

Institution: Lancaster University

Unit of Assessment: 19, Business and Management Studies

Title of case study: Improving Scheduling and Efficiency in Sporting Leagues.

1. Summary of the impact

Professor Wright has developed practical scheduling implementations for sports fixtures and officials, with regular clients at both professional and amateur level in the UK and abroad, including the England and Wales Cricket Board and the New Zealand Rugby Union. His expertise also supports 'what if' exercises, enabling clients to experiment with new ideas and announce changes with confidence that they will work in practice. His work has resulted in financial gains, substantial savings in skilled administrative time and high satisfaction for stakeholders. His research has potential reach across numerous sports, at all levels across the world.

2. Underpinning research

Professor Wright has undertaken research into algorithmic methods for solving scheduling problems for more than twenty years at Lancaster. Most of his work involves the application of metaheuristic techniques; these are sophisticated computer algorithms designed to solve combinatorial problems which are too large and/or too complicated to be solved exactly to a guaranteed optimum solution. The scheduling of fixtures and officials for sporting leagues fits into this category of problem in all but the simplest of cases.

Defining the problem and research insight:

The research has built on standard metaheuristic search techniques in a number of ways. Initially the problems must be well defined and formulated, and this is often far from trivial and necessitates a very close understanding of the issues at stake. Paper 3 in Section 3, for example, describes how the problem was formulated bearing in mind one of the most important considerations, regarding travel and the combination of matches played at some distance from a team's base. This enabled the production of schedules that were considerably more satisfactory than those that could have been produced by any 'off-the-shelf' method.

Much of the other literature in the field is wholly theoretical in nature and can only be applied to simple cases. Other researchers have written about practical studies, but none to this extent. Moreover, while commercial packages are available to help timetablers or those allocating sports officials, these can only produce schedules for very simple cases; otherwise they merely help administrators to input and check their own decisions, rather than proposing whole timetables and schedules for them. In all cases, a major reason for the success of Wright's work is the close contact he keeps with clients, ensuring that the results produced by the computer system are geared as closely as possible to the clients' needs (this is discussed in some detail in Paper 2, among others).

Problems of this type involve the evaluation of many and varied criteria in order to come up with an overall evaluation of the quality of a schedule. Thus it is an important task to determine the relative 'costs' of the many different objectives. These objectives must be set in a way that not only reflects the priorities of the stakeholders, but also ensures that the eventual approach selected will result in very good outcomes - which is not the same thing. In some cases, Wright has found it necessary to introduce the idea of 'catalytic' elements of cost whose sole purpose is to enable the solution technique to work more effectively.

Thus the overall 'cost' of a solution is made up of several 'subcosts' – however, standard techniques ignore this fact and treat the overall cost as if it were homogeneous and not decomposable. Wright came up with the idea of using information regarding the subcosts to guide the search intelligently. He proposed this idea in two papers (papers 4 and 5), and reported on the results of experiments which demonstrated the value of this approach for sports scheduling and other types of problem. Another feature of the solution approaches used is the use of 'neighbourhoods', consisting of

solutions very similar to the current solution for a given problem. The construction of these neighbourhoods can impact significantly on the quality of the eventual outcomes in terms of practical schedules. Wright's research has highlighted this important point, for example in Papers 1 and 6, and a [paper in progress](#) takes this analysis further by proposing a new classification of neighbourhood 'perturbations' which may be much more widely applicable, since neighbourhood search approaches are used across a very broad variety of optimization problems.

In recent years the work has been extended significantly into the area of 'what-if' analyses, where the scheduling system can be run on a variety of scenarios. The testimonial from the England and Wales Cricket Board corroborates the value of this for the customers, and this issue also forms a major part of the work reported in Paper 1.

An earlier paper by Wright on scheduling English cricket umpires was reprinted in 2000 by the Journal of the Operational Research Society as one of only twelve papers to mark the Society's 50th anniversary.

