Institution: Loughborough University

Unit of Assessment: C26 Sport and Exercise Sciences, Leisure and Tourism

a. Overview

The submission for this UoA is based on the research achievements and future research strategy of the staff of the School of Sport, Exercise and Health Sciences at Loughborough University, one of the largest, most successful (as evidenced by the Unit's position in previous research audits), multidisciplinary Schools of its kind in the UK. The Unit is an international centre of excellence that has held a leading role in all previous research assessment exercises and which led the development of the discipline with the first appointed Chair in Sport Science in the UK. Over the assessment period we are delighted to have enhanced our profile by building on our areas of traditional strength and research leadership: sport and exercise science (comprising **physiology**, **biomechanics** and **psychology**) and social sciences of sport (comprising **sociology**, **policy studies**, **physical education and pedagogy**, **coaching** and **business and management**) through an exciting period of development and expansion. This expansion has been in the areas of behavioural medicine (studying "lifestyle" and "lifecourse" interventions, such as engagement with exercise programmes), and biomedical sciences (applying the underlying biological lessons from young, elite athletes and expanding these across both the age and activity continuums). We have increased capacity through both developing existing staff and recruiting new staff into the Unit. A major component of the latter has been the merger of the Department of Human Sciences with the School of Sport and Exercise Sciences. This has facilitated a bidirectional flow of expertise, knowledge and techniques, with fundamental biological (**anthropology**, **molecular biology** and **biochemistry**) and **psychology** skillsets adding to the sport and exercise science research. The strength of this large group is that it permits an academic richness of debate that spans both the underpinning fundamental discipline and a breadth across the range of disciplines and subject areas from which sport and exercise science is derived. Research within the Unit is structured under 4 themes: *Sport Science*, *Biomedical Sciences*, *Behavioural Medicine* and *Social Sciences of Sport*, each led by a senior academic. All staff are members of one or more research groups that are embedded within the themes. The groups provide "day to day" research management and the themes provide longer-term research strategy.

b. Research strategy

The strategic objective central to the 2008 RAE submission was to increase knowledge through internationally excellent research. More specifically, our priorities were to: maintain and enhance areas of traditional strength and to facilitate the development of research in the areas of physical activity and health, Olympic studies and disability sport and to develop further overseas partnerships with leading universities, governing bodies, and industry which places us at the forefront of international activities, particularly in the field of emerging technologies, sport, social sciences, and public policy'.

This narrative and the associated REF2014 documents illustrate where the Unit has delivered against these priorities:

- Traditional areas of strength were maintained and enhanced as demonstrated by a 55% increase in research funding in these areas over the census period. Much of this increase was due to our historical reputation in sport research with income coming from a number of sport nutrition initiatives particularly the Gatorade Sport Science Institute (GSSI; £2.5m).
- Our plans to develop research in the areas of physical activity and health were achieved as shown by the successful award of a National Centre for Sport and Exercise Medicine (NCSEM) to Loughborough (£10m), the first ever award of a National Institute for Health Research (NIHR) Biomedical Research Unit (BRU) to a UoA without a medical school – The NIHR Leicester-Loughborough Diet, Lifestyle and Physical BRU (£2.3m), leadership of two projects within a successful NIHR CLAHRC (Collaborations for Leadership in Applied Health Research and Care), a European Commission (EC) 7th framework programme (FP7) grant entitled "Meta-Predict: Developing predictors of the health benefits of exercise for individuals" (£600k) and two Research Councils UK (RCUK) (Medical Research Council; MRC) grants: "A systems biology approach to studying skeletal muscle ageing" (£1m) and "An intervention to decrease sedentary behaviour in young adults at risk of type 2 diabetes mellitus" (£700k).
- The Unit identified that the 2012 London Olympic Games represented an outstanding research opportunity and responded to this by the establishment of a "Centre for Olympic Studies and

Research" which co-hosted hosted the RCUK (Economic and Social Research Council; ESRC) grant entitled "A sociology of policing and police community relations at the London Olympics" (£50k). Centre staff were partners in a Department for Culture, Media and Sport (DCMS) commissioned evaluation of London 2012 ("London 2012 Meta-evaluation") and were appointed as official advisors to various House of Lords select committees on Olympic and Paralympic Legacy.

- The Unit were instrumental in the higher visibility of the Paralympic Games through Howe's work on the cultural politics of Paralympism and the activities of the Peter Harrison Centre. Generously funded by the Peter Harrison Foundation, the Unit thoroughly prepared athletes for the Paralympic Games in London 2012 and was a major player in the International Network for the Advancement of Paralympic Sports through Science (INAPSS).
- The Unit targeted developments in emerging technologies and did so by attracting RCUK (National Centre for the Replacement, Refinement and Reduction of Animals in Research; NC3Rs) funding for two linked projects – "Engineering fully functional, integrated skeletal muscle" and "CRANNME: The complete removal of animal use for neuromuscular effectors testing" (£500k).
- Building on these initiatives and furthering overseas partnerships with leading universities, the Unit established a significant relationship with Nanyang Technological University (NTU) in Singapore to develop the Institute for Sports Research (ISR; £1.5m).
- Our strategic aim to be at the forefront of international activities in the social sciences and public policy was furthered via a number of collaborative research projects including – Garcia Garcia and Football Research in an Enlarged Europe (FREE) project funded by the EC (eight universities - Stuttgart, Copenhagen, Vienna, Valencia, Poznan, UFC Besançon, ESSCA Angers and METU Ankara), Houlihan and the EC-funded 'Good governance in international sport organisations' project (Cologne, Lausanne, Leuven, Utrecht), Houlihan and Youth Olympic Games project with Ottawa University and Norwegian School of Sport Sciences (£325k in total).

