

Institution:

University of Liverpool

1. Context and mission

As the original 'Red Brick University' founded in 1881, the University of Liverpool maintains a mission to deliver research and impact "For advancement of learning and ennoblement of life". This founding principle provides the basis for our current vision "To be a connected, global University at the forefront of knowledge leadership". We aim to ensure that "Our researchers create solutions aiming to improve health, create wealth and ensure social justice" for citizens globally and locally. A successful global research-intensive university, we are an anchor institution in Liverpool City Region (LCR), a member of the Russell Group and of the N8 partnership of northern research-intensive universities.

We have embedded international links in our Xi'an Jiaotong-Liverpool University (XJTLU) in Suzhou, China and through significant research partnerships with institutions across China, Ethiopia, India, Japan, Malawi and the USA. We make major economic and social contributions across our region, the United Kingdom and internationally. Our strategic ambitions – to connect globally, innovate, increase social mobility and work in partnership – directly support the City Region's performance and prospects. We have enhanced the international profile of the LCR and added over £600m in GVA through partnering with major organisations regionally, nationally and globally in ground-breaking projects and by attracting many thousands of staff and students from across the world.

The University has three Faculties:

- Health and Life Sciences (HLS)
- Humanities and Social Sciences (HSS)
- Science and Engineering (S&E)

These are organised into 12 schools/institutes and 44 departments that are submitting the work of 1,251 research staff. This includes departments with over a century of history, including Architecture and Archaeology, as well as relatively new ones making only their second submission to the REF, such as Communication and Media. We are one of only eight UK HEIs to have an integrated Veterinary School as part of Health and Life Sciences – allowing us to take an holistic view of health challenges. Interdisciplinary research is supported through seven institutional Research Themes that work across the breadth of the University:

- Advanced Materials
- Climate Futures
- Digital
- Heritage
- Infectious Diseases
- Personalised Health
- Starting Well, Living Well, Ageing Well

Defined by University-wide consultation, themes embody areas with a breadth and critical mass of research excellence. Faculties also support local interdisciplinary themes and centres, examples being *Slavery and Unfree Labour* in HSS, *North West Cancer Research Centre* in HLS, and *Autonomy, Simulation and Networks* in S&E. Support and resources for research are provided for research at school, faculty and central levels.

Our research strategy is focused on the inclusive development of colleagues at all levels - PGR, PDRA, ECR and established academics - from "cradle to chair" (see section 3). This builds on our strategic commitment and a long-standing track record of improving the social mobility of our students. Through our Access and Participation Plan 2020-25 we have also committed to reducing unexplained gaps in student success and degree attainment. For Postgraduate study, we offer financial support for widening participation students to progress from undergraduate to postgraduate level. As well as hosting initiatives such as the OfS Data Science and AI Scholarships to encourage under-represented groups into postgraduate study in high-demand sectors.

2. Strategy

2.1 Approach

Our Research and Impact Strategy is about our people and focuses on creating the right supportive environment for researchers at every career stage. Under our Strategy 2026, we aim for the quality of our environment and career development support to make us a location of choice for established and aspiring research leaders. While fully supporting our diverse subject mix, we focus strategic investment on:

- Areas of global knowledge leadership.
- Increasing external representation and influence.
- Demonstrating our civic role.
- Addressing societal challenges.
- Delivering public benefit.

Four guiding objectives are helping us to achieve this:

1. Develop our global knowledge leadership by increasing the proportion of highly ranked research disciplines and leaders (see 2.2 and 2.3)
2. Grow our research power through supporting more staff to deliver world-leading research (see 2.2, 3.3, and 4)
3. Expand our impact by creating meaningful external partnerships and increasing the proportion of research leading to public benefit (see 4.1)
4. Develop the reputation of our University and the LCR through our international presence, and the profile our leading research areas (see 2.2)

Our commitment to developing researchers from postgraduates through to established professors is underlined by our key investments in Tenure Track Fellowships, our ECR recruitment since 2014, our development Academy, the Prosper project (see Section 3) and our research support infrastructure (see Section 4). Our strategy seeks to weave Impact and Knowledge Exchange into all areas of our work. We have central Research, Partnerships and Innovation (RPI) and local faculty teams (see Section 4) to support delivery of our strategy.

