



CSIRO Submission 08/325

Independent expert panel investigation into the reforms required to ensure that Australia's sporting system remains prepared for the challenges of the future

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Executive Summary

Science is playing a key role in Australia's sporting success. By connecting science and innovation with society, Australia can advance its elite sport competitiveness, boost participation in sport, and help build a healthier nation.

CSIRO understands that it is necessary to co-ordinate a multidisciplinary approach to sport science in Australia. In working to advance human performance, we see significant synergies between our efforts to address the challenges of sport, health and rehabilitation, and our wider efforts to advance science on many fronts. In particular, a key sports science research agenda for the future may have the following components:

- Human Factors: developing scientific capability to understand how nutrition, biological variation, and molecular biology impact human function.
- Personal Technologies: addressing performance enhancement with specific regard to the development of new personal measurement methods, feedback, communication and management of information
- Smart Equipment: developing equipment for enhanced performance with specific emphasis on exploring design, modelling, new manufacturing methods, smart fabrics and embedded sensors.

There is also a need to measure and report the impacts of sport and distribute the wellbeing messages of sport into our community through multiple formal and informal channels.

CSIRO is already working in partnership with the Australian Institute of Sport (AIS). This research alliance has demonstrated efficient and effective delivery of multidisciplinary technology, knowledge and services into the national sports system. The breadth of this activity, its structure, and whole of system approach could be used as a foundation to underpin a vibrant sporting industry and directly contribute to the creation of future athlete pathways. Five case studies are provided to demonstrate how science and innovation will help deliver future sporting success.

Sports challenges relate to broader national challenges, particularly preventative health, and require a co-ordinated multidisciplinary approach for solution. A focus on innovation will also liberate latent opportunities for new engagement, economic activity, and increased productivity in sport and health.

Australia is well placed to respond to the new sports challenges, and CSIRO stands ready to assist in building connections and delivering solutions to the national sport and national innovation systems.

Introduction

Elite sporting success in the 21st Century requires our community to connect in new ways to discover and develop Australian sporting talent. As Australia's national research agency, CSIRO's mission is to deliver great science and innovative solutions for industry, society and the environment that address Australia's national challenges. In addressing national challenges CSIRO understands that it is necessary to co-ordinate a multidisciplinary approach that connects science and innovation with our social fabric.

Many of the challenges facing the national sports system are reflected in the challenges we face as a nation. For example:

- Distributed population and assets
- Diverse environment and resource base
- Increased international competition
- Shortage of experts and competition for talent
- An increasingly sedentary lifestyle that leads to disease
- Rapid evolution of advanced technologies and knowledge

This commonality suggests potential synergies in the scientific and technical solutions to both sport and non-sport challenges facing our nation.

The 20th Century institutional model of the Australian Institute of Sport delivered much national sporting success, but this competitive advantage is waning as other nations adopt similar approaches [1]. Our sports institutes are responding to this threat and we are seeing an Australian sporting system [2, 3] characterized by:

- An athlete centred, coach driven, performance based system with a creative approach to talent development and management
- A willingness to form new organisational partnerships to grow sector resources, achieve systemic efficiencies, and improve international results
- Growth in inter-disciplinary research activities that involve expertise that extends beyond the boundaries and capabilities of traditional institutional sports science
- A commitment to invest and foster local sports innovation and improve perceptions of commercialization in sport.
- A desire for a collective understanding of the inter-relationships of the various parts of the national sports system and its interconnections with the National Innovation System.

CSIRO recognizes the potential of the Australian sporting community and the achievements of our elite athletes as a force for enabling socio-economic development. CSIRO believes that applying its extensive scientific resources to the elite sports area can have 4 significant benefits:

- Australian elite sporting success has a positive benefit on Australian well-being
- many scientific discoveries and novel technologies being developed for other sectors and uses can be applied relatively quickly to the elite sports arena, once the connections are made between the relevant groups
- the athletes, coaches and sport scientists of our elite sports system provide lead users to assist the discovery, development and proving of

new technologies, accelerating those developments for a range of uses including those beyond sport

- application of novel technologies to the sports sector can provide an early path-to-market for those technologies, and create new businesses and markets

For these reasons, over the last 2 years, CSIRO has been developing a strategic partnership with the Australian Institute of Sport (AIS), leading to a co-developed CSIRO research theme 'Advancing Human Performance' (the structure of which is discussed in the response to Term of Reference 4). Through this partnership with the AIS, CSIRO is connecting its scientific and implementation resources to the national sporting system to help build a more efficient and effective elite sport system, and assist in the delivery of better athlete pathways.