There is no doubt that the presence of various sporting bodies in the same "work space" as the Unit has contributed to the richness of the research environment. Loughborough University hosts, amongst others, the English Institute of Sport (EIS), the National Gymnastics Performance and Research Centre, the Youth Sport Trust (YST), the England and Wales Cricket Board (ECB) National Cricket Performance Centre, the Amateur Swimming Association and the English Federation of Disability Sport and was also selected, by the British Olympic Association, as the host for Team GB prior to the London 2012 Olympic Games. Our research work with governing bodies of sport (Football Association (FA), ECB, National Gymnastics) has been augmented with the development of a relationship with EIS which has moved from an informal collaboration of colleagues to more formal funding of a cohort of PhD students who are jointly supervised by EIS sport scientists and our academic colleagues. These studentships illustrate the philosophy of the School, which is to ensure the very best fundamental and mechanistic science combined with application to real world challenges.

Since 2008 the Unit has regularly reviewed its strategic research objectives and has confirmed our central strategic objective for the period 2014-19 as being to 'increase knowledge through internationally excellent research'. In addition to 'maintaining and enhancing areas of traditional strength' an associated priority is to ensure that research within the Unit is 'addressing contemporary and emerging challenges'. Historically, the Unit has demonstrated an ability to be nimble and respond to opportunities in a changing landscape and will continue to be reactive to opportunities as they arise. However, in addition, the Unit has set itself strategic priorities for the next period. These are: (i) sport performance, (ii) injury and rehabilitation, (iii) determinants and prevention of chronic diseases of lifestyle and (iv) sport policy and management. The Unit has already made progress with two major projects spanning three of these areas: the establishment of the National Centre for Sport and Exercise Medicine – East Midlands (NCSEM-EM) and the development of a Sport Management Institute (SMI) at the Queen Elizabeth Olympic Park.

The NCSEM project is a £30m London 2012 Olympic Games legacy commitment from the Department of Health (DoH). The investment is in capital projects at three sites, London, Sheffield

and Loughborough with the aim to create new knowledge in sport and exercise science and apply both this and existing knowledge to sport and exercise medicine. The NCSEM comprises work-streams in the areas of prevention, exercise is medicine, musculoskeletal and sport injuries, mental health and wellbeing and performance health. The £16m building (£10m from the DoH and £6m from the University) on the Loughborough campus will be completed in late 2014 with occupancy in January 2015 however research opportunities are already being realised throughout the Unit. The initiation stage of the NCSEM is to be under-pinned by a Catalyst award of £7m from HEFCE that will enable key appointments in rehabilitative medicine to be made and capability and expertise in Magnetic Resonance Imaging (MRI) spectroscopy and functional MRI to be developed. The Unit is also forging new links with Headley Court (Ministry of Defence military rehabilitation centre) and these posts will help drive that initiative. Other areas that will benefit from the Catalyst award will be regenerative medicine, digital healthcare technologies and a series of new PhD posts for clinicians. In addition, the funding will not only provide a forum for the development of the "active office" but will also allow technological capabilities to be incorporated into the building that will significantly enhance our work in sensor development and integrating sensors.

During 2013, Loughborough University has, as part of its plans to expand its existing academic provision and enable further world-leading research and innovation activities, made an initial capital investment of £5.3m in the establishment of Loughborough University in London, a campus based at iCITY on the Queen Elizabeth Olympic Park with a further £9m commitment for investment in staff and set up costs before the operations commence. The Sport Management Institute (SMI) is a significant component of this new activity that will extend the scope of research in sport management and policy. The Unit has appointed a senior academic Professor James Skinner, HoD of Tourism, Sport and Hotel Management, Griffiths University (to take up appointment in 2014) to lead the SMI whose membership will incorporate, in addition to members of this UoA, academics from business and management studies (UoA C19) as well as a series of new appointments. The dual location of Unit activity in management in Loughborough and London will enable new national and international research links to be developed (especially with the commercial sector) and existing links strengthened (with government and sport organisations)..

The remainder of this section provides a more detailed account of research activity within the Unit since 2008, developments within the Unit designed to anticipate emerging research challenges and the Unit's strategy for the coming period to 2019. The account is organised by research theme and by UoA descriptor. Because staff are encouraged to work across themes some staff names and descriptors will appear in more than one theme.

Sport Science

Key strategic achievements since 2008 in this theme (incorporating **adapted physical activity**, **anthropology**, **biochemistry**, **biomechanics, engineering and technology**, **molecular biology, motor learning and control**, **nutrition** and **physiology**) have been the sustained excellence of the Peter Harrison Centre and the developing relationship with PepsiCo through the Gatorade Sport Science Institute (GSSI). Objectives up to 2019 include realising the full potential of the NTU ISR project and continuing to work with key organisations as they develop their sport science strategies around future events e.g. 2015 Rugby World Cup in England, 2016 Rio Olympic and Paralympic Games and the FIFA World Cups 2014 in Brazil and 2018 in Russia. New and developing initiatives are around the integration of our sport science work with sport medicine in the area of sport injuries and the development of a major initiative in rehabilitation science.

During the assessment period, our work in **adapted physical activity** (Bishop, Howe, Smith, Tolfrey V) has been driven through the Peter Harrison Centre for Disability Sport (PHC). The outputs have focussed on developments that advance knowledge on psychosocial health, wellbeing, physical activity and sports performance. The activities span both the psycho-social investigation of disability, health, and wellbeing combined with knowing physiologically how and why people recover from physical activity, illustrating the Unit's flexibility to cross traditional boundaries to meet the challenges demanded by enabling and enhancing the performance of disabled athletes or the wellbeing of disabled people. The Unit's work thoroughly prepared athletes for the Paralympic Games in London 2012 and identified how the health of people who have

become disabled through sport is hindered or facilitated which has been supported by a £300k project funded by the Coca-Cola Foundation building on the legacy of the Games. Researchers in the Unit are actively collaborating with international research projects in Europe, South Africa and Canada. The Centre has generated external funding of £1m from numerous sources including UK Sport, Healthcare and Bioscience iNet, the British Paralympic Association, the Great Britain Wheelchair Basketball Association, YST, ASPIRE and the UK Spinal Cord Injury Research. Funding, of £200,000 pa on a five year rolling basis, from the Peter Harrison Foundation will ensure the further consolidation of research in adapted physical activity.