2.2 Global and local

We have developed strong research partnerships with a wide range of collaborators across regional, national and global business, public, health and cultural sectors.

2.2.1 Global research and impact

We have invested in research designed to achieve global reach and impact. In HLS we host a range of NIHR programmes including two Health Protection Research Units specialising in Infection and Global Health. Work in HLS has informed WHO global vaccine policy and the implementation of infant immunization schedules in 95 countries. Leading edge physics research is undertaken across three continents at world-leading particle physics laboratories including the Large Hadron Collider at CERN, as well as in-house with facilities unique to Liverpool.

We have invested in strategic partnerships, covering the development of joint research programmes, PGR, PDRA and ECR mobility. Our XJTLU joint venture campus makes us the pre-eminent UK academic institution in Jiangsu province, which has China's second highest GDP. We support collaborations with West China Hospital, Xi'an Jiaotong University and East China University of Science and Technology. In India we collaborate with the National Institute of Mental Health and Neurosciences, the National Institute of Advanced Studies and the Mysore School of Architecture. The University of Georgia (Athens) is our key US partner for staff and student exchange. Our Centre for the Study of International Slavery (CSIS) partners with UGA in the \$15.75M US State Department-funded 'Africa Programming and Research Initiative to End Slavery'. in in Sierra Leone, Guinea and Senegal. This builds on CSIS's 'Anti-slavery Knowledge Network' a flagship AHRC Global Challenges Research Fund project

We have supported academic engagement with the development needs of low- and middle-income countries through targeted use of QR GCRF funding. Pump-priming of £1,289,450 has been invested in 176 projects to pilot concepts and build relationships. From this 231 academics are now engaged with 383 partners across 80 countries and ODA is now over 6% of annual grant income.

2.2.2 Local research and impact

We have engaged with over 1300 business and community organisations in the REF period (see Section 4). The Vice-Chancellor chairs the Liverpool Knowledge Quarter Board and is a Liverpool Science Park Board and LCR Local Enterprise Partnership Board member. We have committed to the development of a Civic University Agreement, reaffirming our ethos of putting the local economy and quality of life top of our list of priorities. We will work with local anchor institutions, businesses, community organisations and local authorities to agree opportunities and problems to address. The Heseltine Institute for Public Policy, Practice and Place - a policy research unit that links University-wide academic expertise with policymakers and practitioners for the development of successful, sustainable cities and city regions – exemplifies our regional strategic investment.

We have committed to addressing the challenges of health inequality and child wellbeing in LCR, which has some of the highest rates of child ill health in the UK. The new 'Children Growing-up in Liverpool' (C-GULL) programme is a £5.2M Wellcome Trust funded collaboration. This world-leading research programme will be the first new longitudinal birth cohort (10,000 babies and their families) funded in the UK for almost two decades. The information gathered will provide important evidence to improve the health and wellbeing of children and their families within LCR. In addition, the LCR has provided £5.2M for the Civic Data Cooperative to integrate health data across the region.

2.2.3 Linking the global and the local

A key feature of our work is research that links the global and local. For example, the Materials Innovation Factory (opened 2017) builds on regional strengths and history in materials science and global partnerships (Unilever) (see UoA 8 and 4.4). The Centre for the Study of International Slavery links Liverpool's complex trading history to contemporary slavery and its prevention, working with local partners (The International Slavery Museum) as well as partners across West and Central Africa (see: UoA 19 and UoA 26). The Centre of Excellence in Infectious Diseases Research (CEIDR) co-ordinates research activity between our University, Liverpool School of Tropical Medicine, NHS Trusts and industry partners. Antimicrobial resistance is a priority area for CEIDR and, uniquely amongst UK AMR Centres, Liverpool researchers focus on precision dosing of antimicrobials (see UoA 1).

