Unit-level environment template (REF5b)

Institution: University of Strathclyde

Unit of Assessment: 11

1. Unit context and structure, research and impact strategy

The Department of Computer and Information Sciences (CIS) at Strathclyde believe that technology must be developed from a human perspective if it is to deliver on its potential. With representation from computer science, information science and health science backgrounds, we are a truly multidisciplinary CIS department. Our research profile spans a broad range of interests from the technical to human side of computer and information sciences. From a developing research base in REF2014, we have invested significant resource in strengthening and reshaping all of our research groups over the REF period. Since REF 2014, UOA11 has had significant successes in key research metrics including research spend, PGR numbers, research quality and staffing. We have won major grant awards since 2014, PGR numbers have increased every year and now stand at 76 PGRs in 2020 (33 in 2014), and we have recruited 21 new full time academic staff since 2014 including 7 professors (a total of 31.8 FTE compared with 20.2 FTE in REF2014).

We are comprised of five research groups (shown in Table 1) that are committed to delivering impactful, human-centred research with meaningful outcomes for society. This includes the strategic decision to create two new research groups in Cyber Security and Artificial Intelligence as capacity in these topics is vital given research trends in our subject and funding opportunities through UKRI. The University of Strathclyde is a 'place for useful learning' and prides itself on being a leading international technological University with a focus on impactful, translational, intra- inter- multi-disciplinary and collaborative research. The University has identified several strategic research themes to realise these ambitions and our research is aligned with these as outlined in Table 1.

Table 1: UOA11 Research groups, staff FTE and aligned University strategic themes**.**

Research Groups 2021	University Strategic Research Themes	Research Focus
Artificial Intelligence (AI) 4FTE	Measurement Science & Enabling Technologies AND Health & Wellbeing	Developing tools for analysis, decision-support, and autonomy for a variety of real-world application areas in which AI is used to supplement human creativity and expertise.
Cyber Security (CS) 4FTE	Ocean, Air & Space	Intrusion detection techniques, malware characteristics and social and nature inspired approaches to security and situational awareness in self-protecting systems.
Digital Health & Wellness Group (DHaWG) 6FTE	Health & Wellbeing	Design, development, implementation and evaluation of digital health and care solutions for people, services and organisations.
Mathematically Structured Programming (MSP) 7.8FTE	Measurement Science & Enabling Technologies	The use of mathematics to understand the nature of computation, particularly focussing on programming language development.
Strathclyde iSchool Research Group (SISRG) 10FTE	Health and Wellbeing AND Society & Policy AND Measurement Science & Enabling Technologies	Information-centred research, particularly on information behaviour, information engagement, interactive information retrieval and information policy.

Unit-level environment template (REF5b)

The Departmental research strategy is supported by the Department Research Committee that is chaired by a senior Professor and comprises the leaders of each research group and the Postgraduate Research (PGR) Director. The committee meets quarterly to provide directions for, and monitor progress in, all the thematic areas of research. The Research Committee also reviews the support mechanisms for PGR students and Early Career Researchers (ECRs), grant application writing and output, and various intra- and inter-university collaborations in research, knowledge exchange and impact-related activities. The Research Committee Chair is also a member of the Faculty Research Committee and Department Executive Committee and thereby acts as a conduit between the University and Department in all research and supervision activities.

In addition, in 2017, in order to strengthen the role, capacity and capability of the Director of Research to effect change, a Research Directorate was formed. This group of 5 academic staff, led by the Director of Research, is charged with management of research in the Department. In 2018, it developed a new Departmental research strategy to provide a clear framework for delivery against research expectations. This strategy has been pivotal in redefining our strategic research objectives and fostering a dynamic research environment, including development of staff and PGR students (see Section 2).

Research Strategy

Our vision for this period was to complete the transformation of our Department, begun during the REF2014 period, into one which is 100% research active and effectively harnesses the breadth and depth of our research portfolio to solve problems in the world around us. Our research objectives for the review period were to:

- **Support all academic staff to produce publications of international quality:** We have used internal peer review to support the quality of publications produced in the department to ensure that all academic staff generate outputs of international quality, publishable in journals and at conferences of the highest standard.
- **Ensure each member of academic staff supervises PGR students:** By implementing our staffing recruitment strategy (see Section 2) and providing developmental support opportunities for staff (see Section 2), we have increased the percentage of UOA11 staff supervising PGRs from 77% to 86%.
- **Increase and diversify our research portfolio:** Our objective in 2014 was to translate our increased international research portfolio into an expanded grant portfolio with a greater number of external partners. We have made substantial progress with this objective at REF2021 as we have led and won a number of substantial grants including several over £1m FEC (detailed in Section 3) and obtained our first wins from funders such as Leverhulme Trust, the Marie-Curie ITN programme and the Medical Research Council. At REF2014 we expected all members of academic staff to hold substantial (>£50k) external research grant funding. We have made major progress with this ambition as 20 of 32 staff have successfully won grant funding awards of at least £50K during the REF period.
- **Improve the practical application of our research:** Through Knowledge Transfer Partnerships, industry-funded research, involvement with innovation centres and involvement in Glasgow City Innovation District (GCID) clusters, we have made very substantial progress with our strategic ambition to improve the practical application of our research. As detailed in Section 4, we have secured 4 Knowledge Transfer Partnerships (KTPs) and been awarded research grants with companies including BAE Systems, as well as the National Physical Laboratory and the DataLab and Digital Health and Care Innovation Centres. Our growing reputation for being able to apply our research resulted in us taking leadership roles within the University's flagship Technology and Innovation Centre 2 (TIC2) project (see Institutional Statement) to transform knowledge exchange across the University. Of the six proposed industry facing cluster areas associated with TIC2, four members of our Professorial staff co-lead three of these areas of University excellence.

- **Recruit new research leaders:** We had clear aspirations at REF2014 to recruit new research leaders and thereby create capability in the areas where our external partners face challenges and require research support. We have been very successful in this goal. We recruited 21 new academics, including 7 new Professors (see section 2) and formed two new research groups in the key strategic areas of Cyber Security and Artificial Intelligence. The influx of new staff has reinvigorated the whole department and all staff have benefitted from the rejuvenated research environment (see sections 2 and 3). All staff – new and established – have a personalised strategy to support their development (see section 2). In this respect, new staff have provided established staff with new tangible opportunities for collaboration.