For example, along with the AIS, CSIRO has already

- implemented a 'synergy' program in 2006 that enables multidisciplinary cutting edge science to be aligned with sports applications and rapidly deployed in elite sport (this resulted in a number of technologies being considered and included for training and use in Beijing and ultimately associated with two gold medals and various personal bests, see Appendix A)
- Established in 2006 a CSIRO/AIS Joint Steering Committee, supported by Coordinators in both organizations, to co-ordinate expert engagement and innovation in the national sports system [4]
- established a CSIRO/AIS Relationship Agreement to facilitate close collaboration between CSIRO and the AIS, with additional agreements that enable cross organisational funding for the appointment of new staff (to date, 3 post doctoral fellows)
- contributed to a structured review of the university sector's current and potential contribution to sports research
- made new connections with Australian industry to advance their appreciation of the commercial potential of new sport technologies (including both entities already engaged in sports products and those not aligned with sport)
- begun assisting local SME's to adopt sports technologies and knowhow to develop advanced sports products and apply services for the benefit of the nation's talent and economy
- conducted leading edge science in the national Scientist in Schools program to both engage, inspire and inform future sports scientists and expose young Australians to exciting new sports technologies
- jointly communicated to the media for the promotion of sport and technology



Figure 1. Connecting the experts at the 'Frontiers of Human Performance' workshop, 13-14th March 2008, held at the Australian Institute of Sport in Canberra. Delegates included experts from CSIRO, NICTA, DSTO, AIS, CRC for Advanced Composite Structures and a number of sports technology SMEs. [4]

Appendix A incorporates a set of science and technology case studies that publicly demonstrate our recent contributions to address a number of issues that are the subject of this review.

Response to Term of Reference 1: Ensure Australia's continued elite sporting success

- *Identify any areas of duplication within Australia's sporting system and recommend ways to build a more efficient system.*
- *Examine the relationship between the Australian Sports Commission, Australian Institute of Sport, State and Territory Institutes, academies of sport and regional institutes and how this relationship could deliver better athlete pathways.*
- *Recommend opportunities to ensure maximum returns from talent identification programs.*

CSIRO Response:

Recommend opportunities to ensure maximum returns from talent identification programs.

The relatively low levels of physical activity among children and the resultant issues with health and physical development are recognised by the Australian Sports Commission (ASC) as an area of concern for future talent. Furthermore, the lifestyle demands of the new generation present challenges to scheduling coaching and training activities. These issues accentuate the challenge of delivering programs to the limited and decreasing Australian talent pool. As part of its talent identification strategies, the ASC is seeking new talent identification programs using strategies to more effectively excite engagement in sport, and to leverage the advances of innovation and technology. [3]

There are a number of key areas of cutting edge scientific research and innovation conducted by research groups in Australia (including CSIRO), that could collectively contribute to future talent identification programs:

Enable new engagement and accelerated learning through the use of new mobile technologies for distributed remote skill development.

New technologies are enabling individuals to actively experience and develop their own skills in new ways, and may excite engagement. Australian youth (aged 9 – 16 years) typically spend approximately 150 to 100 minutes per day in moderate to vigorous activity and approximately 250 to 200 minutes per day on 'screen time' [5]. Whereas it is proving difficult to encourage youth away from the digital entertainment, mobile interactive technologies can be used to combine the categories of physical activity and virtual entertainment in new meaningful ways [6].

Sharing experiences of physical activity through new media is a natural progression for the new generation. Interactive mobile technologies are bringing physical activity into digital entertainment, and also enable both the assessment of skill performance and the sharing of experience. The ability of new interactive technologies to be used for widespread skill development and assessment as part of real training programs in sports academies, schools, and at home as part of play, is currently being explored (see Appendix A). The goal is to link experts and non-experts through generic technological media in a fun and engaging manner.