2.3 Developing interdisciplinary work

Our seven broad interdisciplinary themes bring together international excellence to address key contemporary challenges:

- Advanced Materials – building on the success of our Materials Innovation Factory, this theme links research across multiple sciences with projects combining AI, Robotics, Chemistry and Biology. See UoAs 8, 9, 11 and 12.
- Climate futures – building on long standing expertise this new theme brings together research across all three faculties to address the challenge of climate change and net zero carbon, focusing on the science, societal response and solutions. See UoAs 6, 7, 8, 12, 13, 14, 15, 27 and 28.
- Digital – this theme brings together research across all three faculties to harness the digital revolution to help deliver better health, social justice and industrial competitiveness. See UoAs 1, 2, 4, 11, 18, 20, 22, 26, 27, 30 and 34.
- Heritage – this theme brings together research from the humanities and social sciences to explore how a better understanding of the past helps create a more prosperous, fair and healthy world for everyone. See UoAs 13, 15, 19, 26, 28, 33 and 34.
- Infectious Diseases – this theme builds on a century of work at Liverpool that brings together medical and veterinary science with a focus on emerging infectious diseases and zoonoses. See UoAs 1, 2, and 6.
- Personalised Health – this theme brings together the breadth of clinical sciences to deliver a personalised approach to medical treatment that maximises efficacy and improves patient quality of life. See UoAs 1, 2, 8 and 11.

- Starting Well, Living Well, Ageing Well – linking research across all three faculties, this recently established theme aims to ensure that fair and equal access to the benefits of world-leading research can reach everyone throughout their lives. See UoAs 1, 2, 4, 17, 18, 26, and 27.

Institutional themes have a central budget and have professional services support from University and faculty teams. RPI manages a range of ‘pump-priming’ funds designed to support research innovations across our priority areas (see Section 4).

2.4 Impact strategy

Developing and capturing research impact is built into all levels of support. To ensure sustainability of the impact agenda we have introduced Faculty Impact Officers and Support PDRA roles (HLS: 5 HSS: 5; S&E: 3). RPI manages and supports the wide range of central Knowledge Exchange and Impact funding programmes that underpin delivery of impact across the research portfolio (see Section 4). We take a three-fold approach to our Knowledge Exchange (KE) strategy:

1. To equip all academics with the skills to undertake KE through the flagship *Making an Impact* skills development series (see 3.3) and investing in expertise and systems including specialist capability in commercialisation and consultancy (see 4.1.2).
2. To focus intensive activities on our distinctive research strengths, which attract clusters of talent, resources and partners to create greater opportunities for KE. This includes major joint investments in infrastructure (see 4.4) plus integrating KE and impact within our research themes (see 4.1.2).
3. To catalyse further KE through student enterprise opportunities, including multiple competitions involving more than 250 students in collaboration with Unilever.

2.5 Open data and open science

We are committed to open and transparent practices in research conduct and outputs. Our Library team has been proactive in developing open science internally and nationally. It is our goal that all research outputs are quickly made freely available online with as permissive a re-use licence as possible. We provide tools and support to enable researchers to engage with open science and highlight the Plan S ‘whitelist’ for open access journals. To make our archived research data easily found and cited we utilise the Datacite service to assign DOIs to datasets in our Research Data Catalogue. We maintain a range of Open Access subscriptions including SCOAP3 consortium and Open Library of Humanities membership and we are members of the Digital Preservation Coalition.

2.6 Research integrity/Reproducibility

In 2017 we made a commitment to follow the Concordat on Research Integrity recommendations. As such, we became one of the first 12 academic members of the United Kingdom Reproducibility Network. Research integrity is a formal core training requirement for all research staff and PGRs. We are also piloting digital tools, such as electronic notebooks and active data archives, to improve and support good research integrity practice.

3. People

3.1 Overall strategy

We support and develop staff at all career stages, detailed in the ‘People’ strand of our Strategy 2026. This includes our Equality Framework that sets high expectations for equality, diversity and inclusivity, and covers staff recruitment, retention and progression; diversity competence and representation, employer of choice and family friendly culture. This commitment is led by the PVC Research and Impact. In 2020 we have successfully retained the HR Excellence in Research Award, reflecting our commitment to a sector leading role in addressing EDI issues and developing research staff. We are working to address the full range of development needs for colleagues at all levels from “cradle to chair”, recognising that this includes supporting the many researchers who develop careers outside of HE.

3.2 Responses to REF2014 and charter commitments

Our REF2014 Equality Impact Assessment identified three issues to review: a relatively low proportion of staff within minority groups within the eligible population; using the analysis of

equality data provided to identify any potential concerns over quality assessment decisions; and a need to understand lower submission rates for older women academics. We responded with numerous activities to support colleagues from all backgrounds.