Strategic Research Objectives for the Unit:
Over the next 5 years, our strategic research aims focus on the following key objectives:

1. Increase Research Intensity: Since REF2014, we have meaningfully intensified the volume and quality of our research. This is only part of the journey. Thus, our first strategic goal is to continue to increase our research intensity. For example, while we have won grants up to about £1m, we have also come close to winning much larger grants (£2-3m) by getting to the final interview stage of schemes including EU ERC, UKRI CDTs and UKRI Trustworthy Autonomous Systems Call. In the next REF period, we set ourselves the task of reaching this next level. We will complete the process of ensuring all staff supervise PGR students and for all staff to win research grants of increasing scale and value. Research intensity will also be increased by further investment in staff (see below). Finally, we will capitalise on our growing reputation within the University and beyond to become part of larger, collaborative research activities with national and international partners.

2. Strengthen and expand our research groups: We have invested significant resource in strengthening and reshaping all of our research groups as detailed above. Due to the increasing projected investment by UK government, industry and other stakeholders in Cyber Security, Artificial Intelligence, and Digital Health, a strategic priority over the next five years is to strengthen these research groups with further appointments. We also intend to increase the size of our UOA to 50 staff by the next REF to ensure we have the capacity to grasp new research opportunities. While ambitious, this is also achievable as it replicates the achievements of this REF period.

3. Deepen distinctiveness: As previously stated, our belief, and the belief of our stakeholders, is that technology must be developed from a human perspective if it is to deliver on its potential. Therefore we will maintain a research profile that spans a broad range of perspectives from the technical to human side of computer and information sciences. Over the next 5 years, our third strategic goal is to extend this distinguishing feature of our research approach. This will be achieved firstly by focussed recruitment and we began by hiring in the area of human factors of cybersecurity (*Moncur* and *Renaud*) to complement existing expertise in the technical side. The second approach will be to strategically seed-fund new collaborative engagements between the traditionally more human-focussed research groups and the traditionally more technically-focussed research groups within the Department.

4. Increase stakeholder relevance: We jointly lead the three of the industry facing clusters that support the University's contribution to the Glasgow City Innovation District (Industrial Informatics, Health Technologies, FinTech) and contribute to three (Space Technologies, 5G and Quantum). Continuing to align with areas of national and international need, and associated strategic University activity, will enable CIS to deliver scientifically valuable activities that are relevant to industry and the public. A key stakeholder with which we wish to further align is the National Physical Laboratory (NPL). NPL is a strategic partner of the University which already funds iCase studentships and the Trusted Systems research project in the department (*Ghani, McBride, Forsberg*: £600k). We will deepen this relationship with NPL via further projects and joint appointments in data analytics - a key

area of mutual interest. We will also continue to build on KE opportunities with the Digital Health and Care Innovation Centre (DHI) following recent success in digital health evaluations by *Lennon*, *Maguire* and *McCann* (£299k) in collaboration with DHI. DHI is one of 8 national innovation centres in Scotland and its location on the University campus as part of our department provides tangible opportunities for transformative and impactful research to co-design and evaluate digital health and care solutions across service, business and technical innovation directly with researchers from UOA11.

The above objectives will be supported through transformational improvements to both our physical and research infrastructure over the next 5 years. Specialist research labs will be created within a new building with space to support further development of our research groups e.g. an expanded Cyber Security Lab. We will also have a physical footprint in the forthcoming TIC2 building (a purpose-built state of the art facility to be located within the Glasgow City Innovation District - see Institutional Statement) which will host an Institution-wide Living Lab for our Digital Health & Wellness Research Group.

Impact Strategy
At REF2014, we saw a need to increase our level of research impact by capitalising on opportunities and support from the University to develop strategic partnerships with industrial, commercial, professional and governmental organisations. The opening of the University's Technology and Innovation Centre (TIC) in 2014 facilitated engagement opportunities with a variety of industrial companies and partners looking for research-based solutions to their problems. We purposefully sought further ways to develop external use of our research and so appointed a Knowledge Exchange Fellow (*Wallace*) in 2016 to develop these activities. We were the first Computer Science Department in the UK to create this role. The investment has been particularly fruitful: we have generated over £1million in Knowledge Exchange funding in this review period because *Wallace* has actively managed the introduction of our research to relevant interested external organisations (including the previously mentioned 4 KTPs).

Wallace's appointment has also supported the successful award of 10 innovation voucher research projects (innovation vouchers are administered by Interface - a central hub to connect national and international industries with academics and researchers across Scotland - to encourage the development of new business and academic partnerships to accelerate innovation). Consequently, we have developed 10 new industrial collaborations over this review period with organisations such as My Customer Lens (our contribution: ontology development); Welbot Ltd (our contribution: prototype development and data analytics); Fash Consulting Analysis (our contribution: machine learning); and the Riverside Museum, Glasgow (our contribution: novel methods for prototyping and creating digital and tangible interactions). We have recently appointed a second KE Fellow (Sutter) to work specifically on the cross-institution initiative Health and Care Futures at Strathclyde.

Staff are supported to actively pursue impact-generating activities by releasing them from allocated academic duties and responsibilities. This is achieved by acknowledging the importance of KE activities in the department's workload model. Staff with Knowledge Exchange Leadership roles (*Chowdhury, Ghani, Maguire, Revie*) are allocated reduced workloads in other areas to support effective engagement in these activities.

The success described in our impact case studies was enabled and facilitated by focussing on three specific impact-generating areas: networks and relationships, public engagement, and informing and influencing policy. We encourage staff to actively pursue impact generating activities by releasing them from academic duties and responsibilities. For example, in relation to the research on dependent types in Haskell (which forms one of our impact case studies) protected time and associated funding was provided for *McBride* to be released from academic duties for 6 months to

develop relationships with key academic and industrial partners, including 2 extended periods with Microsoft UK to further enable impact-related activities. We also allocated dedicated time and staff expertise to publicly generate awareness of *Lennon*'s research in digital health (which forms another of our case studies), when she chaired dissemination sessions at four national Digital Health Roadshows held in Glasgow, Belfast, Cardiff, and London attended by over 1500 health and social care professionals and technology providers across the UK.

Approach to Supporting Interdisciplinary Research
In this period, we determined to leverage the University's Strategic Research Themes to develop and deliver impactful interdisciplinary research that aligned with the objectives of our research groups. In particular, we targeted Strathclyde Centres for Doctoral Training (SCDT) and now lead 5 centres as a direct consequence of aligning with the University Strategic Research Themes and developing internal collaborations forged at University supported events. These initiatives support the development of the Department's next generation of research leaders in Digital Health & Data Analytics; Human Centric AI in Healthcare**;** FinTech; Explainable AI; and Cyber Security, and operate in collaboration with colleagues from Strathclyde Institute of Pharmacy & Biomedical Sciences, Strathclyde Business School, Mathematics & Statistics, Engineering and Marketing.