3. References to the research

This research has been published in the following peer-reviewed international journals and book chapter:

1. Johnston, M. and Wright, M.B. (2013) 'Prior analysis and scheduling of the 2011 ITM Rugby Union Cup in New Zealand', *Journal of the Operational Research Society*: 1-9
2. Wright, M.B. (2007) 'Case study: problem formulation and solution for a real-world sports scheduling problem', *Journal of the Operational Research Society*, 58(4): 439-445.
3. Wright, M.B. (2006) 'Scheduling fixtures for Basketball New Zealand', *Computers and Operations Research*, 33(7): 1875-1893.
4. Wright, M.B. (2001) 'Subcost-guided simulated annealing', in Ribeiro, C.C. and Hansen, P. (eds.) *Essays and surveys in metaheuristics*, Boston: Kluwer Academic Publishers, chapter 28, pp. 631-639.
5. Marett, R.C. and Wright, M.B. (1996) 'A comparison of neighborhood search techniques for multi-objective combinatorial problems'. *Computers and Operations Research*, 23(5): 465-483.
6. Wright, M.B. (1994) 'Timetabling county cricket fixtures using a form of tabu search', *Journal of the Operational Research Society*, 45(7): 758-770.

4. Details of the impact

The research described in Section 2 has led to pioneering and world-leading impact upon sports competitions, and has been greatly welcomed wherever it has been implemented, whether by Wright himself or by clients acting under his guidance. The reach in terms of the number of people (players, officials, managers, spectators, TV viewers, etc.) who have already been positively affected by this work is substantial and widespread. The algorithms mean for example, that TV companies know they will be offered a schedule that matches and fits in closely with their requirements, which generates substantial revenue.

Wright's what-if analyses of the proposed 'Twenty-20' county cricket competition helped to ensure that it could be introduced successfully in England in 2003 without the need for any kind of pilot programme. As a result of its success, the concept has since spread worldwide to competitions including the [Indian Premier League](#), valued at \$4.13 billion, and the [ICC World Twenty20](#), with matches attracting up to an estimated 1.4 billion TV viewers.

Impact on Fixture Scheduling

The England and Wales Cricket Board:

Wright has been working with the England and Wales Cricket Board (ECB) for over twenty years. The impact of his work on fixture scheduling is corroborated by the Head of Operations for First-Class Cricket at the ECB who writes that, 'from the very earliest starting point to the final publication of the fixture list, Mike's close involvement is essential. The 2010 season would be an excellent

example; we have reduced the number of competitions from 4 to 3, changed the format of 2 of the competitions resulting in more matches, begin the first year of a new broadcast contract with BSkyB, will stage neutral Test matches for the first time, and are required to finish the season 10 days earlier than in 2009.'

New Zealand Rugby Union:

Together with a colleague from Wellington, Wright produced the fixture schedule for the ITM Cup for New Zealand Rugby Union (NZRU). The Rugby Operations Manager for NZRU corroborates that the impact, *'can be best illustrated by the fact that despite the many challenges with the new format and the condensed window in which it could be played in 2011, the competition was regarded as a great success by all key stakeholders in the end of season review that year. Further, it led to the unlikely situation of two of the midweek matches being retained for the 2012 season.'*

Impact on Umpire Scheduling

The England and Wales Cricket Board:

With regard to umpire scheduling, i.e. the allocation of umpires to specific matches throughout a season, Wright has also been working with the ECB for more than twenty years. The Umpires' Manager at the ECB suggests that *'The 2012 season is a good example to illustrate the adaptability and functionality that is required by Mike as this includes the period while the London Olympic Games are occurring and it was essential that the planning of the umpire appointments minimised the disruption this major event could potentially cause.'*

The Devon and Home Counties Cricket Leagues:

Wright has also provided computer systems for use by the Devon Cricket League (DCL) and the Home Counties Premier Cricket League (HCPCL) under his guidance and support. The Appointments Officer at the Devon Association of Cricket Officials states that they *supply '720 umpires for 360 fixtures in the DCL, and these appointments are actually produced in about 4 minutes!! ... It saves a huge amount of time, and contributes greatly to the umpire appointing process.'* The League Secretary at the HCPCL concludes that *'with the more recent demands of both the clubs and the umpires to cut travelling costs, your programme addressed this situation in our trial season (2011) and I am sure that it will provide more savings this season now that we have been able to regionalise appointments with one of our criteria being to cut down on travel.'*