We have formalised our commitments through membership of the following charters: [Athena SWAN Charter](#); [Bambis Breastfeeding Mayoral Charter](#); [Disability Confident](#); [Stonewall Diversity Champion](#), [Time to Change](#) and moving to [Level 2 Disability Confident](#). We support a range of fora involving research staff in supporting, developing and addressing diversity and equality issues. These include the [Black & Minority Ethnic Staff Network](#), the [Disabled Staff Network](#), the [Female Early Career Researcher Network](#), [Liverpool Women in Science and Engineering Society \(LivWiSE\)](#) and the LGBT Network.

Our 'Supporting the Female Early Career Researcher' network (established 2013) explores the unique challenges and opportunities for women. In 2020 we committed to sign up to Advance HE's Race Equality Charter with the explicit goal of eliminating racial disparities for our staff and students. Our initial submission will take place in spring 2021.

We joined the Stonewall Diversity Champions programme in 2009 and are a Diversity Champion member. The LGBT Network is a forum for consultation between LGBTQ staff, PGR students and the University's governing body. In 2013 and 2014 the LGBT Network won a Stonewall Star Performer Network Group Award. We were designated a Disability Confident Employer in 2016 in the Government's Disability Confident Charter - a commitment to supporting disabled people into employment, retaining and developing disabled employees.

Disclosure of individual circumstances to ensure time away from research is considered within annual Professional Development and Review. EDI assessment is embedded within University research planning and practices especially regarding assessment of research and preparations for REF2021. To monitor the impact of our support and planning we annually undertake analyses of ongoing research assessment process as set out under our Research Policy Principles. This has already informed best practice around REF2021 preparations, decision-making and planning (see 3.8). Over the census period we have established EDI committees with research as a key focus at department, school and faculty level.

3.3 New initiatives

3.3.1 The Academy

To deliver on our commitment to support colleagues at all career stages, we inaugurated 'The Academy' – a team focused on excellence in organisational and academic development. The Academy works in partnership with research stakeholders including the N8, Russell Group fora (Researchers14), UKRSA, Vitae, and the European Educational Research Association. Academy programmes cover research management and leadership from first steps to senior strategic leadership (see 3.4). 152 ECRs have completed its programme for those developing their first research team. The Academy actively engages with the UK and Liverpool Research Staff Associations (RSA), which provide a representative voice for all PDRA staff. The RSA local ECR networks help to coordinate central and faculty support for researcher development. Membership of these networks reflects the diversity of these staff groups.

The Academy oversees our delivery of the UK Concordat Action Plan. This builds on our own Statement of Expectations for Principal Investigators and Research Staff, which defines responsibilities focused on embedding development and professional practice. We led on developing and became a signatory of the Technician Commitment in October 2017. The Academy coordinates action plans for this and our 'HR Excellence in Research'.

3.3.2 Developing ECRs

To support new researchers, we have developed a strong programme of Tenure Track Early Career Fellowships, including the Derby Tenure Track Fellowship scheme (HSS), Royal Society Fellowships in Chemistry (S&E) and numerous schemes, including a Wellcome Trust Fellowship programme supported in HLS. These programmes competitively offer five-year research fellowships leading to permanent academic positions. We have seven UKRI Future Leaders Fellowships across all three Faculties.

The Academy's annual 'Making an Impact' programme supports staff, especially ECRs, to develop their multi-disciplinary research and impact knowledge, skills and competencies. The framework

consists of impact clusters relating to the REF; knowledge and skills framed around KEF and the Industrial Strategy foci. In 2020, 58 development sessions were attended by 650 individual research staff including 165 ECRs.

We have invested in 113 'Early Career Researcher and Returners Fund' awards. Open to ECRs and those returning to research this enables career development and re-establishing of career trajectories. This has led to significant outputs such as UKRI FLF fellowships and the development of REF impact case studies.

We are leading an innovative new project: 'Prosper: Unlocking Postdoc career potential'. This £4.4M project, funded via the first award from Research England's RED fund, is designed to boost the success of postdoctoral researchers inside and outside of academia. In collaboration with the Universities of Lancaster and Manchester, and in coordination with the N8, Prosper is developing a programme to provide researchers with the broader capabilities and attributes needed to thrive in multiple careers. The unique approach of Prosper includes PI development alongside PDRA development, co-creation of development tools with industry and other stakeholders; and placing equality, diversity and inclusivity at its heart.