Research in **biomechanics** and **motor learning and control** (Allen, Hiley, King, Pain, Yeadon) uses a unique combination of computer simulation, facilitated by Loughborough University's new High Performance Computing facility, and experiments using the latest equipment for motion analysis, muscle function measurement, and virtual reality environments, to investigate the mechanics and motor control of sports technique. This research has provided insights into optimum technique in triple jumping, the limits of performance in freestyle aerial skiing, and learning to view during simulated gymnastics skills in a virtual environment. Complementary research on the fundamentals of muscle function and soft tissue mechanics has led to an understanding of injury risk in gymnastics, tennis, cricket and martial arts. This research has been supported by £400k in grants and studentships (with much of this support coming from National Gymnastics and the ECB). Future developments will include research into aspects of motor learning in skilled performance that will have applications beyond sport performance e.g. prevention of sport injury and rehabilitation.

Our strategy in the area of **psychology** (Arcelus, Bandelow, Fletcher, Harwood, Hogervorst, Jowett, Meyer, Morgan, Plateau, Reyner, Spray, Taylor) in sport and performance has been focussed on enhancing an understanding of social-psychological and organisational factors that influence key stakeholders in sport (e.g. youth and elite athletes, coaches, managers, parents, teachers and school children). Specifically, the Unit has extended its scholarly work in coach-athlete relationships to examine the role of attachment theory and transformational leadership; has investigated youth sport environments by examining parental stress in sport, and empowering coaches to integrate psychosocial skills in their practice; has targeted elite sport populations and systematically provided insights into organisational and competition stress, eating psychopathology, psychological resilience and performance leadership and management. Research in the Unit has also advanced the motivational literature in youth sport by taking longitudinal approaches. Recent progression of the Unit into biological and cognitive psychology has added investigations into cognition in sport and exercise and the effects of perturbations in sleep patterns on performance. Since 2008, research income of £2.9m has been generated from a variety of sources such as the British Academy, EIS, FA, International Tennis Federation, Lane 4 Management Group, Lawn Tennis Association, Nottingham Forest FC and the Nuffield Foundation. Future strategic intentions include consolidating research on the impact on performance of sleep and eating patterns and developing a stronger focus on expertise in sport parenting.

The response of the human body to exercise and how those adaptations can be measured, influenced and maximised have formed a significant strand of Unit activity in **physiology** (Barrett, Brooke-Wavell, Edwards, Ferguson, Folland, Lewis, Lindley, Macdonald, Mastana, Nevill, Tolfrey K) over the past 5 years. We have continued to study human skeletal muscle function with novel findings about how explosive force production influences athletic performance and response to training and how it constitutes an injury risk factor. We are conducting investigations into temperature changes and the role of the blood supply (important in both heat exchange and nutrient flow) to and from the muscle and how this might be manipulated to gain a performance edge and enhance responses to exercise. Although the work of the Unit concentrates on the major muscle groups of the leg and arm, we have also extended investigations into other relevant muscle groups such as the inspiratory muscles. In addition, work in the Unit recognises the importance of the structures ancillary to skeletal muscle, especially bone: we have elucidated the "exercise prescription" for maximising bone strength in young and older adults and factors related to stress fracture in female endurance athletes. The Unit's focus on growth and development (**anthropology;** Bogin, Varela-Silva, Rousham) is now underpinning our work with children and for

the future the Unit will further develop physiological aspects of the holistic talent identification and development process by continuing to work in multi-disciplinary groups involving physiologists, psychologists, sociologists, practitioners and sports medicine staff.

There has been a dramatic increase in the application of **molecular biology** in this area in this Unit (being a major component of more than ten projects in 2012/2013 from zero projects in 2008/2009) especially when considering relationships between genotype and skeletal muscle adaptability and such techniques are now being used in the Unit in a number of "whole human" (children, adults, elderly) studies. To complement this, the Unit has also invested in emerging technologies around **engineering and technology**. This work has centred around the creation of "pre-clinical models of exercise"; using cell culture systems combined with tissue engineering principles and techniques to "grow muscles in the lab". We have been working on models of skeletal muscle that can be stimulated in a way analogous to that seen in exercise but also to further develop those models to be more biomimetic. External funding for this physiology-related research has come from the DoH, NIHR, RCUK through the Engineering and Physical Sciences Research Council (EPSRC) and the NC3Rs, Wellcome Trust, Child Growth Foundation, National Osteoporosis Society, EIS, FA, The Cricket Foundation, British Heart Foundation (BHF), YST, PepsiCo, Coca Cola and GlaxoSmithKline to the value of £2.5m.

Sustainability in the areas of **biomechanics**, **physiology**, and **engineering and technology** is supported by a five-year engagement with the Nanyang Technological University (a top 100 University in the 2013 QS rankings) in Singapore (launched in 2011). This initiative is funded by a partnership award from the Singapore Economic Development Board of £1.5m, under the Innovation Development Scheme. The resulting Institute for Sports Research supports the joint supervision of 40 PhD students and is already reaping rewards in areas such as development of a robotic athlete's foot and tissue scaffolding for enhanced recovery from injury. In addition, this work of the Unit is also part of a multi-university consortium that successfully bid for the Arthritis Research UK Centre of Excellence in Sport, Exercise and Osteoarthritis and which was launched in June 2013.

The unit's research in **nutrition** and **biochemistry** has a long and distinguished history and despite retirements of prominent figures (Maughan, Williams) we have made strong replacements that have enhanced and invigorated a new team (Arcelus, Gleeson, Hulston, James, Meyer, Phillips, Wadley, Watson). We continue to investigate the effectiveness of novel diet and exercise interventions in modulating performance, altering immune status and driving adaptation to training in athletes. The Unit's recent partnership with PepsiCo (GSSI) has provided funding (£2.5m) to support sustainable research, independent of the GSSI business, in sports nutrition and its relationship to performance. This funding supports a number of academic posts and through a rigorous process of internal assessment has funded 7 projects with relevant consumables and research assistant (RA) support. The partnership also gives us access to the full bioscience laboratories of PepsiCo and their nutrigenomic expertise. Additional funders for this work include World Anti-Doping Agency (WADA), Society for Endocrinology, European Hydration Institute, Volac, PepsiCo, Coca Cola, and GlaxoSmithKline, contributing £1.4m.

