Institution: Swansea University
Unit of Assessment: 26 - Sports and Exercise Sciences, Leisure and Tourism
a. Context

The Applied Sports Technology Exercise and Medicine (A-STEM) Research Centre academics are organised into the following research groups: **(1) Elite and professional sport** and performance and **(2) Exercise medicine and health**. Research in A-STEM is "applied" in nature and occurs symbiotically with users. Our scientific activity occurs naturally within the context of elite and professional sports and clinical, school or home environments. Research goes beyond the academic with scientific endeavour occurring as part of a continuous feed-back / feed-forward cycle in the quest for improved performance of elite athletes or the health and well-being of the general or clinical populations.

Impact on Athlete Performance in Elite and Professional Sport

The group's research work with elite and professional sport has impacted policy, practice and improved performance at the highest level. Academics from A-STEM are represented on elite sport groups and are leaders and founders of sports, science and technology networks. The growing cross fertilisation of sport and technology has also resulted in the creation of *SportsViz Ltd, a* Sports Visualisation spin-out company. Research conducted in Australia, Canada, the USA, and the UK examining stress and coping in elite sport and parental involvement in youth sport has enabled practising sport scientists in A-STEM to develop and deliver research-informed educational materials and consultations to national and international sports organisations and elite performers. Research on pre-conditioning and recovery strategies have international reach and are being used by elite athletes across a range of sports in the UK and abroad. This group apply their science with the Scarlets, Ospreys, Biarritz, England 7's, Welsh Rugby Union professional rugby teams, GB Bobsleigh, GB Skeleton Bobsleigh, GB Cycling, GB canoeing, GB Gymnastics, Sport Wales, RFU, Swansea City, West Ham United, Lawn Tennis Association and Premier League. Sports and ethics research has produced new critical thinking which has resulted in changed policy in anti-doping in national (UK anti doping agency; UKAD), and international organisations (Union Cycling Internationale (UCI), World anti-doping agency (WADA). A-STEM sports ethicists have also had significant reach and impact through their academic endeavours: the World Anti Doping Agency's educational package "Sport Physicians" Toolkit included major contribution to sports medicine ethics from A-STEM staff and is used by Sports Physicians globally.

Exercise Medicine to Improve Health

Applied research in exercise medicine has informed health care practitioners, developed health care products with industry, created a spin-out company *SwanSTEM* and informed international public health guidance. The group's research with clinical populations has assisted type 1 diabetics control the condition more effectively, contributed to the medical engineering of an artificial lung, and used new mathematical techniques to understand the links between cardiac function and exercise in pregnant women. In public health, paediatric exercise scientists have helped children increase physical activity and promoted healthy weight and fundamental movement skills. In achieving these goals academics have developed strategic links with the College of Medicine for access to clinical groups, and integrated work in Medical Engineering in partnership with industry. The Exercise Medicine and Health group creates its pathway to people through its relationships with Abertawe Bro Morgannwg (University Health Board (ABM UHB) and Hywel Dda Local Health Boards, schools and health promotion. These relationships firstly influence clinical practice related to exercise prescription and secondly influence physical activity promotion through the design of public health programmes. This work has also had influenced public health work in Western Australia.

In addendum to the work of the 2 research groups an A-STEM biomechanist has developed a novel line of enquiry through research work on the skeletal remains from the Mary Rose. This work

has direct impact on the historical analysis of the life of those who lived on the flagship of Henry VIIIs fleet which sank in 1545. The analysis of the bones of archers (elite athletes of their day) demonstrates the significant skeletal remodelling of the ulna and humerus and these biomechanical findings will be displayed in the Mary Rose museum in Portsmouth. This work has had significant recent media coverage, including part of the Big Bang exhibition in the Science Museum in London.

b. Approach to impact

Leadership

Conducting research with impact is recognized in the *University Performance Enabling Scheme* and *Career Pathways* model for staff promotion, which specifically rewards innovation and engagement. Our approach has exploited this institutional change by promoting a lecturer to Associate Professor on a Teaching, Innovation and Engagement (T, I+E) contract. Concurrently we have formed an Innovation and Engagement (I+E) group of representatives from elite and professional sport, the NHS, voluntary sector, fitness industry, public authorities, education and schools and engineering and technology industries. The aim of this group is to work with A-STEM to develop an I+E strategy. Development of A-STEM innovation and engagement has been supported by Welsh Government (WG) funded Knowledge Economy Skills Scholarships (KESS) and Knowledge Exchange Programmes (KEP) as well as HEFCW-funded Strategic Insight Programmes (SIPs). These programmes promote knowledge exchange and joint industrial and university collaborative research. They also aim to encourage innovation and facilitate interaction between university staff and industrial public, private and voluntary sector organisations. A-STEM has collaborations for KESS, KEP and SIPs with a number of organisations such as the Ospreys and Scarlets professional rugby regional sides, the Welsh Amateur Swimming Association, the Welsh Rugby Union, Sport Wales, Play Wales and Regional Health Boards.