The key challenge in this domain is to provide mobile technologies that are acceptable and desirable to use in everyday life to deliver professional services and interaction between expert knowledge and emerging talent. Similar research

and innovation being developed for the industrial, telecommunications, defence and entertainment sectors can be adapted to the sports talent identification field.

Elucidate a greater awareness of factors that contribute to human performance so as to inform future talent identification programs.

New research is required to link knowledge of social demographics, nutritional intake, genetic predisposition and models of high performance to the likelihood of task success in various environments. This higher level knowledge will primarily arise from integrated multidisciplinary research where measures of performance are linked to the knowledge of an individual's state of being.

Recent technological advances are enabling the large scale collation of information on a subject's nutritional intake, genetic predisposition, mental health, extent of fatigue during a task, and their capacity to learn and perform tasks over sustained periods in diverse environments. Coupled with knowledge of social demographics, it is likely that future talent identification programs can be tailored to individual needs. Developments in the collation, manipulation and analysis of large complex data sets, systems science, and distributed monitoring technologies can be applied in the sports talent identification area.

Response to Term of Reference 2: Better place sport and physical activity as a key component of the Government's preventative health approach

- *Examine Government frameworks to ensure an on-going focus on grassroots and community sport and physical activity.*
- *Examine Government programs to increase participation rates in sport and physical activity, including analysis of existing programs.*
- *Identify and recommend opportunities to break down barriers to participation at junior, adult and senior ages with a view to making it simpler and easier for Australians to participate in the sport or physical activity of their choice, including for women, the disabled and Indigenous people.*
- *Recommend strategies to increase the effectiveness of the promotion of sport by the Federal Government to better communicate positive health and activity messages to the broader community.*

CSIRO Response:

Technological innovation and science has the potential to better place sport and physical activity as a key component of the Government's preventative health approach in two ways.

Identify and recommend opportunities to break down barriers to participation at junior, adult and senior ages with a view to making it simpler and easier for Australians to participate in the sport or physical activity of their choice, including for women, the disabled and Indigenous people.

The barriers to participation in sport or physical activity include the availability and cost of key equipment, expertise, and the wider community's enthusiasm for an individual's involvement in sport. Innovations to produce new and low cost sporting items for use by junior, adult and senior ages that enable new modes of access to equipment and expertise (including those tailored for women, the disabled and Indigenous people) will assist in part.

Recommend strategies to increase the effectiveness of the promotion of sport by the Federal Government to better communicate positive health and activity messages to the broader community

Sport potentially offers an effective medium for promoting health messages to the wider community; however greater understanding of the effectiveness of techniques and practices through systematic evaluation is necessary to guide the delivery of evidence-based health promotion campaigns that maximise impact and uptake in the community to develop a healthy Australia.

CSIRO has just completed a national survey (in collaboration with University of South Australia) for the Department of Health and Ageing, Australian Food and Grocery Council and the Department of Agriculture, Fisheries and Forestry on nutrition and physical activity in children [5]. The results of that survey suggested that 69% of children met the national physical activity guidelines (at least one hour of moderate to vigorous physical activity each day). However the average time spent doing moderate to vigorous physical activity decreased with age.

There is scope for further work to be undertaken in this area and for development of greater knowledge as to what extent can sport be used as a means to promote both good nutrition and physical activity and other health

messages that would assist in guiding future health campaigns and efforts towards a healthier Australia. Specifically, there could be value in carrying out an ongoing comprehensive analysis of physical activity combined with other key lifestyle measures, eg nutrient intakes, across a broader age group with a view to developing evidence based programs to promote health messages through sport. It would be essential that this be a multidisciplinary activity bringing together those skilled in physical activity, public health and its messages, nutrition and particularly statistics and data integration

Integrating sport into science and social studies teaching in schools may also offer an effective means of encouraging the next generation to engage with sport and its messages. *Scientists in Schools* is an initiative of the immediate past Chief Scientist, Dr Jim Peacock, and is managed by CSIRO Education. The aim of Scientists in Schools is to create and support long-term professional partnerships between scientists and teachers. Its purpose is to promote a deeper understanding of the importance of science in our society for students and teachers, and through them, the wider school community.

