

Editorial

This first issue of ORiON Volume 22 contains seven operational research papers, six of which deal with interesting applications (ranging from safely routing ships through a minefield and formulating optimal fishing and fruit exporting policies to election result forecasting, project auditing and vehicle routing) and one in which a new heuristic is proposed for the job shop scheduling problem with n jobs processed on one machine. These papers utilise a wide variety of operational research techniques from subdisciplines as diverse as mathematical programming, graph and network theory, genetic algorithms, multicriteria decision analysis, discriminant analysis and fuzzy clustering.

In the first paper of this volume, titled *Planning the safe transit of a ship through a mapped minefield*, James Bekker and Jörg Schmid address the challenge of finding a navigation route for a warship through a mapped minefield that minimises a combination of distance travelled and the risk of damage to the vessel that the navy is willing to tolerate. The modelling approach in this paper was prompted by the advent of *autonomous mapping*, through which it became possible to obtain high quality information of mission obstructing sea minefields and their environment before embarking on a mission. The authors employ *Dijkstra's algorithm* to map out routes of shortest distance and of minimum vessel damage risk. Markowitz's notion of an *efficient frontier* [3] is then utilised in order to enable the user to isolate an acceptable combination of travel distance and risk tolerance minimisation. If no such route exists, then a genetic algorithm is employed to devise a cost-efficient strategy for the removal of sea mines until an acceptable route becomes available.

The second paper, by Babul Hasan and John Raffensperger titled *A mixed integer linear program for an integrated fishery*, contains a macro level mixed integer programming model for managing trawler scheduling and production planning in a quota-based commercial fishery. Factors taken into account in the model include fishing trawler capacities and fish product processing firm capacities. The scope of variables and parameters included in the model is rare, in the sense that fishing quota management models often address local problems for certain fishing communities or for very limited species and/or products — this model encompasses management decisions across the whole spectrum of activities in a commercial fishery. The authors conclude the paper by demonstrating the workability of their model in a case study concerning one of the major fisheries in New Zealand.

The third paper, titled *Modelling the South African fruit export infrastructure: A case study*, by Frank Ortmann, Esbeth van Dyk and Jan van Vuuren is the third in a trilogy of papers analysing the South African fresh fruit export supply chain. The first in the trilogy was the award winning paper [4] by Esbeth van Dyk and Emma Maspero in which relevant data were collected, a protocol for joint export operations was established and various recommendations were made so as to streamline the export process for fresh fruit from South Africa. This was followed by a paper [2] by James Bekker, Marize Mostert and Esbeth van Dyk in which a discrete event simulation micro model of the efficiency of fruit export from the port of Durban was modelled and in which it was found that bottlenecks experienced at the port were not as a result of inadequate infrastructure, but rather because of a poor port management strategy. In this third paper the authors develop a macro (maximum flow) model of the national export infrastructure so as to determine

the maximum throughput of export fruit at pack house, cold store and port levels. The conclusion is yet again that bottlenecks are experienced due to a lack of an integrated export management strategy, rather than as a result of inadequate infrastructure, and that the export infrastructure seems more than adequate for the short to medium term future.

In the fourth paper, titled *A rescheduling heuristic for the single machine total tardiness problem*, Juwa Nyirenda proposes a heuristic whereby n jobs may be rescheduled for processing on a single machine with a view to minimise total tardiness. The heuristic is based on the modified due date schedule (MDDS) of Baker and Kenet [1], but unlike most job shop heuristics in which interchanges of two jobs are repeatedly considered, the newly proposed heuristic allows for interchanges of more than two jobs simultaneously. The author illustrates the working of his heuristic in detail by means of a numerical example, and then demonstrates the efficiency of the heuristic experimentally by comparing the total tardiness achieved by the standard MDDS (applied to twenty objectively generated test instances) with that obtained when the MDDS is used in conjunction with the new heuristic. In twelve of the twenty test instances the latter method yields superior results — in some cases the improvements are significant.