We also use the national Innovation Centres and national networks to increase our interdisciplinary activity. We host the DHI as part of our department and we co-locate co-funded PGR students within their office spaces, thereby providing ready access to support from innovation experts. Our strategic links to the DataLab Innovation Centre also enable collaboratively delivered, impactful, human centred research. Opportunities for interdisciplinary research are further optimised through participation in pan-Scottish activities such as the Scottish Informatics and Computer Science Alliance (SICSA) and the Scottish Graduate School for Arts & Humanities (SGSAH) (details in Section 4).

Progress towards an Open Research Environment
Open access comes naturally to researchers in multiple areas of computer and information science where putting drafts, preprints and software online and accessible to all have been part of our research practice over many years This meant that the Department was well placed to embrace institutional provision in this area particularly when Strathclyde established its institutional research data repository and open access facility in 2015, alongside its existing processes to allow access to publications. All active researchers – staff and students – are required to deposit their research outputs, including research papers, reports and theses. We satisfy funder mandates with respect to research dataset deposition and ensure we demonstrate best practice in this regard by requiring PGRs to develop a Data Management Plan for their research.

Staff in CIS benefit regularly from RCUK/UKRI funding at Strathclyde for open access publication. As of February 2020, 97% of the articles published from CIS are Open Access; this is the highest proportion within the Science Faculty.

Supporting a Culture of Research Integrity
University policies on Research Code of Practice, Code of Practice on Investigations Involving Human Beings, and the University Code of Practice for Postgraduate Research provide the foundation for our approaches to research integrity. The Research Code of Practice, with which all staff and PGR students must comply, aims to promote excellence in research practice and dissemination across the whole University and so sets out expected standards associated with research governance for project conduct, data protection, protecting research authenticity, data storage, authorship and publications. To ensure the standards set out within the Code are maintained, we have a Department Ethics Committee that scrutinises research planned by students at Undergraduate, Masters and PhD level and all staff research. For any research projects which fall

beyond the remit of the Departmental Ethics Committee, ethical applications are instead submitted to the University Ethics Committee (UEC) or to external ethics review committees managed by the NHS. Our Departmental Ethics Committee reports annually to UEC on the number of applications submitted, approved, returned for revision or rejected as appropriate. In the most recent full academic year (2019 - 2020), 220 applications were approved by our ethics committee, indicating the thriving research culture in CIS. For those research projects working within NHS settings, researchers are responsible for obtaining relevant NHS Ethics Committee and associated Research and Development approvals in place, alongside the necessary research passports and Honorary Contracts or Letters of Access.

We augment University procedures and process on research integrity by providing regular Departmentally-led training on ethics and integrity. These events, conducted by members of the Department Research Ethics Committee and other colleagues, highlight specific issues relevant to ethical research in the CIS discipline. This training is mandatory for all staff and PGR students within the first 3 months of joining the department and is complemented by further training available from the University and other partners (e.g. NHS). The application of ethical approaches to conducting research is then reviewed with PGR students during annual progress review meetings. Two of our academic staff (*McMenemy* and *Moncur*) are experts in data and research ethics and share their expertise with the Department.

2. People

Our department's success is directly dependent on the quality of our staff and our ability to retain and develop the team. In order to continue the transformation of our department, the recruitment strategy has been hugely significant during the current REF period. However, we have also been working hard to build an environment that fulfils the University's values and enables new and existing staff to thrive.

Recruitment
Since 2014, we have adopted a recruitment strategy in direct response to our ambitions to grow and strengthen our areas of research expertise by expanding our research groups and the volume and quality of the research they produce. This has resulted in a significant increase in staff numbers at both senior and junior levels.

We previously identified a lack of depth in research expertise, experience and leadership as a strategic weakness and so we have focussed on recruitment of world leading researchers and outstanding early career researchers who have the potential to become world-leading. Through the University's Global Talent Programme (GTP) scheme for senior appointments, we have recruited over this review period 7 Professors (*Chowdhury, Dong, Maguire, Mardare, Moncur, Revie, Winskel*) and 1 Reader (*Nagaraja*), adding one new Professor to each of our research groups. We have also benefited from the University Chancellor's Fellowship scheme for future world-class research leaders by appointment of *Atkey, Azzopardi, Cashmore, Forsberg, Lennon, Moshfeghi* and *Thomas* to further consolidate the strength of our research groups. In addition, the department has made strategic appointments of another 6 staff to Research, Lecturer and Senior Lecturer positions (*Egan, Halvey, Innocenti, McCann, Pennington, Wilson*). The total of 21 new academics hired during the review period represents 66% of our staff and demonstrates a clear commitment by the University to reinvigorate research in Computer and Information Sciences at Strathclyde.

Development

We have embedded a number of staff development opportunities, strategies and structures to support the career progression of all CIS staff over this review period – both new recruits and existing staff.

We are committed to supporting staff development across all the job families and grades. We utilise University structures to facilitate this, particularly the University's annual Accountability and Development Review (ADR) process. We jointly agree with staff which senior colleague will act as their ADR reviewer, so they can discuss objectives and development needs with someone whose research is appropriate and with whom they feel comfortable about being open and honest. Annual ADRs are augmented by mentoring support to staff throughout the year and Reviewers and Reviewees meet for an informal six-monthly meeting to consider performance, and discuss ways in which outstanding objectives can be realised before the end of the ADR cycle. In addition, all staff have mentors with whom they meet informally through the year.

We also support staff development by encouraging all staff to engage in whatever training will benefit their roles and responsibilities within the department. We encourage staff to participate in University-provided training courses delivered by the Organisational and Staff Development Unit (OSDU) and the Researcher Development Programme Team in Research and Knowledge Exchange Services (RKES). Staff are also encouraged to complete training courses relevant to research leadership via the Institution-wide Strathclyde Programme in Research and Leadership (SPIRAL). During the review period, 84% of staff have attended University training courses including sessions focussed specifically on grant and paper writing skills and research career development and leadership, which has contributed to an uplift in grant success, the quality of research outputs and general research leadership across the department.

At a Departmental level, we closely monitor and evaluate all staff development needs, regardless of seniority or FTE status, through the Departmental Executive Committee, Departmental Research Committee and Research Directorate (See section 1 for details). Our research groups (see section 1) provide a supportive environment and mentoring opportunities for staff and aligned PGR students and researchers. We have an internal Peer Grant Review process that staff are required to follow prior to final submission of grants. This process arose directly from the aforementioned Research Strategy developed in 2018 and was purposefully implemented to increase the quality of grant application submissions. Individual research groups coordinate the development of grant applications and arrange review workshops where lead researchers receive focussed assessment of research proposals at different stages from inception to submission. A senior member of staff is available to help staff develop grants throughout this process. Care is taken to ensure that applications are targeted to the most appropriate funder and that the constructive comments on proposals are provided by peers with appropriate expertise. We also facilitate opportunities for internal research collaborations and networking via 'research speed dating' activities for staff. In 2018, we instituted the new idea of an annual research away day for all staff and PGRs to foster a collegiate and inclusive research community, reflect on what has been achieved and consider what might be developed in the year ahead.

