

Institution: University of Central Lancashire
Unit of Assessment: UoA11 Computer Science and Informatics
1. Unit context and structure, research and impact strategy

Context

The Computer Science and Informatics Unit of Assessment at the University of Central Lancashire (UCLan) is comprised solely of staff working in the Computing Division of the School of Physical Sciences and Computing within the Faculty of Science and Technology. **Fourteen current staff** (and one who left) are being submitted and these comprise: one professor, two readers, four senior lecturers (SL) and seven lecturers (L) of whom three are ECRs. Within this UoA, work is currently focused in **three broad areas**: Human Computer Interaction (HCI), Agile Software Development and Security and Forensics. There is one highly specialist group which is in Child Computer Interaction (CCI); this is within HCI. This is the **first REF submission** for UoA11 at the UCLan research in Image Processing, which is situated within Engineering, is separately submitted to UoA12.

The three areas within UoA11 are at different stages of maturity. The most mature field is that of **HCI** where the Child Computer Interaction (**ChiCI**) group (www.chici.org), formed in 2003, is currently the largest such group in Europe. This is the home to one Professor (Read), two Readers (Fitton and Sim), two of the three Senior Lecturers (SL; Cassidy and Guo) and four of the Lecturers (L; Horton, McKnight, Doumanis, and Lochrie). The Agile Software Development (**ASD**) group, formed in 2012, consists of one SL (Gregory) and one L (Campbell). Bowes was an SL in this group until he left the University. The Security and Forensics Research (**SaFeR**) group, formed in 2016, is currently home to one SL (Ta) and two Ls (Eiza and Abubahia).

The research carried out by the submitted staff is diverse and includes theoretical and empirical studies, investigations and case studies, and design-based research.

Structure

The UoA11 researchers, while having different specialisms, identify as **a team of researchers** in Computing. All are members of the **University Research Centre for Digital Life (URCDL)** which was founded in 2019 as part of the University's research strategy. This cross disciplinary Research Centre is managed by Read and the Computing researchers are the largest single disciplinary team within it. The Centre includes researchers from digital humanities, digital design, health informatics, and psychology, and acts as a mechanism to encourage and support multi-disciplinary collaborations between researchers across the University. The **Research Groups** within Computing provide subject-specific foci. Figure 1 shows how the University Research Themes (on the left) are represented within the URCDL and how the Computing Research Groups are then situated within the URCDL.

Research and Impact Strategy

2014 - 2020

A strategic decision was made by UCLan management, based on the small size and limited breadth of Computing Research at that time, to not submit UoA11 to REF2014. In the light of this, the strategy for the Computing team between 2014 and 2020 was focussed on submission to this REF period. We had three main objectives:

- to encourage staff to submit **higher quality research**.
- to broaden the scope of our outputs and develop **new areas of research**.
- to **increase the impact** of our research by doing more interdisciplinary research and engaging with communities and businesses.

