



**DEFINITIONS OF PERFORMANCE INDICATORS IN
REAL-TIME AND LAPSED-TIME ANALYSIS IN
PERFORMANCE ANALYSIS OF SPORTS**

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A DISSERTATION

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Abstract

Performance analysis is an objective method of gathering the data of performance, and generally transforms these observations into numerical data. Performance indicators, as well as a selection or elements of successful outcome, have often been used in order to feedback augmented information in performance analysis systems, but they have rarely been considered within the classifications of performance analysis systems based on timing of analysis and feedback. The main aim of this study is to investigate performance indicators used within real-time and lapsed-time systems so that the definitions of the performance indicators, the effectiveness of the performance indicators, their reliability and validity within real-time analysis systems can be analysed.

In this research, there were four main studies :-

Design and test real-time and lapsed-time notation systems for basketball; evaluate different quantitative methods of assessing reliability of such real-time systems, evaluate different quantitative methods of assessing the relative importance of the different performance indicators in performances and relating these to game 'state' rather than the end result, and evaluate the effectiveness of real-time and lapsed-time notation systems for basketball both quantitatively and qualitatively. Particularly, a

basketball system and data were used to investigate the condition of using real-time data, reliability issues and its effects within the real-time feedback process as an exemplar sport, but similar analyses of tennis data demonstrated the generic applications of this approach.

Consequently, this study found that the performance indicators within the real-time analysis systems should be considered with rationality and objectivity. For the real-time data gathered by the basketball analysis system, a particular reliability test, kappa, conformed to the construct validity within the prescribed range of agreements in inter-operator reliability tests. The valid range of performance indicators were found to be different for segments of performance, (quarters in basketball, sets in tennis) compared to those defined by whole match outcomes – this was again demonstrated in both tennis and basketball. An attempt to define an optimal set of performance indicators found through statistical tests (using neural networks, multiple linear regression and principle components analysis) has been presented and further analysed qualitatively, using interview techniques with an elite basketball coach. Multiple linear regression models based on performance indicators with the highest criterion validity had the highest prediction accuracy (92.25 %). There is little benefit to using more than 10 performance indicators within the current exercise as a stable prediction level was

found when using 6 to 9 variables. Thus, the reduced set of action variables, commonly performance indicators, would be used in real-time analysis systems where the indicators were found in statistical methods. The interviews of coach have pointed out the validity of the performance indicators, qualitatively, such as locations of shots, movement patterns of opponents, 2 point shots %, 3 point shots %, free throw %, total rebounds, scores and personal fouls. In addition, some of the selected performance indicators by the coach were descriptive indicators - such as how well the defenders block the key scores.

Finally an attempt to measure the effectiveness of these performance indicators was made quantitatively and qualitatively. Different types of feedback were given to a basketball team at half-time using the performance indicators identified in the previous study. Statistical comparisons were made between the first halves and second halves and grouped by the types of feedback. A qualitative assessment of their worth was also made by interviewing the coach after each match throughout the season. The statistical tests did not confirm the effectiveness of use performance indicators in real-time analysis systems, the 2 points attempts was the only significantly difference on the 'one-way feedback' model between before and after the feedback using the performance analysis, and this was a deterioration of performance. On the other hand, the scripts of

interviews contained the details of effectiveness of using performance indicators in the real-time analysis systems. Especially, the data feedback in real-time has been used within many purposes in the coaching such as confirmation of its observations, information of the game situation, oppositional analysis and educational tool to players with visual impact.

Consequently, it was concluded that performance indicators for real-time and lapsed-time systems have to be chosen by scientific methods in order to ensure that these variables are selected with rationality and objectivity. The scientific methods for the performance indicators for real-time and lapsed-time analysis systems are concerned in rationalised data sets, optimal set of performance indicators, effectiveness of use the performance indicators selected and their reliabilities. In addition, the way to reduce the limitations of real-time and lapsed-time systems should be considered within the development of data entry structures addressing ergonomic issues and cooperation between coach and analysts.

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