

REF Environment Statements

REF5b

Institution: Hartpury University
Unit of Assessment: 24 Sport and Exercise Sciences, Leisure and Tourism
<p>1. Unit context and structure, research and impact strategy</p> <p>1.1 Context and Structure</p> <p>The research presented in this submission encompasses activity across the breadth of the unit of assessment, applied to the sport, equine and animal industries, which is of relevance to organisations, individual professional practitioners and recreational participants in these fields. As a specialist institution, although a relatively new University, we have a long history in sport and exercise sciences founded on over 20 years of teaching and applied work, in particular in equestrian sport. Our history enables us to be uniquely placed to utilise our own elite sporting academies and specialist sport and equestrian facilities, as well as working with industry partners to engage in research within this unit.</p> <p>Hartpury's areas of specialism have received significant investment in recent years, both in facilities and people, which has enabled the University to establish pockets of excellence in research. The University boasts equestrian facilities that are of such high quality that they are utilised for international competition and within specialist and collaborative research. For example, our Rider Performance Centre (Section 3.1) is a world-leading facility that uniquely combines eventing and racing simulators with access on-site to elite and amateur riders and jockeys, which are key to international projects evaluating rider performance. Therefore, equestrian sport is, and will continue to be, a significant part of the research the University undertakes within the scope of this unit.</p> <p>Sport and exercise science research has developed more recently, underpinned by investment in outstanding sport and laboratory facilities in our Sports Academy II buildings (Section 3.1), opened in 2019, and a significant investment to attract senior research staff (including two professors and a reader). Our Animal and Agriculture Research Centre is the least developed but is already contributing to this unit through applied research in canine sport.</p> <p>During this period the University has evolved our three Research and Knowledge Exchange Centres (ILES, Section 2). As a relatively small specialist institution (approximately 2,000 HE students, 88 academic staff, including 9 teaching and research staff), we aim to be selective in the projects we undertake, making use of our available resident human and animal populations to deliver applied research on a substantive (working rather than laboratory) scale. The Centres were established in the last quarter of 2019 and their relationship with this unit specifically relates to:</p> <ul style="list-style-type: none"> • Sport and Exercise: Developing real world practical solutions and impact for individuals, communities, and industry through our research to build an increased understanding of elite sport performance, the health benefits of exercise to maintain physical and psychological wellbeing, and how to prevent sports-related injury. • Equestrian Performance: Determining the role of the jockey, the rider, the horse and the interaction between horse and rider to improve performance, health and welfare across all the Olympic and Para-Olympic disciplines, competitive horseracing, and recreational riding. • Animal and Agriculture: A specific interest in leisure environments and activities that involve animals from a human-animal perspective; in particular how human visitors impact the behaviour and welfare of zoo animals, and embedding an evidence-informed approach

to the management of health, performance and welfare in dogs involved in sport, as well as in other companion animal species.

There are natural overlaps in the areas of interest and expertise between the Centres and our research facilities and populations which benefit interdisciplinary working. The development of our research portfolio in equestrian sport is a prime example of this. Equestrianism is popular worldwide, with millions of horses and riders participating in competitive horse sports and non-competitive leisure riding; in the UK alone equestrianism has an economic value of £4.7 billion (National Equestrian Survey, 2019). Equestrian sport is unique as most disciplines involve a human athlete (the rider or jockey) working in partnership with an independent horse, offering opportunities for research into jockey, rider, and horse performance, together and independently.

Hartpury University is well placed to be a leader in applied research within jockeys and riders, and sport and racehorse performance. We have an established reputation for holding successful international equestrian competitions (from 1992) and the facilities to support these, have established world-leading Equine Therapy and Rehabilitation and Rider Performance Centres on-site, enjoy long-standing relationships with British and international equestrian federations, have access to elite level jockeys, riders and sport horses, an equine academy, and a resident population of approximately 250 amateur and leisure horse and rider combinations. This, combined with our foundation in sport and exercise science research, supported by exemplary human exercise testing facilities, has placed us at the forefront of global research in rider performance and performance analysis in equestrian sport. These include: working with the International Federation for Equestrian Sports (FEI) and the University of Central Lancashire to evaluate key performance attributes that contribute to para-athlete riding performance to inform the revision of the existing para-dressage grading criteria for riders; and exploring barriers to female participation in equestrian sport in partnership with colleagues at Portsmouth University. We are also well placed to conduct research into the impact of management, training and competition on sport and racehorse performance and welfare. As a result, research into equestrian sport is a key component of outputs across all three Research Centres.

Sport at Hartpury benefits from its people and its places. Sport staff span disciplines from applied practitioners and coaches, through to experienced researchers. The interplay between the 'science-focused' staff and the 'practice-focused' staff facilitate an effective scientist-practitioner approach to better understand sport and exercise issues that enable the generation of impact that leads to useful applications. Our research aims to have real world practical implications and impact for individuals, communities, and industry.