The program offers significant potential to deliver knowledge of various health benefits of sport and physical activity in real projects in an experiential fashion. The exposure to the creation of knowledge, such as the benefits of sport practices, naturally promotes the sharing of information with their fellow students in informal peer-to-peer exchanges that contribute to a culture of learning and engagement. To quote a year 11 student exposed to a recent study involving new skill acquisition and evaluation technologies ... "it was a blast and I would do it again any day! I've learnt so much and am more interested in the sports science and biomechanical side of things."

The effects of this could be expanded rapidly by developing a suite of such experiential learning exercises and providing these to Australia's teachers through teacher training, newsletters and courses, and web-based communications.

Response to Term of Reference 3: Strengthen pathways from junior sport to grassroots community sport right through to elite and professional sport

- *Examine the capacity of the system to ensure optimal and efficient delivery of the athlete and coach pathway for any given sport.*
- *Recommend the most effective support and recognition for the coaches, officials, umpires, administrators and volunteers who keep our community clubs alive.*
- *Examine how relationships between the Commonwealth Government and National Sporting Organisations, State Sporting Organisations and Australia's peak representative bodies at key multi-sports competitions may be strengthened to deliver better performance outcomes.*

CSIRO Response:

Examine the capacity of the system to ensure optimal and efficient delivery of the athlete and coach pathway for any given sport.

CSIRO believes that that the concepts identified in its responses to terms of reference 1, 2 and 4 may assist the national sports system to operate where any given sport has a limited capacity in terms of the number of officials and experts available. Technology can assist with skill development, performance measurement, rehabilitation, and reporting. This offers particular advantage for remote communities and where participation rates are low or distributed. It is increasingly possible to connect developing athletes, scattered around the country, to the better coaches, (or even to a set of specialist coaches and experts for different aspects of their development), without either party always having to travel far from home – the “virtual institute of sport”.

Performance measurement in elite sport is an important part of competition management. Junior and grassroots community sport often suffer from a lack of officials for performance measurement and information recording. New sports technologies that affordably enable results to be automatically recorded and communicated may have a role to play in assisting the capacity that keeps our community clubs alive. For example, amateur boxing suffers from a small volunteer and club base and typically requires numerous officials to effectively run a fair and safe competition. Recent work to develop textile based impact sensing garments for combat sports has contributed to the development of the AIS amateur boxing automated performance monitoring system (a collaboration between the AIS, PWP Designs (an SME) and CSIRO), see Appendix A.

The system has been used during sparring at the AIS as part of a campaign to monitor and assist elite athletes. A synergistic outcome of this work has been the parallel development of an automated boxing scoring system for use in community sports such as ‘Boxtag’. The research proceeded with the following goals:

1. Development of a unique competitive training edge for elite Australian Amateur Boxers
2. Commercialisation of a system to enable the promotion and talent development of boxing skills in the wider community.
3. Adoption of an automated scoring system that is endorsed by Amateur International Boxing Association (AIBA) [stretch goal]

This work is also assisting to link and develop indigenous and junior sport and encourage new participation in the sport in an environment that is more acceptable to a wider diversity of people [7].

Performance measurement in elite sport is also an important part of sustaining peak performance and rehabilitating elite athletes. Many promising stars never make it due to injury, be it catastrophic failure or over-use. There is an opportunity for innovative measurement and monitoring technologies to enhance the efficiency and effectiveness of the pathways and so protect our developing athletes. Further opportunities exist for assisting with recovery and rehabilitation.

Response to Term of Reference 4: Maintain Australia's cutting edge approach to sports science, research and technology

- *Examine the capacity of the system to ensure provision of cutting edge technology, innovation, sport science, sports medicine, applied research to underpin sport performance and development, including ways to maintain Australia's position as leaders in anti-doping.*
- *Examine the current partnerships in place within these fields and recommend any potential partnerships.*

CSIRO Response:

Sport is increasingly adopting many new technologies from beyond the boundaries and capabilities of traditional institutional sports science. Sports administrators are demonstrating a new willingness to form inter-organisational partnerships to grow their science and innovation base. In general, the research to expose new insights into human performance is becoming increasingly multi-disciplinary and parallels other national challenges. Australia has a significant opportunity to achieve competitive advantage from this trend because it has world leading national agencies in the Australian Institute of Sport (elite sport development) and CSIRO (science addressing national challenges).