Biomedical Sciences and ***Behavioural Medicine*** *(N.B. Because of the significant and vital interactions between these two Themes, the narrative will discuss them in combination*)
Since 2008, key strategic achievements within these themes (which incorporates **nutrition, physical activity and health** and **molecular biology**) include our fruitful collaborations with health services both in the UK and overseas (e.g., NHS, Australia and the United States). Alongside these organisations, we have prioritised our effort to achieve joint success in attracting NIHR funding (especially the BRU) and numerous other collaborative bids, including Research for Patient Benefit, CLAHRC, EC FP7 and Health Education Innovation Council. Objectives for this theme up to 2019 involve realising the full potential and impact of the BRU in guiding the prevention and treatment of chronic diseases of lifestyle. The BRU supports capacity building and is central to our objective to develop the next generation of sport and exercise scientists who can work with patient groups. A further key objective is to maximise our recent and developing expertise in novel digital monitoring / therapeutic technologies and informatics which we will continue to expand with the aim

of advancing the fields of applied nutrition, psychological and physical wellbeing.

In relation to **nutrition**, the Unit has extended both its fundamental and applied research to the development of restrictive and other pathological eating behaviours across a range of sports (including a variety of different athletes; Arcelus, Haycraft, Jowett, Meyer, Wallis). Our partnerships with health services in the UK and overseas and the growth in our capacity in the field of clinical eating disorders and child and adult eating behaviours has led to increased work in the development of novel assessment and treatment approaches for both athletes and those who compulsively exercise. A new focus on child growth and obesity (including maternal and child nutrition) is now underpinning our work in various aspects of nutrition. The studies extend into investigations on obese and patient groups primarily through our collaboration with University Hospitals Leicester NHS Trust and the award of the Leicester-Loughborough NIHR BRU in Diet, Lifestyle and Physical Activity (£2.3m). This BRU draws on the interplay between exercise and appetite, and exercise and prevention and treatment of chronic disease (Stensel, Nimmo, Bishop). It also interacts with our **physical activity and health** agenda (Biddle, Cameron, Clemes, Esliger, Griffiths, Haslam, Munir, Sherar, Stevinson, Timmons). Alongside our NHS partners, our BRU is also part of a larger BRU/Centre network with Southampton and Bristol.

The Unit's focus on exercise regimens extends from work on sedentary behaviours to studies on moderate to high intensity exercise and groups investigated include obese "at risk" populations to those suffering from Type 2 diabetes and renal disease. The Unit contributes to the "Born in Bradford" birth cohort study that has quantified the increased risk of infant obesity and led to the development of an iPhone App to predict this risk. The Unit's development of emerging technologies to monitor physical activity means that we are making significant advances in the field of digital monitoring. The expertise that has now been built around informatics significantly extends the capability of the whole Unit and is a major outcome of the BRU. Additional projects have been levered against this BRU funding including the impact of physical activity and sedentary behaviour on psychological and physical well-being. The Unit's staff have also been involved in a successful NIHR CLAHRC bid where the tools will be assessed in the clinical setting and a successful MRC bid to investigate sedentary behaviour in older adults and a British Academy Mid-Career Fellowship in predictors of adolescent health outcomes. A substantial addition to our research trying to understand the mechanisms behind health outcomes derived from high intensity exercise was the introduction to the Unit of an in-depth genomics and informatics (**molecular biology**) network through an extensive EC FP7 grant (£600k). The aims of this project are to "identify the biological networks which influence health so stimulating biotechnology efforts; identify the biological networks which connect lifestyle stimulating biotechnology efforts; provide proof of principal for personalised healthcare and so help evolve modern medicine; produce products which reduce the risk of chronic disease so improving health and quality of life". The EC has endorsed this work as their best "cutting edge" research in the Diabetes sector. The total research income in these areas over the census period has been £5.3m.

Social Sciences of Sport

The success of the 2008 research strategy within the social sciences (**business and management, coaching, economics, physical education and pedagogy, policy studies, sociology**) is reflected in sustained high quality published output, organisational developments, success in generating external income and in the development of an extensive network of research-focused international links. Key strategic achievements since 2008 include: the consolidation of research around the Olympic and Paralympic Games and the governance of sport organisations and the generation of £1.5m in external income. The key strategic objectives to 2019 include the development of research capacity in relation to the study of mega-events, the management of sport organisations and the analysis of sport policy. Among the new initiatives in the theme is the establishment of the Sport Management Institute that will be a focus for the development of research across the Loughborough in London and existing Loughborough campuses and enhance capacity through new appointments (including a new Professor of Sport Management, James Skinner, from July 2014). This initiative will foster stronger links with researchers in UoA C19. International research links have been facilitated through the Centre for Olympic Studies and Research that hosted the first International Colloquium of Olympic Studies

and Research Centres in July 2012. Other examples of international collaboration include research on governance in international sport organisations that involved partners from six countries and research on the Youth Olympic Games that involved collaboration with the University of Ottawa and the Norwegian School of Sport Sciences.

