

A constraints-led approach to analysing performance in team-based sport

by William Sheehan

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under the supervision of Prof Mark Watsford, Dr. Job Fransen, &
Dr. Andrew Novak

University of Technology Sydney
Faculty of Health: Sport and Exercise

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Certificate of Original Authorship

I, William Sheehan, declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Health at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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William Sheehan

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Date Submitted

Preface

This thesis is written as per the requirements of the degree, Doctor of Philosophy and published according to the “Thesis presentation and submission” guidelines. The manuscripts included in this thesis are logically progressive in nature and form a body of work that encompasses the analysis and investigation of multiple components of performance in professional Australian Football.

The data collected during this candidature and associated research methodology has resulted in six manuscripts being accepted for publication with one more manuscript currently being reviewed by a peer-reviewed journal. The Introduction section provides a brief background of the current state of the literature in Australian football, defines the research problem, and outlines the aim and purpose of each study. As outlined in the introduction, unlike other contextually similar sports such as soccer, there are significant shortcomings with the application of tactical analysis methods in professional Australian football. Accordingly, the literature review utilises soccer as a medium to provide a synopsis of the current available literature on the current methods for analysing tactical behaviour in team-based sport. The subsequent chapter describes, in more detail, how the methods identified in the literature review will be applied in an Australian Football context and subsequently used in the ensuing studies. The next seven chapters encompass the manuscripts which are presented in a logical sequence that specifically address the research problems outlined in the Introduction. Each manuscript in chapter four to chapter ten is presented as per the guidelines of the peer-review journal in which they were submitted. Next, a General Discussion chapter provides a synopsis of the findings from the various manuscripts. Practical recommendations are provided to exemplify the real-world relevance for coaches, sport scientists and performance analysts. The limitations and delimitations of the current work is also discussed. The final chapter, Summary & Recommendations offers an interpretation of the collective findings resulting from the thesis. Finally, suggestions of future research are provided in light of the findings in this thesis.

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List of abbreviations

AFL - Australian Football League

AIC - Akaike's Information Criteria

CFI - Comparative Fit Index

CI - Confidence Interval

CV - Coefficient of Variation

FIFA - Fédération Internationale de Football Association

GNSS - Global Navigation Satellite Systems

GPS - Global Positioning System

ICC - Intraclass Correlations

IMA - Inertial Movement Analysis

IQR - Inter Quartile Range

KMO - Kaiser-Meyer-Olkin

KPI - Key Performance Indicator

LPS - Local Positioning System

OR - Odds Ratio

PCA - Principal Components Analysis

PNFI - Parsimonious Normed Fit Index

RHO - Cluster Phase

RMSEA - Root Mean Square Error

SaEn - Sample Entropy

SEM - Structural Equation Modelling

SRMR - Standardised Root Mean square Residual

SSG - Small Sided Game

TEM - Technical Error of Measurement

UEFA - Union of European Football Associations

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Abstract

While substantial information is available on the physical and technical components of Australian Football, objective methods of assessing the tactical demands have been scarcely examined. Despite enhancements in the quantity and quality of data available for assessing the technical, physical and tactical characteristics of match-play, it is not common to combine these when analysing professional sport. To overcome these shortcomings, this thesis aimed to simplify an array of physical, technical, and tactical variables utilised in Australian Football to simultaneously examine differences in successful quarters as well as specific phases-of-play.

Studies one-four reduced the dimensionality of cooperative network (*study one*), technical (*study two*), physical (*study three*), and spatiotemporal (*study four*) characteristics obtained from Australian Football League games in order to facilitate their practical use and interpretability. Principal components analyses provided simplified metrics that assisted in the reduction of complexity when analysing and interpreting multiple facets of performance while retaining a high level of variance. These metrics were subsequently used in studies *five-seven*.

Study five concurrently examined the influence of the aforementioned components on quarter margin. *Scoring opportunity* and *ball movement* had direct associations with quarter margin. Further, negative associations between *physical behaviour* and *ball movement* suggest that with less physical work, a team's collective ability to transfer possession between teammates is facilitated, offering an interesting dichotomy between skill and physical loads in Australian Football.

Study six differentiated between phase-of-play using duration, physical, and spatiotemporal properties subsequently providing new insight for coaches and providing direction for conditioning and practice design. Offensive and defensive phases presented greater *low-moderate volume*, defensive phases revealed stronger affiliations with *decelerations/impacts*, and contested phases demonstrated superior *explosiveness* and *change of direction* likely leading to lower values of synchrony and coordination. Interestingly, contested phases were strongly associated with *high-speed* metrics which may be due to players attempting to enhance positional advantage to gain possession.

Finally, *study seven* related phase duration and physical and spatiotemporal metrics with successful outcomes across various phases-of-play. Results indicated that a direct style of play with players moving erratically and unpredictability to misalign defenders or provide passing opportunities may be important for offensive success. In contrast, defensive success may be a result of players slowing movement to coordinate and synchronise movements to avoid being perturbed. The collective results from this sequence of studies provide direction for coaches and practitioners when contemplating practice design, tactical strategies, or the development of behaviour through specific training exercises.