Institution: Manchester Metropolitan University

Unit of Assessment: C24 Sport and Exercise Science, Leisure and Tourism

1. Unit context and structure, research and impact strategy

Since REF2014, there has been compelling growth and significant investment in all areas of sport and movement science research at Manchester Metropolitan University. The Department of Sport and Exercise Science has moved to central Manchester and into new £26.4m facilities, and the Faculty of Business and Law has created the £1.3m Sports Policy Unit. Research provision in physiotherapy, neuroscience and psychology has also increased. We have made 38 new appointments across all areas including six new professors, increased our postdoctoral researcher numbers to 11, and recruited 145 postgraduate students with 57 doctoral completions. There has been extensive capital investment in equipment (e.g., £1.8m Siemens 3T fMRI scanner). We have led the €1.4m Erasmus Mundus Move-Age doctoral training programme and continue to lead the multicentre University Alliance DTP for Applied Bioscience. Our sport and exercise science research was ranked 5th in the UK and 41st in the World (2016 Shanghai Jiao Tong Global Research Quality Index).

These strong markers of success have empowered our bold and primary strategic aim to deliver the Manchester Metropolitan Institute of Sport – an innovation focussed on integrating sporting expertise from across the organisation - to deliver a world-leading research and education agenda in biomedical science, health, business, policy and the culture of sport, and aligned with a city ranked 7th in the world for sport (BCW 2021 Ranking of Sports Cities).

Our record of attracting high quality staff and postgraduate researchers, immersed in excellent facilities and research governance processes, that facilitates key partnerships with Manchester City Council, and National and International Governing Bodies, continues to enable a truly distinctive and world-leading profile. Since 2014, we have delivered three large MRC grants and our research outputs have contributed directly to new Government policy for exercise and activity in the UK (e.g., output ref: 1269). Our research impact has changed lives in elite sport and we have led the development of anti-touting policies in The Netherlands (output ref: 1120). Our physiologists and psychologists have worked with the European Space Agency to understand the effects of unloading on the musculoskeletal system, and produced new interventions for combating functional declines in their SIRIUS isolation and confinement programme, informing policy and practice in physical activity and ageing. We support and benefit from the Northern Powerhouse economy and the devolved Greater Manchester (GM) healthcare budget, linking the GM Combined Authority and the GM Health and Social Care Partnership. We also provide specialist advisors to Public Health England and have established successful collaborations with our four regional NHS Foundation Trusts to address the active healthy ageing needs of diverse communities. We can evidence high quality research with extensive links with sporting and clinical practice to deliver impactful and innovative research.

Manchester Metropolitan has a strong heritage in sport and the human movement sciences. We have built on the success of the high quality work that was returned to the Allied Health Professions Unit in 2008 and 2014, and have now prioritised sport and exercise-related research to extend our 45-year history in the discipline. The total research income within the assessment period is £4.22m (with £5.02m in awards), double the benchmark median, as well as £2.5m of QR funding that has impacted directly on the contributing research activities.

Research Structures

Three of our University Research Centres have a significant responsibility for sport and exercise related research: (i) **Musculoskeletal Science and Sports Medicine**; (ii) **Health, Psychology and Communities**; and (iii) **Future Economies (Sports Policy Unit)**. Within and across these Centres there is considerable interaction, collaboration, co-production of research activities, and PhD supervision. The unit submission comprises 13 professors, 15 early career researchers (ECRs), and 23 mid-career researchers.

We deliver research that makes a leading contribution to the understanding of key mechanisms controlling human movement, with a particular focus on the musculoskeletal system. We apply techniques from: physiology; biomechanics; psychology; neuroscience; physiotherapy; engineering; computer science; and cell biology to understand and refine human movement, taking a fully translational approach to musculoskeletal science and building on the inherent interconnectivity between related disciplines. We are recognised as an authority in the creation, communication and commercialisation of musculoskeletal science and sport medicine knowledge, optimisation and rehabilitation (evidenced by results of RAE 1996, 2001, 2008 and Shanghai Rankings). We are uniquely positioned to provide research solutions to combat musculoskeletal ageing through our work across integrated research themes: i) Movement Impairment; ii) Musculoskeletal Function in Health and Ageing; iii) Sports Medicine and Elite Performance; (iv) Physiotherapy; (v) Stress, Health and Performance; and (vi) Neuroscience of Ageing and Impaired Mobility.

Research in **Movement Impairment** targets the unmet needs of hard-to-reach groups by embedding research within primary user and support groups, NHS trusts, charities, clinics and hospitals, and funding body committees. Work includes: neural control mechanisms of postural balance; prosthetic limb use; mechanisms of gait impairment, instability and falls in diabetic neuropathy; and mechanisms associated with weakness in myositis. We have developed novel in vitro co-culture models of skeletal muscles to study the effects of disease states, such as diabetes and as a novel platform for drug discovery. In **Musculoskeletal Function in Health and Ageing** our research has been instrumental in defining musculoskeletal function across the lifespan. We have pioneered techniques including muscle imaging, particularly using ultrasound and muscle activation assessments that have provided a unique insight into the loss of muscle mass and function accounting for physical declines associated with ageing. We have cultured novel in vitro 2D and 3D platforms of muscle-nerve interactions to allow the study of ageing effects and to test novel therapies.

The **Sports Medicine and Elite Performance** research group's work includes sports genetics, motor function and whole-body performance. The group specialises in optimising elite performance across a range of disability and able-bodied sports including athletics, boxing, cycling, dancing, football, orienteering, rugby, shooting and swimming; we have worked with British Swimming, Para Swimming and International Para Swimming at Olympic and Paralympic training centres for over 30 years. Our research has made major contributions to informing athlete classifications in Para Swimming (ICS 03) and our expertise in the genetic determinants of elite sports performance has had a direct impact upon performance in marathon running, football and rugby (ICS 05). The **Physiotherapy** group has strong links with clinical practice to ensure our work is translational, meeting the needs of injured athletes, patients and other service users. We have active research leadership within NIHR research governance, regional NHS Trusts and GM-Applied Research Collaboration networks, as well as on the boards of private health care providers, such as Nuffield Health and Connect Health. Within **Stress, Health and Performance**, the team deliver research that helps people in demanding performance environments. Research includes working patterns, well-being and productivity, cardiovascular reactivity under stressful, challenging and threatening states. The team has delivered translational research and real-world impact for athletes and coaches, the Ministry of Defence and British Armed Forces, large corporations, the emergency services and political leaders.

In the **Neuroscience of Ageing and Impaired Mobility** group, Wellcome Trust-funded projects have shown, for the first time, how age and age-related diseases change how the brain controls human movement. We have developed new biomarkers identifying the brain's microstructure changes that predict postural and gait symptoms in Parkinson's disease (output ref: 1190) and can now predict the onset of movement disorders that can be used to stratify patients in clinical trials of mobility interventions.

Our sport and movement scientists deliver world-leading research aligned with the GM devolved health agenda, the UK's Industrial Strategy through Sustainable Societies, and Industry 4.0 themes, such as personalisation and digitalisation. We play a strong role in the development of sustainable societies through work in healthy ageing, community physical activity, and sports development initiatives.