The Sport and Exercise Research Centre is also building on Hartpury's established reputation for sporting excellence. Hartpury promotes sporting excellence across its Sports Academies (equestrian, football, golf, modern pentathlon, netball, rowing, rugby union and an open athlete performance academy for other elite student athletes) and boasts numerous professional and international athletes amongst its alumni, including 11 alumni participating in the 2020 Rugby Union Six Nations squads, Olympic medallists in eventing and rugby 7s, and performance analysts and coaches in Premier League Football and Rugby clubs. This structure, boasting approximately 1,000 athletes across the University and College, provides the ideal environment for applied research in sport and exercise sciences. University academic staff are working with the medical, coaching and analysis Academy staff to engage in relevant research utilising the large population of athletes on-site. The Academy also ensures there is a strong engagement with professional sports clubs and governing bodies for the University to maintain an applied and industry-relevant approach to research. The University has a less well-established research record in physical activity and well-being, however utilising our network of Gloucestershire schools (for example: HARTLINX; ILES, Section 2.3) we have large-scale projects in physical activity in schools. The successes of the Clem Burke Drumming Project (Section 4.2) in physical activity programmes in special populations and the appointment of senior research staff have also resulted in high quality research projects in this area, generating a substantial positive impact in our county and community.

We are also deploying our sport and equine expertise into other animal species, thus helping to build research relationships in canine sport. The University has established collaborative relationships within canine sport, for example with the UK Kennel Club and the British Flyball Association. Projects are under way incorporating our on-site canine hydrotherapy practice, human performance laboratories and biomechanics suites to identify risk factors for injury in the canine athlete, analysing performance variables to enhance success in canine sport and to evaluate the benefits of dog ownership on human health. Hartpury is also well placed from a teaching and research base to exert a positive influence on performance, human-dog partnerships and animal welfare in canine sport, and we aim to use the breadth of our sport and animal expertise to become a leading base for research in canine sport in the future.

Whilst the Research Centres encapsulate our core research activities, our Communities of Practice create the dynamic space and mechanisms for dialogue, translation and application of our research knowledge across the whole institution and with our partner organisations and professions. The networking afforded by the Communities provides a scaling effect, to enhance the impact from our relatively small size. Communities of Practice provide an interface between research, curriculum and broader industry and practice, where like-minded individuals can come together to co-create and undertake research and knowledge exchange activities that have the potential to make a real-world difference across our subject areas. Of the 16 Communities already established, 10 have a focus wholly or in part within the scope of this unit of assessment. The activities of this initiative have led directly to published peer-reviewed outputs, international research collaborations and public research dissemination events.

1.2 Research and impact strategy

The Institutional Level Environment Statement (ILES, Section 2.1) has presented the strategic aims and goals for our research and knowledge exchange. Within this unit, the specific aims for each of our thematic areas are:

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| Sport and Exercise | <ul style="list-style-type: none"> • How drumming can be used as a physical activity intervention for people with developmental disorders; • Developing an increased understanding of how the female menstrual cycle affects wellbeing, recovery, and performance in high performing field sport athletes; • Optimising strength and conditioning methods to aid wellbeing, sporting performance, and reducing incidence of sport and exercise injuries; and; • Furthering the understanding of how rates of volunteerism can be increased for the benefit of individuals both young and older, sport and exercise clubs, and organisations, communities, and economies. |
| Equestrian Performance | <ul style="list-style-type: none"> • Development of biomechanical techniques that can quantify and analyse jockey and rider performance across equine sport disciplines; • Enhancing saddle design through applying biomechanics principles to improve performance and health of both rider and horse; • Use of exercise and outcome measures within rehabilitation of sport horses to promote performance and career longevity; and; • Evaluating risk factors for jockey and rider falls and injury across equine sport disciplines including racing and endurance. |

Animal and Agriculture

- Canine sport: embedding an evidence informed approach to the management of health and welfare in sporting dogs and determining the physiological demands of dog handling (e.g. Agility, Flyball);
- Human-animal interaction in leisure and tourism: evaluating how people attend zoos as a leisure experience and how this impacts on visitors, and the behaviour and welfare of the zoo animals; and
- Animals in our care: evidencing the impact on human physical activity, health and wellbeing from dog ownership.

Communities of Practice

- Offer a supportive environment to develop and engage in sport and exercise research and knowledge exchange activities;
- Create and operate channels for dialogue and translation of research into practice with industry, relevant professions, the general public and internally with our own University and College sporting academies;
- Promote the uptake and benefits of physical activities and exercise in special school populations;
- Provide a testing base for academy athletes and community sport to engage with performance analysis technology and exercise testing; and;
- Promote evidence-based approaches to human and animal sport that improve performance and generate positive health and wellbeing outcomes.

1.3 Research achievements

Our applied research has evolved from experience in scholarship and practice into coordinated themes, retaining alignment and connection with our curriculum. A key component of our research expansion has been the development of significant collaborative research activity with a range of external collaborators from academia and industry. For example, we work with colleagues at King's College London, Charles Sturt University in Australia and international sport governing bodies (Section 4.1). All Research Groups have utilised existing and new Visiting Professors and Researchers to enhance research quality and translation. Whilst building our capacity, we have been successful in a number of topic areas, as summarised here.