Sociological research (Bairner, Giulianotti, Howe, Malcolm, Maguire) has been strengthened by recent staff appointments and centres on the analysis of the media representation of major/mega sports events, particularly the Olympic and Paralympic Games. Focus is on the significance of these events for identity and culture, branding, elite athlete injury and the management of recovery, the problems of ensuring security and police-community relations and the representation and experience of Paralympic athletes. Work in these areas has involved substantial theoretical and methodological innovation. In addition to maintaining these research foci, the Unit is in the process of expanding its sociological research into the area of sport for development and peace (SDP). The Unit will investigate how the SPD sector is constructed through the interrelationships between different stakeholders at local, national and international levels and how SDP projects are developed, implemented and experienced by user groups in different contexts. This research is funded by a grant of £300k from the ESRC. Sociological research within the Unit has been enhanced through the extension of its network of research links (particularly in South East Asia) for example in hosting a cohort of doctoral students from Waseda University, Japan and National Taiwan Normal University. The Unit is also hosting a Marie Curie scholar studying football fandom, reflexivity and social change, supported by the EC. Other sociological research has been funded (across the census period) to the value of £100k by the Welcome Trust, DoH, Portuguese government, EC, Nuffield Foundation and the PHF.

Research in **coaching** and **physical education and pedagogy** (Bradbury, Cale, Cushion, Evans, Harris, Sandford, Spray) is concentrated on school health education, coach development and teaching methodology and critical health studies. Unit work in the area of critical health studies has been instrumental in advancing foundational and applied policy and practice knowledge of the relationships between health/obesity discourse and the wellbeing of young people. On-going research on the health/obesity discourse was initiated through an international collaboration with partner institutions in New Zealand and Australia. Research in coaching has concentrated on analyses of professionalization of coaching through the application of Bourdieusian theory. Priorities for the period 2014-19 include strengthening existing areas of research excellence in pedagogy and critical health studies and developing research in the area of equity. Total research funding in this area in the census period was £700k.

The Unit has extended its research activity in the subject areas of **policy studies** and **business and management** (Amara, Bodet, Downward, Garcia Garcia, Henry, Houlihan, Piggin) particularly in relation to sport governance, fan loyalty and football within the context of an enlarged European Union. Research on governance included participation in an EC-funded seven-nation project to develop an analytical instrument to assess the extent to which international sport organisations conform to contemporary standards of good governance. The instrument, the Sport Governance Observer published in 2013, is now being used by a number of sport organisations to assess their governance profile. Research in relation to the significance of the European governmental institutions for sport policy and management, especially the European Union and the Council of Europe, has a long history in the Unit and has covered, *inter alia*, issues of equity, doping and elite athlete career management. A more recent focus that illustrates the scope of research in policy and management is the FREE (Football Research in an Enlarged Europe) project that involves eight countries and is funded by the EC FP7 £325k). The FREE team, which includes expertise in **anthropology, history, politics** and **sociology**, will provide an analysis of changing perceptions of European approaches to football governance as a legitimacy-enhancing project and produce strategic recommendations for policy-makers and other stakeholders in this field. The Unit's strategic priority for research in the social sciences will focus on mega-events, development of and through sport, identity, governance and integrity. Total research funding in this area was £700k.

Research related to the Olympic and Paralympic Games exemplify the multi-disciplinary approach to research within the theme. With a particular emphasis on policy evaluation the Unit (Downward,

Henry) has been part of the team, in conjunction with consultants Grant Thornton, tasked by the Department of Culture, Media and Sport with developing and implementing a methodology to assess the legacy of the London 2012 Olympic and Paralympic Games (London 2012 Meta Evaluation). The Unit has also provided formal advice (Henry) to the 2013 House of Lords Committee on Olympic and Paralympic Legacy. Innovative evaluation research, informed by policy analysis and economic analysis (Bradbury, Downward, Garcia Garcia, Houlihan, Sandford) has also been focused on young people's participation in sport, analysis of adult participation and anti-doping education initiatives. Discipline-based and multi-disciplinary research associated with mega-events and policy evaluation (Giulianotti, Howe, Houlihan, Henry, Downward) has been funded by RCUK through the ESRC, the International Olympic Committee, EC, WADA and the United Nations Educational Scientific and Cultural Organization.

c. People

The Unit recognises that the critical aggregation of leading researchers in a world-class research environment is a prerequisite for the effective delivery of high-impact collaborative research. The Unit's staffing strategy focuses on the recruitment of staff with international reputations and/or exceptional research promise, and in creating pathways for staff to grow and develop in ways that help deliver our vision and objectives. We carefully align capital investment in our facilities and environment in such a way as to provide our staff with an excellent research infrastructure. Since 2008, the total number of staff returned has increased due to transfers into the Unit, recruitment of replacements and additional investment. This has allowed us to reinvigorate the Unit's expertise in ways that align better with our priority research themes. During the reporting period, seventeen staff have left the Unit - three have retired (Horne, Maughan and Williams, all of whom remain Professor Emeritus) and two sadly passed away (Green and Webb). The remainder took up senior positions in other institutions. During the same period, 23 new staff appointments have been made to strengthen research capacity and capabilities: six professors (Arcelus, Giulianotti, Lewis, MacDonald, Phillips, Timmons), two senior lecturers (Esliger and Smith) and fifteen lecturers (Allen, Bradbury, Edwards, Garcia Garcia, Hiley, Hulston, James, Piggin, Plateau, Sandford, Sherar, Stevinson, Taylor, Wadley, Watson). Arcelus, Hulston, James, Phillips, Wadley and Watson have been recruited into **nutrition** and **biochemistry** where retirements and departures have required the building of a new team. This group has been augmented by the transfer of Haycraft, Meyer and Wallis from RAE2008 UoA 6 (Epidemiology and Public Health) into the reporting Unit along with Bogin, Cameron, Griffiths, Rousham and Varela-Silva who add skills in **anthropology** that are under-pinning our work with children and the elderly in a number of areas especially **physical activity and health** (Haslam and Munir). In addition, this growth area has also seen four new recruits in Esliger, Sherar, Stevinson and Timmons (who also adds capacity in **molecular biology** and **physiology**) as well as the transfer of Clemes. **Policy studies** and **sociology** has also seen three additional academics (Garcia Garcia, Giulianotti, Piggin). New developments in **engineering and technology** has seen Lewis recruited (who also adds capacity in **molecular biology** and **physiology**) whilst already established areas have also been invested in, namely **adapted physical activity** (Smith), **biomechanics** (Allen, Hiley), **physical education and pedagogy** (Bradbury, Sandford), **physiology** (Edwards, MacDonald) and **psychology** (Plateau, Taylor). The transfers of Brooke-Wavell and Lindley into **physiology**, Mastana into **molecular biology** and Bandelow, Hogervorst, Morgan and Reyner into **psychology** complete the picture.