The **Future Economies** Research Centre focuses on the challenges facing sport in the economy, policy and business. **The Sports Policy Unit (SPU)**, funded by the University's Strategic Opportunities Fund, delivers research in: i) sports mega-events and their economic, cultural, legal and political impacts; ii) the governance of sport; iii) sport volunteering; iv) sport sponsorship and ambush marketing; v) women's sport; vi) the economic forecasting of sports events; vii) Chinese football development; viii) the governance of E-sports; and ix) the regulation of sports stadiums, spectators and ticketing. SPU works with a number of NGBs of Sport and is able to work out of Sport England's premises on the Etihad Campus where we lead sports research. SPU also leads the research associated with the Rugby League World Cup 2021. Since 2017, SPU has secured funding from the IOC, UEFA, UK Sport, Sport England, the Social Science Fund of China, Rugby Football League, Rugby League World Cup, Football Supporters' Association, and the Face-value European Alliance for Ticketing. SPU will host the 6th Sports Volunteering Conference and hosted the Political Studies Association Sports Specialist Group Annual Conference in 2017 and 2020.

Review of Research Strategy and Plans
Since 2014, a strategic plan with an emphasis on sport, quality, place and people provided the ideal opportunity to bring together the critical mass of sport-related research within our Institute of Sport (IoS). The IoS has been delivered, and high quality research is central to its future planning. As the major UK urban Centre of Excellence for our existing and planned sports-related research, led by the Director, Prof. Cable, the IoS will deliver a unique, globally-recognised sports brand to enhance the University's international networks for research, and support Manchester's ambitions as one of the major international cities of sport.

Future Planning and Strategies
The significant expansion of our sport and exercise infrastructure and staffing base has established the platform from which our exciting IoS research vision can be delivered. The IoS will continue to provide a clear strategic focal point, providing opportunities for sport, business, local authorities and clinical partners, to access our research expertise in the human movement sciences, business, law and policy. The IoS will deliver:

- world-leading translational research to continue to inform government policy and impact on sport, health and care pathways;
- promotion of the health benefits of sport and physical activity driving initiatives to promote healthy living in order to reduce the economic costs of sedentary behaviours;
- academic expertise to raise professional standards and share best practice.

We have established key strategic partnerships with elite sports, NGBs, and healthcare providers across Greater Manchester, the UK and globally. With them, we will continue to shape policy, lead research and prepare our postgraduates for employment. Our 2021-2030 strategies are informed by the Global Challenges, Sustainable Development Goals, UK's Industrial Strategy, and the Research and Development Roadmap, and we will continue to invest to meet external demand in a city that has a global reputation for sport. We will continue to lead impactful research with, and for, communities across the human movement continuum, from local 'hard-to-reach' groups through to elite international sport performers.

Developments in the science, medicine and business of sport must be governed, managed and led effectively, with due regard to the law and ethical practice. We will lead research in sports law and policy, providing an additional dimension to our science disciplines. We will promote sport as a force for good, for the whole population: equality in sport promotes equality in life. We will provide the social impact evidence to justify Manchester engaging with sport as both a

mega-event and as a means of securing healthy communities and promoting social inclusion for the benefit of all. Our extensive collaborations with GB Paralympics, the Sport and Recreation Alliance, Sport England and other major sporting organisations ensure that our research will have an impact upon all the communities in which it operates.

We will continue to engage with the powerful health data landscape that exists within Greater Manchester and take further advantage of the presence of the UK Biobank in Stockport, the Farr Institute of Health Informatics Research, clinical centres of excellence in Manchester and the integrated electronic health records system at Salford Royal. Access to these research assets is facilitated by our active membership of Health Innovation Manchester and the Applied Research Collaboration-GM. We will continue to lead research for the prestigious £2.5m strategic partnership with Nuffield Health that has recently expanded to include management of the Manchester Institute of Health and Performance (MIHP) at the Etihad Campus. Hosting the English Institute of Sport, our co-location with Nuffield's Institute will provide significant research and incubation opportunities.

Enabling Impact

We actively support and enable impact for all our research. Teams are able to request funding for impact activities, including for staff to join at the development stage to ensure impact is embedded from the project's inception. Returned staff have had access to the expertise of four RKE Impact and Engagement Managers, who have been involved directly with the returned Impact Case Studies. Our Research Development Managers and Faculty Business Development teams also ensure that all our projects have a 'pathways to impact' style plan and keep stakeholders and policy generators informed. To develop ECRs, the Head of Research Environment and Impact, and specialist Impact Managers, deliver regular impact advice workshops. All faculties have discipline-focussed Strategic Advisory Boards comprising leading individuals from business and industry, who are able to guide and enable social, economic, public policy or services, and health impact. In addition, our Public [and Patient] Involvement Engagement Network, which includes our impact team, enables research teams to develop strong co-production, embed impact early, and plan meaningful impact pathways in line with our impact strategies.

Payton's impact case study is an excellent example of how this comprehensive support and advisory team has worked with British Swimming and Para Swimming to deliver high quality research-informed evidence for change, communicated through academic, professional and sports performance fora to achieve meaningful impact. Since 2000, Payton's workload has included allocated time to work directly with these NGBs, travel to international competitions and training camps, and co-appoint researchers to help deliver coach education workshops and research in order to inform global para swimming, as well as our own student communities. To support the genetics-based case study, Williams was encouraged and supported to be involved fully in the legal case for Caster Semenya. Our significant and wide-reaching support for impact will be sustained. The permanent Impact Manager posts will continue the programme of impact literacy, and the early identification of interdisciplinary areas of impact that align with our mission and strategy will be enhanced and guided by the new International Strategic Advisory Board for the Institute of Sport.

Multidisciplinary and Interdisciplinary Research

Manchester Metropolitan produced the first BASES Interdisciplinary Sport and Exercise Science publication (Burwitz, Moore & Wilkinson, 1992) and our research structures and strategies reflect the deep understanding of the complex thematic unmet needs in 21st century sport. We have innovative solutions for sport, human movement and health challenges. We have brought impactful, knowledge exchange-focused interdisciplinarity to many aspects of our research: epidemiologists, movement scientists, physiotherapists, psychologists, sociologists and sports lawyers working together on collaborative projects and doctoral teams to address complex research questions. We have delivered new knowledge for greater understanding of high performance sport (output ref: 1225); the disease process (output ref: 1113) and health behaviour change (output ref: 1275). We also work closely with colleagues in computing and

digital media to develop novel interventions, such as the App-delivered interventions for knee reconstruction (output ref: 1119), Parkinson's patients (output ref: 1345) and DCD children (output ref: 1252) - work that is being prioritised for NIHR Programme Awards by the Applied Research Collaboration in Greater Manchester (GM-ARC) for roll out nationally as part of the digital health theme.

We host an enterprise unit for research evaluation and assessment to review the impact of interventions in order to contribute to sustainable, impactful behaviour and meaningful quality of life changes. Within the eligible staff, we have a strong multidisciplinary and active practitioner expertise of professionally-registered individuals; for example, HCPC qualified (9), MCSP Physiotherapists (4), BPS Chartered Psychologists (8), BASES Accredited Practitioners (3) and Barristers (1). Groups can, therefore, draw on a wide range of professional supporting services to inform their research. SPU has also been established to generate cross-, multi- and interdisciplinary research. The wide range of staff disciplinary backgrounds and the collaborative nature of SPU projects ensure that an interdisciplinary approach to research is central to its philosophy.

Research Integrity

Research Ethics and Governance

Research ethics and governance are at the centre of our responsible and impactful research, a mandatory part of our researcher's development, and embedded in staff Personal Development Reviews. All our research is fully compliant with the Concordat for Research Integrity. All returned staff are active ethics reviewers with 36% contributing directly to effective governance within Departmental, Faculty and University Ethics Committees. Staff holding professional registration and accreditation awards complement the University's research ethics and governance through comprehensive codes of conduct underpinning their contract research, knowledge exchange and sports consultancy. Within our impact cases (e.g., ICS 05) our staff are at the forefront of some of the most sensitive ethical debates in sport.

