and was largely as a result of increased, and better forecasting of, taught student intakes.

Research awards secured during the year showed an increase on the previous year and consultancy income and other income from industry (eg studentships) were positive, also.

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 scope to further increase recruitment of non-controlled taught student cohorts, however this must be undertaken in a planned manner, proportionate to available to resources and maintaining the quality of the student experience.

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 three main buildings: research and administration within the Informatics Forum; teaching and student services currently decanted to Forest Hill; commercialisation, commercial tenants and some of the computer services team currently decanted to the Wilkie Building. In addition, the School also is responsible for space within 15 South College Street, which accommodates Disney Research.

Most of the currently decanted functions are scheduled to return to Appleton Tower prior to the start of Semester one of academic year 2017/18. The commercialisation team will relocate to the Bayes Centre/DTI, in 2018.

The growth of the School in terms of staff, students and space presents a number of challenges. Whilst the School will, in the relatively short-term, benefit from additional space for teaching within Appleton Tower and space within the Bayes Centre, primarily for research and research training, current growth trends suggest that current space for growth will be expended within the next three years. Careful consideration will be required as to how any further growth is to be accommodated.

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

We consulted with staff and students on the potential for additional and reconfigured teaching space within Appleton Tower, to meet the current and future needs of our growing taught student body. An application to the University for joint funding of the project was successful.

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.

During the year, the restriction on activities that can be undertaken within the Informatics Forum, due to value added tax regulations, was lifted. Whilst the School wishes to maintain the ethos of the Forum as a primarily research-focused facility, the lifting of the restriction does allow a more flexible approach to the use of the Forum for events for taught students and a new revenue stream through charging for appropriate external events.

Existing strengths

- Appleton Tower (and temporarily Forrest Hill) provides purpose-designed space for Informatics teaching with computing facilities served by the School's 'DICE' platform.

- The School has secured approval and joint funding from the University for an increase and enhancement in teaching space and student facilities in Appleton Tower, due for completion for the start of semester one of 2017/18.

- 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, where (under normal circumstances) 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/DTI, 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.

- Taking existing strengths and the Bayes opportunity together, the School can accommodate growth in research, teaching and commercialisation. It can also reflect on how we make most efficient and effective use of the space available to meet the needs of each of these activities as they continue to evolve.

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.

2. We will work with the Data Technology Institute/Bayes Centre project board to ensure that the future research, research training and commercialisation needs of the School are appropriately catered for within the new building and that these are fully integrated with the activities within the Informatics Forum.

3. We will work with colleagues in Estates and with external contractors to deliver the Appleton Tower levels 3 to 9 reconfiguration and enhancement project, and the return of teaching to Appleton Tower, for the start of semester one of 2017/18.

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.

The School's role of Director of Internationalisation is in process of being handed on from Henry Thompson to Don Sannella, who takes up post in September 2017. We intend to take this opportunity, with Henry's and Don's support, to review the School's internationalisation activity with a view to focussing resources on the areas likely to be most productive in helping to achieve the School's objectives.

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 three large-scale efforts of this sort in the last year.

In March 2016 Jon Oberlander represented the School at the University's Pop-Up Campus in the San Francisco Bay Area, co-organising a one-day symposium on Digital Humanities and Enlightenment at Stanford and presenting on Grand Challenges in Big Data.

In May 2016 Henry Thompson represented the School as part of a 12-strong delegation from across the College in a visit to Santiago de Chile which included both a Government-sponsored conference and specific programme-level discussions with the two largest Chilean universities;

In November 2016: Henry Thompson represented the School as part of a 15-strong delegation from across the University in a visit to Singapore, which included a reception at the British High Commission, meetings with government funding agencies, and detailed discussions with colleagues at NTU and NUS, ranked 5th and 6th in Asia respectively.

Closer to home, during the summer, with the help of nearly 20 academic staff, we hosted two undergraduate research-intensive visiting programmes for students from Stanford (16 students for four weeks) and 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, up from two three years ago. We recognise opportunities to further increase such arrangements, working with colleagues from across the College and in the University's International office.

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.

- The groundwork is in place to negotiate specific Memoranda of Agreement covering undergraduate double degree programmes and/or joint PhD programmes with leading institutions in Mexico, Chile and Singapore.