In addition to our body of academic staff, we seek to augment our expertise through our cohort of 20 visiting professors and fellows who provide academic expertise in our focus areas, e.g. Professor Clyde Williams, the first chair of Sports Science in the UK and former Chair of the REF panel; Professor Asker Jeukendrup who provides us with expertise in Sports Nutrition and links with GSSI, one of our key Industrial Partners, and Professor Kathleen Martin Ginis who provides expertise in physical activity participation among people with spinal injury. The Unit spends over £100k per annum on core funded RAs to pump prime strategic areas of research, currently two RAs are employed in the Unit on this basis to support Physiology and Physical Activity and Health. The Unit also funds a 0.2 FTE Computer Systems Developer who contributes to biomechanics research (Knight). We now have a well stratified staff complement which represents those at all stages of development. The mean age of staff returned is 44, and with only 7 retirements likely over the next five years and 11 staff currently Readers, with aspirations to become Chairs, this

provides us with an excellent platform for delivering our strategic objectives.

Staff are provided with opportunities to access funded research studentships, along with access to capital funds for laboratory equipment and/or software and hardware. The Unit allocates funds to investigators to assist their research development and to support the preparation of future bids. The Unit has also allocated almost £1m since 2008 for Academic support; this provides staff with a personal budget and additional funds to support PhD students along with access to funds to support travel, conferences and networking. We have robust policies for supporting the development of all staff, and a specific staff development system for probationary staff to ensure their on-going contribution to our priority research themes and development areas. A structured probationary system restricts probationers' teaching and administration duties for three years during which they are advised by a probationary supervisor who helps them develop their research activity. Research performance is a key priority, and all academic staff complete an annual Personal Research Plan (PRP) which facilitates discussions around areas for development for individuals and across the Unit. This process informs discussion on research in performance monitoring and reward systems. The Institute of Leadership and Management accredit a structured staff development programme, available to all Unit staff. Investigators are also provided bespoke one-to-one support for staff writing grant proposals, which further enhances the research culture. In 2011/12 the Unit provided a programme for developing mid-career academics with exceptional research (LEADer), which included a range of development initiatives and special projects aimed at supporting participants towards achieving chairs (Folland was selected and made a study of research into performance related themes). In 2013, the Unit was awarded £100k from EPSRC funds that were spent on early career researchers to purchase small items of equipment, which has helped enhance their careers by broadening their research capacity. Perhaps the best demonstration of the effectiveness of our staff development approach, and our policy of promoting and retaining those demonstrating a sustained record of research excellence, is the success of 26 of the 48 eligible staff being promoted over the REF period: Six staff were transferred from Research only staff to Research and Teaching staff – Allen (**biomechanics**), Bradbury (**physical education and pedagogy**), Garcia Garcia (**policy studies**), Hiley (**biomechanics**), Sandford (**physical education and pedagogy**) and Watson (**nutrition**). Seven staff were promoted to Senior Lecturer – Bandelow (**psychology**), Bodet (**business and management**), Brooke Wavell (**physiology**), Clemes and Munir (**physical activity and health**), Fletcher (**psychology**) and Howe (**adapted physical activity** and **sociology**). Eleven staff were promoted to Reader – Downward (**economics**), Folland (**physiology**), Griffiths (**physical activity and health**), Harwood (**psychology**), Jowett (**psychology**), King (**biomechanics**), Pain (**biomechanics**), Smith (**adapted physical activity**) Stensel (**physiology**), Tolfrey K (**physiology**), and Tolfrey V (**adapted physical activity**). Bogin (**anthropology**) and Meyer (**nutrition**) was promoted to Chair; all Reader and Chair promotion applications are made via a process in which external peer review is vital. Overall in the assessment period, the Unit has seen 26 promotions, 20 recruitments, 17 departures and 20 transfers in. The annualised average staff turnover in this period is therefore around 5%, a figure that clearly demonstrates that the environment encourages retention.

Along with other Units at Loughborough University, we undertook a comprehensive analysis of our alignment with the Concordat to support the Career Development of Researchers in 2009/10, and published an implementation plan in 2010, for which the EC's HR Excellence in Research Award was received. The plan (updated in 2012) includes a continuing commitment to a Research Staff mentoring scheme, a revised Code of Practice for the Employment of Researchers, and establishment of a Research Staff Association (chaired by two research associates from the Unit). The Unit aims to achieve equality for all and have made training in equitable recruitment and selection processes mandatory. We are committed to Athena SWAN, and are currently a Silver award holder (the only academic entity that works in this area in the UK with this award); the Unit is scheduled to apply for its Gold award in April 2014. In support of this, we are currently engaged in an EU FP7-funded action research programme that aims to implement good practice initiatives in providing equal opportunities for its female staff. The Unit sees high standards of integrity and ethics as the foundation of its research ethos and all research is subject to stringent ethics procedures and approvals. The Unit has a robust ethical approval process and a Research Misconduct and Whistle-Blowing Policy and Procedure ensuring research integrity is maintained.

The Unit has developed effective support, training and supervision structures for PGR students and the attractiveness of this environment is attested to by the numbers enrolled (**Table One**):

	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013
FTE	120.45	110	88.77	90.55	106.71

Table One: FTE of postgraduate research students enrolled on doctoral programmes in the Unit over the assessment period.