Engagement

A-STEM has representation on the newly formed European Commission Expert Group on Recreational Doping, UK Sport Science Winter Sports Advisory panel (2011- 2012) and on GB Cycling Marginal Gains Research steering group (2008-2012). A-STEM is one of the three co-founders of the recently launched (2013) IRB international rugby science research network. We are also the recipients of a £300k grant to set up the Wales Elite Sport and Innovation Network (WEPSIN) which aims to bring together elite sport, academics and industry to impact elite sport for the Rio Olympics 2016 and beyond. In Exercise Medicine and Health, academics from A-STEM coordinate the Physical Activity and Diabetes Research Network Wales and chaired the programme development group for the National Institute of Health and Clinical Excellence (NICE, 2007-09) and the UK Chief Medical Officers sub-group (2011). Both groups were responsible for producing recent national physical activity guidelines for children and young people. These guidelines are current and are used to inform public health policy and promote good practice by health professionals across the UK and Europe.

Funding

In addition to WEPSIN described above, we have received further income that directly supports impact. Research funded by the EU Framework 7 (£86k) on the ethics and governance of global anti doping policy was undertaken 2010-12 as part of an international study on the ethics of enhancement. The ESPRIT sports science and engineering project funded by EPSRC (£111k) produced a biosensor for use by elite sports to improve immediacy of feedback on training and performance. A Welsh Government Collaborative Industrial Research Project (CIRP) linking academics to business (A4B) provided £290k to enable Sports Industries to Develop Advanced Video Visualisation. An outcome of this project was the production of The Match-Pad sports analysis system used by Wales during the rugby World Cup in 2011 and resulted in the formation of the *SportsViz Ltd* with a growing list of software licences and products. An integrated exercise science and engineering project received CIRP funding (£225k) to develop responsive control systems for an artificial lung in partnership with industry (*Haem-Air*). In an extension of this work A-STEM formed a spin out company, *Swan-STEM*, to further exploit industrial impact. Funds to work directly with industry are also provided by the Knowledge Economy Scholarship Scheme (KESS) scholarships funded by the European Social Fund. KESS provides partial funds to support the

stipends of students engaged in projects developed in collaboration with a company. Both the company and A-STEM are expected to provide significant additional funding per scholarship. In total 7 postgraduate students funded by KESS completed their studies during the 2008-13 period.

Public Engagement

A-STEM academics have been involved in significant science-related, public engagement activity. Of note are the Royal Society's annual joint meeting with the Welsh Government (WG) (2012) which featured an invited talk on ethics and sports medicine. Presentations have been made on Children's fitness and obesity to WG (2013) and to West Australia's government departments of sport and recreation and public health (2011). The Mary Rose Project and artificial lung projects have been exhibited in the National Museum, with A-STEM academics in attendance (2013).

c. Strategy and plans

A-STEM has 6 strategic drivers the third of which is focussed on research impact. Our plans for impact are to strengthen our integrated and applied research with consumers and to extend its international reach. Our plans will be developed in partnership with our recently formed innovation and engagement group who will help maintain a real world context to our studies and assist in accessing contexts and populations where our research is valid.

A-STEM strategy for the next 5 year cycle will be to

1. Formalise impact as a standard auditable outcome from all applied research.
2. Attract income to accelerate applied and industrial research.
3. Strengthen local-global collaborations.
4. Develop further integrated sports and exercise science and engineering industrial links in sensor and medical device development and application.
5. Identify new collaborators and potential audiences and beneficiaries and further develop the international reach and significance of A-STEM research.
6. Widen research visibility and demonstrate transferability of research expertise through all forms of media.

This strategy will be delivered in the context of the move to the £250m Science and Innovation (S&I) Campus (2015). The S&I Campus is predicated on an open innovation model, whereby industrial research and development activity is embedded with academic research and teaching so as to maximise the mutual benefits to all partners and provide immediate routes for exploitation and knowledge transfer. The University also holds an Engineering and Physical Sciences Research Council (EPSRC) Impact Acceleration Account and will be using a portion of this funding to instigate an institution-wide impact award scheme in 2014 to recognise and celebrate research impact. The scheme will be open to all researchers at the University, and will be judged by a panel involving external research users.

In combination our strategies aim to achieve the increased reach and significance of our research on physical activity (with a particular emphasis on children), clinical exercise physiology and elite and professional sports performance.

d. Relationship to case studies

The case studies presented by the elite and professional sport group are a result of sustained research endeavour in two distinct areas. They demonstrate impact at an individual and policy level and highlight the relevance of creating sustainable relationships with elite and professional sports men and women, and the organisations that govern them. Moreover the impact of this work permeates the international scene and satisfies our local-global agenda.

In A-STEM the I+E group direct impact strategy has provided a framework to develop constituent case studies. This strategy has enabled academics to (1) develop performance enhancement approaches that have helped British Skeleton Bob and British Olympic Cyclists to win gold medals and (2) use critical thinking in philosophy and ethics that has contributed to anti-doping policy development at the global level for both the UCI and the World Anti Doping Agency (WADA). These case studies reflect the approach to impact implemented by A-STEM academics.