3.3.3 Post COVID-19 planning

In response to the COVID-19 pandemic we have sought to address the effects on staff, research and impact, and consider its substantive EDI impacts. Concurrently, the external research landscape is changing, due to COVID-19 but also Brexit and government R&D policy. We are undertaking a two-year institutional 'big conversation' project focused on delivering 'Research in an Inclusive and Sustainable Environment (RISE)'. RISE is fundamental to understanding how we might collectively prepare for and co-create our response to these challenges. RISE will listen to staff through multiple channels, to inform a range of reports and policy proposals for the future research environment and staff support.

For the current academic year, we have pooled and simplified funding across all HEIF pump priming schemes (see Section 4) to target partners on two large scale challenges:

1. Long-term impacts from the COVID-19 crisis
2. Accelerating towards a Net Zero Carbon future with a local or global impact

3.4 Athena SWAN

We joined the Athena SWAN charter in 2009 and received an Institutional Silver award in 2016. The University holds a Gold award (Institute of Integrative Biology, 2017) and six Silver and seven Bronze departmental awards. Athena SWAN action plans have driven various activities to address the staff gender pay gap, including the introduction of family friendly advisors to provide an initial point of contact for staff with questions on parental and adoption, policy and support for carers and for those undergoing fertility treatments.

We have encouraged the broadest range of applications for promotion and converted them to successful outcomes for all qualified staff. Actions have included ensuring representative panel memberships and unconscious bias training, mentoring and promotions workshops, personal feedback for unsuccessful candidates and new online resources. There has been strong engagement with Academy's development activities, with proportionally much higher attendance at leadership training by women academics. We have provided access to the women only Aurora Leadership Programme (71) and the Springboard Careers Programme (31). In the period 90% of women applying for Senior Lecturer, Reader and Professor were successful compared to 85% of men. Overall, we have increased our percentage of women professors from 18% to 25%. With the proportions in HLS (33%) and HSS (32%) being above the sector benchmark of 25%.

3.5 Developing PGRs

We are recognised by HEFCE as having one of England's highest doctoral completion rates. PGRs are supported by a combination of faculty and University teams. Over the REF period our annual PGR completions have increased by 64%. The Liverpool Doctoral College (LDC), alongside faculties and the Academy provides the core innovative doctoral training relevant to all disciplinary areas. The LDC also manages and oversees our international joint and collaborative PGR programmes, including those based at XJTLU. We currently have 24 externally funded Centres for Doctoral Training and Doctoral Training Programmes running. These are matched with University-wide sector leading programmes. The Engage@Liverpool programme is a cross-

faculty research and methods training initiative. We are a partner in the cutting edge ESRC-funded National Centre for Research Methods.

We have developed a substantive cross-faculty PGR Peer Wellbeing Ambassador Network building on a Catalyst funded pilot project, with 34 PGR wellbeing ambassadors and 11 staff scheme leads. The project advocates a bespoke approach to PGR mental health and wellbeing and provides peer-support and non-supervisor contacts for PGRs. All ambassadors receive mental health and wellbeing support training. PGR student mental health training is mandatory for supervisors.

3.6 Use of metrics

Having signed the San Francisco Declaration on Research Assessment (DORA), our protocols on assessment explicitly state that we do not permit the use of journal-based indicators when judging research quality. This has been integrated into our REF Code of Practice. During 2020 we have developed a full strategy to implement responsible metrics based on DORA, 'The Metric Tide' and the 'Leiden Manifesto'. This strategy includes comprehensive training and support for key staff involved in research assessment.

3.7 REF submission

We have included EDI in all aspects of the REF submission process. The full details are laid out in the University REF Code of Practice. Three key components are:

1. EDI training for all staff with REF2021 decision making responsibilities via a mixed portfolio of content and delivery, including commissioning specific Advance HE equality training for over 100 staff involved in research assessment and leadership. This training has been converted to online modules to further support staff and disseminate good practice.
2. Regular ongoing and final EDI assessments of internal research assessment processes, REF processes and selections. This work has led to regular updates and support for colleagues involved in REF process, informed the composition of REF selection panels and REF decision making groups.
3. Cross UoA oversight of process and meetings, particularly regarding the impact of EDI issues.

The results of these actions and the outcome of EDI assessments have been regularly reported to University Senior Leadership team, Senate and Council.