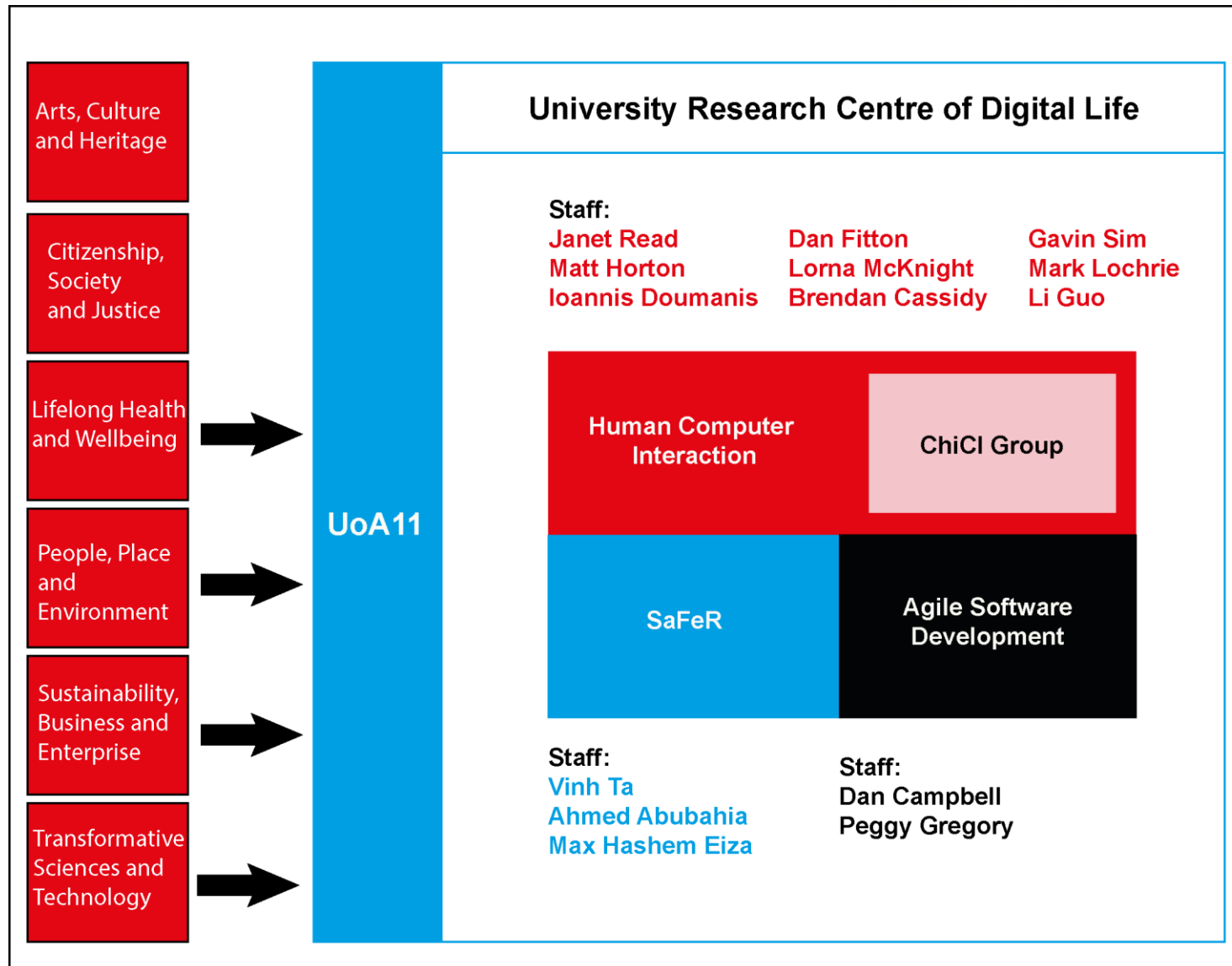


Figure 1. Structure of research in UoA11 and its relationship to the University's overarching research themes. In-post submitting staff are shown aligned to the Computing Research Groups.

Unit-level environment template (REF5b)

These objectives have been successfully achieved. We have delivered over **40% more papers** of international quality (published in high-ranking venues) than in the previous period. We have developed the **new Security and Forensics Research (SaFeR)** group and **expanded** our software development, HCI and CCI research into new areas including ontologies, VR and inclusive technologies. We have worked with schools, organisations and companies, including the BBC and Kano Computing, to **empower children**, improve profitability, innovate in healthcare and engineering solutions, influence accessible design, and **facilitate improved UX** in companies specialising in design for children. These successes are further described in the later sections of this document and in our Impact Case Studies.

2020 - onwards

Going forward we imagine a vibrant research team built on our strength in HCI that embeds a **people centred approach** towards solutions and insights for a diverse range of interdisciplinary societal problems, a set of organisational IT challenges and an increased reliance on technology in all walks of life in a post pandemic landscape. Reflecting on our journey towards this current REF submission we have consulted with our own staff, have met with senior management and have explored the research landscape to develop **three main objectives, of specialisation, growth and impact**, for this coming period:

1. to **specialise and excel** by developing new HCI research around AI, XR, Robot Interaction and Data Science and to continue being world leading in Child Computer Interaction.
2. to **grow our portfolio and reach** by increasing the number of submitted staff, increasing the range of computing subjects represented, and raising the percentage of highly rated outputs
3. to **have a greater impact** by focussing on grand challenges and putting impact at the forefront of our thinking.

Meeting Objective 1 – Specialise and Excel

We will continue investment in HCI whilst ensuring that our CCI work remains at the forefront of HCI research globally. This will be enacted in three main actions:

- **We will strengthen ChiCI by developing distinctive themes** designed to give extra focus. Already, through our keynotes and workshops, we have been developing research around **Child-Like Computing**. Taking inspiration from the EPSRC Human-Like Computing initiative with its emphasis on machine learning, perceptual and reasoning abilities, Child-Like Computing is the intersection of **CCI, AI and Data Science** focusing on innovating in child sensitive ways. We will develop this work with *UKRI projects and a continued workshop series*. We will exploit the recent appointment of a Professor of Data Science (Ellison), and the soon to be established UCLan Data Innovation Centre to additionally support this work. Other development in Child Computer Interaction will include interaction with robots, business centric evaluation methods and the design of assistive technologies. These foci have recently seen investment from the University through the purchasing of two robots and over £50K worth of eye-tracking hardware and software.
- Much of our research, and one of the REF2021 Impact Case Studies, concerns **methods for evaluation and design** in Child Computer Interaction where we aim to strengthen our world leading position. We want to enhance our methods to better fit business needs. Part of this enhancement is the further development of the multimedia **CCI UX Playbook** which is a recently launched tool for industry. In the next REF period this will be developed into a set of interactive tools and will be evaluated in large scale research trials across several countries and continents.
- A core theme for all our **HCI research** is on **inclusion**. In particular, we aim to increase our research in places where technology is scarce, building on our strong links with developing countries. We will use our experience of working closely and sensitively with children to expand to include older adults, people with disabilities and very young children including infants and babies. With existing, and new, **responsive, partnerships** we will address

societal and technical challenges for health interventions, future transport, local economic and climate related challenges, and social integration. One example is to continue our work with IIT Guwahati in India, continuing our joint work in areas of cross-cultural design in a range of contexts including speech therapy and communication technology; another is with a Turkish school for the visually impaired; and a third is with a care home for the older adults aged 85+ in Yogyakarta, Indonesia.

