A Perspective on Bridging the Gap Between Theory and Practice in University Timetabling

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Abstract. The study of the relationship and interaction between the work carried out in the academic literature and the requirements of university administrators is essential if ideas generated by research are to benefit every-day users. Conversely, it is crucial that the needs of the timetabling community influence the direction taken by research if high-quality practical solutions are to be produced. A main objective of the work presented here is to provide up-to-date information which will enable researchers to further investigate the area of timetabling research in relation to the generation of robust and flexible techniques which can cope with complexities experienced during implementation in 'real world' scenarios. Furthermore, although not discussed here in detail, it is essential, from a commercial perspective, that these developed leading edge techniques are incorporated and used within general applicable timetabling tools. The aim of this paper is to motivate the discussion required to *bridge this timetabling gap* by bringing timetabling research and educational requirements closer together.

1 Introduction and Context

In the recent international review of Operational Research in the UK (commissioned by the Engineering and Physical Sciences Research Council), a major identified weakness in the current approach to Operational Research is described as follows [50]:

> ... a gap still remains between the output of a successful research project and what is needed for direct use by industry.

In general, the area of educational timetabling is one such area. Our research-based spin-out company, eventMAP Limited, has an important role to play with respect to this 'gap' as it is in a unique position to integrate leading edge research techniques with the requirements of the user base in the provision of timetabling solutions. One of the primary overall aims of the company is to specify software which acts as an enterprise resource planning tool as well as a management information service, informing on strategic ways forward for the need for, use of and allocation of resources within an institution. A major aspect of the adopted strategy for achieving this is to highlight the important aspects of institutional

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requirements to researchers in the field while updating algorithmic techniques within the software, thus enabling research solutions to be produced which are both workable and of a high quality. The intention of this paper is to focus on the initial part of the strategy by reporting on the needs of educational institutions from a practical point of view in terms of two main areas where timetabling is required, i.e. examination and course timetabling. In each area, a number of challenges are detailed which are based on the author's experience of working in the area from both an academic and practical view point. It is stressed that these challenges certainly do not represent all of the issues that require work from researchers, rather they represent a selection of key themes which, in the author's view, will help bridge the identified gap and move the area of educational timetabling to a new level both in research and practical terms.

2 Examination Timetabling

The examination timetabling problem, studied in numerous papers in the PATAT conference series [15,16,22,40,61], is characterized by a set of students taking a set of exams over a specified time period within the context of various constraints. The quality of the timetable is normally measured as a function of best spread of examinations per student though some notable exceptions do occur [8,70]. Various algorithms have been used with their effectiveness being measured in relation to a standard set of benchmark data. An up-to-date review is provided in [72]. In addition to the PATAT Conference series, many papers have been published on specific techniques along with reporting of various surveys [37,76]. It is worth noting that research in this area has been instrumental in the continued development of the field of search methodologies and, in particular, metaheuristics. Although it is not intended to provide a general commentary on the approaches adopted to date it is possible to argue that the nature of the gap between research and practice has not been aided by the simplicity of the current datasets, e.g. the lack of substantial benchmark data with sufficient room, constraint and solution modelling data. It is expected that the release of six new datasets [30] along with a dedicated web service to the research community via the web site at `http://www.cs.nott.ac.uk/~rxq/data.htm` will go a long way to remedying this situation. This service will also act as a repository of information relating to techniques and solutions generated and will enable researchers to easily and accurately test and compare approaches.

EventMAP Limited released the latest version of its flagship examination product, $\text{Optime}_{\text{xam}}$, in January of 2006. An earlier version of the software was presented at the PATAT conference in Konstanz, 2000 [61]. The additional functionality made available through this new version will be discussed at the conference during a software presentation [23]. In general, the aim of improving $\text{Optime}_{\text{xam}}$ is to make the system as intelligent and intuitive as possible, providing maximum information to the institutional administrator, allowing informed strategic and managerial decisions to be made. This has been achieved through the inclusion of the user in all stages of the 'examination modelling' process. It