Big Data and More at the 2017 Sports Analytics Conference, Australia

Sian V Allen, Will G Hopkins

High Performance Sport NZ, Auckland, New Zealand; Institute of Sport Exercise and Active Living, Victoria University, Melbourne, Australia. Email. Reviewer: Elaine Tor, Victoria Institute of Sport, Melbourne, Australia.

The latest in this now international series of commercially organized symposia was highly successful. Computer Intelligence: count and classify actions in swimming, high diving, tennis, team sports; masters and PhD opportunities. Assessing Individual Athletes: injury prediction at the AIS; talent identification in the AFL. High-Tech and Smart Equipment: insoles, cricket ball, soccer boots, compression garments; Doppler radar at the USOC; Microsoft's golf club, app for golf-shot strategy and golf-club selection, virtual golf course, motorsport technicians' knee pads; mobile apps for soccer and referees; marked-up garments; personalized videos. Analyzing Team Sports: soccer/football, AFL, other sports. Fans and E-sports: entertainment on smart phones; betting; DraftStars, AFL's daily fantasy sport. KEYWORDS: competition, deep learning, elite athletes, injury, machine learning, monitoring, neural net, performance, talent identification, tests, training.

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This one-day conference in Melbourne on August 4 is an annual event that began in Australia just a few years ago and now extends to Asia and Europe. Check out the series website for any forthcoming conference near you, and don't miss it! The website does not name organizing or founding personnel, but it appears to be an initiative of the Vumero Institute, which positions itself as "the world's education company for finance, technology, and data-driven industries." It's hype, of course, but they certainly promoted a winner on this occasion.

We were surprised to find well in excess of 1000 attendees, which speaks both of the success of previous conferences in the series and of the promotion of this one. All presentations were by invitation, and there were no poster sessions or abstracts, so *symposium* would be more accurate than *conference*. About half of the sessions were chaired panel discussions, which were generally less informative than the solo speaker sessions. Slides of at least some of the latter will be available, but when and for whom are not clear. Watch this space.

There were three concurrent streams: "Sports Teams and Leagues", "Brands, Fans and Engagement", and "Sports Technology and Data Science". Some of the presentations were little more than advertisements for the latest products, but it was still interesting to learn about such products and the people who use them. As usual, this report is focused on factors affecting athletic performance, with **sport** and **topic** highlighted. Backgrounds to each of the named speakers (managers and marketers of sports organizations and software companies, experienced practitioners, innovative researchers) are available at the conference website. As in this year's ECSS report, we have highlighted our favorite presentations with Wow!

Computer Intelligence

We've used this term to embrace the synonymous topics of artificial intelligence, neural networks, machine learning, and deep learning. This kind of analysis is the only way forward with the complex **big data** coming from videos and smart wearables. Although there is only one presentation under this heading here, several others summarized under other headings included aspects of computer intelligence. Traditional parametric data analysis, especially mixed modeling, still has a place with small-ish datasets coming from correlational, experimental or measurement studies, but these took a back seat at this conference.

Wow! Laura Anderson set the scene in her opening address when she said "**big data** is the new world order, making the impossible possible". Just how possible was apparent in Stuart

Morgan's session on **artificial intelligence**, in which he gave examples of neural networks that have been trained with deep learning of big data to monitor stroke rate and related kinematics of a **swimming** squad using ultra-high definition 4K video footage, to count and classify dives in **high diving**, and to count and classify strokes in **tennis**, all in real time or straight after a training session. Neural networks can also annotate videos of games with SportsCode-type labels; for example, identifying attacking opportunities in **team sports**. "If a human can interpret correctly what's happening in a complex sport, a computer can, too," he said. The goal is to teach the computer to understand sport, not only to reduce the error rate that occurs with human coding and recording, but also to free up the human to spend more time on higher-order analysis and decisions. Fine, but one of the benefits of manual coding and traditional analysis is that you pick up things along the way and think differently about the meaning of the data. What are the knock-on effects of computer intelligence making this process obsolete? At this stage, it's also unclear how long we will have to wait before computers quantify the highest orders of skill that only an experienced coach can see, such as a swimmer's "feel for the water".

In question time, someone asked how wearable sensors fit in with deep learning from videos. Stuart replied that the sensors can help with training a neural net to correctly classify and quantify movements, and the neural net can then be used on videos in settings where wearable sensors do not work or are not permitted.