Both CSIRO and the AIS have seen this potential and have already begun building the basis for a powerful partnership that could once again put Australia at the forefront of elite sports development. Operating within a constrained budget to date, the AIS and CSIRO have built their collaboration around 2 approaches:

- (i) Addressing big issues and key directions for sport science in the future.

A strategy has been developed and implemented to relate the big issues of sports to cutting edge science and innovation. A structure modelled on the CSIRO Flagship concept is used and lends itself to natural growth, (should future funding permit). The initial 3 big issues programs are interrelated and collect specific sports activities under 'Human Factors', 'Personal Technologies' and 'Smart Equipment'.

Human Factors: developing scientific capability to understand how nutrition, biological variation, and molecular biology impact human function. The focus is on knowledge related to performance management, skill identification, fatigue, and recovery with a drive toward understanding individual performance. Certain activities will be directed at the needs of specific sports, including ways to maintain Australia's position as leaders in anti-doping.

Personal Technologies: addressing performance enhancement with specific regard to the development of new personal measurement methods, feedback, communication and management of information (in real time and over long time periods) for subjects and experts, and informatics related to performance management. The focus is on skill acquisition, skill identification, strategy development, fatigue management, and rehabilitation with a drive toward building, extending and sustaining personal performance. The personal technologies will be applied in a series of case studies that involve field testing in key sports (e.g. in elite

sports such as rowing, athletics, boxing, cycling and team sports).

Smart Equipment: developing equipment for enhanced performance with specific emphasis on exploring design, modelling, new manufacturing methods, linking non-destructive test methods and embedded sensing for in situ measurement of key performance metrics related to human and equipment performance, all validated through case studies that involve field testing in key sports applications (e.g. in elite sports such as sailing, rowing, cycling, kayaking and athletics).

- (ii) A “synergy” program to connect science with sport.

This is a program to specifically connect existing research programs (CSIRO and beyond) to enable these to use elite sport as an opportunity for technology development. This involves prototyping and working with lead users like coaches, athletes and AIS sport scientists, and additional potential market players. The approach is very resource efficient and effective.

In less than 2 years, the synergy program has facilitated a rapid alignment of many CSIRO capabilities with specific sports needs identified by the AIS. This is evidenced by a growing program involving 18 project activities related to sports including swimming, cycling, kayaking, netball, basketball, sailing, boxing and a variety of other team and athletic events. The synergy program is fostered by a “Sports Science and Technology Network” within CSIRO. This program has been extended to include research beyond CSIRO.

The establishment of a strong research alliance, relationships and collaboration models that allow resource sharing is paramount. Since 2006, CSIRO has been developing a strategic partnership with the Australian Institute of Sport (AIS), which in 2008 has led to a co-developed CSIRO research theme ‘*Advancing Human Performance*’. The agreements that are in place enable people, knowledge, and technologies to be accessed, shared and combined to enable fertile collaboration across various organisations with interests related to advancing the frontiers of human performance in a sporting context.

A cornerstone of this structure is that it enables researchers to collaboratively apply their research to sport across organizational boundaries in synergy with their efforts to explore science frontiers and/or address other national challenges. A key part of establishing this structure is the way that the capabilities of each organisation are accessed and how projects are realised within existing administrative systems.

The major collaborators are currently CSIRO and the AIS. Other collaborators such as state sporting institutes/academies, universities, medical research institutes, commercial companies/SMEs have been engaged and continue to be selected to assist in specific areas. The Human Performance and Protection Division of DSTO has also already expressed keen interest in the possibility of contributing to collaborative programs with potential for outcomes of benefit to the Australian Defence Force, and there is the potential to include other research

agencies such as NICTA.

Further avenues relating the initiative to health and rehabilitation are being explored, including technology solutions for people with disabilities. Paralympic sports sit at the interface between the disabilities field and able-bodied elite sports. Our shared vision is that a collection of diverse collaborators may form part of a future Innovation Centre for Human Performance.