Meeting Objective 2 - Growth

We have three actions to deliver on this objective:

- The first is to **develop additional interdisciplinary research by** expanding our UoA11 portfolio by building on the strength of other research groups from across UCLan. For example, Human/Autonomous System Interaction in future aircraft systems is an enduring research theme within Aerospace Engineering at UCLan and creates opportunities for the Computing ASD group. Human factors in aerospace engineering are an essential consideration and increasing autonomy brings many challenges of trust and effective human engagement with the systems opening more opportunities for our SaFeR staff. Engineering studies looking at Urban Traffic Management systems create opportunities for UX design, usability and information systems studies. This growth will be achieved through the recruitment of *several interdisciplinary PhD students* and through *URCDL grants* for interdisciplinary work.
- **Growing research in Cyber Security with a focus on People Centred Security.** The University is committed to teaching cyber and internet security at all levels and is supporting the growth of research in this area to underpin its taught provision. Two of the recent Computing posts have been appointed in the area of computer security and there is a plan to recruit a **Professor of Cyber Security** in the coming academic year to head up the anticipated Cyber Security Solutions Centre. UoA11 staff are active members of this initiative and will *actively seek to recruit staff with Cyber Security research* interests.
- **Research Quality** will be improved via **transparency and internal peer review** through the *establishment of an internal peer review panel*. Our **joint authoring with external academics** will drive improved research quality building on our previous high-quality collaborations with KU Leuven, Imperial College, Lancaster University and the Open University. We will aim for at least 25% of our next REF submission to be papers with authors from outside the institution *and* staff will be actively supported to network with other institutions through *grants from the URCDL*. Through the appraisal system, senior staff will be encouraged to collaborate on research with other international universities; this has been shown to be beneficial in recent years, with publications arising from joint supervision of MSc students with IIT Guwahati, PhD students with University of Athens, and EU research funding with South Ural State University.

Meeting Objective 3 - Greater Impact

Our approach to impact is that it can be much better realised by bringing together a clear plan and the right connections. To that end we have three actions:

- **Action 1: Focus strategically on the two main impact areas which resonate with the team and align to our research strengths.** The first of these is **Children's Health and Wellbeing** in a post pandemic world. This is an area where technology can have a role and where HCI and AI, as well as research in trust and privacy, can come together to create better solutions for the benefits of children across the world. Our recent work on developing an app for outdoor same place – different time play is an example of how this can be realised. Our second focus area will be on the **Climate Emergency**, building on our EPSRC work around energy saving and on work that the URCDL already invests in, including data explorations around air quality. The climate emergency is a strategic focus for our University and our work on sensing technologies, traffic planning, business solutions and trust and security of IT systems will all feed into this agenda. We will run *quarterly*

seminars on these two topics throughout the next REF period and funding from the URCDL will seed projects on these themes.

- **Action 2: Further develop existing partnerships and grow new industry relationships**
Our existing partnerships with Kano and the BBC will be strengthened whilst we also **develop new partnerships** with a *mainstream UX company and a major international software provider*. Work placements and co-authoring as well as visiting academic activities will all support this aim. Staff will be particularly encouraged to develop Knowledge Transfer Partnerships with local companies to develop research capabilities, benefit local organisations and solve real world problems. Partnerships will focus on areas that align to the overall objective of benefitting people and society using technology.
- **Action 3: Early engagement with stakeholders.** With a strong history of co-design and stakeholder engagement in both the HCI work and the ASD work, we recognise the benefits of **engaging with end users early** on in research and / or development. Building on the strengths of the REF2021 Impact Case Studies, we already have an informal but active panel of teachers and school personnel who value our outreach activities. Going forward we will convene, via the HCI and ASD groups, *twice yearly 'research user' panels* of schools and businesses which will meet termly to inform research directions. This will enable us, as a group, to react to business and local needs. As an example, in 2019 we submitted a research grant application to answer a research question that was posed to us by a school headteacher (did online exam completion disadvantage students?); this is something we aim to encourage. We want our work to improve the lives of people. This cannot be done in a vacuum so we will create reciprocal networks of influence with businesses and industry to make a difference.

Facilitating Impact

Our UoA11 team are committed to the application of technology, and the development of methodologies, to **improve and benefit society** - the Impact Case Studies submitted in this REF exercise reflect our ethos and describe how our methods have been adopted by industry and how we have worked with children across the world on design projects. A strategic approach to the attainment of impact was taken with Read leading on impact delivery while mentoring the Readers within the unit of assessment. This mentoring process ensures that UoA11 can continue to focus on the delivery of high-quality impact in the future.

Since 2014, the team has obtained more than £15K internal financial support for impact activities, including funding for the design and development of the ChiCI UX Playbook and for work overseas with children. Impact is tracked through the use of Trello boards and websites including www.chici.org where members of the group list schools and events. Whilst impact in this REF is primarily reported from the HCI / CCI work, the other groups are developing impact for future submissions. The ASD group maintain a database of companies they have collaborated with and they share findings at industry events where they influence organizations such as the [Agile Business Consortium](#) who promote and finance their work. The SaFeR group have plans in place to deliver impact in the next REF cycle.

Outreach

Members of the UoA have a long tradition (since 2003) of doing outreach activities, and often this is where the members of the different groups work together – we work as a team. The team continually works with local schools and colleges to promote STEM, and in particular Computer Science. As an example, over a three-year period, a team from UCLan has delivered **three different ten-week enrichment** activities at Ribblesdale High School in Clitheroe on Wednesday afternoons with over 60 pupils. The team have also staffed events at five of the Lancashire Science Festivals and have even facilitated a remote STEM activity for children in Iceland. For the ChiCI group in particular, STEM activities help maintain strong connections with schools which facilitates research projects and helps drive the impact agenda. Each year we work with different schools to ensure we are impacting the lives of children from different communities. Recent schools we have worked with can be seen at <http://chici.org/schools/> where we show that over 30% of our work with schools has been outside the UK with some being in developing countries.