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 target increases in overseas taught students through developing existing and new international institutional relationships, including working with other Schools, College and the International office to identify and exploit opportunities; significant growth being predicated on a commensurate increase in resource in order to be able to accommodate these students and to provide a quality student experience.

4. We will undertake a review of the School's internationalisation activities. This will include identification of opportunities to cooperative with others within the College of Science and Engineering, and beyond, and to participate in University-led initiatives.

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 student intakes are shown in the following table.

Full-time Attendance	Level	Fee Grp	Entry	2016/17	2017/18 Precise	2017/18 Minimum	2017/18 Stretch	2017/18 Maximum	2017/18 Budgetary	2018/19 Budgetary	2019/20 Budgetary	2020/21 Budgetary
UG - SEU												
Full Time	UG	SEU	Yr 1 entry	118	125					125	125	125
Full Time	UG	SEU	Yr 2 entry	3	0					0	0	0
Full Time	UG	SEU	Yr 3 entry	0	0					0	0	0
UG - RUK												
Full Time	UG	RUK	Yr 1 entry	35			35	45	40	45	50	55
Full Time	UG	RUK	Yr 2 entry	0			0	0	0	0	0	0
	UG	RUK	Yr 3 entry	0			0	0	0	0	0	0
UG - OVERSEAS												
Full Time	UG	Overseas	Yr 1 entry	56			70		65	75	85	95
Full Time	UG	Overseas	Yr 2 entry	2			4		3	4	4	4
Full Time	UG	Overseas	Yr 3 entry	1			3		2	4	6	8
UG - VISITING HOME												
Full Time	UG	SEU		5					5	5	5	5
UG - VISITING OSEAS												
Full Time	UG	Overseas		3					3	3	3	3
PGT - HOME												
Full Time	PGT	SEU		105			115		115	115	115	115
PGT -VISITING HOME												
Full Time	PGT	SEU		0					0	0	0	0
PGT - OVERSEAS												
Full Time	PGT	Overseas		217			235		235	235	235	235
- ADVANCED DES. INF.												
Full Time	PGT	Overseas		6			7		6	6	6	6
PGT - VISITING OSEAS												
Full Time	PGT	Overseas		0					0	0	0	0
GR - HOME (non-CDT)												
Full Time	PGR	SEU		47			58		55	55	55	55
PGR - CDT(s)												
Full Time	PGR	SEU		31			27		25	25	25	25
PGR -VISITING HOME												
Full Time	PGR	SEU		0					0	0	0	0
PGR - OVERSEAS												
Full Time	PGR	Overseas		23			26		24	24	24	24
PGR -VISITING OSEAS												
Full Time	PGR	Overseas		0					0	0	0	0

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.

STAFF RECRUITMENT

In accordance with the School's stated strategy, it is intended to continue to prioritise investment of projected surpluses in additional academic appointments, alongside increasing the funding available for School funded PGR studentships.

In addition, further support posts will be required, aligned to the increase in staff and student numbers and associated activity.

Future academic posts will be aligned with the School's existing research areas and developing opportunities (see the Research section of the School Plan), in addition to teaching priorities. Whilst four of the projected posts are in identified discipline areas, the others are, at this stage, unspecified. This is reflective of the fast moving nature of our discipline areas and the wish of the School to undertake a more detailed review of research and teaching priorities, including at the School's Research Day, to be held in May 2016. The School also needs to take into account the need for succession planning, with a number of senior academic staff expected to retire or reduce their time commitments over the next few years.

Included in the academic appointments are two University Teacher roles. These are given the highest priority, as the School would wish to have these posts in place before the start of Semester 1 of 2017/18, in order to help address teaching resource requirements for the coming academic year and the increasing taught student intake and cohorts. In practice, these roles may be filled through a number of fractional posts adding up to two full-time equivalents, as we wish to encourage innovative models of flexible working, to address the variability of demand over the academic year. Initially, these posts will be on a three-year trial basis.

The following posts have been included in the School's investment plans.