Research involving human participants is regulated centrally through two Research Ethics and Governance Managers (one, a registered nurse with expertise in ethical approval and sponsorship of NHS research; the other, a published academic in social sciences) dealing with NHS Foundation Trust Research and Innovation communications, and all NHS IRAS proposals. Returned staff (e.g., Cooper, Littlewood and Selfe) add specific expertise in clinical trials, their skills being used to guide ethics, governance and integrity in clinical research requiring CTU support.

We have a university-wide approach to **Human Tissue Authority (HTA**) compliance, with a fully-ratified HTA committee, including the Designated Individual and four Persons Designate reporting to the University Research Ethics and Governance Committee. We conduct annual internal audits of HTA compliance and have invested significantly in new systems, including the upgrade of storage freezers, alarm systems and inventory software. The University's Designated Individual (Degens) is returned in this unit and oversees compliance, internal and external auditing, and integration with the University and Faculties Research Ethics and Governance committees. We have active research covering at least 16 of the named types of tissues and cells that are regulated. Our **LabCup** lab management system interfaces with the ethics systems to capture all research activities involving the use of human material covered by the HTA.

Open Access (OA)

We have a clear OA Policy that is consistent with the requirements of REF2021, the Finch Report and mandates from funders, such as UKRI, the Wellcome Trust and Research England. We are fully compliant with the Concordat for Open Research Data. All journal articles are deposited in the University's institutional *e-Space* repository. Many of these outputs have a significant number of downloads, for example, output ref: 1299 has been downloaded 1,452 times since 2019 and output ref: 1121 more than 750 times.

Comprehensive OA training is provided and colleagues are encouraged to publish in journals supporting Green OA or to build costs for Gold OA into external grants; staff can also access internal funding, including a UKRI OA grant and an institutional budget of £165k for Gold OA. Funding is prioritised for work that can demonstrate quality markers, international partners and impact benefits. For example, output ref: 1112, funded by MRC and the Wellcome Trust, has been featured in more than 50 global news stories and received a high number of citations since it was published in 2015; and output ref: 1227, published in *Diabetes/Metabolism Research and Reviews,* was able to access £2k in OA funding providing greater reach and leading to higher citation metrics.

Research Data Storage (RDS)
The University's RDS policy applies to all staff and PGR students, fully endorses the Concordat on Open Research Data, and the data management expectations of individual funders. The University has invested £500k in its RDS solution that provides researchers with the highest quality provision, protecting data and providing full end-to-end support. This investment underpins our ambition to strengthen a commitment to research excellence via excellent facilities and process that go beyond compliance, protect our research data and enable the University to make informed decisions that will enhance our reputation and position as leading research institution. All projects that inform the returned research outputs and impact case studies are contained within the RDS system. The system provides storage that scales both performance and capacity to meet current and future growth needs (i.e., multiple Petabytes). Our data management plans are compliant with internal and external ethics procedures and GDPR requirements. The RDS provision integrates with our pre- and post-award Worktribe® cloud-based research management platform, our online ethics system and our institutional repository of research outputs. In 2020, all postgraduate research students' projects were also included in the RDS provision.

2. People

There has been significant investment in staff associated with sport, attracting talent from top-ranked HEIs: Cooper (Kings College); Faisal (Imperial); Grix (Birmingham); Littlewood (Keele); Ray (Oxford) and Uiga (Hong Kong/Waikato). We have also retained all the senior research leadership team returned in REF2014. In addition, departments have invested significant research time, typically 40%+ of annual workloads, to support and incentivise early and mid-career researchers in line with the Concordat for the Career Development of Researchers. Ray represents our submission around the Concordat that has contributed to our status as EU HR Excellence in Research award holders for the past eight years. We can also evidence strong succession planning, leadership and development opportunities: Morse, Ray and Winwood have been promoted to group leads; Pearson succeeded Reeves as the Director of Musculoskeletal Science and Sports Medicine and Reeves moved to Head of Research and Knowledge Exchange for Science and Engineering.

Support and Development Strategies for Research
Staffing and Recruitment
We have retained the majority of staff who were returned in REF2014. We have also invested in 35 new staff: six professors; two readers; ten senior lecturers; 12 lecturers and five research fellows. Of these, 13 early career researchers are returned to this Unit's FTE profile. Principles of equality, diversity and inclusion are embedded throughout our recruitment processes. One member in the submission has a fixed-term contract and has access to all the same development opportunities and internal funding as permanent colleagues. 12 staff have been awarded internal promotions or new posts demonstrating an institutional commitment to staff retention, support for early and mid-career researchers, our own postgraduate student community and clear alignment with the Researcher Development Concordat (9/2019). There is a streamlined route for new professors to allow strategic and targeted recruitment. The respective Faculty Head of RKE is a member of all academic post interviews to ensure research quality and strategic alignment. Currently, Holmes and Reeves are in these senior thematic roles providing direct leadership input to appointment quality for sports-related research. We support

staff at every stage of their academic career, as reflected in our staffing contract profile (Table 1).

Professor	Principal Lecturer and Reader	Senior Lecturer	Lecturer, Research Fellow
25%	20%	35%	20%

Table 1: Staff contract level profile

Induction

All new staff undertake an induction programme and on-line essential training, which provides an overview of research structures and processes within the University, Faculty and Centres. The Induction Team, including Academic Research Leads, Heads of Department, RKE teams, HR and Professional Services, provides the key information relating to all research activity, integrity and ethics, and implementation of our equality and diversity policies. Heads of RKE meet with, induct and manage all new professors and readers for as long as required. Induction training is provided for staff for specialist laboratory areas, health and safety, procurement, and grant management. Institutional and Faculty training is provided for PGR supervision processes, examination panels, and thesis assessments (see PGR student section below).

Annual Professional Development Reviews (PDRs)

The PDR plays an important role in performance monitoring and progression for all staff. Staff are required to present their PDR achievement and planning forms along with five-year plans for RKE. These are used, in part, to determine UCRKE membership status and significant responsibility for research in line with our Institutional Code of Practice for Research. The information informs individualised research planning and mentorship needs, and encourages self-evaluation and ownership of research progression. Personal circumstances and wellbeing are balanced alongside expectations around career development. Departments can fund skills development and professional scholarly activities. This support is over and above that available through the Office for RKE, or devolved budgets to Research Centres and Faculties for targeted research activities. Heads of RKE and UCRKE Directors work with Heads of Department to co-deliver all Reader and Professor PDRs. Faculty PVCs also meet one-to-one with their Professors.

Individualised Support and EDI

Full consideration is given to the Equality Act in all areas of open research support. Individualised and targeted support is also considered for staff, researchers and postgraduate students with protected characteristics. Staff and student wellbeing is a priority for the University and comprehensive professional teams, online resources and referral systems are in place for all communities. We provide individualised support for staff and research students returning from ill health, and those managing long-term illness and caring responsibilities through targeted interventions, such as reviews of research time in workload models, funded training and CPD, and restructuring of research teams. All staff involved with coordinating the REF submission, or making judgments on research outputs, completed mandatory EDI training.

Career Pathways and Mentoring

The University provides two career pathways for all academic staff: Education, Pedagogy and Citizenship (EPC); and Research, Education and Citizenship (REC) (see 'How we develop our staff' in REF5a). Each route provides staff with a clear understanding of the requirements for development and progression from Lecturer through to Professor. Senior staff across the University and the wider Professoriate mentorship team provide direct support for staff at all stages of career progression, providing one-to-one support and feedback. Mentoring schemes are well developed and embedded fully within all our research centres, and allow early and mid-career researchers to develop with support from self-selected senior staff and, in some cases, mentors that are external to the University. Staff receive time and resources for confidential mentoring meetings in addition to the more structured annual reviews and internal appraisals mentioned above. As examples, Ray, mentor Holmes (2018-19), and Jarvis, mentor Reeves (2019-20), were supported through to full UKRI Future Leaders Fellowship applications. We offer a wide range of bespoke training opportunities and weekly research seminar series for staff and

postgraduate students. Training examples include: research integrity; impact; EDI; wellbeing; mentoring relationships; being a researcher of international standing; creating a reflective space to plan quality research and prioritise effort; receiving constructive, independent comment on research outputs to accelerate quality publications; and embedding researchers in a developmentally-oriented academic community to aid the strategic development of academic networks.