Reward and recognition for research, knowledge exchange and impact
Achieving excellence in research, knowledge exchange (KE) and impact generating activities is recognised at both Departmental and University levels. For staff to get the best out of their endeavours, they must have dedicated time and financial resources.

We utilise our workload model to allocate time to staff for their research, KE and impact generating activities as well as other responsibilities. Winning grants and other successes in research and KE are rewarded by allocation of additional time for these activities. This offers protected time from teaching and citizenship roles so staff can focus on achieving maximum success in their research

and impact generating activities. Also, the employment of Teaching Demonstrators, to supervise laboratory classes and assist with marking, releases academic staff time for research, etc. Over the period, use of Teaching Demonstrators has increased from 1560 hours in 2014/5 to 2723 hours in 2019/20. Additionally, non-academic staff take more responsibility for administration duties associated with assessment and the management of research/KE grants. In practical terms, these initiatives typically provide academics with 30% more time for research, KE and impact activities than would otherwise be possible, incentivising success.

Non-professorial staff who write papers considered to be of world leading quality (as gauged by internal review) are provided with a £1000 payment per paper into their individual research fund to reward and thus incentivise production of world leading research. Where staff supervise dissertations on MSc programmes beyond CIS, the £1,000 payment from the host department is allocated directly to the individual staff member's research funds account.

We are committed to providing opportunities for staff to contribute their research at major conferences. For any staff member presenting a paper that is considered to be of international quality which is novel, significant and impactful, the Department uses its central research funds to support attendance when no other funds exist. Central research funds are also used to reward research excellence by prioritising financial contributions towards Departmental or University PhD studentships.

We utilise the university-wide Starter Grant initiative to help newly appointed staff establish their research careers at Strathclyde. Newly appointed Professors are awarded £25k via the New Professor Fund, while Readers, Senior Lecturers, Lecturers and Research Staff on Open Ended Contracts are awarded £10k.

The University also has an annual promotion scheme to reward exceptional performance of staff. Following the ADR process, professorial staff may be rewarded financially for their research, knowledge exchange and impact excellence through the University's Senior Academic Review and Development (SARD) panel. The University operates a Professorial-zoning system (zones 1 to 4), so promotion between zones may also be recommended by this panel. During the review period, 9 staff in the UOA academic staff have been promoted to senior lecturer or reader (*Atkey, Azzopardi, Cashmore, Halvey (promoted twice over this review period), Kupke, Lennon, McBride, Moshfeghi, Pennington*). *Duncan* was promoted from research fellow to senior research fellow and *Egan* was promoted from research associate to research fellow. Together these 12 promotion cases are over half of our non-professorial staff. Exceptional performance of staff at all levels is also recognised through the University's annual Contribution Pay programme, which rewards staff through salary increases or one-off payments.

Research Students

We supervise PGR-students studying full-time, part-time and by distance learning. Year-on-year increases in the number of PGR students registered in CIS have grown the number of PhD students from 33 in 2014-15 to 76 in 2020/21. Since REF2014, 49 PGR students have been awarded PhD. Recruitment into PhD studentships is achieved by a number of mechanisms:

Having established in REF2014 that supervision of research students was an expectation of all academic staff, we have ensured that staff advertise their research interests and expertise via their staff profile webpages and are available to prospective students that make direct approaches to discuss their own research ideas and aspirations. Prospective students submit their research proposals via open competitive processes in CIS for Departmental/University funded studentship awards. These are competitive processes so we encourage and aim for excellence in both our student applicants and the research proposals.

Additionally, we have become increasingly strategic in our student recruitment through targeted use of internal funds, and external networks and relationships. We have regular success in recruiting excellent students through Strathclyde's John Anderson Research Award Scholarship scheme, which awards funding to students holding First Class Honours or Masters with Distinction, and requires a substantial funding contribution from an industrial partner. We have also an established record of obtaining PGR studentships from major external funding bodies, including from: AHRC (x 1), Capita (x 2), EPSRC (x 3), EPSRC-iCase (x 4), and NPL (x 1). We attract the best calibre students by providing a supportive research environment in which students thrive and by securing funding for innovative research projects that leverage our research networks to provide interdisciplinary supervision support. An example is our Joint Supervision Programme with three Universities in Saudi Arabia. This initiative is aimed specifically at supporting female students from Saudi Arabia to establish a research career (the programme also aligns with our commitment to Equality & Diversity - see further details on this in the Equality & Diversity section below). To date, 5 females from Saudi Arabia have joined this programme in CIS; two have graduated with PhDs in this review period and 3 are currently supervised by CIS academics. This unique programme provides PGR students with a University of Strathclyde supervisor and a supervisor from the host institution in Saudi Arabia. The students are expected to visit Strathclyde for a 2 – 6 week period at least once during each year of study. In future, we will broaden opportunities for postgraduate research by widening access to our Professional Doctorate programme (to support people working in industry who wish to complete PhD research in CIS either full or part-time alongside their professional commitments) from Information Science professionals to people working across other industrial sectors.

PGR students are embedded within research groups and undertake annual formal reviews to monitor their progress. In 2020, we implemented a CIS PGR and Supervisor Learning Agreement (developed collaboratively with our PGR students). This document outlines the expectations on students and supervisors in relation to PGR research and supervision, and is signed by both the student and their supervisors. This Department level guidance complements the University's Policy & Code of Practice for PGR Study (see Institutional Statement). Research Group Leaders ensure PhD students aligned to their research group are provided with opportunities to present their research to their wider research group at least twice per year. Review panels are convened with the supervisory team and another member of academic staff, and constructive feedback is provided to the student.

We also strive to support participation of students in conferences and other external events where they can present their research and benefit from engaging with leaders in their field of study. The positive impact of the training we provide to our PhD students is reflected in their successes when presenting at conferences. Highlights include: the Marc Resnick Best Paper Award to Azzopardi and Halvey's PGR student Sylvain Daronnat at the 64th International Annual Meeting of the Human Factor Society (2020); best paper award at the CHI Conference on Human Factors in Computing Systems ACM (2020) for Dunlop's PGR student Gibson; best paper award for Azzopardi and Halvey's PGR student Foulds at Association of Computer Machinery Special Interest Group on Information Retrieval (ACM SIGIR) Conference on Human Information Interaction and Retrieval (2020); and Best Paper Award for Simpson with Ghani and Forsberg at European Joint Conferences on Theory And Practice of Software (ETAPS) (2016). Another notable PhD student success was the Carnegie Trust Robertson Medal for the best research PhD proposal (2016) for Levine's PhD student Damien Anderson.