There is also potential to expand the Sports Technology Network. AIS and CSIRO have committed to expanding our joint activities to encompass others in the Australian sports and science community with the capability and capacity to contribute to the advancement of human performance with a focus on elite sports. This includes universities and other research organisations. A related aspect is to grow sport research capability through PhD and Post-doctoral programs.

Response to Term of Reference 5: Identify opportunities to increase and diversify the funding base for sport through corporate sponsorship, media and any recommended reforms, such as enhancing the effectiveness of the Australian Sports Foundation.

CSIRO Response:

Innovation requires engagement with industry and commerce. As part of linking technologies from existing industries with sport, the AIS CSIRO collaboration has begun to identify opportunities to explore new avenues of potential sponsorship where there is a new technological contribution to elite sport. Additionally, in creating 'in game' monitoring technologies, such as that used for impact detection in boxing [see Appendix A], novel opportunities are becoming possible for live media broadcast.

A more vibrant sporting industry will also create additional opportunities for diversification of the sporting funding base. One of CSIRO's primary objectives is to develop innovative technologies that can stimulate economic activity in Australia, and it is already clear the research program in elite sports performance can contribute to that objective. Already we have technologies that can be considered for commercialisation in terms of new equipment and knowledge products, and are awaiting and engaging prospective work to connect them with industry. In many cases, it will be innovative SMEs that will adopt and commercialise these technologies.

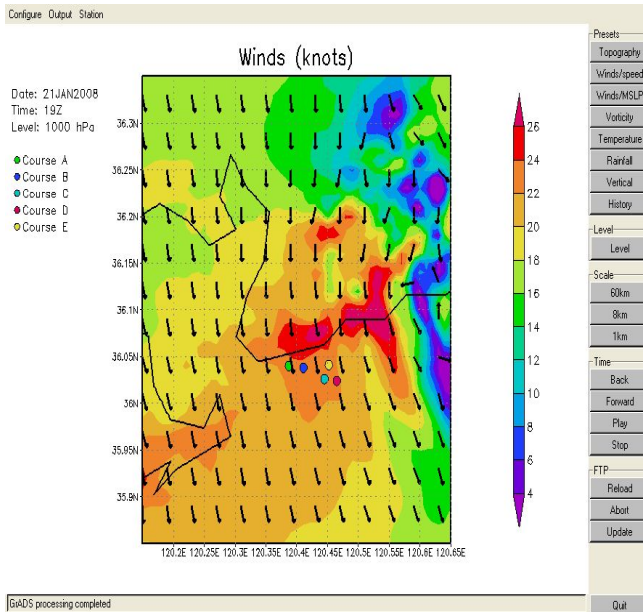
Enabling increased productivity of our sports experts, both sports scientists and coaches, lies at the heart of future delivery of knowledge services in sport. In enabling improvements in the quality of talent management through combinations of regulation and technology, we can potentially keep Australia active and create deeper participants. This may lead to an increase in the wider productivity of the populace through improved health consistent with Government initiatives [9, 10]. It will be necessary to implement productivity measures relating investment, infrastructure, and human resources to sports participation, resource utilisation, health, economic activity, and elite sporting success to understand the impact more fully.

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Appendix A: Sports Technology Case Studies

A1 Ensuring Elite Sports Success: Applying Worlds Best Technology



Unique Weather forecasts for Qingdao

The Australian Sailing Team (AST) System developed by CSIRO is a unique meteorological visualisation tool tailored specifically for the AST following extensive collaboration with the team meteorologist. At the heart of the system is CCAM, a suite of high resolution weather forecasting and visualisation software tools which CSIRO has been developing for a number of national needs. High resolution information is critical in dynamic local environments. The CCAM atmospheric model laptop software represents a very reliable weather forecasting system. Its strength lies in its ability to aggregate myriad data

and display it in a form easily exploited by the team. The sophistication of the AST System means the information, in breadth, detail and timeliness, is far beyond that currently offered commercially.