The RKE Directorate oversees a comprehensive portfolio of internal funding schemes that underpins the ambitions of the University's RKE Strategy and returned staff have benefited from £461k investment to progress careers through the development of high-quality research, the achievement of impact or engagement with business and external partners; for example, The Future Leaders Programme (Tole benefitted from a 12-month full-family sabbatical to the University of Windsor, Canada); and Good to Great Programme (Ireland, Lightfoot and Ray funded to a total of £169k). Devolved QR has also been used to support training needs of ECR members (e.g. the externally-supported scheme co-delivered with NHS R&D North West and using elements of the Vitae Researcher Development Framework). The Developing Research Excellence (DRE) programme provides mentorship to ECRs and new appointments to enable them to develop work into high quality outputs. This two-year programme comprises one-to-one mentorship for research planning and career development, and bidding for internal and external funding, publication strategies and writing. James and Grix are mentors for this scheme, which has seen Peng graduate to a permanent position.

Promotion, Progression and Reward
Staff applying for research promotions across all levels can discuss applications with the Head of Department, mentor, UCRKE Director and Faculty RKE Head. ECRs are considered under the University's Accelerated Promotion Scheme and in this REF period, Franklin, Stebbings and Wood received Senior Lecturer promotions. Colleagues at the top of Lecturer, Senior Lecturer, and Reader scales can apply for additional 'Contribution Zone' increments to reward their excellent research or impact.

For Readership and Professorship, open information workshops are delivered by the Faculty Head of RKE and Pro-Vice-Chancellor for RKE ensuring the process is open and inclusive. In addition, workshops are held for BAME and female colleagues. Since 2014, Burden, Tole, Ray, and Winwood have been promoted to Reader and Degens, and McPhee and Payton have been promoted to Professor. Professors have their pay reviewed in an annual Professorial Contribution Process to reward outstanding work against published criteria.

The University Teaching Academy offers support, leadership, advice and guidance relating to all aspects of learning, teaching and assessment as it relates to the careers of research-focussed staff. All returned staff have at least Associate Fellow status of the HEA, many are Fellows and some are Senior Fellows (Burden, Wright). In 2016, Holmes was awarded Principal Fellow status for his work in developing PGR training environments, and embedding research and consultancy across all levels of the academic curriculum.

Sabbatical and Staff Exchange Opportunities
Senior Research Leads work closely with Heads of Departments to identify and support research sabbatical opportunities that align with research strategies. The length of any sabbatical is determined by the planned activity, typically four to 12 months. There are various funding routes for sabbaticals with some supported by central strategic opportunities funding, whereas others are provided through Faculty and Department workload adjustments. There are no restrictions concerning who can apply for sabbaticals.

We have a collaborative research exchange agreement with La Trobe University (LTU) in Australia allowing innovative research across all disciplines; sport is a particular area of focus. Linked to returned outputs (output ref: 1132), Callaghan (with Crossley, Exercise and Medical Sciences, LTU), has explored the feasibility of an international RCT treating sports-related patellofemoral pain with topical anti-inflammatory medication (transdermal patches). The SPU

team are working with colleagues at La Trobe on eSports, traditional sports and empowerment within an emerging ecosystem. Other centrally-supported schemes allow staff exchange to allow career progression (e.g., Tole was supported in a 12 month exchange with University of Windsor in Canada).

Early Career Researchers (ECRs) and Postdoctoral Research Staff
The REF2021 definition for early career research is used across the University although staff who self-identify as ECR are also supported (e.g., staff joining from clinical or professional practice). We have 13 ECRs as returned staff (25%) demonstrating a sustainable pipeline of talent. There is ECR representation at all Faculty and University RKE Committees, Faculty Professoriate meetings and the ECR Forum, as well as an independent Postdoctoral Researcher Group with a devolved operational budget. Our ECRs benefit from a wide range of internal funding streams to support research development; they include: Research Accelerator Awards; Health Research Accelerator Awards (co-funded with University of Manchester); Researcher Development Fund; International Visitor and Networking Awards; Impact and Public Engagement Awards; Business Engagement Awards; Research Network Funding; Global Challenges Research Fund; The RKE Future Leaders Scheme; The Good to Great Scheme and Professorial Recruitment. All research staff are supported through direct mentoring and line management by experienced researchers to develop, for example, grant writing as Co-I and PI, co-authored publications at quality, REF literacy, planning and output review, and PhD supervision where Principal Supervisors are encouraged to include at least one ECR on a student's team wherever possible. We are currently supported by 11 postdoctoral researchers including five senior research associates/fellows with permanent contracts funded by the University and six staff on fixed-term contracts linked to external grant awards. All postdoctoral research staff are automatically full members of UCRKE. Career support opportunities and internal funded support routes are identical to full-time permanent staff.

Postgraduate Research Students (PGR)
We recruit high-quality students and support their career development in a nurturing and challenging environment. We believe that PGRs are a vital part of our vibrant research community and culture and all PGRs automatically become full research centre members upon registration. There are typically three-four staff on each supervisory team, including one ECR. There is a strong commitment to publish high quality work during the registration period. This has been important in allowing students to secure prestigious postdoctoral and full academic posts through their enhanced profiles; more than 25% of our returned outputs have postgraduate research student co-authorship. 144 students have been registered in the assessment period and there have been 57 successful completions.

Recruitment of Doctoral Research Students, Including Those With Protected Characteristics
Research management teams lead the advertising, recruitment and appointment of PGR students to ensure the strategic alignment of the proposed projects. All PGR students are interviewed by a panel whose members have completed the appropriate equality and diversity training, including unconscious bias, to ensure reasonable adjustments are made where appropriate. Academic research leads work closely with the central and local postgraduate research degrees team to ensure students' applications are processed efficiently and effectively. Research Centre Full Members are appointed to all supervisory teams and, where appropriate for a student's supervision, there are good examples of cross-Centre supervisory teams.

PGR Equality and Diversity Identified Demographics present strong representation against the sector norms: 76% White; 4% Black; 1% Chinese: 11% Asian; 5% Mixed race; 3% Unknown. 8% have declared a disability. 26% are aged 30 and under; 51% between 30 and 40; 18% between 40 and 50; 5% between 50 and 60; the oldest student is 66 year old (range 25-66 years). We recruit from 31 different countries. 85% of students are home/ EU with 15% International. 36% of students are part-time.

Studentships from Major Funding Bodies and the Erasmus Mundus Move-Age Project. In 2019, we completed the eight-year, €1.4m Erasmus Mundus *Move-Age* doctoral training programme.

39 dual PhD students completed degrees from the three partner universities: Manchester Metropolitan, KU Leuven and VU Amsterdam. All students graduated with two-four research publications. Some of the outputs submitted in Impact Case Studies 1 and 2 are from work linked directly to the scheme. The successful PhD programme provides strong evidence for co-operation and collaborative arrangements for PGR training, including formal recognition through international networks.

