Preface

Angel A. Juan*

Department of Computer Science,
Open University of Catalonia,
Rambla Poblenou, 156, 08018 Barcelona, Spain
E-mail: ajuanp@uoc.edu
*Corresponding author

Javier Faulin

Department of Statistics and Operations Research,
Public University of Navarre,
Los Magnolios Building, Campus Arrosadia,
31006 Pamplona, Spain
E-mail: javier.faulin@unavarra.es

Scott E. Grasman

Industrial and Systems Engineering Department,
Rochester Institute of Technology,
81 Lomb Memorial Drive, Rochester, NY 14623, USA
E-mail: Scott.Grasman@rit.edu
E-mail: segeie@rit.edu

Kannan Govindan

Department of Business and Economics,
University of Southern Denmark,
Odense, 5230, Denmark
E-mail: gov@sam.sdu.dk

Biographical notes: Angel A. Juan is an Associate Professor of Optimisation and Simulation in the Computer Science Department at the Open University of Catalonia, Spain. He holds a PhD in Industrial Engineering, an MS in Information Technologies and an MS in Applied Mathematics. His research interests include applications of metaheuristics and simulation to logistics and transportation problems. He is an editorial board member of the *Int. J. of Data Analysis Techniques and Strategies*. His website is http://ajuanp.wordpress.com.

Javier Faulin is a Professor of Operations Research and Statistics at the Public University of Navarre (Pamplona, Spain). He holds a PhD in Economics, an MS in Operations Management, Logistics and Transportation and an MS in Applied Mathematics. His research interests include logistics, vehicle routing problems and simulation modelling and analysis. He is a member of INFORMS

and EURO societies and an editorial board member of the *International Journal of Applied Management Science* and the *International Journal of Operational Research and Information Systems*.

Scott E. Grasman is a Professor and the Department Head of Industrial and Systems Engineering at Rochester Institute of Technology. His primary research interests relate to the application of quantitative models, focusing on the design and development of supply chain and logistics networks. His recent and ongoing studies have focused on alternative fuels programmes, public-private-partnerships in transportation, alternative energy infrastructure modelling/simulation, and sustainability in supply chain and facility logistics, as well as engineering education. His collaborations have resulted in numerous funded research projects, over 100 technical papers, including multiple best conference paper awards, and reviewer/editorial roles for various technical journals and books.

Kannan Govindan is an Associate Professor of Operations and Supply Chain Management in the Department of Business and Economics at the University of Southern Denmark. He holds a PhD in Supply Chain Management (Deemed University) and a Master of Engineering (Bharathiyar University). His research interests include: green and sustainable supply chain management and reverse logistics. He is the Editor-in-Chief of both the *Int. J. of Business Performance and Supply Chain Modelling* and the *Int. J. of Advanced Operations Management*.

Vehicle routing problems (VRPs) have been extensively studied by researchers and practitioners during the last decades. Being complex problems with numerous and relevant potential applications, researchers from the fields of computer science, operations research, and industrial engineering have developed very efficient algorithms, both of exact and approximate nature, to deal with different types of VRPs. However, most of these methods are still far from being tremendously applicable to real-life scenarios, either because they are too complex to be implemented in practice without the direct support of the experts who developed them, or because they solve only an oversimplified version of a realistic routing problem.

This special issue contains recent works related to the development of efficient yet relatively simple algorithms that can be employed in practice to solve realistic VRPs with non-standard objective functions and/or constraints, as well as case studies regarding the applications of existing methods to solving real-life VRPs.

In the first paper, 'A multi-objective solid transportation problem in fuzzy, bi-fuzzy environment via genetic algorithm', S. Pramanik et al. develop a bi-fuzzy multi-objective transportation problem (MOSTP) using a bi-fuzzy expected value method (EVM). A transportation model is developed. This model uses fixed charges and vehicle costs where either an all-units, incremental or combination discount is considered and varies based on the choice of origin, destination and conveyance. To solve the problem, a multi-objective genetic algorithm (MOGA) based on roulette wheel selection, arithmetic crossover and uniform mutation has been suitably built and applied. To illustrate the models, numerical examples and corresponding results have been presented. To provide better customer service, the entropy function has been also considered.

Road transportation is a big contributor to the existing CO_2 emissions, among other greenhouse gases (GHGs) and air pollutants. The amount of emitted pollutants by a vehicle depends on the amount of fuel consumed and the type of fuel utilised. Moreover,

the fuel consumption level is dependent on distance, load, speed, road gradient, driving pattern and many more factors. In the second paper, 'A green routing problem: optimising CO_2 emissions and costs from a bi-fuel vehicle fleet', by K. Salimifard and R. Raeesi, the authors extend the VRP literature by developing a new variant as a GRP that deals with optimising CO_2 emissions and costs from a bi-fuel vehicle fleet, which runs on both the main fuel and the cleaner alternative fuel. The modelling approach deals with not only the fuel consumption level, but also with the optimised utilisation of the alternative fuel of the vehicle. To analyse environmental and economic performance of the GRP, two extensions as P-GRP and CB-GRP were developed and implemented in a case study. Results of the case study and computational experiments suggest a possibly significant reduction in CO_2 emissions and costs when compared to a CVRP with a simple distance minimisation objective.

The VRP is a flourishing research area with clear applications to real-life distribution companies. However, most VRP-related academic articles assume the existence of a homogeneous fleet of vehicles and/or a symmetric cost matrix. These assumptions are not always reasonable in real-life scenarios. To contribute to closing this gap between theory and practice, our third paper 'Solving vehicle routing problems with asymmetric costs and heterogeneous fleets', by R. Herrero et al., proposes a hybrid methodology for solving the asymmetric and heterogeneous vehicle routing problem (AHVRP). In their contribution, the authors consider:

1 different types of vehicle loading capacities (heterogeneous fleets)

2 asymmetric distance-based costs.

The approach combines a randomised version of a well-known savings heuristic with several local searches specifically adapted to deal with the asymmetric nature of costs. A computational experiment allows for discussion of the efficiency of the approach and also how routing costs vary when slight departures from the homogeneous fleet assumption are considered.

Finally, the fourth paper 'Solving the heterogeneous vehicle routing problem with time windows and multiple products via a bacterial meta-heuristic', by J.R. Montoya-Torres et al., aims at solving a variant of the VRP with heterogeneous fleet, time windows, and multiple products (HVRPTWMP), using a novel meta-heuristic based on the behaviour of the bacteria to the stimulus of light. The meta-heuristic recreates the different processes that make a bacterium to be as close as possible to a light source, considered as the objective to reach. The problem is associated with two objectives: the minimisation of the number of vehicle and the total travelled distance. The proposed meta-heuristic was tested on instances from literature with sizes of up to 100 nodes (clients). Results show that the proposed algorithm gives good quality solutions in regard of both objective functions.

Together, these four papers add to the literature on rich and real-life VRPs. We hope that you enjoy the special issue.

We thank the reviewers for their assistance with the special issue.