4. Income, infrastructure and facilities

4.1 University research support

Overall academic leadership rests with the PVC for Research and Impact supported by three Faculty APVCs for Research and Impact and a central APVC for Research Environment and Postgraduate research. Our central RPI directorate provides professional services support at every stage of the research, impact and knowledge exchange process. RPI works in close partnership with faculty research support and other professional services teams.

4.1.1 Funding applications and award management.

The RPI team proactively identifies important UK and overseas funding opportunities for the University that can support larger, long-term research projects. Recent key priorities have included the Industrial Strategy Challenge Fund, the Global Challenges Research Fund and the Newton Fund. The team actively unites cross-faculty research teams for these strategic bids providing project management support to develop compelling proposals.

The team is key in managing peer-review and process for 'pump-priming' of new research and impact projects and teams using central funds (HEIF/dedicated QR). It has dedicated support for critical internal proposal peer-review for major funding programmes, especially those with demand management requirements (UKRI, Leverhulme, Wellcome), including interviews to maximize the chance of success for strategic bids. The team manages our institutional Peer Review College and coordinates action around key funding such as GCRF. The team has developed various measures to assess EDI aspects of central support and central facilities provision, including tracking the EDI characteristics of QR allocations. Such assessments form a key part of RISE (see 3.3.3)

The effectiveness of this support is exemplified by the success of our UKRI Future Leaders Fellowship (FLF) scheme applicants. We currently hold 5 FLF grants and select candidates in an open and transparent fashion via a 'demand management panel'. Potential candidates get bespoke feedback. This includes feedback and support for ECRs not selected, enabling them to improve future applications. Those selected to apply to the UKRI FLF scheme attend sessions providing practical information, timelines for proposal development, support from academic colleagues who sit on FLF panels and from previous successful applicants. Each candidate is assigned a named RPI contact who advises on interpreting the guidance, and reviews the application, providing feedback. The contact liaises with UKRI on behalf of applicants. The same team supports response to reviewers, interview coaching and hosts a mock interview for each candidate. Similar support structures are provided around GCRF and ODA funding leading to significant outcomes such as the AHRC 'The Antislavery Knowledge Network' (see Section 2).

4.1.2 Knowledge exchange, impact and collaborations.

Working closely with Faculties, the RPI team supports all of impact and knowledge exchange activities across the University. Support includes:

- Consultancy (including a dedicated IT support system)
- Continuing Professional Development
- Facilities, equipment and testing services for partners and business
- Extensive support for Intellectual Property Commercialisation
- Knowledge Transfer Partnerships and Knowledge Transfer Network activities
- Strategic public engagement and public policy and framework activities

Since 2014 these support activities have become established across all three faculties. The RPI Consultancy Team was named KE Team of the Year at the PraxisAuril KE awards in 2020 and supports 250-300 projects per annum with a combined value of £2.5 to £3M.

The RPI team, working with faculties, supports and manages relationships with regional, national and international external partners spanning not-for-profit, public and private spheres. The team also handles legal, contractual and logistical aspects of visits, events, exchanges and collaborative research projects and supports our key international relationships (described in Section 2) plus local partnerships (see Sections 2 and 3). The work of the team was recognised in 2017 with the UKRI/Praxis Unico best partnership award for their work with Tate Liverpool. This partnership is built around common goals of broadening participation in art and culture and increasing impact among diverse audiences. It brings a rich variety of research perspectives to Tate's exhibitions - from our Computer Scientists' working robots in Tate's Cécile B. Evans exhibition to our Egyptologists inspiring creative responses to the Book of the Dead.

This work has led to significant KE and impact success across our research themes and faculty portfolios. For example, in Advanced Materials the longstanding collaboration with Unilever led to the establishment of the Materials Innovation Factory (MIF) in 2018 (see 4.4). Catalysed by an unprecedented return to Unilever of £16m (2006-17) and seven major product innovations delivered to market based on molecules developed through the collaboration. Commercialisation based on this work has led to three advanced materials spinouts in last three years. In Infectious Diseases, KE and impact support underpinned the development of CEIDR (see 2.2). The Tandem Nano spinout develops novel formulations of drugs for HIV, Malaria, Tuberculosis and Hepatitis C and is the commercial partner on a Unitaid grant of \$32 million to develop Long Acting Injectables. Our Heritage theme has developed multiple engagements to support the Liverpool cultural and creative sectors, a visitor economy worth £4.9bn and 57,000 jobs in LCR. This includes longstanding collaborations with National Museums Liverpool and Tate as well as supporting Aberdeen Asset Management and Gower Street Estates' future strategy for the Albert Dock, a key heritage asset.