As part of these numbers, the Unit fully supports 30 PGR studentships per year (10 new per annum) including stipend, fees, project costs, travel costs and sundries (e.g. computer). Irrespective of the core external source of funding, all of our PGR students are financially supported through the provision of fee waivers, additional project costs (over those provided by the external funder), travel costs and sundries; this amounts to just under £1m of Unit support per annum. The Unit is also eligible to bid into a central pool of PhD studentships that are allocated strategically across UoAs, often for multi- and inter-disciplinary projects. Our internal doctoral training centre and the broader institutional support available from the Loughborough University Graduate School provide an engaging and supportive environment for our students. The Graduate School is responsible for the delivery of transferable skills and employability training to meet the requirements of the Researcher Development Framework, comprising face-to-face workshops, an annual research conference including poster competition and the 'Café Academique' - a forum where PhD students can debate the latest ideas from all areas of research. Each student has a supervisory team normally consisting of a minimum of two supervisors. Progress is monitored through regular supervisory meetings and a major academic progress review is held at the end of each year of registration. The Unit provides opportunities for all students to present their work to academic staff at research group or theme meetings in addition to an annual research student conference. Across Units, there are ample opportunities for dissemination and interaction – this is achieved via the cross-Unit Research Schools (e.g. Research School of Health and Life Sciences). The Unit's systems are reviewed centrally by the Dean of the Graduate School who leads a cycle of regular research degree programme reviews as part of our quality assurance mechanisms.

d. Income, infrastructure and facilities

The Unit's strategy for generating grant income in the assessment period was founded upon the recruitment of, and investment in, the highest performing staff within the fields that we work in, coupled to our sustained encouragement of collaborative and interdisciplinary working. By mobilising interdisciplinary teams around particular funding calls, we have developed significant capacity that enables us to align with major funding programmes. Invariably these also demand inputs from colleagues in other Units/disciplines, and Loughborough University has a structured set of mechanisms for facilitating this collaboration including cross-cutting research schools that help manage such calls for research funding. At a Unit level we have a full-time Research Administrator who oversees and supports all funding applications through to submission, an Operations Manager who manages the School's resources including technical and administrative staff, an Operational Support Officer who provides management information which is used for bids and reporting and a team of 11 core funded technicians. The Unit's researchers contribute to shaping research bids through meetings, annual away days and strategic research reviews. We have therefore built upon our success in RAE2008 to further grow our grant income over the REF period. Total spend is in excess of £15m including funding from research councils (£2.5m), UK charities (£5.4m), industry (UK, EU and non-EU; £2m), UK and EU governmental bodies (£1.7m) and other funding agencies (£3.4m). The pattern of funding has also changed over the assessment period, with a move to both increase total research income and to target that won in open competition. This has been extremely successful as evidenced by: (i) the Unit's Research Council UK funding growing from £250k in 2008/2009 to £1.13m in 2012/2013 (ii) the proportion of the Unit's total funding from UK charities won in an open competitive process has risen consistently through the period from 0% to over 50% in 2012/2013, (iii) a sustained increase in research income over the period from UK government and industry, (iv) a rise in income from a variety of EU-sources including significant FP7 funding – these monies being won in open competition and (v) a dramatic increase in funding from non-EU sources over the assessment period – much of this increase based around our reputation in sport research (e.g. the ISR initiative with NTU and the GSSI initiative with PepsiCo).

The Unit has invested heavily over the assessment period in its infrastructure, both in terms of

creating new space and improving existing research facilities. During this period, the Unit has consolidated its activity from over 15 buildings to 7, a move that has enabled more research staff to be co-located with other staff sharing similar research interests. The Unit has increased the space available to accommodate the growing numbers of PhD students and Research Associates during this period reflecting the Unit's strategy to increase research activity. All academic staff are provided with their own office and the necessary equipment to undertake their role. The Unit has almost 3000 m^2 of laboratory space that includes space to conduct research into behaviours, physiology, nutrition, biomedical science, biomechanics and body composition. The Unit has spent almost £2m on equipment for these laboratories over the period. This has allowed the Unit to invest in new facilities to enable an expansion into cellular and molecular research (£800k), a CAREN system to further research into balance (£300k), £200k on cameras and force plate to enable research into gait and £600k to further physiological research through the purchase of climate chambers, treadmills and adapted exercise equipment. Staff are also encouraged and supported in including necessary equipment in research bids and core funds are made available for 'match funding' where appropriate.

In August 2008, HRH The Princess Royal opened the Health and Biological Sciences (HEBS) building, formally named the Clyde Williams Building. This £12m investment in a new facility to provide additional high quality biosciences and physiology research laboratories. As introduced earlier in section (b), the £16m NCSEM building will open in 2014 and will provide excellent research facilities, including a research kitchen and observable eating areas, a special populations laboratory that will enable disabled people to exercise under test conditions, clinical diagnostic facilities (including access to a MRI capable of functional and spectroscopic analysis, ultrasound and an imaging lab) and additional laboratories. The research in this building will be conducted alongside clinical activity with the aim of accelerating the translation time between research developments and clinical practice and to increase the involvement of patients in research.

e. Collaboration or contribution to the discipline or research base

The individual and collective international reputations and esteem held by our Unit staff is evidenced by the numbers and diversity of honours, awards, industry collaborations, prizes, nominations, editorial board memberships, and international speaking invitations they have received totalling 171 keynote addresses and 424 invited presentations. Significant Visiting Professorship appointments held by key staff from the Unit include: Bairner (**sociology**) – National Taiwan Normal University, Taiwan (2012); Biddle (**physical activity and health**) – NTU, Singapore (2012); Cameron (**anthropology** and **physical activity and health**) - Princeton University, USA (2008 to 2010); Downward (**economics**) – German Sport University Cologne, Germany (2013); Evans (**physical education and pedagogy**) – University of Queensland, Australia (2006 to present); Giulianotti (**sociology**) – Telemark University College, Norway (2013); Gleeson (**biochemistry, nutrition** and **physiology**) - University of Birmingham, UK (2003 to present); Henry (**policy studies**) – Hitosubashi University, Japan (2008); Houlihan (**policy studies**) – Norwegian School of Sport Sciences, Norway (2011 to present); Howe (**adapted physical activity**, **anthropology** and **sociology**) - University of Stellenbosch, South Africa (2011); Meyer (**nutrition**) – Leicester Partnership NHS Trust, UK (2012 to present) *and* University of Sydney, Australia (2009 – 2010) *and* Kings College London, UK (2009-2010); King (**biomechanics**) – University of Vienna, Austria (2012); Lewis (**engineering and technology**, **molecular biology** and **physiology**) – University College London, UK (2009 to present); Maguire (**sociology**) – University of Western Cape, South Africa (2013); Nimmo (**physical activity and health** and **physiology**) – NTU, Singapore (2011 to present); Stensel (**nutrition**) – Waseda University, Japan (2011); Timmons (**molecular biology**, **physical activity and health** and **physiology**) – University of Stockholm, Sweden (2007 to 2011).