Unit-level environment template (REF5b)

Interdisciplinary Research

Staff within UoA11 have a long history of collaborations with researchers from different disciplines, reflected in the outputs that include work with health (Guo), design (Sim) and educational technologists (Read). Having the University Research Centre for Digital Life managed within the unit facilitates interdisciplinary research as it brings together a diverse range of subject disciplines to tackle both local and international challenges. With over 50 members, the URCDL includes researchers from Health, Psychology, Journalism, Education and Computing. Its formation has facilitated the writing of research grants with Health, Tourism and Social Science.

Open Research Environment

The researchers within this UoA are committed to open science in all its forms – with the sharing of data as well as publications being important to the team. Where publication venues make sharing of articles difficult, the team strive to find solutions. As an example, Cassidy obtained funding from the Bill & Melinda Gates Foundation to make one publication gold open access. Beyond their actions as authors, team members also influence publishing venues; Sim has been working with the British Computer Society to make publications for the British HCI conference open access via <https://www.scienceopen.com/>. One feature of open access which will perhaps be **unique to this REF submission** is that UoA11 ChiCI researchers also work exceptionally hard to share their papers and their research with children – an action which has been applauded by headteachers. The team actively seek to report back to children and to explain research findings to those who have contributed.

Ethics and Research Integrity

UCLan strives to promote the attainment of high ethical standards as per the Global Code of Conduct for Research in Resource-Poor Settings (<https://www.globalcodeofconduct.org/>). This Global Code influenced work by Sim who has published jointly with IIT Guwahati in India and in work by one of Read's PhD students who was working with children in Nepal – both these projects took careful account of their resource-poor situations.

All research projects must gain formal ethical approval prior to research being conducted, with ethics submissions directed to the University's Science Ethics Review Panel. This panel, on which Sim currently acts as Vice Chair, has delegated responsibility for ethical review and approval from the University's Ethics and Integrity Committee.

The Computing team apply the Vancouver protocol as a basis for determining how research is attributed. The practical implementation when a paper is proposed with joint UCLan authors, is that authorship is determined ahead of work being created but also reviewed after the work is completed. When student work is published the principle is that the student should be first author.

2. People

Staffing Strategy and Development

Staffing Strategy

Recruitment has been influenced and shaped by both the University's strategic plan and the Computing research strategy (2014 – 2020). We have increased research activity by bringing more staff into UoA11, in 2014 there were only five staff who were returnable, now we have 13. Appointments have balanced the need for teaching staff alongside the need to strengthen and develop research areas. All staff being recruited as lecturers are required to be doing research that can align with the broad themes outlined above. In the REF period, Ta, Eiza and Abubahia have been recruited to develop our security related capacity and have come together to create the SaFeR group, meanwhile Lochrie and Doumanis have brought diversity into the HCI and ChiCI group bringing expertise in design, software engineering and AI. Since 2014 we have primarily recruited Early Career Researchers who have CVs that show research enthusiasm, fresh ideas and dynamism. The ASD group has benefited from the recruitment of two research assistants during the REF period.

Development**Development of Staff and Promotions**

Within UoA11 we want staff to have as **optimal an experience** as is possible. We want them to build rewarding and fulfilling careers and build broad and useful CVs whilst also maintaining a healthy work-life balance. Within the workplace we want staff to be free to think creatively and support one another, to feel both supported and enthused in productive teams.

We work hard to build an identity for the group within a large multi-disciplinary school. **New staff** joining the team are **allocated mentors**, placed in shared offices with supportive more senior staff, and are actively integrated into the subject and research teams. As an example, Doumanis joined the staff in September 2018 and was given a desk with Sim who was allocated as his mentor. Read met with Doumanis to talk about his research and help set research objectives and she saw an opportunity to bring him onto a newly funded Erasmus project thus giving him an easy integration into the research team. Sim worked with Doumanis to complete a paper from research he had undertaken as a postdoc. These actions gave Doumanis a sense of accomplishment, a feeling of belonging and, through the project, a new set of academics with whom to network.

All staff have **research as an appraisal target** and are typically expected to deliver at least three significant research outputs every two years. The Readers and SLs within the team are appraised by the Computing Professor (Read), with all other team members being appraised by the two Readers (Fitton, Sim). This process is an opportunity to discuss plans and refine focus, but it is also the moment where development needs are identified, and requests made for funding to attend workshops and events. In the REF period, UoA11 staff have attended more than 70 academic conferences and over 40 workshops.

All staff are actively developed within the Computing team **using an apprenticeship model**. As a small team, the Computing researchers support one another in non-hierarchical ways, organising themselves into teams that reconfigure according to the research specialisms required. Researchers 'check in' and 'check out' with one another in informal conversations facilitated by the senior researchers who help in connection making.