University Alliance Doctoral Training Alliance (DTA)
Since its inception in 2014-15, we have been instrumental in creating and establishing the University Alliance DTA. As Deputy Director for Applied Bioscience for Health, McPhee led the design and delivery of the programme across partner universities. Building on research strengths and an industry-focused ethos, the programme has produced independent, highly-employable researchers. It is the largest multi-partner initiative of its kind with 14 UK university partners and 32 PhD students in Year One, 30 in Year Two and 32 in Year Three. McPhee became Director in 2018 and secured a €6m EU COFUND (€12m total project) to recruit a further 82 PhD students in the 2018/19 and 2019/20 intakes with 16 partner universities. Manchester Metropolitan leads on 12 of the total COFUND studentships. As well as benefiting from the shared world-class facilities, supervisors, asset sharing registers and summer schools, our postgraduate researchers benefit by joining a broader professional community.

Our match-funded full-time scholarship scheme encourages high quality research with new and existing key partners (e.g. MoD; Nuffield Health Partnership). Members of the partner company or professional body join the supervisory team and many projects are embedded in the partner company environment. In addition, the prestigious annual 'Vice-Chancellor' studentships are awarded for projects reviewed to be of the highest quality and potential impact. Staff returned in this submission hold two current VC awards (Holmes/McPhee/Morse/Ray) and five Faculty Scholarships. We also advertise focussed self-funded projects through our websites. Designed for international students, the projects' details are comprehensive and align to areas of quality and strategic fit. We have also appointed postgraduate students through a range of prestigious funding routes: IOC/UKSport; the Wellcome Trust; Diabetes UK and Nuffield Health.

Monitoring and Support
The University's bespoke online PGR governance system, *SkillsForge*, allows detailed monitoring of all enrolled and registered students. All student-staff meetings are recorded and all milestones of the student's progression are managed within *SkillsForge (*see REF5a for more details). Students have direct access to the Faculty PGR administrative teams as well as the central Graduate School team; both are embedded in the main RKE team. All Faculties have a Head of PGR and s/he is supported by Departmental and UCRKE representatives. The Faculty Research Degrees Committee has full and part-time student representatives who also attend the Faculty Research and Knowledge Exchange Committee to give all, opportunities for effective support and support for the student voice.

Training and Skills Development
We continue to invest considerable funding and social capital to develop the research culture for PGR students. We offer Faculty and Graduate School Annual PGR student conferences, with external sponsorship from, for example, the journal *Experimental Physiology,* where PhD students present alongside other ECRs. Weekly seminar series provide opportunities for students to demonstrate progression and highlight registration milestones. In addition, PGRs have full access to the Vitae Researcher Development Framework and students can access support for conference attendance from the Graduate School, external project funding, their research centre or home department. PRES (2019) results show that we are particularly strong in terms of PGR supervision, with 100% of our respondents agreeing that they had regular contact with supervisors that was appropriate for their needs; 100% agreeing that they knew what was expected of them in relation to their theses; 100% of respondents indicated that they knew what their responsibilities were in relation to research including ethics and integrity; and 100% agreeing that their communication and public engagement skills have improved. 93% of PGR students agreed that they would manage to complete within the institutional timescales.

Throughout the pandemic period this high quality supervision has been especially evident and students have reported positively about support and adjustments for their research, as well as their health and wellbeing.

Equality, Diversity and Inclusion (EDI)

The University is committed to developing and sustaining a collegiate working environment where every staff member and student is treated with dignity and respect (see REF5a for details). The University's EDI Implementation Plan sets out actions to maintain and develop further the aims of the strategy. Faculties and Departments have EDI leads and teams to implement the Plan. There is inclusive leadership and decision-making at all levels of the organisation with understanding of our communities and support for their needs. We have accessible and inclusive campuses with a progressive, informed, diverse and supported workforce and an inclusive student experience. The University produces an annual equality monitoring report in order to support our aspirations in relation to Athena SWAN, the Race Equality Charter Mark, the Disability Standard and the Stonewall Workplace Equality Index. The University has supported staff through Advance HE`s Aurora Leadership Development Initiative for women and those who identify as a woman (Holmes and Pearson act as Mentors for women within this scheme). The University's EDI Team has designed a mandatory comprehensive training package in support of its policy portfolio. Courses include: unconscious bias recruitment and selection panels; standalone unconscious bias training; managing diversity; and equality and diversity essentials. Women and BAME staff are represented across the returned staff and leadership: Pearson is a Centre Director and an IoS Research Lead; Tole is a Centre Deputy-Director; Ray and Cooper are Group Leads; and Franklin is Equality and Diversity Representative for Sport and Exercise Science. We actively monitor and promote all protected characteristics continually and strive to increase awareness of EDI across the institution. **The Institute of Sport is one of the University's leading areas for championing equality, diversity and inclusion**.

Staff EDI Identified Demographics

The EDI data, in general, show that the Unit is more diverse than the eligible population. The gender balance for returned outputs ratio is equitable at 68% male/32% female, higher than the sector profile for Sports, Exercise and Leisure (64% male/36% female and 3% other: 2019 Advance HE Equality Report). The data for race show: 86% white (eligible population 90%); 2% black (eligible population 1%); 2% Chinese (eligible population 1%); 2% Asian (eligible population 1%) and 8% Mixed/Other (eligible population 7%) suggesting that the submission is also in line with the sector for BAME staff. 4% of the submission declared a disability (against 3% of the overall population and 3.7%) for the sector average.

Arrangements for Supporting Flexible Working

We facilitate temporary part-time working, compressed hours, job sharing, home-working and career breaks, combined with a promotion scheme to ensure colleagues are not penalised for career breaks. Timetabling arrangements support colleagues with caring responsibilities, with all meetings and research seminars held during normal working hours. Our established systems for homeworking also allowed for a smooth transition to Covid-19 working requirements. ECR colleagues have reduced expectations for research output and we make similar adjustments for colleagues with caring responsibilities, chronic disabilities including mental health problems and those returning to work after maternity, paternity and adoption leave, periods of sickness or family-related absence. The RKE Delivery team ensures that negotiations for extensions or pauses can take place with external funders, and staff returning from extended leave for whatever reason have access to confidential routes to disclose circumstances that can lead to adjustments in expectations.

EDI Considerations in the REF Submission

We have aimed to be fair, transparent and inclusive in our REF preparation complying fully with the University's Code of Practice to ensure that EDI is reflected in the submission. All colleagues with significant responsibility for research and independent researcher status are included. Staff involved in preparing the submission completed mandatory training on managing diversity,

equality and diversity essentials and unconscious bias. We have taken positive steps to maximise EDI in the selection of outputs. Colleagues could request a reduction in the expectation of outputs due to individual circumstances and two staff used the process to set out their circumstances, which we have considered in the selection of our work. We have not applied to seek a reduction in the required volume of outputs for the submission because we have been able to manage the impact of these circumstances in line with the guidance from EDAP and Research England.

Career Pathways and Other Forms of Support
Part-time and fixed-term staff have access to the same support and progression systems as full-time staff, including conference and career development funds, training/development opportunities, teaching qualifications and ECR development programmes.

The Submitting Unit's Approach to Supporting the Wellbeing of its Staff and Research Students
A range of professional services teams contributes to the wellbeing offer available to all staff and students to support mental, physical and social wellbeing. Our *Lifeworks* employee assistance programme is a fully-integrated wellbeing platform that provides support and assistance across a comprehensive range of needs. Support can be for counselling services, confidential advice (personal, financial and legal) accessed via telephone or electronically via articles, podcasts, online toolkits and interactive bespoke programmes. Our *Wakelet* areas also provide wellbeing resources for staff and students and is curated by our HR and organisational development People Development Team.