Equality and Diversity
We implement all relevant University policies at Departmental level and adapt these if required to provide personal support to CIS staff and PGR students. Our Head of Department is from an ethnic minority and this gives visibility to that traditionally under-represented group. In addition, over this

review period we have recruited staff from ethnic minorities at Professor, Reader and early career researcher levels. We monitor gender equality issues in terms of the operational structure of the Department in the following ways: the workload model and allocation of duties and responsibilities are gender-neutral; staff with parenting or caring duties can negotiate flexible working relationships; we monitor committee memberships and all major departmental committees contain at least one female member. Women and men have held the Director of Research and Deputy Director of Research roles during the current review period. *Innocenti* Chairs the Athena Swan working group in CIS and will lead submission of our Bronze Award application in 2021. *Pennington* represents CIS at the institution-wide Women in Science and Engineering group and the STEM equals Committee which discuss issues and opportunities and recommend best practice for advancement of females within the STEM sector. Despite there being fewer females in the CIS domain generally, during this assessment period, we have successfully appointed two female Professors (*Maguire, Moncur*) and 3 Senior Lecturers (*Innocenti, Lennon, McCann*) and 1 Lecturer (*Pennington*). *Lennon* has since been promoted to Reader and *Pennington* has since been promoted to Senior Lecturer.

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3. Income, infrastructure and facilities

During the review period we have made considerable advances towards our aim of having an internationally leading portfolio of research and KE activities. This success has been achieved through a combination of substantial university investment in our research infrastructure and facilities, alongside notable improvements in competitive external funding.

i) Research & KE Income Portfolio
At REF2014, we expected our research strategy would lead to an expanded grant portfolio. This has occurred in three ways. Firstly, whilst RCUK/EU grants are still our main source of research income, we have diversified significantly (28% of research income in REF2021 was non-RCUK/EU income compared to 5% in REF2014). Research income been further strengthened through increased industrial funding (£402k in REF2021 compared to £78k in REF2014), UK central government funding (£353k REF2021, £39k REF2014), and charity funding (£190k REF2021 compared to £34k REF2014). As illustrated in Figure 1, the trajectory of income from these sources is strong and consistent.

Figure 1
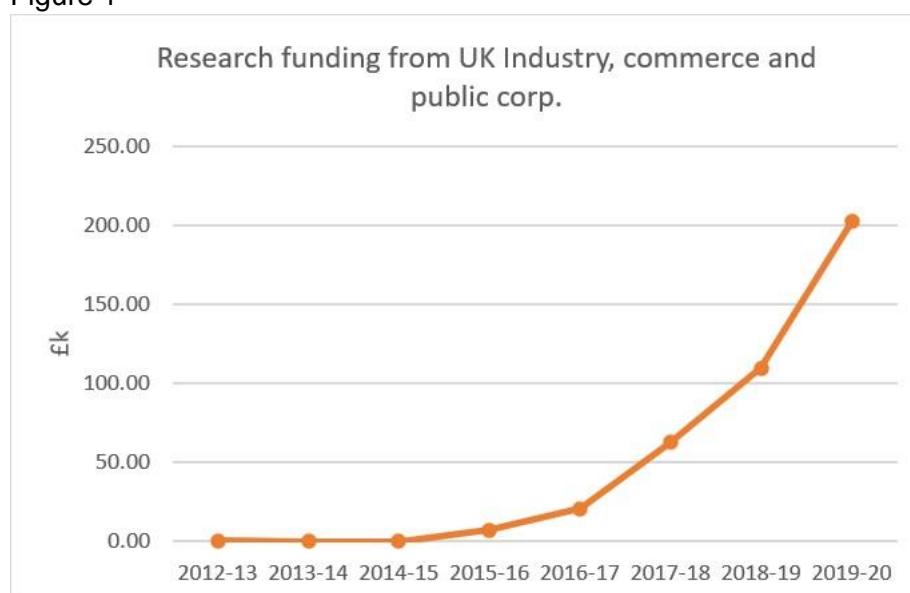
Secondly, we have seen a significant increase in large grant wins, with 8 grants over £500k FEC achieved including three over £1m FEC. Thirdly, at REF2014 we expected all members of academic

staff to hold substantial (>£50K) external research grant funding. In REF2021, 20 staff have successfully won grant funding awards of at least this value.

We began this REF period with annual total research income of over £300k (2013-2014) and end it with over £670k (2019-2020). Within the cycle (in 2017-2018 and 2018-2019) this annual total was exceeded as a result of our leadership of the FP7 eSMART project (one of our grants over £500k). Of the 33 colleagues eligible for REF2021, 24 have achieved grant success whilst at Strathclyde during the current REF period, 5 of those who have not yet won grants are in post for less than 2 years and we fully expect that they will also be successful early in the next period. We have had research grants awarded from industrial partners such as BAE Systems (*Moshfeghi, £34k*), DataLab (*McBride, Forsberg, Roper, £60k*), the National Physical Laboratory (*McBride, Forsberg, Ghani*, £595k) and the Digital Health and Care Innovation Centre (*Lennon, Maguire, McCann*, £299k).

During the REF2021 period we gained our first Knowledge Transfer Partnership (KTP) and built on that success. The KTP scheme facilitates transfer of knowledge and expertise from academics and researchers into UK-based business-critical projects. Over this review period, we have been awarded four KTPs, worth a combined income of over £700k, with the following organisations: BIP Solutions (*Azzopardi* & *Moshfeghi*, £244k), Cambridge Quantum Computing (*Atkey, Forsberg, McBride*, £199k), Symphonic Software (*Atkey & Kupke*, £151k) and Syngro Limited (*Roper* with *Revie* & Barlow from Management Science, £186k). As previously mentioned, this growing reputation for being able to apply our research resulted in us taking a number of leadership roles within the TIC2 project to transform knowledge exchange across the University in key areas. As outlined in the Institutional Statement, there are six proposed cluster areas representing University excellence and four members of our Professorial staff co-lead on three of those six proposed clusters (*Ghani*: Industrial Informatics; *Chowdhury & Revie*: FinTech; and *Maguire*: Health and Care Futures). This creates a platform for future significant and sustainable expansion of our Knowledge Exchange activities.

ii) Infrastructure

Scholarly Infrastructure and Facilities: Our Department is housed over four floors within the Livingstone Tower at the University of Strathclyde. One floor is dedicated to our Departmental professional support services staff and houses dedicated study spaces for students. The other three floors co-locate our research group academics, researchers and PGR students in individual and group office spaces. All four floors were refurbished during the period through investment (£113,000) provided jointly by the University and the Department. A number of improvements and configuration changes were made to the environment to improve interaction, support and collaboration between peers and colleagues, thereby enhancing the sense of community within the department.