Impact on sporting fixtures and stakeholders:

The benefits of this work include financial gains, substantial savings in skilled administrative time and high satisfaction among many sets of stakeholders, including administrators, managers, players, umpires and spectators:

'What-if' runs enable tournament administrators to examine a variety of ideas concerning possible modifications to the timetable structure every year, trying out all sorts of different structures to satisfy fast-changing sporting and commercial imperatives. Administrators at a professional level need not spend a great deal of time preparing schedules for themselves and therefore their time is freed up for more strategic considerations. Amateur administrators are also saved a great deal of time, reducing the danger that the administrative burden may be so onerous that nobody will take it on and the competition will cease to exist.

Travel expenses and time can be substantially reduced for both teams and officials, without compromising on other objectives relating to quality – this is especially important at amateur and semi-professional level, where such expenses can threaten the viability of a competition and major travel-time requirements can make it hard to recruit new officials.

Clubs are able to schedule other events (such as concerts) at their grounds in the confidence that this will not unduly upset the timetable. They can avoid clashes with other important local events and play their matches on the most advantageous days of the week, so as to maximise attendance receipts. This also benefits spectators, who are offered a good balance of home fixtures to watch. TV companies know that they will be offered a schedule of matches that fits in very closely with all of

their requirements and preferences, thus giving a good service to viewers as well as increasing advertising revenues; also sponsors can be sure that the competitions will be well structured and stand a good chance of reaching a climax in the final slot, which increases spectator interest as well as enhancing the image of the sponsors. This high-quality service to TV companies and sponsors gives the competition's administrators a strong negotiating hand, thereby increasing the amount of money in the sport.

Officials are given an appropriate balance of matches of different types, at different levels and at different times during a season, thus ensuring that standards are maintained, that new officials get the breadth of experience that they need and that officials perceive their duties as fair and well-constructed. In addition, a good balance of teams and colleagues is provided to officials, thus improving their visibility, enhancing perceived fairness and improving experience all round not just for the officials but also for clubs and their players.

The potential reach of this approach extends to all sports, at all levels across the world, from highly prominent competitions such as the English Premier League right down to the smallest local amateur competitions.

5. References to corroborate the impact

Testimonials:

1. Head of Operations (First-Class Cricket), England and Wales Cricket Board (2010), corroborates the use of this scheduling approach, including details of its contribution for the 2010 season.
2. Rugby Operations Manager, New Zealand Rugby Union (2013) corroborates that the scheduling of the 2011 season under very difficult circumstances was regarded as a great success by the key stakeholders and resulted in an unexpected policy change regarding the 2012 season.
3. Umpires' Manager, England and Wales Cricket Board (2012) underlines the value of the umpire scheduling work, giving an example that it helped to minimise any disruption that might have been caused by the 2012 London Olympics.
4. Appointments Officer, Devon Association of Cricket Officials (2012) corroborates details of the valuable contribution made by the umpire scheduling system.
5. League Secretary, Home Counties Premier Cricket League (2012) corroborates the value of the umpire scheduling system, particular towards the cutting of travelling costs.

In the media:

6. 'Crossover bids work well for Turbos', Manawatu Standard, available at: <http://www.stuff.co.nz/manawatu-standard/sport/4386504/Crossover-bids-work-well-for-Turbos>, 25th November 2010. This relates to work on the 2011 ITM Cup in New Zealand, with a reference to 'a professor from England', i.e. Wright. Other articles referencing the results obtained from the work include: <http://www.stuff.co.nz/sport/rugby/provincial/4377467/Provinces-to-select-crossover-matches-for-NPC>, 23rd November 2010
<http://www.stuff.co.nz/sport/rugby/provincial/4381958/ITM-Cup-crossover-match-ups-determined>, 24th November 2010