1.3.1 Enhancing athlete health and career longevity:

Fernandes' research focusing on fatigue and recovery in well-trained female athletes has developed synergies between the Sport and Exercise Research Centre and Hartpury's sport academies. This research utilises Hartpury's population of well-trained female athletes, many of whom compete at elite and sub-elite levels, and Human Performance laboratories and Strength and Conditioning suites to discover how the menstrual cycle affects acute responses to training and recovery. The results are providing practitioners with female-specific findings that will support the better design and monitoring of female athletes' training and adaption. This is complemented by research undertaken within the University's sports academies, which has focussed upon acute strength and power diagnostics in special populations. This work has shown that maximal strength can be accurately predicted from submaximal loads, therefore practitioners can screen athletes without high loads and fatigue; we are applying this approach across our academy athletes.

Worldwide, there has been an exponential increase in the number of equestrian businesses installing water treadmills within the last 25 years. Research by **Nankervis** on water treadmill use by elite sports horses and racehorses developed between the University, leading equine therapy centres and researchers around the world has identified water treadmill exercise protocols for horses, culminating in the development of 'Guidelines for the Use of Water Treadmill Exercise in Horses' (Section 4.1). **Tabor** has undertaken research with equine physiotherapists discovering that they require objective, time-efficient and inexpensive outcome measures to be able to effectively monitor neuromuscular health and promote sports performance, prevent injury, and assess progress during rehabilitation for horses and dogs involved in sport. This knowledge has led to a body of work evaluating new objective measurement methods and the development of clinical guidelines for equine and small animal assessment produced by the University in collaboration with the Association of Chartered Physiotherapists in Animal Therapy (ACPAT) (Section 4.1). Both of these guidelines are influencing practice and provide an evidence-informed approach to the training and management of sports and racehorses.

1.3.2 Enhancing wellbeing through sport and physical activity:

The University's support for innovative research and utilising its estate for research purposes resulted in research investigating the therapeutic benefits of drumming as a physical activity in autism spectrum disorder (ASD). The Clem Burke Drumming Project (Section 4.2) has developed a partnership between the University and special schools in Gloucestershire. **Professor Draper** found drumming to have positive behavioural and coordination effects in children with ASD. To date the project has provided lessons for ASD children at local special schools, with over 100 children benefitting from this relationship. It has led to drumming being adopted by these schools and a large mainstream school, benefiting the physical and mental wellbeing of the children involved, and also forms the focus of further research projects by the University.

Professor Lovell has examined the experiences of coaches of elite athletes with disabilities. Working with various Australian national Paralympic sports teams, this research has highlighted the challenges faced by coaches of elite para-sport athletes, identifying issues associated with coach recruitment influencing coach development and increasing coach expertise in disability sport (Section 4.1). **Davies** has researched with elite riders across Dressage, Showjumping and Eventing to evaluate the psychological impact of their own injury and the injury or loss of their horse. This work found riders face negative psychological impacts comparative to athletes in other sporting disciplines, highlighting the need for appropriate psychological interventions to be implemented. As a result, we have run industry workshops for equestrian national governing bodies and with our own Academy riders within sports psychology sessions. The University is now working with Racing Welfare to expand this research within the 6,700 racing staff employed in UK horseracing, evaluating the impact of injury on stable staff with the aim to develop interventions to limit the negative impact of injury in this extensive and often forgotten population.

1.3.3 Identifying key performance attributes in jockeys and riders:

Hartpury was the first university in the UK to install an eventing (horse) simulator within our Rider Performance Centre, which we have combined with a racehorse simulator to create a unique environment to evaluate jockey and rider performance. This investment has supported our first funded PhD studentship, which applies sport science within an equestrian context, using the simulator to assess coordination variability using biomechanical techniques. Studies by **Nankervis** and **Wilkins**, based on data obtained over the course of various national and international competitions at Hartpury, have detailed the range of movement strategies employed by elite dressage riders to achieve skilled horse-rider movement synchrony as well as evaluating the impact of pain on rider performance. This work challenges the established status quo in rider performance with implications for coaching and the classification of para-dressage athletes. The results have been presented at international and national sport and equine conferences, within industry workshops, scientific and lay press.

Research evaluating competition scheduling and race strategies adopted by endurance riders has identified risk factors for gait-related elimination in horses participating in equine endurance racing. **Williams**, in partnership with Endurance GB, discovered a key relationship between faster loop speeds in racing and increased cumulative distances across events that leads to a higher incidence of lameness and elimination in competing horses. The results are informing the development of updated equine welfare guidelines by Endurance GB's Welfare Committee and underpinning ongoing research evaluating risk factors for elimination, injury and horse welfare in the sport.

1.3.4 Understanding the impact of Zoos within tourism:

Zoos represent a leading leisure and tourism attraction, with two British zoos featuring in the top 10 most visited UK attractions in 2018; in second place, Chester Zoo was visited by almost 2 million people. Zoos can be viewed not only as visitor attractions, but also as family leisure facilities promoting wellbeing through human-animal interactions and increasing physical exercise, as most visitors will navigate zoological parks on foot. The economic survival of zoos is therefore based on visitor footfall and an increased understanding of how visitor-animal interactions influence footfall numbers, with these factors critical to their long-term success. Research by **Professor Melfi** has evaluated the extent to which this messaging has the desired positive impact on visitor perception of zoos, and how this translates to increased visitor numbers, including showcasing how physical contact between zoo animals and unfamiliar people can represent positive human-animal interactions. This work has informed international policy on zoo visitor-animal interactions and influenced practice in zoos globally.