The University supports staff with **funding from the Faculty** being used to prioritise research time. Senior staff have regular research time ringfenced whilst time can also be found for ad hoc instances. One example is that of Cassidy who was given a reduced teaching load in 2014 to write his first EPSRC grant application. Supported in this by Read and using her connections with Lego, Cassidy wrote an exemplary proposal, with particular focus on his research plan and was rewarded with funding of £90K (EP/L027658/1). Since then, Cassidy has had a promotion to SL, has extended his work into VR and XR with the UCLan archaeology team and has developed collaborative research with MacKenzie at York University in Canada. This latter collaboration was seeded from a connection made some seven years earlier when Read introduced Cassidy to MacKenzie at an eye tracking conference. This demonstrates the power of distributed thinking and openness of sharing networks and ideas across a broad research team. Currently Cassidy is mentoring two of the recent ECRs.

Within UoA11, **Senior Lecturers** are actively **appraised towards Reader** appointments. They are advised to build a portfolio of papers that demonstrates specialism whilst also ensuring they engage with the research base, apply for grants and carry out supervision of students. Engaging with the research base is particularly encouraged especially in regards of arranging academic events and workshops and editing volumes. An example is Fitton who was promoted to Reader during this REF period having been supported to focus on Teen Computer Interaction. He ran a series of workshops on that topic and edited a Springer volume. Fitton, as Doumanis, was first initiated into the research team by being brought onto an EPSRC grant as soon as he arrived and his promotion from L through SL to Reader is testament to the active leadership of staff, a core feature of this team. The research leadership now comes from Read, Fitton and Sim; Fitton has taken on the responsibility for Graduate Teaching Assistants and Sim has taken on much of the REF work. In this way, there is a progressive process towards developing the **next generation of leaders**.

Leadership and Collegiality

This collegiate approach to leadership is very important in a University System where managers may not be subject specialists. **Senior staff within UoA11 actively monitor staff's aspirations** to ensure they are meeting the criteria for future promotions. This holistic understanding is important due to there being a distributed appraisal system without a Head of Computing.

Collegiality ensures opportunities to develop CVs, including PhD examinations and academic roles such as course leaderships, are fairly distributed amongst staff. Within this system staff can informally discuss progress towards promotions enabling them to identify barriers that may prevent them from meeting their existing targets.

Staff are encouraged to **pursue their own research interests** within the broad themes that are supported. A physical noticeboard in the Computing and Technology building showcases new papers and **internal awards** (rosettes) are given within the UoA for grant capture and completion of projects. No research idea is ever dismissed but there is a narrative with staff to explore the value of the research that is being proposed. Often a staff member will talk with several others during their development of an idea. One example is Eiza who had conversations with Ta, Read and Sim while writing a Leverhulme application. Having many views was beneficial as they each saw different things that could be changed and/or expanded.

Supporting ECRs

Two different seminar series are run each academic year. The first is the **Naked Researcher** event which encourages staff to present early work to be critiqued by their peers. The intention in this event is not to present published or finished work and it is deliberately designed to include two or three inputs to each event to ensure it is wide ranging and interesting. The second seminar series runs in a more traditional way where researchers from within and from outside the University come to present work that has typically been completed. Newly appointed staff are expected to present their work at a seminar as part of their probation criteria. This is to ensure integration into the groups and to begin an early discussion of their future work and to encourage collaboration with peers. This **prevents early career researchers from feeling isolated**, ensuring they maintain research activity within what may be their first teaching post.

All staff within UoA11 are encouraged to make use of research development opportunities including the Academic Research Induction programme supplied by the University. Other training provided centrally includes the supervision of PhDs, grant capture and impact management. The University has held the HR Excellence in Research Award for 8 years. Where there is a need to develop staff skills from outside the University, funding has been made available for staff development to bring in external people. For example, in 2019 Prof. Brewster from University of Glasgow, where he was Chair of CHI, came to UCLan to facilitate a **one-day workshop on writing CHI papers**.

Students

At undergraduate level, students are exposed to our research through **research informed teaching** across a range of modules. For example, in the 2nd year HCI module, Doumanis teaches the module based on the experience he gained in Horizon 2020 projects. Students are also given the opportunity of working with researchers for their final year projects and have successfully published work at the British HCI Conference and the International Journal for Infonomics.

Students studying with us on MSc courses are also encouraged to conduct research for their final thesis and publish this with staff. **Students have published** work at CHI, British HCI, ISD and the IDC conference. Each year students can select from a number of projects put forward by staff with a view to developing their research skills. This also helps new staff develop by gaining experience of supervising students at both undergraduate and postgraduate level and then further helping to develop their supervision of PhD students.

PGRs

Our PhD students are typically self-funded with some taking advantage of UCLan schemes that provide part bursaries. One such scheme provided part bursaries to three Nigerian students who

Unit-level environment template (REF5b)

worked with the ChiCI group. A more recent scheme is planned that will encourage top UCLan undergraduates into **PhD study with bursaries** from the Faculty. The University supports students with infrastructure and equipment and provides additional funding for conferences and specialist equipment.

Supervision of students working in UoA11 is always **by a specialist in the area** with assistance, where needed, from a senior academic. Several staff from UoA11 were involved, during this REF period, in the PWs@PhD ERASMUS project concerned with **instructing PhD students**. This was a large international project with PhD students from Jordan, Russia, Portugal, Denmark, Finland, Germany and Greece. Two or three UCLan students were able to visit each of these countries for two weeks to have specialist training. At UCLan we delivered a two-week course on HCI to around 15 PhD students from the scheme.