In the fifth paper of this issue, titled *A combined AHP-GP model to allocate internal auditing time to projects*, Hennie Kruger and Giel Hattingh demonstrate how techniques from the disciplines of mathematical programming and multiple criteria analysis may be used to allocate internal auditing time among competing projects optimally. The authors use an integrated approach by employing the analytic hierarchy process to deal with qualitative risk assessment and a goal programming approach to distribute the number of hours available among the projects in such a way that risk is minimised. The paper is concluded with a case study, based on an international gold mining company, in which the workability of the combined approach is demonstrated lucidly.

The penultimate paper of this issue, titled *A model for election night forecasting applied to the 2004 South African elections*, contains a description by Jan Greben, Chris Elphenstone and Jenny Holloway of methods used by the CSIR to forecast the final 2004 South African national election results, based on early results as they come in. The authors cluster the electorate according to their behaviour in previous elections and then extrapolate these behaviour profiles to cover the entire electorate. Their method seems to be particularly suited to the South African situation where results are initially heavily biased (early results do not give a proper indication of the final results, because of the non-random order in which results come in — results tend to come in much faster from urban, affluent areas than from rural areas). The methodology in this paper includes a number of clustering techniques (including k -means clustering and fuzzy clustering as well as a k -means approach in combination with discriminant analysis). The efficiencies of the different approaches are assessed by means of a comparison of resulting convergence rates toward the final election results.

In the final paper, titled *A sequential insertion heuristic for the initial solution to a constrained vehicle routing problem*, Johan Joubert and Schalk Claasen develop a procedure that determines an initial solution to an integration of three well-known variants of the Vehicle Routing Problem (VRP), namely that of the VRP with multiple time windows,

the VRP with a heterogeneous fleet and the VRP with double scheduling. The heuristic is based on the well-known *sequential insertion heuristic* (SIH), but incorporates the notion of time window compatibility to reduce the computational burden of the SIH. After testing the heuristic on a number of bench-mark instances of the VRP where clients are either (i) clustered, (ii) randomly distributed or (iii) a combination of the aforementioned two, the authors conclude that the procedure improves upon the initial solution considerably for a significant portion of the problem classes considered, although the procedure seems to be highly sensitive with respect to the specific problem instance. The authors conclude the paper by proposing that the newly developed heuristic be incorporated in a metaheuristic approach, such as a tabu search — such an incorporation is expected to be very efficient for the specific integrated VRP considered in the current paper.

As always, I am confident that the diversity and quality of the seven papers in this issue are such that each reader of ORiON will find something suiting his/her particular tastes and interests.

I would like to thank the fifteen authors who contributed their interesting work to Volume 22(1) of ORiON — their support of ORiON is invaluable — the readership of ORiON are encouraged to continue utilising ORiON as publication vehicle for their research. My sincere thanks also go to the fourteen anonymous referees who generously gave of their time to evaluate the papers in this issue timeously and in a very professional manner; they have made valuable suggestions which have led to a substantial improvement in the quality of papers in virtually all cases. Thank you also to Associate Editor John Hearne for managing the refereeing process of one of the papers in this issue on my behalf. Finally, I would like to thank the business manager, Stephan Visagie, for his usual high standards typesetting the manuscripts in L^AT_EX and for overseeing the time-consuming publication process of this issue.

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References

- [1] BAKER KR & KANET JJ, 1983, *Job shop scheduling with modified due dates*, Journal of Operations Management, **4**, pp. 37–42.
- [2] BEKKER JF, MOSTERT M & VAN DYK FE, 2005, *Simulation of fruit pallet movement in the port of Durban: A case study*, ORiON, **21(1)**, pp. 63–75.
- [3] MARKOWITZ H, 1959, *Portfolio selection — Efficient diversification of investments*, Yale University Press, New Haven (CT).
- [4] VAN DYK FE & MASPERO E, 2004, *An analysis of the South African fruit logistics infrastructure*, ORiON, **20(1)**, pp. 55–72.