1.3.5 Influencing future practice:

As well as the external contributions of our research, there have been various examples of research findings affecting our pedagogy and delivery of teaching. Our unique structure means our sport and exercise research informs our curriculum delivery, particularly in Masters programmes in Strength and Conditioning and Applied Performance Analysis, and also directly impacts the training of our high-level athletes within our academies and semi-professional sports teams (for example in Premier League women's rugby and Championship men's rugby). Looking to the future, we have invested in technology to enable tracking of academy athlete performance to inform ongoing dynamic performance analysis research.

Research in equine and canine sport informs practice and teaching across our animal, equine and veterinary physiotherapy programmes. Musculoskeletal health is essential for sport horse performance and management. Over half of the Chartered Physiotherapists undertaking additional training in the UK to practice as ACPAT-accredited Veterinary Physiotherapists, are trained at the University. Their PGDip and MSc programmes are underpinned by evidence-informed approaches derived from our research (Section 4.1).

The University acts as a link between various practitioner groups to translate research into practice. Current research includes links between PE practitioners across Gloucestershire and a collaborative project between student physiotherapists and saddlers (Section 4.1). We also actively engage in public dissemination of our research and employ numerous mechanisms that make our research accessible to athletes who are engaged in sport and exercise as well as to practitioners and governing bodies (Section 4.2).

2. People

2.1 Staffing strategy and staff development

Our staffing strategy has been driven by institutional level investment and infrastructure development and cultural change, which have created a focus on enhancement of research capacity (ILES, Sections 2.1, 2.4, 3.1 and 3.4). The University supports staff research in this unit through time allocation in workloads, mentoring, annual opportunities for sabbatical and open calls for funded PhD studentships. We provide specific support for research through our dedicated

Research Assistants and Technicians within our science laboratories, Rider Performance Centre, and biomechanics and human performance laboratories. In all cases we ensure that these resources are deployed to support our strategic directions, by making the application and real-world impacts of the proposed research a formal part of these applications. The University provides many opportunities for sharing ideas and best practice through research training events, our internal research conference and Communities of Practice. The annual Professional Development Review (appraisal) is used to set research and scholarly targets for all academic staff; senior research staff inform this practice and ensure that the targets are set to encourage quality ahead of quantity for staff research outputs. In these ways we promote the key strategic principles of applied research with impact, collegiality and quality.

The introduction of the new career structures led to the identification of 9 people (8.6 FTE) with substantive research responsibilities and a clear, regular process with defined criteria for others to be identified in the future. The University takes a structured approach to workload allocation, providing time for research and knowledge exchange for staff with research responsibilities. We use flexible approaches to timetabling in order to maximise the concentrated time for research.

Hartpury supports the wellbeing of all staff and students, including those with a responsibility for research, through a strong wellbeing agenda and flexible associated policies (ILES, Section 3.1). We have an active development programme for our researchers, tuned to each person's requirements and including access to the support of Visiting Professors to develop their research. All of our staff have taken part in such activities, including general training on research integrity, research ethics, science communication, and specialist skills development. The University's Take20 staff development scheme is particularly popular as it enables staff to schedule development at a time that suits them.

The University's sabbatical scheme plays an important role in enabling focused time for research and support for Early Career Researchers (ECRs). Staff can apply annually for study leave to accommodate the particular needs of their research. While this mechanism has supported research across all areas of our activity; this unit has benefitted specifically by supporting staff to write up existing datasets, establish industry partnerships and engage in increased knowledge exchange and public engagement activities. For example, **Wills** benefited from a series of sabbaticals, which she used to expand her publication portfolio, establish partnerships with key national stakeholders in canine sport and to gain funding for a PhD studentship in canine sport. This underpinned her progression to become a Category A member of staff. **Davies** used her sabbatical to publish studies and increase public engagement within horseracing. This enabled her to develop a collaborative partnership with Racing Welfare that will underpin the future progression of her research exploring the psychological impact of injury in staff across the horseracing industry (Section 1.3.2).

All staff can access a fund to disseminate their research through conference attendance requiring a session, paper or poster contribution up to £750 per annum. The University staff development fund supports staff attendance at conferences for scholarship and research development. All of our researchers have taken advantage of this support, and researchers have presented their work at leading conferences including the American College of Sports Medicine, the British Association of Sport and Exercise Sciences, the European College of Sports Science and the International Conference for Equine Exercise Physiology. Our work has also been presented at industry events such as the Global Dressage Forum and to internal governing body committees including the British Equestrian Federation and British Showjumping.

Development of individuals' research plans is an integral part of the University's appraisal and performance review process. In addition, individuals are able to draw on experienced colleagues and are supported in identifying suitable mentors (external as well as internal, including our Visiting Professors). Our staff come from a range of backgrounds, including practitioners as well as those from a more traditional academic career route. This is an advantage in terms of the breadth of expertise and experience that individuals bring. However, we also recognise the need to support some staff in establishing their academic research credentials, including undertaking a PhD. We

have implemented targeted staff development, funding for Level 8 study and mentor schemes to support this.