During the REF period two of our female PhD students have taken up **post doc research posts** in academia in Ireland and in Finland, two others have gone on to work in industry and two (also both females) have continued in their work with the Dubai police and are now in promoted roles. One of our recent PhD students, Ilyena Hirskey-Douglas worked with Read and Cassidy at the forefront of the emerging research field of **Dog-Computer interaction**. She developed an ethical framework for his unique field, as well as a novel installation. Hirskey-Douglas wrote articles for the Conversation, had conversations with Doggy TV and dog toy manufacturers, and took on leading roles in the annual Animal Computer Interaction Conference.

Equality and Diversity

Equality and Diversity runs through all our work from recruitment and treatment of staff, through design of research, and through the exposure of our research. In recruitment we are specifically trying to raise the number of female staff we have (currently Computing has over 20% female staff, but we are still seeking to raise this proportion) and so we include in all our adverts a specific reference to encourage applicants from **women and from BAME** groups. We work hard to ensure adverts are gender friendly and we always aim to have more than one female, and at least one BAME academic on interview panels. In our UoA11 submission, 3 staff are from BAME groups and 3 (including the Professor) are women. When recruiting to funded and part funded PhD posts we also actively encourage applications from women. In the current REF period, over 30% of our PhD students are female.

Equality of treatment is promoted by **transparency and inclusivity**. All career and research opportunities are shared with all staff and, mindful of a collegiate approach throughout the team, all are encouraged to apply for funding with internal competition seen as healthy for the development of individuals and the team. Events are planned to fit around school times to support those with childcare constraints.

In the **design of our research**, we take great care not to prioritize or favour one group of users over another. Similarly, when reporting research, we aim for **inclusive language and wide coverage**. It is worth noting that the inclusive practice work of the ChiCI group – consolidated in the CHECK toolkits (www.chici.org/ethics) – has influenced how research is reported and talked about **across the ACM** conference series. This is described in a UoA11 Impact Case Study.

3. Income, infrastructure and facilities

Income

Income to the UoA has come from Research Funding bodies and Industry. During this REF cycle, staff within the Centre for Digital Life have secured over £1.8M in research funding. In addition, two EPSRC grants totalling over £1M were completed during the REF period as well as four EU Erasmus grants (totalling around £130K to UCLan but the total funding was in excess of £2M). All the income brought into the UoA has been gained following competitive bidding processes. Small grants from ESRC (£3K) and AHRC (£3K) have supported research and RAEng money (£5K) has been used to bring an international researcher to UCLan from Canada to work on research collaborations around input technology for special needs users.

Unit-level environment template (REF5b)

Industrial income has come from the Agile Research Network who have supported our research in ASD, recently **funding two PhD posts**. The Agile Business Consortium has provided research income of £370K to UCLan during the REF period on a variety of projects; this has been a long-term investment rising from £15K in 2013 to £225K in 2019. Other industry income has come from consultancy work with the BBC and Amberlight (£40K).

Infrastructure and Facilities

In 2019 a major investment from the University created a set of research centres and the **University Research Centre for Digital Life** was one recipient of funding following a successful bid from Read for over £60K a year. This Centre now distributes money to its members using competitive bidding process for projects that align with its strategic aims. The University has also invested in the UoA through small grants that members bid for with considerable success. These include funding to bring in visiting professors (£8K), grants to purchase equipment (£20K), grants to buy research time (£4K), grants associated with GCRF (£6.5K), research impact (£6K) and the research interns programme (£2K).

The UoA has **three specialist labs** in the Computing and Technology (CT) building as well as access to specialist equipment across the University including that housed in the new £35M Engineering Innovation Centre (EIC). The specialist labs in the CT building are the ChiCI PlayLab, the IDPCC lab and the Agile lab. **The ChiCI PlayLab**, is the largest such lab in Europe and is designed in such a way that research can be done with a whole class of children at a single time, using specialist equipment in a safe child-friendly space. When not being used by children this is a hub for an assortment of research activity including 3D printing, tangible prototyping, Internet of Things development and VR / XR work. **The IDPCC lab** houses a suite of Apple computers used for research related mobile development and has a usability testing bay with two-way mirrors and movement and activity recording facilities. Also, in this lab is a driver simulator with emotion-sensing capabilities to investigate the key factors influencing trust in autonomous cars. **The Agile lab** is a bespoke configuration used for meetings and consultation. Specialist equipment used by the research team includes a NAO robot, an eye tracking system, several different configurations of XR kit and a large collection of IoT hardware. The EIC is the centre for investment from the Lancashire Enterprise Partnership (LEP) which will see growth opportunities for data, medical technology and cyber research.

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

Collaborations

Industrial collaborations

Over the REF period we have collaborated with a handwriting recognition company in France, Vision Objects, on writing a joint funding bid around a planned project on text entry. We have also run workshops and courses for Kano Computing in London enabling us to partner with them on usability testing and design work. Kano have also collaborated with us on funding bids and workshops. We have also **written funding bids and shared workshops** with the BBC and Lego and they have attended courses that we have run at the International Interaction and Design and Children conference. Currently we also have two visiting fellows from BBC Research and Development and Avanade (an international UX company)

The Agile Research Network has worked with a variety of companies and organisations from Banking, Education, Retail, the Public Sector, and from Charity. Some of our collaborators wish to remain anonymous, but named collaborators include: LShift, Daiwa, Mastek, Workplace Systems, Aylesbury Vale District Council, Your Homes Newcastle, and the RNIB.