3. Income, infrastructure and facilities

Income
External audited income for the census period totals £4.22m, with £5.02m in awards. The success, from diverse sources (see Table 2), includes spending against prestigious awards from three large MRC grants (e.g. Loram: £952,341); European Union (Reeves: £450,000) Innovate UK (Reeves: £215,533); BBSRC (Tole); Framework7 (McPhee); NIHR (Holmes); Diabetes UK (Reeves); Arthritis UK (Selfe); British Heart Foundation (Degens); National Lottery, UKSport and British Swimming (Payton); Manchester United FC (Callaghan); Holos Life Science (Williams); Waterloo Foundation (Wright); Nuffield Health (Franklin) and the continuation of the Erasmus Mundus programme with Vrie Amsterdam (Degens).

We have used external funding to support development; for example, McPhee, Loram and Tole used £570k from an MRC cross-council Lifelong Health and Wellbeing initiative to support Ireland's PhD (returned here as an ECR) and produced 20 research outputs directly linked to the project between 2014 and 2019. McPhee is also site lead for another £840k MRC award and, with Cooper, delivered 16 original publications from this funding between 2014 and 2019.

Our internal income includes £2.5m of devolved Quality Related income that has been invested directly and strategically in our research staff, researchers, PGR students and our activities. We also receive back the overheads from projects to reinvest in research.

Strategy for External Research Income Generation
In line with our overall strategy, we will continue to focus on quality, people and place. We have introduced more selective and higher quality bidding procedures with rigorous internal peer review processes and a greater engagement with fewer funders. Our growing research expertise, through high quality appointments and retention of quality people, has brought detailed and specific funder knowledge and a quality internal peer review. Using this knowledge has been successful with, for example, Diabetes-UK, NIHR and Parkinson's UK, where we have returned staff who are members of the respective research committees.

Our success with UKRI, EU, Health Charities and UKSport since 2014 motivates further large targeted projects. We will continue to improve bidding opportunities for our ECR and MCR career staff with focussed training and support as described above. Key partnerships in business

and industry will also form part of our funding strategy and we will continue to collaborate with research-intensive academic institutions in the UK and abroad.

Source of Income	BEIS Research Councils	UK Charities, Open Competition and Other	UK Govt, Industry and other UK Sources	European Union	Non-EU
Percentage of Income	28%	14%	33%	21%	4%

Table 2: Diversity of Income Sources

Infrastructure and Facilities

Research and Knowledge Exchange Directorate
We receive exceptional support from the RKE Directorate and have a strong relationship with our RKE Research Development Managers who attend our management meetings and work with us on our long-term funding strategy. We also have access to two EU and International Research Development Managers and an experienced delivery team that enables us to fulfil our full range of funder responsibilities. These relationships have been a key part of our success and provide us with high-levels of confidence, capacity and support, going forward.

RKE offers full service support incorporating the Graduate School, RKE Systems, and support for grant bidding, IP, commercialisation and contracts. Our researchers work with a dedicated Research Development Team and a Research Delivery Team including post-award specialists and legal professionals supporting procurement, logistics and financial management. We have access to three Research Impact and Engagement Managers who also support our public engagement activities, and two Research Ethics and Governance Managers offer guidance and training. Engagement with business is supported by Business Development Managers, a Partnership Manager and an award-winning KTP team.

RKE Systems manage *Symplectic,* which staff use to maintain records of outputs, OA compliance, and web profiles; *Worktribe* is used for the online management of external funding applications and reporting; *EthOS*, for research ethics and governance; and *SkillsForge*, to manage the PGR student journey. *RKE Systems* also provide management reports and data for annual review processes.

Administrators in the University's *Graduate School* work closely with our Research Degree leads. We also have three dedicated press officers, an HR business partner, ISDS support, and Finance and Legal Services. We receive professional marketing and web development support for our website and social media presence.

Library
The University Library is open 24/7 and offers access to extensive online resources for staff and PGRs. A subject-specific librarian advocates for extra resources and updates journal provision, as well as contributing to workshops and training in *InfoSkills* and *Open Research*. Journal titles and online resources are reviewed annually. Inter-Library loan requests are free for all and the SCONUL network facilitates access to other university libraries. International research methods packages are available, e.g. SAGE Research Methods was adopted as part of the Library's 2019 review. New subscriptions to SAGE Premier and Taylor&Francis collections have expanded free and discounted APC charges. The Library also manages Green OA through the University's *e-Space* repository and funding for Gold OA. It also hosts Manchester Metropolitan's Special Collections and the *North-West Film Archive* with unique collections in the history of sport and leisure.

IT Infrastructure
Our research activities, including next generation DNA sequencing and MRI imaging generate huge quantities of digital data. We have a comprehensive Research Data Storage facility to

provide a centrally-managed storage solution to meet current and future storage growth needs (multiple Petabytes). **The system stores data securely, authenticates user access and supports Open Science**. IT services support all advanced hardware and specialist software for our research needs.

Technical Services Support for Research
Specialist technicians (N=13) in our science teams have expertise to improve the quality of research delivery and cover: molecular and cell biology; vascular biology and neuromuscular function; biomechanics; imaging; phlebotomy and climate control; movement simulation; physiotherapy; dietetics and nutrition; psychophysiology and neuroscience; and kinanthropometry. We are a signatory to the Science Council and Gatsby Foundation's Technical Commitment, and also have pathways for technicians to cross over into academic REF returned positions (e.g. Ireland).

The Nature, Quality, Provision and Operation of Specialist Infrastructure and Facilities.
The University's strategy to focus on excellence in sport and exercise has led to investment in a £26.5m state-of-the-art facility, placing us as one of the UK's leading institutions for the academic study of sport, exercise, health, and movement science.

We have access to world-leading research buildings, laboratories and equipment, and benefit from access to our excellent bioscience provision, further technical expertise and opportunities to co-fund research activities through devolved research budgets. There are 14 dedicated physiology laboratory spaces, each supporting work aligned strategically to our areas of expertise. Dedicated space for microbiology containment is separate from the activities of cell and molecular biology serving our cardiovascular, ageing and lifelong health research. These spaces comprise a large, open-plan molecular lab, six dedicated cell culture rooms and a tissue physiology room. There are further spaces for whole body physiology activities, phlebotomy and blood-processing, containing three Sysmex XS-1000i blood analysers. Our research is underpinned by three facilities for imaging, tissue processing and genomics with equipment for DNA isolation, processing and analytics including: Illumina Next-Seq and Mi-Seq machines; a Fluidigm EP1 sequencer; five qPCR thermocyclers; and a QiaCube DNA extraction machine and next generation sequencing. In addition, we run a large equipment lab that contains two multi-laser flow cytometers, two Luminex multiplex plate readers, an Amaxa nucleofector, a Seahorse XFp metabolic analyser and an AKTA Pure protein purification FPLC machine. A large wet exercise physiology laboratory includes facilities for detailed biochemistry and muscle biopsies. Other laboratories contain a range of Esoate portable ultrasound machines, eight multichannel Delsys EMG systems (including three Trigno wireless systems), an upright Esaote MRI imaging scanner (Model - G Scan 0.25T), a Stratec XCT 3000 PQCT Machine, and two x GE Healthcare LUNAR Prodigy ADVANCE DEXA scanners. In addition, staff have access to interdisciplinary science laboratories comprising multiple force-platform arrangements and three T1/2 Vicon systems. Similar kinetic and kinematic laboratories exist (including Qualysis and four Vicon camera systems, multiple Kistler, AMTI and FDLite Force Platforms) in two other buildings where a bespoke gait analysis laboratory allows for work to interface with our fully-functional Physiotherapy Clinic, the *Manchester Movement Unit*. Our Neurocognition laboratories comprise: brain imaging and electrophysiology; brain stimulation; eye-tracking; neuropsychological testing; and observation labs. Within these are Functional near-infrared spectroscopy (fNRIS), 64 and 128 channel mobile EEG, five mobile eye-gaze systems, Repetitive Transcranial Magnetic Stimulation (rTMS) and two single/bistim TMS systems. For the latter, we are one of the leading teams globally for work in motor imagery and action observation, evidenced by the PETTLEP impact case study and ten research outputs; the team have advised on brain stimulation for motor cognition research and laboratory construction in the UK, France, Germany, Italy, Belgium, Canada and Australia.