The experience gained over time, coupled with the detailed output, gives the Australian Olympic Sailing Team the technology to explore typical weather 'scenarios' as part of their training to develop their competitive edge. Commissioned two and half years ago with CSIRO, the sophisticated weather program (nicknamed 'Boris' by the Australian sailing team in 2008) was a secret behind Australia's most successful sailing team since Sydney 2000. 'Boris' provided the Australian sailing team with an unprecedented advantage in the fluctuating conditions of the sailing venue in Qingdao where the team achieved two gold medals and a silver for Australia. To quote Australian sailing team section manager Michael Jones "It's hard to quantify the impact that it had, but it did allow our team to spend less time training and competing because of the data," and Boris was consulted "...right up until they had to turn their mobile phone off before getting on the water to find out what the information was saying".

A2 Maintaining Australia's Cutting Edge: Going Beyond Sports Science



Manufacturing new smart sporting equipment using the technologies from exploration and mining

The knowledge and knowhow of designing, manufacturing and monitoring smart sports equipment draws together a multidisciplinary team spanning computational modelling, materials science, sensors and sensor networks, performance measurement, biomechanics, physiology and elite athletes and coaches. Often this knowledge is already applied across a wide diversity of industries and research in Australia. Combining these skills in sport has the advantages of directly relating the

performance of new equipment to its human counterpart. A key advantage is being able to assemble teams that represent particular sports and the diverse aspects of materials science to identify, predict and measure credible equipment performance advantages and demonstrate these in real sports competitions. The elite training and competition environment brings all these aspects together. Recent progress in the development of advanced materials and sensing technologies contributed to some of the gold medals and personal bests achieved at Beijing. This work is seen as crucial to future competitive advantages in many sports that use specialised equipment, and may have some particular advantages for Paralympic sports.

A3 Engaging Talent: Linking Elite Sports Innovation and Community Sport



Providing an exciting new form of contact sport with innovative technologies.

CSIRO has partnered the AIS and a small Melbourne company, PWP Designs, in a project aimed at developing an automated system for measuring the performance of AIS and other amateur boxers during sparring sessions. Two other Australian SMEs, Hydrix and Catapult Innovations, are assisting with specific elements of the project.

The system is based on a range of sensors incorporated into boxing gloves, head guards, and specially constructed vests. Signals from the sensors are sent by telemetry to a ringside computer. When a glove of one competitor and the target area of the other register simultaneous impacts, a point is registered.

Scores can be displayed on a large screen and viewed by an audience in real time. A stretch goal is for the system to become an official scoring mechanism for international amateur boxing, providing an alternative solution for the judging controversies that have long plagued international competitions, including the Beijing Olympics. Official adoption of the system by the Amateur International Boxing Association would be a major achievement for Australian sports science, and would gain international media attention.

In the meantime, the system has become integral to a modified form of boxing called Box'Tag. The modified sport is being developed by a Sydney SME called Strongarm Boxing & Fitness. The emphasis is on fitness, speed, skill and fun and the sport is being designed to reduce the potential for any harm to an opponent through a novel combination of technology, performance measurement, and rules. It is designed to enable people who have been involved in boxing-related fitness activities to progress to actual competition without significant risk of injury. Under the rules of Box'Tag, impacts above a quite low threshold force lead to disqualification. Impacts to the head are prohibited and incur deductions of points. The automated scoring system gives the sport the feeling of an active computer game and appeals to young people. A leading Australian paediatrician, Prof John Pearn, has provided a glowing endorsement of Box'Tag, describing it as a 'brilliant innovation'.

Box'Tag is currently based at one club in southern Sydney. It is proving quite popular with considerable potential for expansion. Regular competitions have been held over the past 2½ years attracting large numbers of entries. Approximately 40% of the contestants have been women. There is also significant interest from indigenous communities. The Sydney City Council

recently approved funding that will enable 20 young people from Redfern to undergo preparatory training programs to make them eligible to participate in Box'Tag events. Box'Tag training programs are also now run in several NSW schools. There have also been enquiries from overseas groups wanting to start Box'Tag programs. Two BoxTag competitors have now engaged with conventional amateur boxing and have enjoyed early success in New South Wales competitions.