We have three dedicated, bookable, data collection spaces in the Department for experiments that are frequently used by researchers recruiting participants for face-face activities. The **Usability and User Experience Lab** is a bespoke accessible and reconfigurable lab space for conducting a wide range of research including usability studies, fabrication of technologies, prototyping, and co-design sessions with stakeholders. The laboratory is essential to the human-centred research activities of the Digital Health & Wellness Group and Strathclyde iSchool Research Group. Specialist equipment in this lab includes recording equipment, Virtual Reality headsets, wearable devices (including Google glasses) and a desktop computer for running user studies.

As indicated in Section 1, we are committed to continued improvement in the infrastructure available to our staff. Over the next 5 years, we will create specialist research labs within a new building with space to support further development of our research groups, e.g. an expanded Cyber Security Lab. We will also have a physical footprint in the forthcoming TIC2 building (a purpose-built state of

the art facility to be located within the Glasgow City Innovation District) (see Institutional Statement) which will host an Institution-wide Living Lab for our Digital Health Research Group and support cross-faculty and inter-disciplinary research collaborations and activities.

Our Cyber Security Research Group are members of a cross-institutional Strathclyde Security Research Group and have led the development and testing of a number of security testbeds including: The **Experimental Network of ArChitectures Testbed (ENACT)**, which consists of 1056 switch ports and 96 server ports using Pica8 3290N switches and Juniper 4500EX switches; and **The Ransom Architectures for Network and Systems Opportunistic Malware (RANSOM),** which is an exclusive datacentre that hosts up to 100k virtual machines on a 40Gbps Mellanox network. Two donations from the National Cyber Security Centre (UK Government) were used to procure testbeds and associated equipment valued at just under £200k. This £200k funding was additional to the University of Strathclyde's funding allocation (£119k) as the lead institution in the larger EPSRC grant (£750k) on Software-Defined Networks led by *Nagaraja* with collaborators from the University of Birmingham and the University of Edinburgh. The testbeds were built to investigate the development of next-generation router-security technologies that incorporate machine learning at their core. The testbeds allow us to develop and test cyber-attacks at a significant scale thus enabling the development of defence mechanisms to overcome such attacks in the Software-Defined Networking paradigm. Smart and secure routers are a key part of the Strathclyde vision for a secure network, where the core of the network (rather than just the network periphery) is involved in ensuring cyber security.

We also have a dedicated Systems Support Service within our Department consisting of three IT Systems Support Staff and one Technician. This team provides front line IT support to all staff and students and is responsible for managing dedicated IT budgets and updating/maintaining IT equipment and services for the Department. Additional IT support for staff and students is also available via central University IT services.

Across the University, our collaborations enable access to a range of additional facilities and resources to expand our research portfolios and to deliver impactful research. For example, researchers from the Artificial Intelligence and Cyber Security research groups (see Section 1) utilise the ARCHIE-WeSt High Performance Computing facility, which is a regional supercomputer centre hosted by the University and dedicated to research excellence and industry applications in the West of Scotland. This resource was implemented at Strathclyde in 2012 and facilitates multidisciplinary and collaborative research between Strathclyde and the Universities of Glasgow, Glasgow Caledonian, West of Scotland and Stirling.

Collaboration between researchers from the Digital Health & Wellness Group (see Section 1) and the Digital Health and Care Innovation Centre (DHI) benefit from access to DHI's Demonstrator and Simulation Environment which is used to demonstrate the capabilities of data integration and data exchange across organisations in new and market ready technologies for digital health and care applications.

Our staff regularly access and benefit from the Scottish Informatics and Computer Science Alliance (SICSA) infrastructure. SICSA is a collaboration of 14 Scottish Universities which promotes international excellence research, education, and knowledge exchange for Scottish Informatics and Computer Science**.** One of our ECRs, *Forsberg,* successfully received SICSA research exchange funding to establish a new research collaboration with Dan Licata from Wesleyan University, Connecticut, USA. *Kupke and Weir* have both received SICSA funding to enable attendance at workshops, summer schools, to host cross-institutional research meetings and publicise events to increase their research networks and portfolios respectively, and *Moshfeghi* has co-ordinated and led a workshop on Data Science and Digital Health through this network.

Operational Infrastructure: The University's Research & Knowledge Exchange Services Directorate (RKES) supports research and KE activity across the institution. There are dedicated Research Funding Managers in RKES and Finance Officers in Finance who support the submission of grant funding applications from CIS, and support, respectively, pre- and post-award finance management. Contracts Managers within RKES provide essential support to negotiate contract agreements with funders, collaborators, external partners and third parties to initiate research projects and implement impact generating activities arising from research in CIS.

There are a number of centrally managed university-wide initiatives that provide CIS researchers with opportunities to engage in impact generating activities with partners beyond academia. Researchers from the Digital Health & Wellness Group (DHaWG) have led events at Engage with Strathclyde (Strathclyde's annual flagship programme of events aimed at stimulating engagement with external organisations from industry, business, education and the third sector) on topical areas such as Citizen Science (*McCann*: 2018) and Virtual Reality in Healthcare (*Wilson*: 2019), with attendees from NHS, Third Sector and industrial companies. DHaWG researcher (*McCann*: 2017, 2018) has also utilized the University-led annual Explorathon initiative to engage with over 200 members of the public to generate awareness and understanding of digital health research.

4. Collaboration and contribution to the research base, economy and society

As outlined in Section 1, our focus is on impactful, human-centred research with meaningful outcomes for society. We achieve this by developing relationships with external key stakeholders in academic, industry, NHS and third sector organisations. We lead interdisciplinary and collaborative research at local, national and international levels and have exemplars of wider influence within the discipline across all our research activities.

Research Base & Sustainability of the Discipline
We have successful academic collaborations with high-calibre UK universities such as Birmingham, Bristol, Cambridge, Edinburgh, Glasgow, Nottingham, Oxford, Southampton, and Warwick. Our collaborators include biomedical engineers, computer and information scientists, mathematicians, nursing and medical specialities, psychologists, physical activity for health specialists, sociologists and statisticians. Notable highlights are: *Atkey*'s AISEC project (AI Secure and Explainable by Construction; EPSRC; £348k) with University of Edinburgh and Heriot-Watt University; and *Azzopardi* & *Moncur*'s work on Cumulative Revelations in Personal Data (EPSRC; £249k & £338k) with the Universities of Dundee, Edinburgh & Northumbria.