In terms of strategic development, we have recruited senior research staff expanding our capability and capacity. We target individuals with practical and translation experience as well as those with core research capabilities. We have recently appointed six Visiting Professors to bring experience and different perspectives to assist us in our journey (ILES, Section 4). For example, **Professor Adam Hart** (University of Gloucester) is assisting our sport and exercise research staff with public engagement and science communication, and **Professor Martin Jones** (Ministry of Defence) directly supports research in sport and broader physical activity and wellbeing.

2.2 Early Career Researchers

As we recently become a University, all our research staff are classified, according to HESA definitions, as ECRs. At this stage of our development, as the majority of our Category A staff are well-established researchers (ILES, Section 3.2), we are focusing our support on more junior staff and emerging researchers. However, as we grow we are expecting our profile to include research staff as well as teaching and research staff, and have embedded within our research infrastructure systems to support both groups appropriately, in accordance with the principles of the Concordat to Support the Career Development of Researchers.

2.3 Research Students

As part of our rapid journey to University status in 2018 (ILES, Section 1), we have offered research degrees awarded in partnership with the University of the West of England, since 2017. We have experienced significant growth in postgraduate research (PGR) numbers, particularly focused on projects within equestrian sport, reflecting our expertise, world-class facilities, sustained investment to obtain and maintain Gold Standard equipment (e.g. our Rider Performance Centre containing motion capture cameras, sensor-based technology for jockeys, riders and horses, riding simulators and equine treadmills), and ability to conduct applied research in this field. We have invested in the physical environment, supervisor training and mechanisms to support PGR personal development (ILES, Section 3.3). This, combined with our strategic investment in our research infrastructure (ILES, Sections 3.1, 4), environment, and culture (ILES, Section 2.4) has established a vibrant emergent PGR community, which is generating impactful research and supporting student achievement.

Each student's programme of work is designed to include development of research, practice and employment-related skills. Most PhD projects involve non-academic partners, reflecting the nature of our research; for example, linking to national governing bodies, local schools and charities. This involvement provides additional opportunities for the student, including potential placements with the partner. Where there is no natural opportunity for a placement, we will seek to identify and enable one. We target staff supervisory time and focus by directing students towards strategic titles that capitalise on our strengths in terms of expertise, facilities and industry links. The success of the support mechanisms and quality of supervision provided to doctoral students is evidenced by our student success. Our first completion occurred in 2020 and we have two further students scheduled to complete in 2021; 78% of our current PGR students have published or presented their work at relevant conferences and industry forums annually to date.

The success of our approach is exemplified by **Wilkins** and **Tabor**. **Wilkins** achieved her equine sports science degree at Hartpury and returned as a funded PhD student in 2017 to continue her research, evaluating the impact of postural stability on rider performance, specifically in Dressage. Her work has been published and presented at international sport conferences raising the profile of equestrian sport and informing how rider performance is measured across equestrian research and within para-dressage rider selection (Section 1.3.3). After successfully achieving her doctorate, **Wilkins** will join the Sport and Exercise Research Centre as a Category A member of staff to continue her work. **Tabor** joined as a lecturer aiming to apply her extensive practitioner experience of physiotherapy in the management of sport horses to the education environment.

The University supported her research exploring evidence-based approaches to measure how routine physiotherapy enhances sports horse performance, leading to her completing a Hartpury-funded doctorate by publication (DPhil) in 2020. **Tabor's** research has developed industry best practice clinical guidelines (Section 4.1) and a clinical outcome measures tool for use by practitioners in the field, as well as establishing **Tabor** as a leading researcher evaluating how physiotherapy can improve competitive success and career longevity in sport and racehorses.

2.4 Equality, Diversity and Inclusion

Hartpury has strong equality, diversity and inclusion (EDI) principles and enabling policies (ILES, Section 3.4). While small in number, research staff from this unit sit on institutional EDI committees to ensure that research is part of broader conversations and that the particular challenges of EDI in sport and exercise, particularly in equestrian sport, are highlighted. Related to this, in October 2020, the University launched 'Diversity Dates', a series of webinar interviews with researchers, academics and industry professionals from diverse and under-represented backgrounds. This series aims to showcase the research and experiences of the interviewees whilst providing role models for students and an opportunity for academic staff to utilise these talks as teaching materials. We are also a partner in a collaborative bid via the Guild HE network applying for funding from the OfS to improve access and participation for BAME groups to doctoral study. At an external level, senior staff are members of the BASES EDI Committee, and the BAME Equine and Rural Activities Focus Group.

3. Income, infrastructure and facilities

3.1 Overview

The unit's research income has grown over the census period, in line with our development. Although the award size generally remains small, we are growing our funding on an upward trajectory, with each project helping us to create and enhance links with our partners, be they the funders of our research or those collaborating with us. Our expanding reputation, both institutionally and individually, means that our researchers are more frequently being invited to participate in larger projects, such as the Clem Burke Drumming Project (Section 4.2) and evaluating the Para-dressage classification system (Section 1.1).

