# Optime: Integrating Research Expertise with Institutional Requirements

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## 1 Introduction

EventMAP Limited was formed in 2002 to exploit the commercial potential of scheduling research carried out by the Automated Scheduling, Optimisation and Planning (ASAP) group at the University of Nottingham. The focus of the company is to develop, market and sell examination and course scheduling software into the worldwide Higher and Further Education Sector. We have implemented our systems in Europe, Australia and America. The decision to form a company followed the identification of the obvious market need for a high quality software solution to the scheduling difficulties experienced within the educational sector.

In January 2006 the Company released version 2.5 of the company's flagship examination product, Optime. An earlier version of the software has been presented at an earlier PATAT conference in Konstanz, 2000 [1]. In this paper we discuss the additional functionality made available through version 2.5. The company is in a unique position to integrate leading edge research techniques with the requirements of the user base in the provision of examination timetabling solutions. In the recent international review of Operational Research in the UK (commissioned by the Engineering and Physical Sciences Research Council) [2], a major identified weakness in the current approach to Operational Research is described as follows, "*a gap still remains between the output of a successful research project and what is needed for direct use by industry*" [2]. One of the primary aims of the current efforts by EventMAP Limited is to reduce this gap in relation to examination and course timetabling software. The strategy for achieving this is to highlight the important aspects of the institutional requirements to researchers in the field while continually updating algorithmic techniques within the software, thus enabling solutions to be produced which are both workable and of a high quality.

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In general, the aim of improving Optime is to make the system as intelligent and intuitive as possible, providing maximum information to the institutional administrator, allowing him/her to make informed strategic and managerial decisions. The following details the additional functionality available in Optime version 2.5.

## 2 The Algorithm

The new version of Optime enables the algorithm to be varied depending on the characteristics of the dataset. From observing the relationship between solutions actually used and the characteristics of underlying datasets, it has been concluded that this functionality allows greater institutional control over flexibility within the solution. These observations are the result of a close working relationship with five principal users in the UK and is currently the basis of further research [3]. Currently the combinations of algorithmic structures available are Saturation degree (Heuristic Method) [4], Adaptive [5] and Great Deluge [6] during an additional improvement cycle.

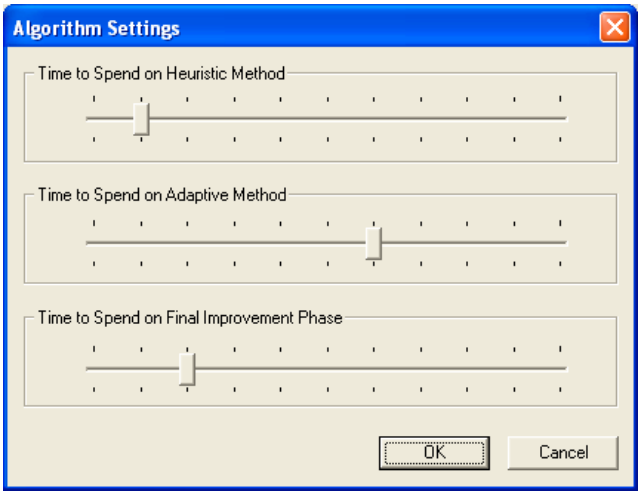


**Fig. 1.** Construction and Improvement Settings

Figure 1 shows how these algorithms may be varied in the construction of a solution. In essence this means that, in addition to allowing multiple criteria to be set relative to each other during the solution modeling process, the user is now able to adjust or 'direct' the search technique in finding a potential solution.

## 3 Diagnostic report tool

A report tool has been added to provide information on the current data and solution. This allows each dataset to be analysed for the purposes of provision of information which may be useful in setting up the scheduling model. This is shown under the heading 'Basic Information' in Figure 2. This represents a starting point with plans to include in subsequent versions, information on subjects such as projected utilisation of space based on particular chosen formats of the timetabling session. This will help answer common institutional questions such as 'What is the least amount of time and space that we need to set up a schedule'. Of course, this only serves as an indication as the incorporation of soft constraints adds to the final relevance of the overall solution.

Once a solution is obtained, various items of information are provided as an overview. This is shown under the heading 'Current Solution Quality" in Figure 2. More detailed information is provided through the reporting mechanism of the software which will be demonstrated as part of the talk at the conference. An important additional report added in version 2.5 is worthy of note here. This provides the number of students x who have y exams in z days, allowing the user to further understand important student centered characteristics of the solution. An example of the reporting set up interface is shown in Figure 3.