Our research has international significance and reach and we regularly collaborate with global academic partners. *Azzopardi, Halvey & Ruthven* are acknowledged experts in Information Retrieval and regularly collaborate with multi-disciplinary academic and industrial partners on world-leading research, such as the EU Horizon 2020 funded Innovative Training Network (ITN) on 'Domain Specific Systems for Information Extraction and Retrieval (DoSSIER)' with partners from Australia, Japan, the USA and 6 European Countries (£772k). *Maguire* and *McCann* have led and collaborated with a wide range of European and USA partners on both FP7 (£830k) and H2020 (£506k) funded research on the development and evaluation of digital health technologies in real-life contexts. *Nagaraja* is a specialist in network security and privacy, and collaborates with the top cyber security department in India (Indian-Institute of Science) and leading industrial partners (AST Telecom Solar Pvt Ltd, India) on projects such as 'Secure and Resilient Cyberphysical Systems' (£146k).

In terms of broader networks, we align ourselves closely to SICSA taking advantage of various opportunities for networking and establishing new collaborations with this community of peers across

Scotland. *Ghani* and *Kupke* have both previously been leaders of the SICSA Complex Systems Engineering theme, *Halvey* has previously been co-leader of the Human Computer Interaction SICSA theme (2016 – 2020) and *Moshfeghi* is currently one of the leaders of the Data Science theme. We are regular participants in SICSA sponsored events and activities designed specifically to introduce potential collaborators to opportunities and benefits of collaborating with our researchers. We also support and encourage attendance of PGRs to engagement and networking events hosted by SICSA such as the annual SICSA PhD Students Conference.

Members of the Strathclyde iSchool Research Group (SISRG) regularly collaborate with partners through the global iSchool network. *Chowdhury* is Global Chair of the iSchools Organisation and has chaired numerous panels for iSchool global collaborations throughout 2020. SISRG members participated in the recent iSchool European Doctoral Seminar Series and a SISRG PGR student presented at this event.

Our staff are actively engaged in activities that contribute to the wider vitality and sustainability of our discipline as a whole. All academic staff are active peer reviewers for at least one key journal in both Computer Science and Information Science. Colleagues have been members of more than 20 different journal editorial boards across the CIS discipline over this review period including four notable senior positions: Associate Editor of Journal of Personal and Ubiquitous Computing (*Dunlop*); Associate Editor of International Journal of Mobile Human Computer Interaction (*Dunlop*); Editor-in-Chief of Library and Information Research (*Pennington*); Associate Editor of Information Processing and Management (*Ruthven*). Many of our staff have held or currently hold Editorial Board Member positions in leading CIS discipline specific journals. Some examples include Journal of Information Science (*Chowdhury*); Journal of Compositionality (*Ghani*); The International Journal of Information, Diversity & Inclusion (*Innocenti*); Software: Testing, Verification and Reliability (*Roper*); Software Quality Journal (*Roper*); Journal of Reliable Intelligent Environments (*Terzis*) and International Journal on Advances in Intelligent Systems (*Terzis*). Five staff have also held edited/co-editing roles for special edition publications over this review period including: Editor for the 2017 TYPES post-proceedings (*Forsberg*); Guest Editor, Special Issue of Sensors on Internet of Things in Healthcare Applications (*Maguire*); Guest Editor, Special Issue of JASIST on Neuro-Information Science (*Moshfeghi*); Guest Editor, Evidence-Based Library and Information Practice (EBLIP) (*Pennington*); Guest Editor Information Processing Management (*Ruthven*); Guest Editor Journal of Computing and Cultural Heritage (*Ruthven*).

Our staff contribute regularly to the sustainability of the CIS discipline through membership of various national and international research grant funding bodies, as well as holding leadership roles and positions of influence at national and international levels. The breadth of our expertise is reflected in the variety of funding organisations that seek our opinion on grant proposals as panel members. Some examples are: Engineering and Physical Sciences Research Council; Arts and Humanities Research Council; Medical Research Council; Israel Science Foundation; European Commission led funding calls such as Horizon 2020, Marie-Curie Fellowships and FP7 programmes; and Norwegian Research Council. A notable contribution was *Ruthven*'s role as a senior strategic advisory reviewer for Arts and Humanities Research Council from 2014 to 2016.

With respect to positions of influence, *Lennon* was an Academic Advisor to the National Telecare Advisory Board for the Scottish Government and is an Academic Advisor on the Ethics Board for the DHI; *McMenemy* was Trustee of the Chartered Institute of Information and Library Professionals (CILIP) and a member of the Board from 2014 – 2016; *Pennington* was awarded Fellowship of the Higher Education Academy (2016) and Fellowship of the Royal Society of Arts (2017); *Revie* is a member of Technical Advisory Group (TAG) of the Aquaculture Stewardship Council (2018-2025) and member of the World Organisation for Animal Health Expert Group on Animal Health Data Codification Systems (2019-2021); *Ruthven* has been Chair of the Scottish & Library Information

Council since 2017 and Chair of Information Seeking Conference Series since 2020. In recognition of their contributions, *McMenemy* was awarded CILIP Honorary Membership (2020) for outstanding services to CILIP, libraries, information services and the wider profession; and *Ruthven* was awarded the prestigious Tony Kent Strix Award in December 2020 for his outstanding contributions to the field of information retrieval.

More than half of our academic staff hold roles with other Universities and external agencies and these roles further facilitate our influence across society in local and international contexts. Some notable examples are: *Azzopardi* – Honorary Associate Professor, Queensland University of Technology, Australia (2016 - ongoing); *Chowdhury* – Global Chair of iSchools Organisation (2020–2022); *Maguire* – Visiting Professor, Queensland University of Technology, Australia (2018-2021); *Mardare* – Honorary Professor, Aalborg University, Denmark (2020-2021); *Nagaraja* - Adjunct Faculty Position with the Co-ordinated Science Laboratory in Illinois, USA (2009 – ongoing); *Pennington* - Chair of the Chartered Institute of Library and Information Professionals (CILIP) Metadata and Discovery Group (2020 – ongoing); *Revie* – Visiting Professor of Epidemiology, Atlantic Veterinary College, University of Prince Edward Island, Canada (2018 – 2022); *Ruthven* – Chair - Scottish Library & Information Council (2017 – ongoing); Chair – Institute of Information and Library Science (2020 – ongoing); *Weir* – Adjunct Professor at the School of Criminology, Simon-Fraser University, Canada (2018-2021).