If you are just starting out in a research career and are interested in such issues, you should sign up either for the [master's degree in sports analytics](#) under Stuart at La Trobe University, or for one of his three PhD scholarships there. If we didn't already have PhDs, we wouldn't hesitate.

Assessing Individual Athletes

Wow! **Injury prediction**, permitting intervention before lost training time adversely affects performance, was the key driver for physiotherapy-trained Michael Drew's interest in analytics. Data collected through the Athlete Management System at the Australian Institute of Sport (AIS) have since yielded population insights (e.g., athletes completing ~80% of planned training have greater chance of achieving performance goals) that triggered system-wide policy changes, and individual insights through machine-learning models that allow ongoing adjustment of **athlete** training loads. Adding qualitative data sourced through text analytics (e.g., subjective wellness, medical opinions) to the quantitative data (e.g., injury history, test scores) "transformed the predictive capability" of the algorithms.

Wow! John Quinn, head of academy and talent identification at **AFL** (Australian football league) team the GWS (Greater Western Sydney) Giants, gave the most inspirational of the talks we saw. He was emphatic about the wastage of future talent that occurs with the current emphasis on talent selection (of kids who already have talent), as opposed to **talent identification** (finding and retaining kids who will develop talent). He had strong ideas about the best kinds of tests (e.g., the Yoyo, not the beep), and he has benchmarks for the tests that focus on conditioning, skill, "footy IQ", and attitude (which he called "grit and passion" and which he thought you could not coach). He was particularly keen on the role of perceptual skills of visual search, information processing, and expectation, all of which he thinks *can* be coached. Gazing into his "crystal ball", he sees exciting futures for quantifying such skills, along with virtual reality, holograms, nanotechnology, drones, and pattern recognition/analysis.

High-Tech and Smart Equipment

Wow! Tino Fuss of the Centre for Design Innovation at Swinburne University included original data in his presentation on **smart equipment**, including **insoles** (better than the current gold standard insole and a fraction of the cost), **cricket ball** (just the one so far, capable of quantifying spin but not yet fully impact resistant), **soccer boots** (which identified the "sweet spot" and nearby "dead spot" for kicking goals), and **compression garments** (capable of quantifying muscle, joint, and amazingly, even ligament forces). At times we were overwhelmed with complexities, but it was clear that validation of these smart new devices was paramount. Keep tabs on Tino and his team.

In between making us envious of the world-class facilities and climate available to US Olympic athletes at his Chula Vista base, US Olympic Committee head of sports technology, Phil Cheetham, outlined his philosophy on the role of **technology** in **high-performance sport**. The gospel according to Phil: technology must provide immediate and straightforward feedback, be accessible enough to permit remote

coaching, be invisible to the athlete (not interfere with their training), and be accurate (i.e. "not say more than can be said truthfully"). The Trackman **Doppler radar** system he uses for tracking trajectories of **shot put** throws ticked all the boxes, allowing him to work with the men's 2016 Olympic gold and silver medal winners to optimize their angle, speed, and height of release.

Anton Davie walked us through several of Microsoft's "digital-transformation partnership case studies", including a **smart club** for **golf** (capable of quantifying grip position and pressure), an app that provides personalized **shot strategy** and **club selection** recommendations for almost any golf hole in the world, and a mixed reality headset allowing golfers to customize their experience by "dropping a virtual ball" anywhere on a given **course**. **Motorsports** also got a look in: impact and contact time data collected from **sensors** in the knee pads of tyre changers have been used to train machine-learning algorithms predicting crew fatigue, saving precious pit-stop fractions of a second. **Team-sports** enthusiasts should keep their eyes peeled for the roll-out of the Microsoft Sports Performance Platform, developed in collaboration with Seattle Reign football club, which uses deep-learning algorithms to integrate all manner of monitoring and performance data into real-time **player readiness** scores. Cognizant of the changing role of sport analysts in a future with greater automation of data collection and prediction, Anton finished with a call-to-arms of "more data scientists with greater sport-specific knowledge".

Those who stuck around for the closing session on start-up and early-stage sports tech commercial developments (aptly dubbed "game changers") were treated to some impressive 4-min sales pitches from five budding entrepreneurs, competing for an AU$35,000 investment package. Ideas included: two **mobile apps** for **soccer**, one providing instant feedback on **kicking** speed, curve and accuracy, the other helping **referees** to record match data digitally; **garments** with anatomical markers for motion analysis; a **platform** allowing users to brand and personalize video content; and the winner, artificial intelligence software for **soccer**–see below.