A4 Sharing Knowledge: Applying Elite Sports Innovation in Schools



Exploring innovative interactive technologies for skill development in schools

CSIRO is developing wearable body mapping garments that the Australian Institute of Sport (AIS) is assessing for improving sports performance. A unique advantage of the CSIRO technology is its ability to be used in a diverse range of sports in challenging field environments to both measure and teach skills. In a current project with the Australian netball team, an interactive textile is being used to train goal shooters in automatic rhythms to enable their natural action to remain undisturbed by their conscious thoughts in

stressful situations. The goal is to help netballers synchronise their natural motion with rhythms they recognise. Researchers are hoping to see practical improvements in skills acquisition for netball shooters and then use these tools to work with other sports in the lead up to the Olympic Games in London in 2012.

In parallel to this work, research is being conducted as part of the *Scientists in Schools* CSIRO Student Research Scheme where a skill intervention study using the Interactive Throwing Sleeve has the participation of 4 schools, 6 student assistants and 22 student subjects. The interactive sleeve is placed on the arm of a learner and angular displacement information (movement kinematics) can be recorded and immediately fed back to a learner as auditory feedback. Such technology provides an opportunity to overcome the limitation of previous feedback research and more thoroughly examine the viability of auditory feedback in a sports skill learning context.

A5 Understanding Australia: Measuring the Next Generation

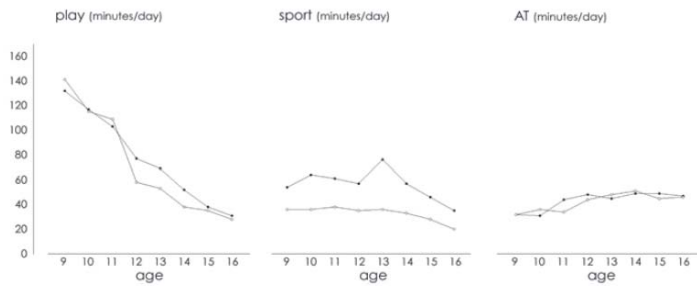


FIGURE 3: Age and gender-related patterns in MVPA and some of its components [free play, sport, and active transport (AT)]. The filled circles represent boys and the open circles represent girls.

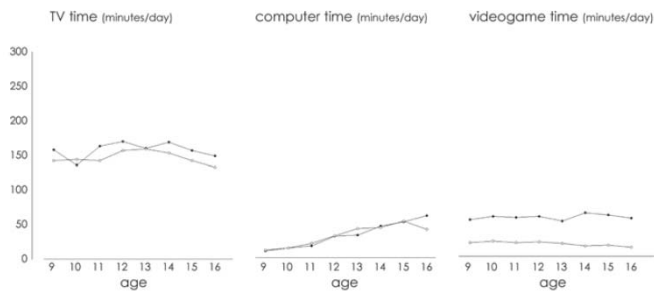


FIGURE 4: Shows age and gender-related patterns in screen time and its components (television, computers and video games). The filled circles represent boys and the open circles represent girls.

*Understanding the balance of physical and sedentary activities;
The 2007 Australian National Children's Nutrition and Physical
Activity Survey, see [5]*

The 2007 Australian National Children's Nutrition and Physical Activity Survey (Children's Survey) was commissioned by the Department of Health and Ageing, the Department of Agriculture, Fisheries and Forestry, and the Australian Food and Grocery Council. Jointly funded by government and industry, the survey is the first survey of its kind to address both dietary intake and exercise. The Children's Survey was undertaken in recognition of the need to have national data on children's weight status, dietary intake and

activity levels for monitoring purposes. This information is also important for assessing the nutritional

adequacy and the physical activity participation of the children surveyed. The CSIRO Preventative Health National Research Flagship and the University of South Australia conducted the survey with I-view Pty Ltd undertaking the survey fieldwork (with assistance from Flinders University).

The report provides important information to help governments, health professionals and the food and beverage industry to understand changes in our children's eating and exercise habits. For example, in recent years there have been significant changes in the Australian food supply and eating habits, an increasing use of technologies that facilitate sedentary behaviour such as video games and the internet; along with a changing family life and structure. All of these factors are likely to impact on what children eat, what physical activity they are involved in, and their bodyweight. The report provides the information needed for public and private sectors to work together to develop targeted strategies to address a range of health concerns in children. It also sets a benchmark against which to measure the impact of health strategies.