Our staff also contribute to the vitality of the CIS discipline through membership of the organising committees of major conferences. Examples are: *Dunlop*: Various Associate Chair, Co-Programme Chair, Sub-Committee Chair roles for Association of Computer Machinery (ACM) Conferences on Human Factors in Computing Systems (CHI) and ACM International Conferences on Mobile Human Computer Interaction (MobileHCI) (2014 – 2019); *Halvey*: Various Senior Program Committee, General Chair, Local Chair, Short Papers Chair, Demos Chair Roles for ACM CHI / ACM Conference on Human Information Interaction and Retrieval (CHIIR) / MobileHCI / ACM International Conference on Multimodal Interaction (ICMI) (2017 – 2019); *Mardare*: Organising Chair for the Workshop on Higher-order Probalistic Programming (2019, Barbados); *Pennington*: Local Organising Committee Co-Chair, International Evidence Based Library and Information Practice Conference (EBLIP10) (Glasgow, 2019); Publicity Chair, CHIIR (2109); *Ruthven*: Conference Co-Chair, CHIIR (2019); Programme Committee Co-Chair, The Information Behaviour Conference (ISIC) (2020); *Roper*: Programme Committee Co-Chair, IEEE International Conference on Artificial Intelligence Testing (AITest) (2019 & 2020); General Chair IEEE AITest (2021); *Weir*: Technical Programme Committee Chair - 4th International Cybercrime and Digital Forensics Conference (2016, Vancouver, Canada); Programme Chair - Cybersecurity and Cyberforensics Conference (2016, Jordan); *Wilson*: Associate Chair, ACM CHI 2019 and ACM SIGACCESS Conference on Computers and Accessibility (ASSETS) 2019.

Researchers from UOA11 have been active in delivering keynote presentations at discipline-leading national and international conferences over this review period including: *Lennon*: International eMental Health Forum, Belfast; *Revie*: Annual Meeting of the Society for Veterinary Epidemiology and Preventive Medicine (SVEPM), Ghent, Belgium, 2015; *Revie*: XV11 International Symposium of the World Association of Veterinary Laboratory Diagnosticians (WAVLD), Saskatchewan, Canada, 2015: *Ruthven*: Information Seeking in Context (ISIC), Zadar, Croatia, 2016; *Weir*: The Ninth International Conference on Cloud Computing, GRIDS and Virtualization (IARIA), Barcelona, Spain, 2018.

In addition to our research visits and exchanges to partnering organisations and institutions, we also have an active Visiting Researcher programme whereby we host national and international academics, expert scholars and key industry partners in our Department to develop collaborative research projects, and deliver guest lectures and seminars to students and staff. Over this review

period, Visiting Researchers include: Mohammed Al-Fairuz (Sultan Qaboos University, Oman); Gerard Canal (Kings College London); Yoshio Hosaka (University of Japan); Annemaree Lloyd (University College London); Michael Olsson (University of Technology, Sydney); Anabel Quan-Haase (University of Western Ontario, Canada); Amy Vab Scoy (University of Buffalo, USA); Anna Maria Tammaro, University of Parma (Italy) and Brendan Wilson (University of Tokyo).

Economy & Society

Our staff have significant strategic relationships with high-profile industrial partners and we have leveraged these relationships to develop successful KTPs during the period with BIP Solutions, Cambridge Quantum Computing, Symphonic Software and Syngro Limited. KE and research activities have also occurred with partners including Google, Indian Institute of Science, Keysight, Microsoft, Police Scotland and the Scottish Institute for Policing Research, and Spartan Solutions Ltd. We have cultivated our strategic relationship with the National Physical Laboratory (NPL) to facilitate impactful research on discipline leading areas such as Trusted Systems (*Forsberg, Ghani & McBride,* £600k). *Azzopardi* has twice been seconded to Microsoft in the USA to specifically develop collaborative projects focusing on modelling and measuring search engine result pages. *McBride* has had two fruitful secondments to Microsoft to develop Haskell related impactful research (see Section 1 and associated impact case). *Nagaraja* has twice been seconded (2019 & 2020) to industrial partner QinetiQ and the visits were used to leverage specific QinetiQ input to future research proposals from the Cyber Security Research Group, including a recent submission (2020) to the PETRAS national centre of IoT Cyber Security in collaboration with NPL. Development of a strategic partnership with BAE Systems has funded an industrial case PhD studentship supervised by *Moshfeghi*. Over the period we developed industrial collaborations with 10 new organisations (referred to in Section 1) including with My Customer Lens (*Pennington, Roussinov*: ontology development) and Welbot Ltd (*Terzis, Lennon, Roper*: prototype development and data analytics).

Researchers within the Digital Health & Wellness Group and Strathclyde iSchool Research Group regularly collaborate with NHS clinical partners and clinical services across the UK and Europe in the development, deployment and evaluation of person-centred technological solutions to support health and care provision. *Ruthven*, an Information Scientist, collaborated with sociologists and third sector organisations such as Barnardo's and Glasgow Life on the project 'Understanding the Information Needs of Young First Time Mothers from Areas of Multiple Deprivation' funded by ESRC. *Maguire* and *McCann* collaborated with international academic, industry and health sector partners in the largest randomised controlled trial to date of a mobile phone based remote monitoring system for people with cancer in 5 countries across Europe. *Lennon*, with *Maguire* & *McCann*, led an evaluation at scale of digital health products in NHS settings in two different areas of Scotland to inform changes to service pathways and collaborated closely with industrial partners MedTronic and CorporateHealth and academic colleagues during this work. *Dunlop*'s PGR students Gibson, Khan and Meiklem have worked closely with the Scottish Commission for Learning Disability, Down Syndrome Scotland, NHS Queen Elizabeth University Hospital, Glasgow and Return to Life Charity respectively. Furthermore, five academics in CIS hold Honorary Academic/Research posts with NHS Lanarkshire.

We capitalise on University and Departmental events designed to promote and foster research networks across Strathclyde. At a University level, in 2019 *Revie* led a Herald AI Business Breakfast event with Incremental Group, one of our industrial partners, to promote the expertise of AI research at Department and University levels. At a Departmental level, we hosted our inaugural CIS Alumni and Friends Event in 2019. This event provided an opportunity for members of the Strathclyde CIS Community past and present to come together to celebrate the achievements of the Department and highlight our research strengths, diversity and expertise to student and

staff Alumni and invited guests. Our keynote speaker at this event was Dr Pauline Burke, Global Head of Experimentation and Personalization at eBay.

The expertise of CIS staff has also been utilised in patent cases as *Dunlop* has provided Expert Witness input into two international patent cases over this review period (2018 & 2020) for high-profile industry clients. Awareness of *Lennon*'s MyCityGlasgow app, developed specifically for the 2014 Commonwealth Games and gold medal winner for the most innovative app for the Commonwealth Games was made available to the public through various press releases in 2014. In terms of media coverage, *McMenemy*'s expertise in information law and ethics was visible and accessible to the public via widespread media coverage for his interdisciplinary research 'Corporate Surveillance on Writers' published in 2018 (The Times, Herald, Scotsman and Daily Mail). *Thomas*'s 'Booting the Booters' research evaluated law enforcement interventions in relation to cybercrime and his proficiencies in this area resulted in widespread media coverage for this work in 2019. *Weir*'s research on readability measurements received public attention in 2018 via an article published in The Sunday Times.