Since we achieved University status, we have been collaborative partners on nine bids totalling £517k, of which seven have been successful (total value £269k). Through being partners in collaborative bids, we are seeking to increase our own expertise and research income in the coming years. To date, our water treadmill work with colleagues at the Animal Health Trust and Centaur Biomechanics has received financial support from UK Sport, the Horserace Betting Levy Board and Petplan Charitable Trust (Section 4.1). We have also been successful in smaller 'pump primer' projects including funding for preliminary projects investigating rider-horse-saddle interaction. The success of these projects has attracted additional investment to evaluate key industry questions such as how saddle design influences jockey, rider and horse performance from the Worshipful Company of Saddlers. The results will influence competition performance, rider safety and research-informed saddle design as well as promoting a multi-disciplinary approach across equestrian professionals (saddle fitters, therapists, and veterinary clinicians) to enhance sport horse performance.

3.2 Facilities

Hartpury has an integrated and self-contained campus, with international level sport and equine facilities and events, animal collections, a working farm, and an Agri-Tech Centre, all set in a rural estate on the outskirts of Gloucester (ILES, Section 4). There are particular strengths in our provision for sport and exercise including:

- **The Sports Academy:** A range of specialist facilities and equipment that are used for research, applied within our teaching and athlete management. Hartpury has invested £8.8 million into its Sport Academy and laboratory spaces, including 1,500m² multi-sports hall, 3G

pitches, rugby and football pitches, golf ranges, courts, strength and conditioning suites, biomechanics and human performance labs, and a rehabilitation suite. These include a hypoxic chamber, anti-gravity treadmill, and 3D motion capture camera systems. A substantial focus of our research is how new technologies, e.g. accelerometers, linear position transducers, portable mobile/tablet applications, which are located in the biomechanics and human performance laboratories, can be used to monitor resistance training and exercise generally. **Fernandes** has conducted studies which seek to determine the validity, reliability and between- and within-unit agreement of these new technologies. Findings from this work inform the use of these technologies for practitioners at Hartpury and externally, but also their use within research.

The team of researchers who are investigating the effects of the menstrual cycle phase on fatigue and recovery are using the facilities located in the biomechanics and human performance laboratories, as well as the strength and conditioning suites to support their work (Section 1.3.1). These studies are making use of the linear position transducers, dynamometers, blood analysis equipment, force plates, and ovulation kits (to determine menstrual cycle phase). These studies will inform how training is planned and programmed for female athletes. Moreover, the findings have the potential to impact policy and contraceptive use within female sport. A new area of research being piloted with the sports academy is the use of acclimation and deception at simulated altitude. Using the hypoxic chamber, **Fernandes** is attempting to reduce the acute negative effects of low-oxygen environments at altitude. A variety of tools are being used to conduct this work, such as, electromagnetically-braked cycle ergometers, motorised and non-motorised treadmills, and blood analysis equipment. This work influences the practices of athletes when training and competing at altitude.

- **The Rider Performance Centre:** A world-leading specialist unit at Hartpury, providing a unique environment dedicated to the development and management of jockeys and riders as athletes, whatever their experience, ability or discipline. The Centre was refurbished in 2015 at a cost £250,000, funded by the Margaret Giffen Charitable Trust, and complements the Equine Therapy and Canine Hydrotherapy centres. The Centre includes a rider-specific biomechanics suite, eventing and racing simulators, rider rehabilitation facilities and physiology testing within our human performance lab and wider equestrian facilities enabling assessment of the rider on the live horse. These facilities provide a unique unit, capable of analysing the rider as an athlete across all equestrian disciplines and racing. As a facility, it supports the integration of our research, teaching and enterprise activities, enabling students, elite and amateur riders, and the public to engage with and be involved in our research. The Centre also provides opportunities for students to see practice and gain industry experience, and facilitates international research collaborations that have and continue to progress the sector's knowledge and understanding of rider performance and management.
- **Equine Therapy Centre:** The Centre has an international reputation in research and clinical practice involving equine water treadmills, and is the lead provider of hydrotherapy for horses in South West England. Facilities include an equine water treadmill and high-speed treadmill, as well as extensive equine arenas that enable physiological and biomechanical evaluation of horse performance in training, when ridden, and during rehabilitation. Our research has made a substantial contribution to the current understanding of the physiological and biomechanical responses of horses to water treadmill exercise, and informs industry practice through the guidelines produced by **Nankervis** and international colleagues (Section 4.1). Our evidence base has been used to develop the hydrotherapy programmes of many internationally successful sports horses in their preparation for numerous national and international titles, including as part of preparation for World Championships and Olympics.
- **Canine Hydrotherapy Centre:** The University's specialist canine hydrotherapy facilities are leased to an SME, owned by a Hartpury graduate, and treat approximately 50 clients per week, employ eight people and serve 30 veterinary practices. Hartpury staff and PGR students

actively utilise this facility for research investigating the impact of hydrotherapy within the training and rehabilitation of dogs participating in Agility, Cani-cross, Sled-racing and Flyball.

- **Canine Agility Arena:** The University has an all-weather canine agility arena and equipment which supports field-based research evaluating risk factors for injury and biomechanical assessment of performance in dogs participating in Agility, Flyball, etc. The facility has also been used by a local agility group and Hartpury has been a training base for Agility GB international competitors. Research in this area is developing and will be an important element for the Animal and Agriculture Research Centre in the future.