Academic collaborations

We define an academic collaboration as one that has resulted in either a peer reviewed publication or a grant application. We can count around **100 academic collaborations** with institutes around the globe spanning enrichment (Fitton with University of Strathclyde), experimental research (Cassidy with York University, Canada), NSF grant writing (Read with University of Florida),

qualitative research (Gregory with Uppsala University) and case study research (Horton with University of Bristol). Individuals typically have many collaborations focussing on a number of different things; as an example, Sim has collaborated with IIT Guwahati on the organisation of the IndiaHCI conference, with KU Leuven on HCI research and with South Ural State University on a pedagogical paper. Since 2014, the ChiCI Group has a very strong record of collaborations in workshops, funding bids and papers at a national and international level. Collaborations include **6 of the top 50 universities** in the world based on the Times Higher Rankings (2018), including Stanford University and the University of Texas at Austin.

To support academic collaborations, UoA11 has taken advantage of schemes run by UCLan and elsewhere to bring guest researchers to the group. These have included **distinguished scholars** including Paulo Bilkstein from Stanford University, Ole Iversen from Aarhus University, I Scott Mackenzie from York University, CA, Russell Beale from University of Birmingham, Alan Dix from Swansea University and Steve Brewster from University of Glasgow. In addition, the doors have been open to scholars seeking to work with the ChiCI group on extended projects – we have had four academics from Italy, Spain and Russia take advantage of these opportunities and we regularly support fellowship applications. These collaborations have resulted in joint papers, PhD exam invitations, and joint conference workshops.

School collaborations

Over the REF period we have collaborated with **over 25 primary and secondary schools** in the local area and across the globe. We have worked with schools in India, Malaysia and UAE on design activities. Primary and secondary school groups from across North West England engage with us on research projects and STEM activities (most of which we have described earlier in this document). We have also worked with **special schools** in Lancaster, Liverpool and the Fylde on input mechanism design, and have worked with a school in Reading on a robot project. Feedback from the schools and the children themselves shows their enthusiasm regarding their designs and the chance to contribute to real computer games and app design. We have strong evidence that this encourages STEM focus.

Networks and Partnerships

Members of UoA11 are active in several formal and informal networks. Read is the chair of the International Federation of Information Processing SIG on Interaction Design and Children and Sim is the Chair of the BCS HCI group. Fitton is an active member of the European FabLearn network, having been instrumental in its formation and Gregory is a leading member of the Agile Research Network.

Contributions to the research base

Senior staff in the UoA hold Journal Editing roles; Read is the Editor in Chief of the Elsevier International Journal of Child Computer Interaction (IJCCI) and is an Associate Editor for the IGI journal International Journal of Mobile HCI and the Oxford Press Interacting with Computers (IWC) Journal. Fitton is an Associate Editor for IJCCI. The ChiCI team have **run three conferences** over the period with FabLearn and ACMIDC in 2016 and British HCI in 2014. In addition to running these events, members have taken on significant chair roles including paper chair at ACMIDC2016 (Fitton) and HCI2014/18 (Sim). Other members have all actively reviewed for major conferences and journals within the field and taken on roles such as associate chairs. The ACM invited Read, Fitton and Sim to a SIGCHI Summit in 2020 (<http://summit.acm.org>) for strategic planning of events and the dissemination of research to the community for the next decade. Our ECRs are encouraged to take on reviewing roles and to fully participate in their research communities. The senior staff are well placed to encourage this by using their editing roles to pass on suitable assignments to the ECRs who are then able to construct reviews in a supportive environment.

Senior members have also taken on grant reviewing roles. Read was a panel member for the EPSRC Human Like Computing Call and has regularly reviewed EPSRC grants as well as grants from outside the UK including Horizon 2020 and grants from four overseas research councils. Sim and Ta have also reviewed overseas grants (Sim for Dutch Research Council 2019; Ta for Israeli Ministry of Science and Technology). Read has been asked to review promotions and appointments in Finland and Sweden and was invited to contribute the **ACM SIGCHI overseas**

initiative which involved her running training events in India and China in a scheme paid for by the ACM.

Staff have been active delivering courses, workshops and keynotes. A series of **specialist courses on Child Computer Interaction** have been delivered at many major conferences (Read, Sim, Horton) and at IIT Guwahati as a special invitation (Read, Sim). The course on Child Computer Interaction has been successfully run across the Globe, including in Korea (2015), San Jose (2016), and Mumbai (2019). These courses have been attended by Industry delegates including Microsoft, Lego and Hyundai to determine how to integrate CCI methods into their development practices. Workshops on Teen CCI (Fitton), and on Participatory Design and Ethics (Read) have also been delivered in five international locations. Read has keynoted at ISD2017 and UXIndo2018 and was invited to keynote at British HCI in 2020.

Read is an invited member of the ACM SIGCHI Ethics panel where she is called upon to evaluate and comment on ACM papers that have raised ethics questions. In this role she has participated in four panel discussions at conferences across the spectrum of HCI. In 2016, in his role as the Chair of the BCS Interaction Group, Sim initiated a fact-finding mission with eight UK Professors to determine the state of HCI in the UK to help inform the EPSRC on future funding directions. Sim is currently working with Helen Petrie at University of York to set up a **PhD student training network** across the UK. This will involve professors running a series of one day events for the HCI community on topics such as writing high-quality papers, working with vulnerable groups, and mastering statistics. This initiative is being funded by the BCS with universities across the UK running the one-day events.