Academic appointments 2017/18

- Two University Teacher posts (UE08)
- Lecturer/Senior Lecturer/Reader in Medical Imaging Analysis
- Lecturer/Senior Lecturer/Reader in Hardware Systems for Security and Privacy
- Lecturer/Senior Lecturer/Reader in Human-Centric Artificial Intelligence
- Lecturer/Senior Lecturer/Reader in Post Moore Computing

In addition to the above, four posts at Lecturer, Senior Lecturer or Reader have been included.

Academic appointments 2018/19

A further eight posts at Lecturer, Senior Lecturer or Reader have been included in the plans for 2018/19.

Support post appointments 2017/18 and 2018/19

A total of ten additional support posts are included in the investment priorities (seven in 2017/18 and three in 2018/19). These cover additional support for teaching, research and research training, aligned to projected growth in staff and student numbers.

A post is included to provide admin support to the Director of Teaching and the Director of Research. The increased size of the School means that these posts have become all but unmanageable in their current form, if the academic staff undertaking these roles are to maintain their respective research programme. The intent is therefore to remove some of the more routine administrative burden, in

order to allow the post holders to focus on their higher-level responsibilities, including taking a more strategic and longer-term view of future opportunities and developments in teaching, curriculum and research. It is hoped to have this post in place for the start of academic year 2017/18.

A particular priority is to recruit one or more trainee technicians, ideally on apprenticeships, in order to provide succession planning in an area where it is difficult to recruit staff with the necessary skill sets.

Other posts are intended to strengthen the teaching office, graduate school, research support, finance team and computing support.

There will be a need, also, to review the resource allocated within the School to commercialisation and industry engagement. This will be done once a new Director of Commercialisation and Industry Engagement is in post and there is greater clarity of the programme of enterprise and industry engagement activities to be associated with the new Bayes Centre and the support from Scottish Enterprise for these activities. Consultancy, scholarships and industry-funded research are and will be increasingly important to the School in order to increase funding and diversity of funding. It is important that support for securing these revenue streams is appropriately resourced.

COLLEGE GROWTH TARGET

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

The School has applied this growth trajectory to staff, student cohorts (where these are not capped) and research income.

Progress towards the target is as below.

Staff

Staff cohorts and growth trajectories				
	12/13 baseline	*16/17 act*	*16/17 %age*	*25/26 target*
Academic	86	104	+21%	120
Research staff	124	124	+0%	174
Support	89	99	+11%	125

Current and planned recruitment would see the academic staff cohort grow to in excess of 120 by 2025/26. This will depend on the continued positive financial position of the School, however a figure of 130 to 140 academic staff might be anticipated by the REF2021 census date, in 2020.

The number of research assistants has increased (to 151 in 2014/15) and then declined, to show no increase on the baseline. This, of course, reflects the research award success profile, noted below (subject to a delay between the year of award and appointment to posts).

Whilst support roles have increased, this is at a lower rate than academic posts and at a significantly lower rate than the increase in student cohorts, shown below. This indicates significant efficiency gains in administration and support roles. Further growth, at the current trajectory, would see a total of 113 support roles in 2025/26.

Students

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

Student cohorts and growth trajectories				
	12/13 baseline	*16/17 act*	*16/17 %age*	*25/26 target*
Undergraduate				
RUK[1]	65	137	+111%	81
Overseas	23	80	+248%	29
PGT				
Home	70	116	+66%	88
Overseas	93	232	+149%	116
PGR				
Home	154	215	+40%	193
Overseas	63	78	+24%	79
1 = baseline for RUK is 2013/14 being the first year in which RUK fees were applicable				

As can be seen from the above, growth in taught students to 2016/17, in all fee statuses, significantly exceeds the 40% target.

Further incremental growth is projected in undergraduate students, however it is anticipated that capacity in physical space will be reached in 2020/21, if not before. Of the School's undergraduate students, 19% are overseas and 46% are non-UK EU/EEA. The UGT cohort is 35%UK:65% international.

The School has capped postgraduate taught students at 350, in total, with a similar split in fee status as that above (33% home; 76% overseas). 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. Of the postgraduate taught cohort, 29% are EU/EEA fee status. The PGT cohort is 10%UK:90% international.