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

4.1 Collaboration and contribution

The research philosophy at Hartpury University is aspirational and seeks to create a vibrant and dynamic culture that supports and resources an empowered research team working in an excellent environment for applied research. This combination of people, infrastructure and leadership have led to successes and impacts within and beyond academia, providing a solid foundation for the further evolution of our Research Centres and future global impact.

Strategically we have focused on ensuring that a substantial proportion of our research portfolio is collaborative to build our expertise and increase the reach and impact of what we do. Of our published outputs, 54% are in collaboration with other academic organisations. Researchers also collaborate locally, nationally and around the globe with academic and industrial partners to provide world-leading knowledge and research with impact. We engage and disseminate research with society, sport and wellbeing industries through regular research seminars, including staff and research student presentations, workshop discussions of future research, and external guest speakers. Providing and translating research findings to a broader audience is an important aspect of our impact strategy and reflects our practice-based origins.

The University has established specific and strong relationships with key professional body collaborators in the UK and internationally. **Professor Lovell's** research examining the experiences of coaches of elite athletes with disabilities was facilitated by relationships with various national Paralympic sports teams from Australia. In a series of studies, **Lovell** investigated the preconceptions and realities of coaches of athletes with disabilities, sports coaches' experiences and preference of training and professional development, along with senior sports administrators' reported factors affecting coach recruitment and retention. Cumulatively, this research has increased the understanding of the challenges faced by coaches of elite para-sport athletes and the issues associated with recruiting such coaches, providing further coach development, and retaining them. The body of work has produced evidence-based theoretical framed recommendations that aim to enhance the availability and expertise of coaching provision for athletes with disabilities, benefiting National Governing Bodies, coaches, and athletes alike.

The University is also committed to working with relevant industry partners supporting our objective to engage in research that informs real-world practice. We have a strong record of engaging with industry on projects that promote sport horse and racehorse performance through the development of new methods and equipment, and evaluating risk factors associated with injury to improve rider and horse performance and welfare.

Research-informed use of water treadmills in sport and racehorses: Worldwide, there has been an exponential increase in the number of equestrian businesses installing water treadmills within the last 25 years. **Nankervis**, working with national and international partners including representatives from Newmarket, Langdale Equine, Animal Health Trust, Sport Horse Health (Netherlands), Conghua Training Centre (China) and researchers in North America formed The Hydrotherapy Working Group. This group aims to find common ground amongst water treadmill

users and has developed and published guidelines for the safe and effective use of water treadmills for sport and racehorses, and acts as a fast track to establishing what research needs to be done and what regulation and education needs to be provided for Centres and new users.

Our research has made a substantial contribution to the current understanding of the physiological and biomechanical responses of sports horses and racehorses to water treadmill exercise, and informs industry practice through the 'Guidelines for the Use of Water Treadmill Exercise in Horses' produced by **Nankervis** and international colleagues. These guidelines have been approved by the British Equestrian Federation and applied to the training of World Class Programme horses, alongside being adopted as best practice across equine therapy centres informing practice worldwide for elite sport and racehorse clients. The research and recommendations arising from this work have been used to educate veterinary surgeons, horse trainers, veterinary physiotherapists and equestrian businesses via consultancy, CPD, formal educational programmes and bespoke face-to-face training. For example, our Equine Therapy Centre staff advised and assisted the Hong Kong Jockey Club in the provision of hydrotherapy at their \$3 billion Conghua Training Centre, providing water treadmill exercise for the Centre's 600 racehorses. Our evidence base has been used to develop the hydrotherapy programmes of many internationally successful sports horses in their preparation for numerous national and international titles, including within the training programmes of individual and team dressage horses for World Championships and Olympics, such as that of the successful London 2012 and Rio 2016 British Olympic Gold medallist, 'Valegro' (ridden by Charlotte Dujardin).

Evidence-informed management and rehabilitation of sport horses and dogs:

Musculoskeletal health is essential for sport and racehorse performance and management, with animal physiotherapists playing a key role in maintaining and facilitating peak performance of horses and dogs involved in sport. **Tabor** has undertaken research with equine physiotherapists discovering that they require objective, time-efficient and inexpensive outcome measures to be able to effectively monitor neuromuscular health and promote sports performance, prevent injury, and assess progress during rehabilitation for horses and dogs involved in sport. This knowledge has led to a body of work evaluating new objective measurement methods and the development of clinical guidelines for equine and small animal assessment produced by the University in collaboration with the Association of Chartered Physiotherapists in Animal Therapy (ACPAT). These guidelines are influencing the practice of physiotherapists working with animals used for competition and those kept for leisure, and provide an evidence base for assessment of animals undergoing rehabilitation both from an economic standpoint, for instance with racehorses, and from a welfare perspective for all animals.

Our research is regularly showcased by ACPAT at annual meetings and conferences, and informs CPD for veterinary physiotherapists. ACPAT has also provided access to its members to support the University's research. The two organisations are working in partnership to develop an evidence-informed composite outcome measurement tool, which could be implemented by veterinary physiotherapists and veterinarians to provide an objective quantitative method to assess progress within equine rehabilitation programmes. **Tabor's** research advocating the use of outcome measures within equine and canine physiotherapy and the guidelines produced, underpin the therapeutic approach taught to our Masters' students, who engage in reliability and validity assessments based on published studies. As a result, research produced at the University is embedded into teaching, and is subsequently taken into industry both during clinical placements and once qualified, via graduates into practice. The clinical guidelines produced are influencing practice and provide an evidence-informed approach to the design of efficacious practices in training, management and rehabilitation practices of sports horse and race horses both in the UK, and around the world.