Our Platt Lane Sports Complex includes a variety of high-quality sports pitches, including an indoor football pitch, a grass pitch and two full-sized 4G sports pitches that are all available for research use. A dedicated technical team manages the Platt Lane research areas (large Physiology laboratory, human performance studio with Kistler and AMTI force platforms, Vicon

motion capture system, strength and conditioning gym, and performance analysis suite). We also have many partnerships with specialist facilities, for example, our Nuffield Health partnership provides direct access to the Manchester Institute of Health and Performance (MIHP), a world-class healthcare facility, combining modern diagnostic technology, sports medicine and education. Payton's case study benefited from partnership with the Manchester Aquatics Centre and we continue to work in direct partnership with the Winsford Neuromuscular Centre and the Oswestry Movement Centre. The Sports Policy Unit (SPU) is located in the heart of the University's Business School, which holds **the '*Triple Crown*' of internationally recognised accreditations: Equis, AACSB and AMBA**. These quality marques ensure that SPU's reputation is grounded in the wider reputation of the Faculty and University.

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

Collaborations, Networks and Partnerships, Projects with HEIs, Locally, Nationally or Internationally, and Indicators of Success

Our success is contingent on the success of our partnerships. They include: commissioners; providers; other universities; industry; national government bodies and investment agencies. Many of our outputs include our national and international collaborative partners from co-produced funded research projects (e.g. output refs: 1301; 1278; 1138; 1325; 1176; 1246).

We have strong international links with teams in Australia, Brazil, Canada, China, Gulf States, India, New Zealand and USA, all evidenced by funded projects, exchange collaborations and staff supervising international PhD students. The University has offices in Wuhan in the Hubei Province of China. Commissioned by the General Administration of Sport in China, we hosted the China Sport Science and Medical Research Group in Manchester, where we were able to showcase our academic excellence in sports science and sports policy. In collaboration with Leeds University, the partnership built a strong relationship with the visiting delegation to explore further academic engagement. We have a key partnership with Beijing Sports University, the official Training Centre for the General Administration of Sport of China, and regarded as one of the best institutions in China for sport-related studies. We have worked directly with Chinese government researchers to develop their sporting strategies for elite performance and were awarded a China Visiting Fellowship to explore the morphological and structural ultrasound signature of tendon injuries.

We have developed strategically important collaborative links through the City Football Group (La Trobe University in Melbourne, NYU in New York, Columbia, China and India). We have hosted the Nigerian-based Physiological Society to gain research experience to influence national policy within Nigeria. We continue to lead the internationally-successful Research in Imagery and Observation Group, founded at Manchester Met in 2006, and with annual international conferences, the membership continues to lead knowledge generation and dissemination in motor cognition and simulated movement. As highlighted in our Semenya Impact Case Study, Williams' involvement in the IAAF court case in Switzerland received global acclaim and highlighted the importance of international research collaboration in the field of sports genomics. Payton's work with the International Paralympic Committee has been in collaboration with biomechanists at the University of the Sunshine Coast, Australia. Since 2014, submitted staff have held International Visiting Professorship posts (e.g. Holmes, Victoria University, Melbourne; McPhee, University of Padua, Italy; and Williams, Moscow State, Russia).

We have a collaborative agreement with Nuffield Health to co-produce translational research and knowledge exchange for emotional wellbeing and long-term health conditions for the wider population and hard-to-reach communities. The research projects feed into education and workforce development programmes. Activities are led strategically by a cross-organisation Partnership Board, which has commissioned eight catalyst projects, including PhD scholarships. The new management of the MIHP provides direct access to the EIS and world-leading clinical facilities.

Partnerships with National Sporting Organisations
We have key sports partnerships to fund and inform our work and the impact supports many of our multidisciplinary and interdisciplinary research achievements. Examples include: Manchester City Football Club, Manchester United Football Club, The English Institute of Sport, British Cycling, GB Paralympic Swimming and Rugby Football League. We also support many high-profile sporting events that are held in Manchester, such as the Rugby League World Cup in 2021.

Wider Contributions to the Economy and Society
Retuned staff, as professional practitioners and sports consultants, work closely with key users of our research. These include: International Olympic Committees; Governmental Departments (e.g., MoD); National Governing Bodies of sport; professional sports; Talented Athlete Scholars; and patient, carer and support groups (e.g., Parkinson's, stroke, DCD, Duchenne's MD). We are able to work with key users to develop effective Public and Patient Involvement and Engagement (PPIE) groups who then inform our research from the outset through our PPIE network. Returned staff are also members of trustee boards (e.g., OPTIMI, Holmes) linked to active research collaborations with Visiting Research Fellows and Co-applicants on major external grants (e.g. MRC Cerebral Palsy, Loram). Some of our research buildings are part of GM community projects, and the integration with local communities promotes research positively.

Staff and research students engage actively in professional and external academic citizenship activities. These include: executive board membership of NHS trusts; local authority 'healthy ageing' committees; membership of professional body research committees; sports science consultancy; co-production and PPIE groups; charitable support group membership; school governance; invited speaker presentations for user groups; and volunteer coaching activities. We deliver co-produced projects with clinical and public health teams for significant impact across the region; for example, research with diabetologists to reduce the severity of peripheral foot neuropathy and ulcers leading to amputation; raising fitness levels of patients newly-diagnosed with cancer to boost surgical outcomes; and increasing physical capabilities of older adults to reduce the risks of serious falls and developing physical frailty. Our research can also be shown to enhance the impact that the sports industry has on the wider community, both in terms of the direct economic impact of the sport and leisure industry and the benefits of health, wellbeing, economic generation and culture.

We are involved directly in important policy initiatives that continue to influence the economy and society. The impact can be demonstrated in some of the high quality research outputs included in this submission and our impact case studies. With the devolution of health and care across Greater Manchester, we have been active in a number of strategic policy initiatives: Greater Manchester Moving; Health Innovation Manchester; Connected Health Cities; and the Manchester Foundation Trust. Returned staff are active members of these various bodies and committees that are able to influence policy for the devolved £6billion health budget. Holmes and Reeves are the University's representatives on ARC-GM Committees and Networks and are involved directly in discussions with the senior ARC team as to how it should tackle GM's health priorities. Our evidence-based advice and informed input has helped to address unmet needs and to confirm the validity of existing products. One of the significant achievements in this respect has been our involvement in the 2019 Government report on Healthy Ageing, with McPhee and Pearson contributing to The Physiological Society's report, with Pearson's research on habitual physical activity being featured in the Researcher Highlight section of the document. We continue to work in close partnership with other UK universities through involvement with the British Association of Sport and Exercise Sciences, and overseas through high-level engagement with The European College of Sport and Exercise Sciences, where McPhee is a member of the Scientific Review Board. We submitted a response to the Department of Health's consultation on '*Advancing our Health: prevention in the 2020s*'. We were key contributors to the Cheshire East Council's *'Falls Prevention Strategy 2019-2021*'. This work informs the current contributions to leading Manchester Foundation Trust's Falls Collaborative and its Research and Innovation Workstream, where five returned staff are active members. We have led a report on

the effects of remote working on health that saw the launch of a recent white paper. The work, with Professor Sir Cary Cooper (University of Manchester), was funded by Nuffield Health, who claim it to be the most successful they have ever commissioned, with the results being disseminated at corporate events to over 300 businesses.