Analyzing Team Sports

Wow! Well-deserved winners of the sports-tech start-up prize were the developers of Flixsense,

a seriously impressive **automated-analysis** system for **soccer**. It uses artificial intelligence to recognize and classify faces, objects and actions in real time, providing coaches and fans with **live game statistics**. Future functionalities include using facial recognition software for early detection of fatigue and injury risk through monitoring in-game changes in player expressions. Mind-blowing, if it works!

Wow! Ross Munro strutted the stuff on offer from his "broadcast solutions company", Vizrt. Really impressive was Viz Libero, the **analysis product** used by FIFA and the biggest clubs in the European **football** league: it offers built-in player tracking, integration with Opta statistics, and most amazing of all, "virtual flights" between camera views that allow bird's-eye, player's-eye, linesman's-eye, and goalie's eye views of the game. (It was noted by more than one speaker at this conference that the coach's view from the sideline is too limiting.) You will also be seeing local advertising signage overlying the originals in international games, thanks to their Eclipse and Arena packages.

Darren O'Shaughnessy, an analyst/consultant for the **AFL** Hawks, was big on removing the component of **luck/chance** from game statistics to get the contribution of **skill** in "expected goals", which you *can* do something about. So, the elite athlete or coach should not make adjustments following a bad move, shot or unforced error that is a result purely of natural variation. In using data to support decisions, he made the following points: have an evidence-based culture and a framework to evaluate on-field actions; engage in "counterfactual analysis" ("what if…"); record and evaluate, don't just count; and to avoid "dichotomania", grade rather than dichotomize outcomes. On the topic of support for live decisions (during matches): don't let coaches design the interface; limit the use of color to important alerts; use an algorithm to prioritize the most important things; and be aware that reacting to short-term data is usually counter-productive.

Advocating for a paradigm shift in **performance analysis** in **soccer** from "games coded" to "insights created", Doug Kors (head of football analysis, Sydney FC) encouraged analysts to help coaches and players make better informed decisions, and also to provoke questions as opposed to trying to answer them. His mission–to provide insightful information in an effective

and efficient manner–is currently being assisted by Hudl, software that allows analysts to rapidly tag, annotate and push clips directly to players' mobiles, facilitating remote and immediate interaction. Among Doug's wishlist for the future: technology permitting pitchside delivery of real-time game analytics, along with an automated filming and coding system.

A panel of four **high-performance team-sports analysts** (Vince Kelly, Eric Hollingsworth, Eliza Keaney, Eoin Toolan) offered the following opinions: monitor "pressure" in the days between games; don't give the coach things they don't understand; make data collection compulsory; importance of video analysis in games where wearable technology is prohibited; importance of wearable technology in rehabilitation; importance of considering ethical implications of technological advancements, such as implanted athlete-monitoring chips; rugby union is at a crossroads (in trouble) with recruiting talent; virtual reality will provide more training time without the physical stress; and finally, keep up to date by collaborating with a university, by bringing in data experts from other disciplines, and by bringing in young people. With 5 min remaining for questions, someone asked about the role of data analytics in anti-doping; disappointingly, one of the panelists spent the whole time giving his unrelated opinions on doping generally.

Fans and E-sports

The topic of the panel discussion with three CEOs of **Australian sports** (Marne Fechner, Jeremy Loeliger, Jason Hellwig) was "embracing sports tech and innovation". Key points: sport is first and foremost an **entertainment industry**; in the current cluttered and competitive sports environment, ask what the fans really want from your sport; put the fan at the center of all decisions; and the new generation of fans wants short clips on mobile phones, not full games on big screens.

If you are interested in sport as an **online fan**, you should check out Nathan Rothschild's Genius Tech Group, which specializes in providing "tiered and layered offerings" for the broad spectrum of fans in the "wagering space" of online betting, as well as for in-venue, broadcast, and e-sport fan engagement. The latter, in particular the **AFL**'s entry into daily **fantasy sports** with DraftStars, was the topic of the manager of commercial operations of the AFL, Darren Birch. He thinks Australia could eventually match the US's staggering 20% of the population that engages in such self-indulgent trivial pursuits (not his words). Fantasy sports apparently increase online engagement with (i.e., increase profits for) the real thing. Our reflection: is the increasing popularity of fantasy sports a sign of progress or decadence? Who cares, it sells stuff.

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