In Digital the RPI team helped to secure a joint study agreement with IBM in 2018. This has delivered over £10.3M in collaborative projects, with in addition a £1M 'in kind' commitment to support an EPSRC 'Big hypothesis' research programme. We host an IBM visiting Professor in Industrially Applied AI, and IBM will support a co-branded laboratory in the new Digital Innovation Facility (see 4.2.1). The Virtual Engineering Centre (VEC) supports SMEs to capitalise on opportunities provided by digital technologies and through the £4.4m LCR4.0 programme. This has supported over 300 enterprises and 40 new businesses and is set to generate £31m GVA

and 955 jobs over the next three years. Our new 'Starting Well, Living Well and Ageing Well' theme is working with Liverpool City Council on its Child Friendly City initiative and the C-GULL programme (see 2.2.2).

4.2 Facilities and collaborative infrastructure

Our commitment to providing researchers the best possible resources is seen in the exceptionally high proportion of budget allocated to acquiring library resources. This is a third higher than the Russell Group mean, representing the eighth largest level of expenditure on information resources in the UK. Arts and Humanities researchers are particularly well supported by a printed book collection that is the sixth largest in the country. This collection strength allows us to contribute to the research environment worldwide – we are currently the only UK institution contributing to an Ivy League members-led inter-library loan coalition. This ensures our researchers have significantly quicker access to material held elsewhere than peers at other UK institutions. Our Special Collections & Archives have been fundamental in establishing new research centres and supporting the efforts of researchers far beyond our own institution, with visits from external researchers increasing year-on-year through 2014-2019.

We are part of the N8 Research Partnership between 8 of the UK's top 30 universities in the North of England, which generates 88% of all Northern HE research income of £1.2 billion per year. Major collaborative N8 programmes we support are the £16M N8 AgriFood Resilience Programme; the £7.5M N8 Policing Research Partnership working with 11 police forces; the £1.25M DecarboN8 programme for low carbon transport solutions; and the £1.6M N8 Industry Innovation Forums. Shared resources include the new Centre of Excellence in Computationally Intensive Research.

We support an extensive range of collaborative and shared infrastructure. An exemplar is the Malawi-Liverpool-Wellcome Trust Clinical Research Programme. This links local significant infrastructure (see 4.2.1) with the CREATOR building in Malawi (£10M) to support Postgraduate training of African clinical and non-clinical scientists. A significant example from S&E is the Condensed Matter cluster leading the UK Materials Science CRG synchrotron beamline, XMaS, at the European Synchrotron Radiation Source (ESRF) in Grenoble. In HSS we share collaborative research infrastructure, such as our Elizabeth Slater Archaeological Research Laboratories and exhibition facilities, with our NML and Tate partners. Our Victoria Gallery and Museum provides shared resources and infrastructure for both local and international scholars and practitioners.

4.2.1 Capital and facilities investments

Over the period we have invested over £200M in research capital infrastructure, for example:

- Materials Innovation Factory (MIF) in S&E is an £82M investment in estate, equipment and staff. The MIF utilises computer aided materials science and high-throughput automation to develop new materials science approaches, re-thinking and updating potential applications. The MIF houses the Leverhulme Research Centre for Functional Materials Design, created to drive a design revolution for functional materials at the atomic scale.
- We and LCR Combined Authority have invested in a new Digital Innovation Facility. This £12M investment in estate, facilities and staff will establish DIF within our campus as a centre of excellence in simulation and virtual reality. It will focus on three priority sectors where LCR has competitive advantage: advanced manufacturing and engineering, low carbon energy and digital industries.
- The new £22M Yoko Ono Lennon Centre, opening in 2021, will house the 400-seat Tung Auditorium with space for a 70-piece orchestra. The Centre offers a significant enhancement of the University's arts research environment and will support the current interdisciplinary work between Music, S&E and the PRISM Centre at the Royal Northern College of Music. The Auditorium will provide a unique environment for our practice-based researchers making it possible to stage the work of our own composers and performers.