As stressed above in section (b), interdisciplinarity is strongly supported and facilitated within the Unit at both the thematic and research group levels. The following is a list of additional examples: **Biomechanics, engineering and technology, motor learning and control** and **physiology** with UoA B12 (Aeronautical, Mechanical, Chemical and Manufacturing Engineering), **business and management**, **economics**, **sport policy** with UoA C19 (Business and Management Studies), UoA D27 (Area Studies) and UoA C22 (Social Work and Social Policy), **physical activity and health** and **engineering and technology** with UoA B13 (Electrical and Electronic Engineering, Metallurgy

and Materials) and **biochemistry**, **molecular biology**, **nutrition**, **physical activity and health** and **physiology** with UoA B8 (Chemistry).

Unit staff are active advisors to national and international committees and professional institutions. For example, *Biddle* is an advisor to the Greater London Authority strategy to combat childhood obesity and a Strategic Research Programs (SRP) review panel member of the Research Council of the Vrije Universiteit Brussel (VUB); *Cale* was invited chair and member of the Department for Education's National Curriculum Physical Education Expert Group, the remit of which was to advise and provide guidance for teacher training providers, trainees, teachers and schools on the implementation of the new National Curriculum; *Downward* was a member of UK Sport Research Advisory Group (2008-13); *Ferguson* was a member of the UK Physical Activity Guidelines Editorial Group (PAGEG); *Fletcher* was a member of the UK Sport Performance Lifestyle Steering and Advisory Group (2010-12); G*arcia Garcia* is a member of the EC's expert group on 'Sports policy on physical activity and sport'; *Giulianotti* is a member of the Scientific Advisory Board in the Swiss Academy for Development, Switzerland; *Gleeson* is a member of the ECSS/ACSM Task Force on the Overtraining Syndrome (2010-13); *Harris* was specialist advisor to the House of Commons Education Select Committee on 'School sport following London 2012' (2013); *Harwood* is a senior member of the FA Psychology Advisory Board; *Henry* was external Member/Research Adviser for the UK Sport/EIS Steering Group Assessing the Impact of the Performance Lifestyle Programme (2011-12); *Houlihan* was a member of the Board of Trustees, ISPAL, 2008-2011 and chair, UK Sport Anti-Doping Research Steering Group, 2007-2010; *Maguire* was appointed to Committee Official report ICSSPE for the International Olympic Committee (IOC) on Future Directions in Olympic Research; *Meyer* – is a member of Scientific Planning Committee –Academy for Eating Disorders; Advisor to B-EAT Eating Disorders Charity.

38 staff are members of journal editorial boards, including 10 editors: *Bairner* - Asia Pacific Journal of Sport and Social Science; *Biddle* - Psychology of Sport & Exercise; *Cameron* – Annals of Human Biology; *Evans* - Sport, Education and Society; *Fletcher* – Journal of Sport Psychology in Action; *Houlihan* – International Journal of Sport Policy and Politics; *Jowett* - International Journal of Sport and Exercise Psychology; *Mastana* - Internet Journal of Forensic Sciences; *Meyer* - Journal of Eating Disorders; *Smith* – Journal of Qualitative Research in Sport, Exercise and Health.

32 staff have positions on learned societies including for example, *Amara* - co-founder and Vice-President of the International Society of Sport Sciences in the Arab World (I3SAW); *Biddle* - President (2010-11) of the International Society for Behavioural Nutrition & Physical Activity; *Cale* - invited chair of the Association for Physical Education's Research Committee (2008-11); *Downward* - Vice President European Sport Economics Association; *Fletcher* - Member of the British Psychological Society Division of Sport and Exercise Psychology Training Committee (2013 – present); *Garcia Garcia* - Founding member and managing director of the Association for the Study of Sport and the European Union; *Gleeson* - President of the International Society of Exercise and Immunology (2007-09); *Harris* – Vice-Chair of the Association for Physical Education (2006-10); *Harwood* - Vice-President (2007-11) of the European Federation of Sport Psychology; *Howe* - Vice-President of the International Federation of Adapted Physical Activity; *Lewis* – Treasurer of the Tissue and Cell Engineering Society since 2008; *Nimmo* – member of the World Health Organisation Knowledge Transfer Group for ageing and health.
External recognition for Unit activities has been extensive; e.g. *Biddle* was awarded the British Psychological Society's Division of Sport and Exercise Psychology Distinguished Contribution to the Field of Sport & Exercise Psychology Award (2010); *Cale* was awarded the 2011 'Honoured member' award in recognition of outstanding contribution to the aims of the Association for Physical Education; *Fletcher* was awarded the Tom Reilly Memorial Award for a Recently Qualified Researcher in Sport and Exercise Sciences (2009); *Garcia Garcia* has received the 'European Citizen of Honour' award in the 'academic' category by the European think tank Sport & Citizenship and the European Commission; *Maguire* was awarded the Distinguished Service Award: North American Society for the Sociology of Sport 2010; *Timmons* gave the ACSM-ECSS exchange prize lecture in 2010 (Seattle/Oslo); *Yeadon* received the Geoffrey Dyson Award from the International Society of Biomechanics in Sports 2008. Four members of the Unit have been elected to the Academy of Social Sciences since 2008 (*Houlihan, Morgan, Maguire and Giulianotti*).