Growth in home research students to 2016/17 is at 40%. Growth in overseas research students is also healthy, at 24%, however this is constrained by the relatively high fees for such students with limited funding opportunities. Of the current cohort, 27% are overseas and 47% are EU/EEA. The PGR cohort is 26%UK:74% international.

It is intended to use the projected positive financial position of the School as an opportunity to 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.
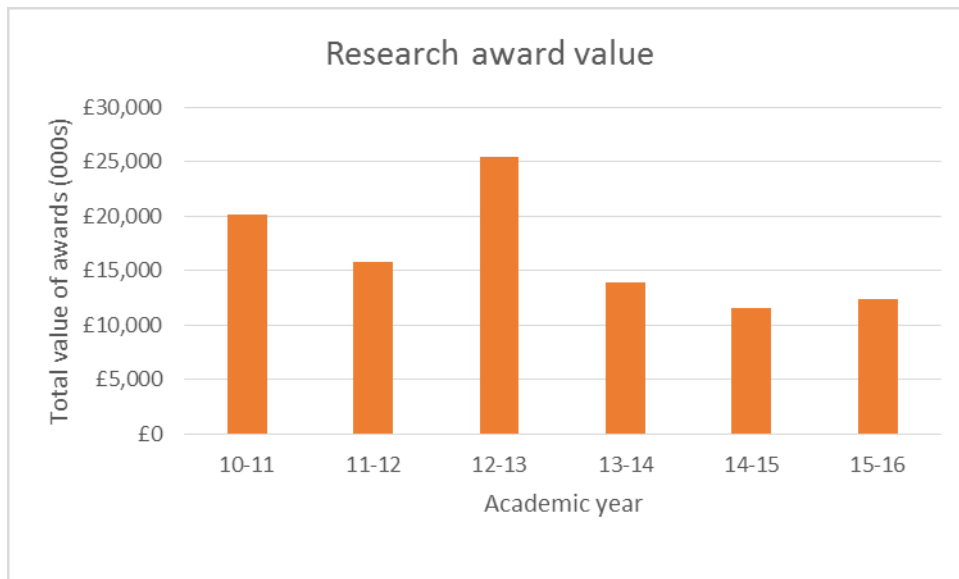
Across all student cohorts, there is a relatively high proportion of EU/EEA students, which is a clear risk factor for the School, in relation to Brexit. There is strong and increasing demand from overseas students, plus steady growth in UGT RUK students, which go some way to mitigate the dependency 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.

In relation to recruitment from Scottish areas of multiple deprivation (SIMD), the School has been monitoring first year undergraduate applicants from SIMD20 areas (the 20% most deprived areas in Scotland). Although total numbers are small, in 2015/16, 13% of applicants and 11% of entrants were from SIMD20 postcodes.

Research and consultancy income

Research and consultancy income and growth trajectories				
000s	12/13 Baseline	16/17 act	16/17 %age	25/26 target
Research awards[1]	25422	12426	-51%	35591
Research o'heads	735	878	+19%	1029
Consultancy[1]	216	286	+32%	302
1 = From ERI KPI reports				

With regards to research award value, 2012/13 was a particularly successful year. Research awards and consultancy income can fluctuate significantly from year to year, as the following graph of research awards shows.

Research award value

Total value of awards (000s)

Academic year	Total value of awards (000s)
10-11	~£20,000
11-12	~£15,750
12-13	~£25,500
13-14	~£14,000
14-15	~£11,500
15-16	~£12,250

Early data for 2016/17 shows a year-on-year increase in both research funding applications and research award success. Renewed focus on this area is expected to produce further improvements in performance.

Projections to 2025/26

Overall, the School is on a strong growth trend and, on the basis of current performance, most indicators are already well in excess of a 40% growth target. The few that are not, are on trend to exceed 40% growth by 2025/26. The one exception is research awards, however this is distorted by an exceptionally high base year performance. The current trend in research awards is positive and this is indicated to continue.

Given the uncertainties in the external environment, the School is reluctant to make firm predictions as to an eventual 2025/26 position, including as to the balance of growth between different segments. What is clear, is that the School is vulnerable to potential changes in the position in relation to EU research funding and the status of non-UK EU/EEA staff and students. This will require positive actions to mitigate the consequent risks.