During the REF period UCLan hosted **two doctoral training events** for UK PhD students studying HCI. Beale assisted with one event and the other was facilitated by MacKenzie from York University, Canada who ran a course on experimentation.

Contributions to the economy

Understanding industry needs is a core interest for the UoA11 team especially as computing is an applied subject and tightly coupled with industrial needs. In 2016 Sim hosted a workshop at The Landing in Manchester bringing academics and industry together to understand the needs of industry to ensure that the curriculum and skills are being met. Gregory has been funded by the Agile Business Consortium to work on projects to inform business practice and drive profitability. Gregory has also worked with large organisations including IndigoBlue to examine and improve their agile processes. It is estimated that this work has **improved the profitability** of the organisation through improved business processes.

Research has resulted in the creation of innovative products (**Guo**) such as the iCardio - a portable electrocardiogram. This product is currently being developed and will **provide employment** for local Preston people. In 2019 Guo worked with Ansteel Mining corporation in China using a big data and reinforcement learning-based approach to optimise efficiency of a grinding circuit **saving the company** a large sum.

Read and Horton's work for Manchester's Chill Factor^e on evaluating user experience resulted in the company gaining customers and thus making greater profit. The ChiCI group also did consultancy work in 2016 for the BBC, working with Amberlight, in which they evaluated the accessibility of CBBC games with children with special needs. Based upon the findings published **the BBC made strategic decisions** about the distribution of the games in order to make them accessible to children within the UK, and thus increasing their market share. Kano (<https://kano.me/>) are also working with the ChiCI group to improve the evaluation of their technology in order to speed up the throughput of their ideas to market. Prior to Covid - 19, they were conducting usability tests every two weeks in schools and they are working with ChiCI to develop remote methods.

Contributions to society

The societal contribution from the research team is significant. Since 2014 the ChiCI group has actively worked with over 25 schools and **2000 children** in a range of activities that have included research studies (1500 children in 20 schools), and STEM activities (500 children in 10+ events).

Unit-level environment template (REF5b)

The research work is organised in a schema referred to as **MESS Days**. In this protocol, children typically come to the University in class groups for half a day or a full day and then spend their time rotating in groups of four or five, thus taking part in many different activities and meeting many members of the research team. On a typical MESS day, around half the activities will be empirical research studies, there will typically be one or more design studies and some activities are arranged 'just for fun'. One of the contributions from this work, to the academic community, is a protocol for the **ethical and informed participation of children in HCI research activities**. Our approach has been widely applauded for its focus on the children's experience. As a consequence of these practices, Read was invited onto the International ACM Ethics committee.

Two other notable activities from the ChiCI group are their engagement in the Lancashire Science Festival where we regularly run IoT activities for over **10,000 children**, and a commitment to support engagement activities at Ribblesdale High School, Clitheroe, where we run sessions over 7 weeks, once a year, teaching pupils about IoT and interaction design. Funding to support these activities has been sought from the Ingenious Fund and the Royal Society Partnership fund.

Within the general theme of HCI we have been **actively working in HCI4D** (HCI for developing countries) contexts. Read and Sim carried out an ethnography in India (2017) to understand technology use in the Dharvani slums and Read worked with UXIndo (2018) to explore the lived experiences of elderly women in Indonesian care homes. Both of these projects are ongoing with the latter being currently the focus of a research grant and the former inspiring the current Stones project, from the ChiCI group, which is discussed in one of the Impact Case Studies.

Our work with industrial partners is inspired by our enthusiasm to **make a difference in society**. With the BBC we (Fitton Horton, Read, Sim) visited family homes in Lancashire, where one or more children in the family had a disability, to discover their experiences with tablet technology. The outcome was that the BBC changed its policy on accessibility – the group benefitted from gaining a much deeper understanding of how these families struggled with technology. Read was subsequently invited onto **Women's Hour**, and later onto the BBC live news programme in 2019, to talk about families and screen time.

Sim contributed to a **Future of Technology in the Home** research project funded by Huawei to examine the likely technological trends for the next 5 years. Sim also appeared on a panel discussion with the head of product services for BT and a Professor from the University of Sunderland to discuss and critique the findings of this research report. The report is expected to shape product development influencing society over the next 5 years.

Outside of the ChiCI group and the HCI team, the SaFeR group have been active in exposing some of the **myths and misunderstandings about personal cyber security** and behaviour with Eiza appearing in the press in Forbes on 14 March 2019. "Was the Facebook Outage A Cyber-Attack?". and the Daily Mail on 08 January 2020 "UK firms and banks on high alert amid fears Iran will mount cyber-attacks in retaliation for killing of Qassem Soleimani".

Conclusion

The UCLan UoA11 team are a relatively small group but we have worked together to take full advantage of opportunities that have emerged from our efforts or simply come our way. A vibrant, environment is emerging - and with virtual pub lunches, naked researcher events and a team approach to supporting one another – this **collegiate paradigm is the hallmark of this submission**. We look forward to the possibilities, opportunities and challenges that are coming our way – the promise of new professors, investment in our current staff, and a commitment to Computer Science growth within UCLan will energise our efforts towards 2027 and beyond.