4.2 Economic and social contributions

Hartpury University ensures an applied and impactful approach to its research, and is an important part of the economy of Gloucestershire, and the Forest of Dean and City of Gloucester districts in particular. We build partnerships with regional sports organisations, physical activity social

enterprises, charities, and other related businesses. Strategically the University research works in close alignment with the national, local, and regional industrial strategies to support local growth and regeneration within its niche specialisms (animal, agriculture, equine, and sport). Hartpury provides wide-ranging support for the region and its outstanding, specialist and commercially relevant facilities represent the ideal test bed for emerging innovations.

Clem Burke Drumming Project: This unique research project, utilises the novel benefits of kit drumming to bring physical activity to special populations locally and nationally. Underpinned by advanced brain imaging techniques (MRI / fMRI) conducted by **Professor Draper** and **Visiting Professor Steve Williams** (Kings College London), this project has demonstrated the motor control and behavioural benefits of drumming for autism spectrum disorder (ASD) and other developmental disorders. The positive results have led to the adoption of the project by all special schools in the County as well as others nationally, and the project is extending into dementia care homes, the Gloucester Multiple Sclerosis Centre, and head trauma rehabilitation. A University-funded PhD is working to utilise the signals from electronic drum kits to quantify motor skill development.

Improving rider and horse performance, and welfare through saddle design: The saddle is a core interface between the jockey or rider and the horse, and affects the biomechanics, performance, and wellbeing of both. We have recently signed a memorandum of agreement and 10-year collaboration plan funded by the Master Saddlers Association, a globally recognised society, to promote research-led education and training, and an ambitious programme of impactful research between the University and the Saddlery sector. Specifically, the partnership aims to increase the level of knowledge and awareness amongst equestrians of the importance of good saddle fit for jockey, rider and horse performance and welfare. The associated research programme has already provided financial support for a full-time funded PhD studentship and the results of initial research by **Nankervis** are informing industry practice and training methods for saddle fitters, providing long-term benefits to rider and horse performance and welfare.

Supporting the equestrian sector during the Covid-19 pandemic: Our links with industry place us in a favourable position to lead responsive research for the benefit of the sectors we align with, enabling us to undertake research which can translate into societal benefits. Recent examples include **Williams** evaluating the impact of the Covid-19 pandemic on horse owners and the equestrian industry; the University was a leading partner in a global collaboration working with all key UK, USA, Canadian and Australian equestrian federations, leading equine welfare charities, and international academics to survey horse owners. The results of this project have informed national approaches in response to the pandemic and include the University producing a Covid-19 plan and guidance in partnership with key stakeholders for use across the sector to protect rider and horse wellbeing. **Davies'** work evaluating the impact of the pandemic in UK horseracing has informed responses to the crisis following presentation to the British Horseracing Authority's Covid-19 Steering Group.

4.3 Public dissemination of our research

We actively engage in public dissemination of our research. We employ numerous mechanisms that make our research accessible to those who are engaged in sport and exercise. This includes holding regular workshops on-site for relevant industry stakeholders and national governing body groups, e.g. British Dressage, British Weightlifting, British Showjumping, Agility GB, the Rugby Football Union, British Eventing, and Riding for the Disabled. Through online webinars and podcasts e.g. ACPAT, Horsetalk and EventFit, plus regular articles in key sector magazines e.g. Horse and Hound (weekly circulation: 26,848), Animal Therapy (monthly circulation: 12,000), Horse and Rider (quarterly circulation: 100,000) and Bunkered (Golf publication circulation: 100,000) as well as through engagement with social media, for example, Barefoot (monthly Beach Soccer online publication, Facebook: 1,173,989 followers; Twitter: 60,000 followers).

We support and encourage our staff to become members of, and to be actively involved in, industry and research boards, policy groups and committees to promote wider engagement at community,

national and international level, and enable this through both workload planning and focused staff development activities. This ensures our research is driven by pertinent and relevant research questions, and includes but is not limited to: the Junior Vice President of the International Society for Equitation Science, the BASES EDI Committee, the Sport Science and Medicine Committee for British American Football, and the ACPAT Clinical Guidelines Group. Alongside this, we provide coaching and research expertise to various governing bodies and national teams, for example: the British Equestrian Federation, Racing Victoria (Australia), the International Federation of Equestrian Sports, the Football Association of Wales, and the Rugby Football Union.

In summary, Hartpury University is a new university that has already established a research culture and infrastructure with an emphasis on applied research in sport, exercise, leisure and tourism. The University has invested in outstanding facilities and built on these, combined with our strong industry partnerships, to support research in sport and exercise (including equestrian sport) to date, and which will continue to support our future research direction. Our applied and collaborative approach to research (involving both academic and non-academic partners) is impactful beyond academia and makes broader contributions to the both the economy and society locally, nationally and internationally.