COVID-19 Outbreak Expert Database.
In 2020, six returned staff signed up to contribute to matters related to public health, sports, behavioural science and medicine, contributing to the current Parliamentary Priority Action List and providing informed and evidence-based feedback. As part of the HERO network, Pearson's research on the benefits of decreasing sedentary behaviour and small increases in activity was referenced in the UK Physical Activity Guidelines and was included in the recent BASES *Expert Statement on Physical Activity and Exercise During Covid-19 'Lockdowns' and 'Restrictions'.*

Engagement with Diverse Communities and Public Through Research
Returned and eligible staff receive media training and are approached regularly by the BBC to provide well-informed and evidence-based views linked to sport and newsworthy events; our proximity to Media City at Salford Quays makes us ideal for immediate expert statement. The reach of our impact has been extended through public discourse, providing evidence-based advice on physical activity through frequent TV and radio appearances, public engagements and news articles across 21 countries. For example, members of the research team have appeared as experts on programmes including: BBC4 Hidden Killers (623,000 views); BBC1 Inside Out (24-10-2016), Trust Me I'm a Doctor (23-03-2018); Holding Back The Years; How To Get Fit Fast (27-02-2019, 1.5 million views); Operation Ouch (23-10-2019) and numerous appearances on BBC Breakfast, World, National and North West News. McPhee's outputs (e.g. output ref: 1104, 1207) featured in a BBC Radio 4 interview and The New York Times. Jarvis' work in stroke in young adults has featured on BBC's North West Tonight, S4C, Bro Radio, BBC Wales, and BBC Radio Manchester. Abbott and Reeves have featured in the Daily Mail and on the Diabetes UK website following their research output in Lancet Digital Health on diabetic foot ulcer prevention (output ref: 1301). McPhee and Ireland's paper in the Journal of Physiology (output ref: 1207) related to sarcopenia was discussed on a main NHS website, BBC news websites and the Daily Telegraph webpages.

Our motor neurone disease physiology projects have included professional choreographers, dancers and martial arts performers, delivering audience participation events to illustrate the impact on those living with the disease and their families. We delivered performances at a range of National (Manchester Science Festival, ImpFest) and International Science Festivals (Manchester European City of Science Public Festival) and also visited a number of schools, targeting young adults from disadvantaged social-economic backgrounds, working with more than 3,000 participants. We were awarded £20k from the Physiological Society to extend this exciting programme and develop a tour of schools. Reeves has led science communication events at the Manchester Science Festival on ageing and musculoskeletal function, and an art-science project on the diabetic foot '*Seven Thousand Feet*' with exhibitions and events organized across Manchester over a two-month period culminating on World Diabetes Day. This project was an excellent example of how our research is able to span disciplines and influence society beyond traditional boundaries and the project has now won a number of awards (Greater Manchester Clinical Research Award for 'Best Public Engagement Contribution' and 'Highly Commended' in the 'Quality in Care' Diabetes Awards, category 'Diabetes Collaboration Initiative of the year – Adults', and the Outstanding Contribution to Patient and Public Involvement and Engagement 2019).

Contribution to the Sustainability of the Discipline
Membership of Research Council or Similar National and International Committees
Returned staff hold many professional qualifications; for example: Full Membership of The Physiological Society (UK); Charted Members of the British Psychological Society; Registered Practitioners within Health and Care Professions Council (Physiotherapy and Psychology); BASES Accredited Sport and Exercise Scientists (e.g. Stebbings and Williams, together with UK

and International colleagues, and World Rugby, were awarded an Expert Statement Grant from the BASES to support the development of two expert statements on sex testing in sport).

Participation on Grants Committees. Refereeing Academic Publications and Research Proposals
Our returned staff are expert reviewers for external funding bodies with examples including: MRC; BBSRC; the Wellcome Trust; NEWFELPRO EU Marie-Curie; the Rosetrees Trust; the Chartered Society of Physiotherapy Charitable Trust; Versus Arthritis; the Stroke Association; Parkinson's UK; the Swiss National Science Foundation; the South Africa National Research Foundation; the Commonwealth Scholarship Commission; and the Estonian Science Foundation.

Invited Keynotes, Conference Roles and Awards
All returned staff have presented at international conferences since 2014 with more than 500 conference papers presented; in over 100 cases, these were as invited speakers or keynote addresses (e.g. Payton, 26; and Williams, 14, on work directly associated with their impact case studies). Other examples include: Selfe's keynotes on patellofemoral research (across Europe, China and New Zealand); and Jones' keynote to NATO on Human Factors and Medicine; Reeves' keynote in India on the biomechanics of the diabetic foot as well as keynotes at the International Society of Posture and Gait Research World Congress. James was the invited keynote for the Sports Law Association conference in Japan, presenting his paper "Controlling athlete behaviour: athlete activism, Rule 50 and the Olympic Games".

Many retuned staff contribute to conference committees and have received awards; as examples: McPhee is on the Scientific Review Panel for ECSS, and Holmes (2014-2017) and Wright (2017-2020) chair the RIO-Group Conferences. Littlewood received the Service of the Year Award from the Association of Orthopaedic Chartered Physiotherapists. Turner received the Albert Ellis (New York) Award for Research in 2018 and 2020, as well as the Association of Rational Emotive Behaviour Therapy Outstanding Contribution Award for Research in 2019.

Indicators of Wider Influence, Contributions to and Recognition by the Research Base
14 returned staff hold professional qualifications that allow them to practice as: HCPC Registered Practitioner Psychologists; Chartered Physiotherapists; Biomechanists and Physiologists. These staff act as consultants to National Governing Bodies, major teams, coaching communities, individual athletes and Talented Athlete Scholarship Scheme athletes. The integration of research with professional practice is important for impact (see ICS 03, 04, 05). The ongoing consultancy work informs our REF-TEF-KEF nexus and is regularly commended by both students and external examiners. A number of applied PhD projects have been funded through these consultancies (e.g. Morse's student, Hussain, works for the FA; and Payton's student, Oh, working across Southern Asia and Australasia in disability swimming). All returned staff teach across all levels of student provision and ensure research and associated consultancy is embedded in unit delivery. There are novel units within the various Level 7 programmes that are unique within the UK and provide students with state-of-the-art research techniques to prepare them for Level 8 research opportunities or other discipline-focussed careers.

Journal Editorial Activities: *Editor in Chief, Senior Associate Editor, Associate Editor, International Advisory Board*.
Within the returned staff, many have editorial roles across a range of journals; examples include: International Journal of Sports Policy and Politics (Grix: Editor in Chief); PMR+ (Selfe: Editor); The Sport Psychologist (Smith: Editor); Entertainment and Sports Law Journal (James: Editor); European Journal of Sports Science (Reeves: Editor); British Journal of Sports Medicine (Callaghan/Selfe); Journal of Orthopaedic & Sports Physical Therapy (Callaghan); BMC Musculoskeletal Disorders (Callaghan); Journal of Science and Medicine in Sport (Callaghan); Cochrane Clinical Answers (Callahan); Physiotherapy Practice and Research (Selfe); Prosthetics and Orthotics International (Selfe); Journal of Musculoskeletal Science and Practice (McCarthy); International Review of Sport and Exercise Psychology (Wood, Holmes); Journal of

Sports Sciences (Williams); International Review of Sport and Exercise Psychology (Wood, Holmes, Jones); Journal of Mental Imagery (Holmes); International Sports Law Journal (James); Law In Sport (James); and Journal of Gerontology: Medical Sciences (Cooper).