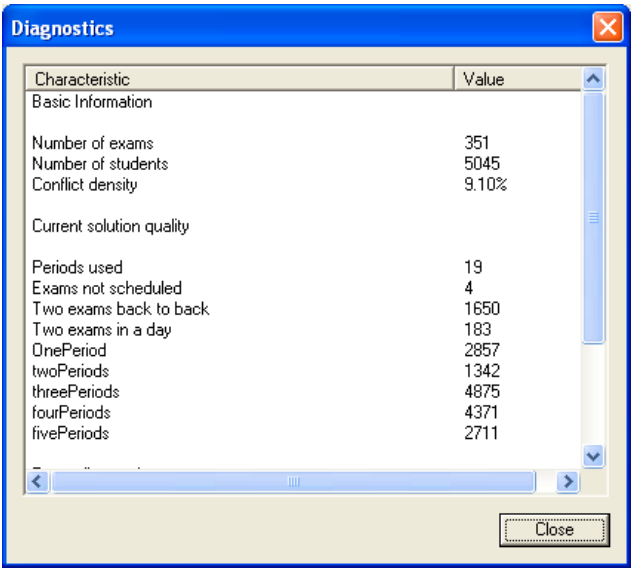


**Fig. 2.** Dialog Information

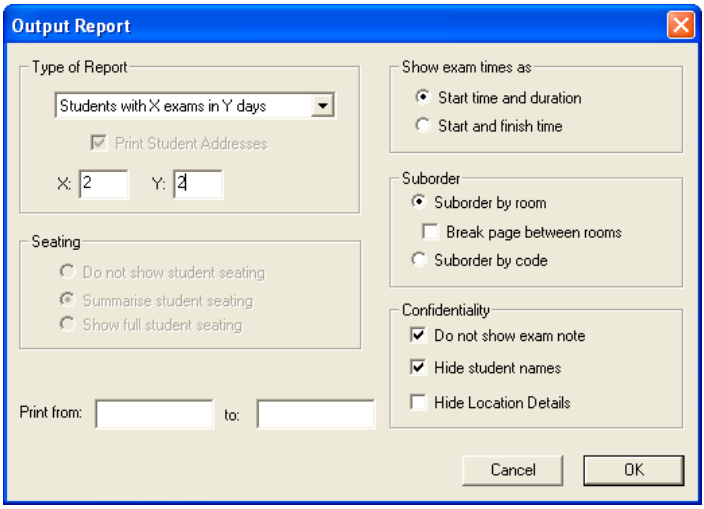


**Fig. 3.** Reporting

## 4 Searching for "wider distribution"

Normally, the optimisation function used in the construction of a solution tries to give students the 'best' spread or distribution of their exams throughout the examination period. Until now, this has been achieved by a combination of avoiding two exams in a row or in a day. Optime v2.5 allows the user to specify longer periods of time e.g. it attempts to optimise the solution based on examinations being x periods apart, where x is user specified. This will apply a penalty for proximity over the usual two in a day constraint and up to ten periods apart. Nights or days in-between events are not considered solely (as in earlier version) and the closer that two exams are, the higher the penalty will be. Of course, enabling this may degrade other areas of the timetable and consideration to the entire pre-solution modeling must be given serious consideration. The implementation of this functionality can be seen at the bottom of Figure 4. The addition of the wider distribution constraint provides the user with increased control over how a solution is generated. This in effect allows the user to set parameters within the evaluation function in a user centered multi-criteria approach [7].

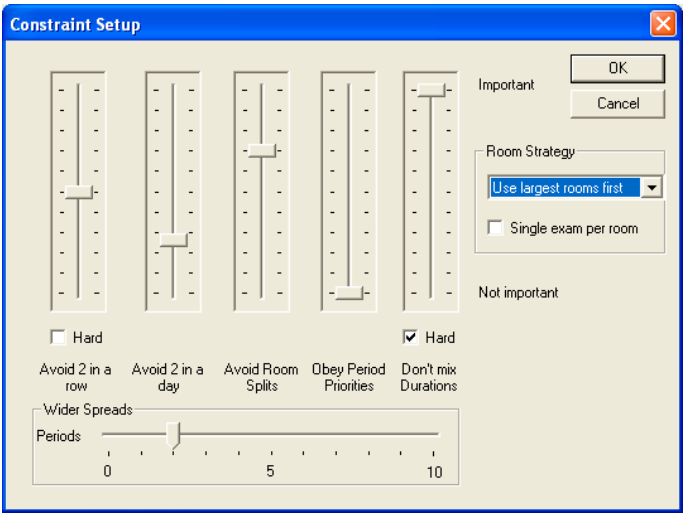


**Fig. 4.** Optimisation Constraints

## 5 Special Needs

Students with special needs (e.g. those requiring extra time due to a disability) need to be catered for within the examination timetable. At our leading implementation site, 9% of the students have special needs. These students can now be imported as an extra column on the students and/or enrollments table. These are done via alphabetical codes which must be defined within the system. This is currently used for reporting purposes only though the availability of full functionality for the purpose of timetabling students with special needs (based on a categorization and application of associated constraints) will be available in version 3.0. Those implemented currently are shown in Table 1. These represent further soft constraints which must be considered as part of the provision of a solution.

| Special Needs Description | Specified Parameters |
|---|---|
| Additional Time Required | Minutes |
| In Separate Room (from) | Room List |
| Must be Seated in Room | Room List |
| Avoid Periods | Period List |
| Students should have no Consecutive Exams | |
| Students should have a clear Day between Exams | |
| General Note | Free Text |

**Tab. 1.** Special Needs

## 6 Future Functionality

The question remaining unanswered in version 2.5 is what happens when a feasible solution is not possible i.e. the specified hard constraints can not be satisfied? Although it is envisaged that the tool should provide a range of reports on how various scenarios would be possible by relaxing hard constraints to soft constraints there is a need for a mechanism of splitting exams into alternatives which may take place at different times. The specification of this functionality is currently at an early stage.

## References

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